

2009-2015 CHEVROLET SPARK & OPEL KARL



SERVICE AND REPAIR MANUAL

EMISSION CONTROL ABBREVIATIONS

Gasoline & Diesel

"A"

A/C

Air Conditioning

A/C-ISUS

A/C Idle Speed-Up Solenoid

A/F

Air/Fuel

AAI

Air Assist Injector

ACL

Air Cleaner (Thermostatic Air Cleaner)

ACL-BMS

ACL Bimetallic Sensor

ACL-CKV

ACL Check Valve

ACL-DV

ACL Delay Valve

ACL-PVS

ACL Ported Vacuum Switch

ACL-RDV

ACL Reverse Delay Valve

ACL-RDVS

ACL Reverse Delay Valve (Single)

ACL-TCV

ACL Thermal Control Valve

ACL-TS

ACL Temperature Sensor

ACL-TSOV

ACL Temperature Sensor Override Valve

ACL-TVS

ACL Thermal Vacuum Switch

ACL-TVV

ACL Thermal Vacuum Valve

ACL-VCDV

ACL Vacuum Control Delay Valve

ACL-VCV

ACL Vacuum Control Valve

ACL-VM

ACL Vacuum Motor

ACL-WP

ACL Wax Pellet Type Motor

ADS

Anti-Dieseling Solenoid

AFR

Air/Fuel Ratio Sensor

AFS

Air/Fuel Ratio Sensor

AIH

Air Intake Heaters

AIH-TS

AIH Temperature Sensor

AIR

Air Injection System

AIS

Air Injection System

AIS-ACV

AIS Air Control Valve

AIS-AMV

AIS Air Management Valve

AIS-ASV

AIS Air Switching Valve

AIS-BPV

AIS By-Pass Valve

AIS-CC

AIS Computer Controlled

AIS-CKV

AIS Check Valve

AIS-CSV

AIS Control Solenoid Valve

AIS-CV

AIS Combination Valve

AIS-DV

AIS Diverter Valve

AIS-IMCV

AIS Intake Manifold Change-Over Valve

AIS-MCV

AIS Manifold Change-Over Valve

AIS-PAF

AIS Pulse Air Feeder

AIS-PM

AIS Pump Motor

AIS-PV

AIS Pneumatic Valve

AIS-RV

AIS Relief Valve

AIS-SAV

AIS Secondary Air Valve

AIS-SOL

AIS Solenoid

AIS-SV

AIS Solenoid Valve

AIS-VCV

AIS Vacuum Control Valve

AIS-VSV

AIS Vacuum Switching Valve

AIS-VT

AIS Vacuum Tank

AIS-VCV

AIS Vacuum Control Valve

AIS-VSV

AIS Vacuum Switching Valve

AIV

Air Injection Valve

AIV-SOL

Air Injection Valve Solenoid

ALVW

Adjusted Loaded Vehicle Weight

AMV

Air Management Valve

AP

Air Pump Injection System

AP-ACV

AP Air Control Valve

AP-AMV

AP Air Management Valve

AP-ASRV

AP Air Switching Relief Valve

AP-ASS

AP Air Switching Solenoid

AP-ASV

AP Air Switching Valve

AP-BPV

AP By-Pass Valve

AP-CKV

AP Check Valve

AP-CS

AP Control Solenoid

AP-DCTO

AP Dual Coolant Temperature Override

AP-DLY

AP Delay Valve

AP-DV

AP Diverter Valve

AP-EADV

AP Electric Air Control Diverter Valve

AP-EAMR

AP Electric Air Management Relay

AP-EAMS

AP Electric Air Management Solenoid

AP-EAP

AP Electric Air Pump

AP-EC

AP Electromagnetic Clutch

AP-ERLY

AP Electric Air Pump Relay

AP-RDV

AP Reed Valve

AP-RV

AP Relief Valve

AP-SOL

AP Solenoid

AP-SOV

AP Shut-Off Valve

AP-SV

AP Solenoid Valve

AP-SWV

AP Switchover Valve

AP-TV

AP Transmitting Valve

AP-VCS

AP Vacuum Control Solenoid

AP-VCSV

AP Vacuum Controlled Air Shut-Off Valve

AP-VCV

AP Vacuum Control Valve

AP-VSV

AP Vacuum Switching Valve

A/T

Automatic Transmission

ATCV

Air Temperature Control Valve

"B"**BP/EGR**

Backpressure EGR System

BP/EGR-BPS

BP/EGR Backpressure Sensor

BP/EGR-BPT

BP/EGR Backpressure Transducer

BP/EGR-BPV

BP/EGR Backpressure Valve

BP/EGR-BS

BP/EGR Bleed Solenoid

BP/EGR-BVSV

BP/EGR Bimetallic Vacuum Switching Valve

BP/EGR-C

BP/EGR Controller

BP/EGR-CLR

BP/EGR Cooler

BP/EGR-CS

BP/EGR Control Solenoid

BP/EGR-CTO

BP/EGR Coolant Temperature Override

BP/EGR-CV

BP/EGR Control Valve

BP/EGR-DCTO

BP/EGR Dual Coolant Temperature Override

BP/EGR-DS

BP/EGR Diagnostic Solenoid

BP/EGR-DSOL

BP/EGR Duty Solenoid

BP/EGR-DTVSW

BP/EGR Distributor Thermal Vacuum Switch

BP/EGR-DV

BP/EGR Delay Valve

BP/EGR-EET

BP/EGR Electric Transducer

BP/EGR-EPV

BP/EGR External Pressure Valve

BP/EGR-FDV

BP/EGR Forward Delay Valve

BP/EGR-LC

BP/EGR Load Control Valve

BP/EGR-PS

BP/EGR Position Sensor

BP/EGR-PT

BP/EGR Pressure Transducer

BP/EGR-PVS

BP/EGR Ported Vacuum Switch

BP/EGR-RES

BP/EGR Reservoir

BP/EGR-RST

BP/EGR Restrictor

BP/EGR-SOL

BP/EGR Solenoid

BP/EGR-TCTVS

BP/EGR Torque Converter Thermal Vacuum Switch

BP/EGR-TCV

BP/EGR Thermal Control Valve

BP/EGR-TCVLV

BP/EGR Temperature Control Valve

BP/EGR-TS

BP/EGR Temperature Sensor

BP/EGR-TVS

BP/EGR Thermal Vacuum Switch

BP/EGR-TVV

BP/EGR Thermal Vacuum Valve

BP/EGR-VCV

BP/EGR Vacuum Control Valve

BP/EGR-VM

BP/EGR Vacuum Modulator

BP/EGR-VRV

BP/EGR Vacuum Regulator Valve

BP/EGR-VS

BP/EGR Vacuum Switch

BP/EGR-VSOL

BP/EGR Vent Solenoid

BP/EGR-VSV

BP/EGR Vacuum Switching Valve

"C"

C-4

Computer Controlled Catalytic Converter

CAC

Charge Air Cooler

CAS

Clean Air System

CB

Crankcase Breather

CB-VC

Crankcase Breather-Vapor Canister

CBPS

Coasting By-Pass System

CBVC

Crankcase Breather Vapor Canister

CCIEV

Coolant Controlled Idle Enrichment Valve

CCS

Controlled Combustion System

CCV

Closed Crankcase Ventilation

CD-REGVLV

Crankcase Depression Regulator Valve

CDRV

Crankcase Depression Relief Valve

CEAB

Cold Engine Air Bleed

CEAB-TVS

CEAB Thermal Vacuum Switch

CEAB-TVV

CEAB Thermal Vacuum Valve

CEC

Computerized Engine Controls

CESS

Cold Engine Sensor Switch

CETS

Cold Engine Temperature Switch

CFI

Continuous Fuel Injection

CMH

Cold Mixture Heater

CNG

Compressed Natural Gas

CO

Carbon Monoxide

CO₂

Carbon Dioxide

CPI

Central Port Injection

CRV

Coasting Richer Valve

CSI

Central Sequential Injection

CTAVS

Cold Temperature Activated Vacuum System

CTOX

Continuous Trap Oxidizer

"D"**DCLV**

Deceleration Valve

DCS

Deceleration Control System

DDI

Direct Diesel Injection

DFI

Direct Diesel Injection

DI

Direct Injection

DKV

Deceleration Kick Valve

DMCV

Deceleration Mixture Control Valve

DMS

Dual Manifold System

DOC

Diesel Oxidation Catalyst

DOHC

Dual Overhead Cam

DPF

Diesel Particulate Filter

DPFE

Differential Pressure Feedback EGR Valve

DPFEGR

Differential Pressure Feedback EGR Valve

DTM

Deceleration Throttle Modulator

"E"

EAIR

Electric Air Injection System

EAIR-DV

EAIR Diverter Valve

ECM

Electronic Control Module

ECU

Electronic Control Unit

EDC

Electronic Diesel Control

EDS

Electronic Diesel System

EEC

Electronic Engine Control

EFE

Early Fuel Evaporation

EFE-CKV

EFE Check Valve

EFE-CV

EFE Control Valve

EFE-DTVS

EFE Delay Thermal Vacuum Switch

EFE-HTR

EFE Heater

EFE-HCV

EFE Heat Control Valve

EFE-OTS

EFE Oil Temperature Switch

EFE-PTC

EFE Positive Temperature Coefficient (Intake Heater Grid)

EFE-PVS

EFE Ported Vacuum Switch

EFE-SOL

EFE Solenoid

EFE-TVS

EFE Thermal Vacuum Switch

EFE-TVV

EFE Thermal Vacuum Valve

EFE-VSV

EFE Vacuum Switching Valve

EFI

Electronic Fuel Injection

EFI-MA

EFI Mass Airflow Sensor

EFI-MAF

EFI Mass Airflow Sensor

EGR

Exhaust Gas Recirculation System

EGR-BCS

EGR Boost Check Solenoid

EGR-BPBV

EGR By-Pass Backpressure Valve

EGR-BPT

EGR Backpressure Transducer

EGR-BPV

EGR By-Pass Valve

EGR-BS

EGR Bleed Solenoid

EGR-BSSV

EGR Boost Sensor Solenoid Valve

EGR-BVSV

EGR Bimetallic Vacuum Switching Valve

EGR-C

EGR Controller

EGR-CC

EGR Coolant Controlled

EGR-CLR

EGR Cooler

EGR-VSOL

EGR Vacuum Solenoid

EGR-CKV

EGR Check Valve

EGR-CS

EGR Control Solenoid

EGR-CSOL

EGR Cut-Off Solenoid

EGR-CSV

EGR Control Solenoid

EGR-CTO

EGR Coolant Temperature Override

EGR-CTS

EGR Charge Temperature Sensor

EGR-CTSW

EGR Charge Temperature Switch

EGR-CTTS

EGR Coolant Temperature Thermostat

EGR-CV

EGR Control Valve

EGR-CVCV

EGR Constant Vacuum Control Valve

EGR-CVS

EGR Control Vent Solenoid

EGR-DC

EGR Digital Control

EGR-DCTO

EGR Dual Coolant Temperature Override

EGR-DPFE

Differential Pressure Feedback EGR Sensor

EGR-DPFS

EGR Differential Pressure Feedback Sensor

EGR-DS

EGR Diagnostic Solenoid

EGR-DSOL

EGR Duty Solenoid

EGR-DTVS

EGR Delay Thermal Vacuum Switch

EGR-DTVSW

EGR Distributor Thermal Vacuum Switch

EGR-DV

EGR Delay Valve

EGR-EPRS

EGR Exhaust Pressure Regulator Solenoid

EGR-EPRV

EGR Exhaust Pressure Regulator Valve

EGR-EPV

EGR External Pressure Valve

EGR/EVAP-CSV

EGR/EVAP Control Solenoid Valve

EGR-EVR

EGR Vacuum Regulator

EGR-EVRV

EGR Electronic Vacuum Regulator Valve

EGR-FDV

EGR Forward Delay Valve

EGR-FJS

EGR Floor Jet System

EGR-FPS

EGR Feedback Pressure Sensor

EGR-LCV

EGR Load Control Valve

EGR-MAP

EGR Manifold Absolute Pressure Sensor

EGR-PFE

EGR-PFE Sensor

EGR-PS

EGR Position Sensor

EGR-PSW

EGR Pulse Switch

EGR-PVS

EGR Ported Vacuum Switch

EGR-REG

EGR Regulator

EGR-RES

EGR Reservoir

EGR-RST

EGR Restrictor

EGR-SC

EGR Signal Converter

EGR-SEC

EGR, Secondary

EGR-SEN

EGR Sensor

EGR-SOL

EGR Solenoid

EGR-SU

EGR Switchover Valve

EGR-SUB

Sub-EGR Valve

EGR-SVV

EGR Solenoid Vacuum Valve

EGR-T

EGR Temperature Sensor

EGR-TC

EGR Transmission Controlled

EGR-TCTVS

EGR Torque Converter Thermal Vacuum Switch

EGR-TCV

EGR Thermal Control Valve

EGR-TCVLV

EGR Temperature Control Valve

EGR-TRANS

EGR Transducer

EGR-TS

EGR Temperature Sensor

EGR-TSW

EGR Temperature Switch

EGR-TVD

EGR Throttle Valve Diaphragm

EGR-TVS

EGR Thermal Vacuum Switch

EGR-TVSOL

EGR Throttle Valve Solenoid

EGR-TVV

EGR Thermal Vacuum Valve

EGR-VA

EGR Vacuum Amplifier

EGR-VCV

EGR Vacuum Control Valve

EGR-VM

EGR Vacuum Modulator

EGR-VR

EGR Vacuum Regulator

EGR-VRS

EGR Vacuum Regulator Solenoid

EGR-VRSV

EGR Vacuum Regulator Solenoid Valve

EGR-VRV

EGR Vacuum Regulator Valve

EGR-VS

EGR Vacuum Switch

EGR-VSDV

EGR Vacuum Switch Dump Valve

EGR-VSEN

EGR Vacuum Sensor

EGR-VSOL

EGR Vent Solenoid

EGR-VSS

EGR Vacuum Switching Solenoid

EGR-VST

EGR Vacuum Surge Tank

EGR-VSV

EGR Vacuum Switching Valve

EGR-VVCS

EGR Venturi Vacuum Control System

EGRB

EGR Boost Sensor

EGRC

EGR Control Solenoid

EGRC-BPT

EGR Control Backpressure Transducer

EGRC-SV

EGR Control Solenoid Valve

EHOC

Electronically Heated Oxidation Catalyst

EHTWC

Electronically Heated Three-Way Catalyst

EI

Electronic Ignition System

EIS

Electronic Ignition System

ELB

Electronic Lean Burn

EPR

Exhaust Pressure Regulator

EPR-SOL

EPR Solenoid

ESA

Electronic Spark Advance

EVAP

Fuel Evaporative System

EVAP-AAC

EVAP Auxiliary Air Control

EVAP-BPSV

EVAP By-Pass Solenoid Valve

EVAP-BVSV

EVAP Bimetallic Vacuum Switching Valve

EVAP-CAV

EVAP Canister Air Valve

EVAP-CCV

EVAP Control Canister Close Valve

EVAP-CCVSV

EVAP Control Canister Vent Shut Valve

EVAP-CCVSVS

EVAP Closed Canister Valve Vacuum Switching Valve

EVAP-CDCV

EVAP Canister Drain Cut Valve

EVAP-CKV

EVAP Check Valve

EVAP-CPCS

EVAP Canister Purge Control Solenoid

EVAP-CPCSV

EVAP Canister Purge Control Solenoid Valve

EVAP-CPCV

EVAP Canister Purge Control Valve

EVAP-CPRV

EVAP Canister Purge Regulator Valve

EVAP-CPSV

EVAP Canister Vent Shut Valve

EVAP-CPT

EVAP Canister Purge Timer

EVAP-CPTVS

EVAP Canister Purge Thermal Vacuum Switch

EVAP-CPV

EVAP Canister Vent Valve

EVAP-CPVCSV

EVAP Canister Purge Volume Control

EVAP-CPVCV

EVAP Canister Purge Volume Control Valve

EVAP-CPVDV

EVAP Canister Purge Vacuum Delay Valve

EVAP-CPVR

EVAP Canister Purge Valve Resonator

EVAP-CS

EVAP Control Solenoid

EVAP-CSPS

EVAP Control System Pressure Sensor

EVAP-CST

EVAP Canister Surge Tank

EVAP-CT

EVAP Catch Tank

EVAP-CVCS

EVAP Canister Vent Control Solenoid

EVAP-CVCV

EVAP Canister Vent Control Valve

EVAP-CVS

EVAP Canister Vent Solenoid

EVAP-CVSV

EVAP Carburetor Vent Switching Valve

EVAP-CVV

EVAP Canister Vent Valve

EVAP-DCTO

EVAP Dual Coolant Temperature Override

EVAP-DF

EVAP Drain Filter

EVAP-DPS

EVAP Differential Pressure Sensor

EVAP-DV

EVAP-Drain Valve

EVAP-EV

EVAP Emission Valve

EVAP-FBVV

EVAP Fuel Bowl Vent Valve

EVAP-FBVS

EVAP Fuel Bowl Vent Solenoid

EVAP-FCV

EVAP Fuel Cut Valve

EVAP-FLS

EVAP Fuel Level Sensor

EVAP-FOLV

EVAP Fuel Overflow Limiter Valve

EVAP-FS

EVAP Flow Switch

EVAP-FSV

EVAP Flow Switchover Valve<

EVAP-FTEV

EVAP Fuel Tank EVAP Valve

EVAP-FTPCSV

EVAP Fuel Tank Pressure Control Solenoid Valve

EVAP-FTPS

EVAP Fuel Tank Pressure Sensor

EVAP-FTS

EVAP Fuel Temperature Sensor

EVAP-FVCV

EVAP Fuel Vapor Control Valve

EVAP-FVS

EVAP Fuel Vapor Separator

EVAP-FVTS

EVAP Fuel Vapor Temperature Sensor

EVAP-FVV

EVAP Fuel Vent Valve

EVAP-FVVV

EVAP Fuel Vapor Vent Valve

EVAP-IVS

EVAP Inner Vent Solenoid

EVAP-LDP

EVAP Leak Detection Pump

EVAP-LDPAF

EVAP Leak Detection Pump Air Filter

EVAP-LDPF

EVAP Leak Detection Pump Filter

EVAP-LDPVV

EVAP Leak Detection Pump Vent Valve

EVAP-LSEP

EVAP Liquid Separator

EVAP-NVLD

EVAP Natural Vacuum Leak Detection

EVAP-ORVR

Evaporative On-Board Refueling Vapor Recovery System

EVAP-ORVRCV

Evaporative On-Board Refueling Vapor Recovery Check Valve

EVAP-ORVRFTVRV

EVAP-ORVR Fuel Tank Vapor Recirculation

EVAP-OVCV

EVAP Outer Vent Control Valve

EVAP-OWV

EVAP One-Way Valve

EVAP-PCDV

EVAP Purge Control Diaphragm Valve

EVAP-PCSV

EVAP Purge Cut-Off Solenoid Valve

EVAP-PFS

EVAP Purge Flow Sensor

EVAP-PFSVVS

EVAP Purge Flow Switching Valve Vacuum Switching Valve

EVAP-PRRV

EVAP Pressure Relief Rollover Valve

EVAP-PSVVS

EVAP Pressure Switching Valve Vacuum Switching Valve

EVAP-PSOL

EVAP Purge Solenoid

EVAP-PSSV

EVAP Pressure Switching Solenoid

EVAP-PSVVSV

EVAP Pressure Switching Valve Vacuum Switching Valve

EVAP-PV

EVAP Purge (Frequency) Valve

EVAP-PVS

EVAP Ported Vacuum Switch

EVAP-RV

EVAP Rollover Valve

EVAP-RV/FTPS

EVAP Rollover Valve/Fuel Tank

EVAP-RVSV

EVAP Rollover Vapor Separator Valve

EVAP-SNR

EVAP Canister Sensor

EVAP-SOL

EVAP Solenoid

EVAP-SOV

EVAP Shutoff Valve

EVAP-SSV

EVAP Shut-Off Solenoid Valve

EVAP-SV

EVAP Solenoid Valve

EVAP-TC

EVAP Trap Canister

EVAP-TS

EVAP Temperature Switch

EVAP-TPBPV

EVAP Tank Pressure By-Pass Valve

EVAP-TPCS

EVAP Tank Pressure Control Solenoid

EVAP-TPCV

EVAP Tank Pressure Control Valve

EVAP-TRWV

EVAP Tree-Way Valve

EVAP-TV

EVAP Thermal Valve

EVAP-TVS

EVAP Thermal Vacuum Switch

EVAP-TVV

EVAP Thermal Vacuum Valve

EVAP-TWV

EVAP Two-Way Valve

EVAP-VC

EVAP Vapor Canister

EVAP-VCAT

EVAP Vapor Canister Air Tank

EVAP-VCF

EVAP Vapor Canister Filter

EVAP-VCSV

EVAP Vapor Canister Shut-off Valve

EVAP-VCTV

EVAP Vacuum Control Valve

EVAP-VCV

EVAP Vacuum Canister Valve

EVAP-VCVS

EVAP Vapor Canister Vent Solenoid

EVAP-VM

EVAP Vacuum Motor

EVAP-VPS

EVAP Vapor Pressure Sensor

EVAP-VPSVSV

EVAP Vapor Pressure Sensor Vacuum Switching Valve

EVAP-VS

EVAP Vacuum Sensor

EVAP-VSOL

EVAP Ventilation Solenoid

EVAP-VSOL/LDP

EVAP Ventilation Solenoid/Leak Detection Pump

EVAP-VST

EVAP Vacuum Surge Tank

EVAP-VSV

EVAP Vacuum Switching Valve

EVAP-VV

EVAP Ventilation Valve

EVRS

EGR Vacuum Regulator Solenoid

"F"

FBC

Feedback Carburetor

FCOV

Fuel Change Over Valve

FF

Flex Fuel

FF-CKV

Fuel Fill Check Valve

FF-FCV

Fuel Tank Fuel Cut-Off Valve

FF-FLVV

Fuel Tank Fill Limit Vent Valve

FGOV

Fuel Gravity/Overflow Valve

FGVV

Fuel Gravity Vent Valve

FI

Fuel Injected

FICD

Fast Idle Control Device

FISR

Fast Idle Solenoid Relay

FLV

Fill Limit Valve

FLVV

Fill Limiting Vent Valve

FP-CKV

Fill Pipe Check Valve

FP-RV

Fill Pipe Rollover Valve

FR

Fill Pipe Restrictor

FT-FLVV

Fuel Tank Fill Limit Vent Valve

FT-GVV

Fuel Tank Grade Vent Valve

FT-OPRV

Fuel Tank Over Pressure Vent Valve

FT-PCV

Fuel Tank Pressure Control Valve

FT-VCV

Fuel Tank Vapor Control Valve

FT-VRV

Fuel Tank Vapor Recirculation Valve

FTCV

Fuel Tank Check Valve

FTDPS

Fuel Tank Differential Pressure Sensor

FTEV

Fuel Tank EVAP Valve

FTPS

Fuel Tank Pressure Sensor

FTT

Fuel Tank Temperature Sensor

FTTS

Fuel Tank Temperature Sensor

FTV/LSV

Fuel Tank Vapor/Liquid Separation Valve

FTVCV

Fuel Tank Vapor Control Valve

FTVPRV

Fuel Tank Ventilation Pressure Retention Valve

FVPS

Fuel Vapor Pressure Sensor

FTVV

Fuel Tank Vent Valve

FVV

Fuel Vapor Valve

"G"

GVWR

Gross Vehicle Weight Rating

"H"

HAC

High Altitude Compensator

HAFS

Heated Air Fuel Ratio Sensor

HAI

Hot Air Intake

HAS

High Altitude System

HC

Hydrocarbons

HCAC-VSV

Hydrocarbon Absorber Catalyst Vacuum Switching Valve

HDC

Heavy Duty Cooling

HDC-CTO

HDC Coolant Temperature Override

HFM-SFI

Hot Film Engine Management SFI

HIC

Hot Idle Compensator

HIM

Heated Intake Manifold

HO

High Output

HO2S

Heated Oxygen Sensor

HP

High Performance

HP

Horsepower

HPCA

Housing Pressure Cold Advance

HSC

High Swirl Combustion

"I"

IAC

Idle Air Control Valve

IACV-SW

IACV Switch

ICOM

Idle Compensator

IDI

Indirect Diesel Injection

IES

Idle Enrichment System

IMCO

Improved Combustion System

"K"

KS

Knock Sensor

"L"

LH-SFI

Hot Wire Sequential Multiport Fuel Injection

LVFD

Liquid/Vapor Fuel Discriminator

LVW

Loaded Vehicle Weight

"M"

MD-TICS

Timing & Injection rate Control System

MDP

Manifold Differential Pressure sensor

ME-SFI

Motor Electronics Sequential Fuel Injection

MFI

Multiport Fuel Injection

MFI-MAF

MAF Mass Airflow Sensor

MFLS

Main Fuel Level Sensor

MI

Mechanical Fuel Injection

MIL

Malfunction Indicator Light

M/T

Manual Transmission

"N"

NAC

Nitrogen Oxides (NO_x) Adsorbing Catalyst

NLV

Non-Linear Valve

NOS

NO_x Sensor

NO_x

NO_x Emission Control

NO_xC

Nitrogen Oxide Catalyst

NO_xS

Nitrogen Oxide Sensor

NO_xTWC

NOx adsorptive TWC

NSC

Nitrogen Oxides (NOx) Storage Catalyst

"O"

OBD

On-Board Diagnostic System

PBD (F)/(P)

Full/Partial On-Board Diagnostic

OC

Oxidation Catalytic Converter

OHC

Overhead Cam

ORVR

On-Board Refueling Vapor Recovery

ORVR-COV

ORVR Cut-Off Valve

ORVR-CV

ORVR Control Valve

ORVR-FMV

ORVR Flow Management Valve

ORVR-FTVCV

ORVR Fuel Tank Vapor Control Valve

ORVR-FTVRV

ORVR Fuel Tank Vapor Recirculation Valve

ORVR-LV

ORVR Leveling Valve

ORVR-OCKV

ORVR Overfill Check Valve

ORVR-RCV

ORVR Refueling Control Valve

ORVR-VCV

ORVR Vapor Cut Valve

ORVR-VRV

ORVR Vapor Recirculating Valve

ORVR-VSV

ORVR Vent Shut Valve

ORVR-VV

ORVR Vent Valve

OVCV

Outer Vent Control Valve

O2S

Oxygen Sensor

"P"**PAIR**

Pulsed Secondary Air Injection

PAIR-ABV

PAIR Anti-Backfire Valve

PAIR-ACOV

PAIR Air Cut-Off Valve

PAIR-ACS

PAIR Air Control Solenoid

PAIR-ACV

PAIR Air Control Valve

PAIR-AIV

PAIR Air Injection Valve

PAIR-ASCS

PAIR Air Suction Control Solenoid

PAIR-ASOV

PAIR Air Shutoff Valve

PAIR-ASS

PAIR Air Switching Solenoid

PAIR-ASV

PAIR Air Switching Valve

PAIR-ASVL

PAIR Air Suction Valve

PAIR-AVCS

PAIR Air Valve Control Solenoid

PAIR-CSV

PAIR Control Solenoid Valve

PAIR-CKV

PAIR Check Valve

PAIR-DV

PAIR Diverter Valve

PAIR-PAF

PAIR Pulse Air Feeder

PAIR-PAV

PAIR Pulse Air Valve

PAIR-RES

PAIR Resonator

PAIR-RV

PAIR Reed Valve

PAIR-SCSV

PAIR Swirl Control Solenoid Valve

PAIR-SCV

PAIR Swirl Control Valve

PAIR-SOL

PAIR Solenoid

PAIR-VSV

PAIR Vacuum Switching Valve

PCM

Powertrain Control Module

PCV

Positive Crankcase Ventilation

PCV-DOV

PCV Dual Orifice Valve

PCV-HCB

PCV Heated Crankcase Breather

PCV-HE

PCV Heating Element

PCV-PRV

PCV Pressure Regulator Valve

PCV-SOL

PCV Solenoid

PEVR

Power Enrichment Vacuum Regulator

PPM

Parts Per Million

PTOX

Periodic Trap Oxidizer

PURCV

Purge Crankcase Ventilation

PVCS

Ported Valve Control System

PVCS-A

PVCS Actuator

PVCS-CS

PVCS Control Solenoid

PVLCS

Power Valve Control System

"R"

ROV

Rollover Valve

"S"

SAI-SV

Secondary Air Injection Shutoff Valve

SAIR-CV

Secondary Air Injection Control Valve

SC

Supercharged or Super Charger

SC MFI

Supercharged Multiport Fuel Injection

SCR

Selective Catalytic Reduction

SCSV

Swirl Control Solenoid Valve

SCV

Swirl Control Valve

SCV-A

SCV Actuator

SFI

Sequential Multiport Fuel Injection

SFI-MAF

SFI Mass Airflow Sensor

SFLS

Sub-Fuel Level Sensor

SOHC

Single Overhead Cam

SPK

Spark Controls

SPK-AVM

SPK Advance Vacuum Modulator

SPK-BVSV

SPK Bimetal Vacuum Switching Valve

SPK-CC

SPK Computer Controlled

SPK-CKV

SPK Check Valve

SPK-CSSA

SPK Cold Start Spark Advance System

SPK-CSSH

SPK Cold Start Spark Hold System

SPK-CTO

SPK Coolant Temperature Override

SPK-DAVS

SPK Distributor Vacuum Advance Solenoid

SPK-DCKV

SPK Distributor Check Valve

SPK-DCTO

SPK Dual Coolant Temperature Override

SPK-DDD

SPK Dual Diaphragm Distributor

SPK-DMV

SPK Distributor Modulator Valve

SPK-DPD

SPK Dual Point Distributor

SPK-DPVS

SPK Distributor Ported Vacuum Switch

SPK-DRCV

SPK Distributor Retard Control Valve

SPK-DRS

SPK Distributor Retard Solenoid

SPK-DSVMV

SPK Distributor Spark Vacuum Modulator Valve

SPK-DTVS

SPK Distributor Thermal Vacuum Switch

SPK-DTVV

SPK Distributor Thermal Vacuum Valve

SPK-DV

SPK Delay Valve

SPK-DVA

SPK Distributor Vacuum Advance

SPK-DVAS

SPK Distributor Vacuum Advance Solenoid

SPK-DVCS

SPK Distributor Vacuum Control Solenoid

SPK-DVCSW

SPK Distributor Vacuum Controlled Switch

SPK-DVCV

SPK Distributor Vacuum Control Valve

SPK-DVDV

SPK Distributor Vacuum Delay Valve

SPK-DVRS

SPK Distributor Vacuum Retard Switch

SPK-DVRV

SPK Distributor Vacuum Regulating Valve

SPK-DVVV

SPK Distributor Vacuum Vent Valve

SPK-EAVS

SPK Electronically Actuated Vacuum Switch

SPK-EDM

SPK Electronic Distributor Modulator

SPK-EI

SPK Electronic Ignition

SPK-ESA

SPK Electronic Spark Advance

SPK-ESC

SPK Electronic Spark Control (Retard)

SPK-ESS

SPK Electronic Spark Selection

SPK-EST

SPK Electronic Spark Timing

SPK-FDV

SPK Forward Delay Valve

SPK-HPCA

SPK Housing Pressure Cold Advance

SPK-ITCS

SPK Ignition Timing Control System

SPK-ITVS

SPK Ignition Timing Vacuum Switch

SPK-NLVR

SPK Non-Linear Vacuum Regulator

SPK-OSAC

SPK Orifice Spark Advance Control

SPK-PVA

SPK Ported Vacuum Advance

SPK-PVS

SPK Ported Vacuum Switch

SPK-RDO

SPK Retard Delay Orifice

SPK-RDV

SPK Reverse Delay Valve

SPK-RDVD

SPK Reverse Delay Valve (Dual)

SPK-RDVLV

SPK Retard Delay Valve

SPK-RDVS

SPK Reverse Delay Valve (Single)

SPK-RETS

SPK Retard Switch

SPK-SC

SPK Speed Controlled

SPK-SOL

SPK Solenoid

SPK-SRRV

SPK Spark Relay Regulator Valve

SPK-TAVIA

SPK Temperature Activated Vacuum Ignition Advance

SPK-TCS

SPK Transmission Controlled Spark

SPK-TCSYS

SPK Timing Control System

SPK-TIDC

SPK Thermostatic Ignition Distributor Control

SPK-TV

SPK Thermal Valve

SPK-TVS

SPK Thermal Vacuum Switch

SPK-VACTO

SPK Vacuum Advance Coolant Temperature Override

SPK-VAS

SPK Vacuum Advance Solenoid

SPK-VAV

SPK Vacuum Advance Valve

SPK-VR

SPK Vacuum Retard

SPK-VRSW

SPK Vacuum Retard Switch

SPK-VSV

SPK Vacuum Switching Valve

SPK-VTCS

SPK Vacuum Timing Control System

SPL

Smoke Puff Limiter

SRI

Service Reminder Indicator

SSCA

Stepped Speed Control Actuator

SSCS

Stepped Speed Control Solenoid

STS

Service Throttle Soon Light

STVS

Secondary Throttle Valve System

SUB-HO2S

Sub-Heated Oxygen Sensor (after CAT)

SUB-O2S

Sub-Oxygen Sensor

SUB-TWC

Sub Three-Way Catalytic Converter

"T"

TAA

Turbo Air-To-Air

TAA

Throttle Actuator Assembly

TAB

Thermactor Air By-Pass

TAD

Thermactor Air Diverter

TAC

Thermostatic Air Cleaner

TBI

Throttle Body Injection

TBPCS

Throttle By-Pass Control System

TC

Turbo Charger

TCC

Torque Converter Clutch

TCCL

Torque Converter Control

TCD

Throttle Closing Dashpot

TC-DV

TC Delay Valve

TC-TVC

TC Thermal Vacuum Switch

TC-VS

TC Vacuum Switch

TD

Thermactor Diverter

TFT

Tank Fuel Temperature Sensor

THOS2

Third Heated Oxygen Sensor

TICV

Thermal Ignition Control Valve

TIV

Thermal Idle Valve

TK

Throttle Kicker

TLUC

Transmission Lock-Up Converter

TLUC-TVS

TLUC Thermal Vacuum Switch

TLUC-VS

TLUC Vacuum Switch

TM

Throttle Modulator

TOS

Throttle Opener System

TP

Throttle Positioner

TPI

Tuned Port Fuel Injection

TPV

Throttle Poppet Valve

TR

Thermal Reactor

TRC

Throttle Return Control

TRCS

Throttle Return Control Solenoid

TRCTL

Throttle Return Control Throttle Lever Actuator

TRSCV

Throttle Return Solenoid Control Valve

TRTVV

Temperature Regulator Thermal Vacuum Valve

TRVV

Transmission Vacuum Valve

TSOL

Throttle Solenoid

TVISD

Throttle Vacuum Idle Speed Diaphragm

TVM

Transmission Vacuum Modulator

TWC

Three-Way Catalytic Converter

TWC+OC

Three-Way + Oxidation Catalytic Converter

"V"**VA**

Vacuum Advance Unit

VAC-AMP

Vacuum Amplifier

VA-CTO

VA Coolant Temperature Override

VCV

Vacuum Cut Valve

VCV-BV

VCV By-Pass Valve

VLFR

Vent Line Flow Restrictor/Anti-Trickle Fill Valve

"W"

WU

Warm-Up Catalyst

WU-OC

Warm-Up Oxidation Converter

WU-TWC

Warm-Up Three-Way Catalytic Converter

ACCESSORIES & EQUIPMENT

Air/Wind Noise - Spark

DIAGNOSTIC INFORMATION AND PROCEDURES

AIR/WIND NOISE

Special Tools

- **CH-39570** Chassis Ear
- **GE-41416** Ultrasonic Leak Detector

WARNING: Refer to Assistant Driving Warning .

To analyze a reported windnoise condition, test drive the vehicle to determine the origin of the noise.

Choose a regular route with smooth and straight streets that run in all 4 directions: North, South, East, and West. The area should have little traffic or little noise in order to eliminate interference with the test.

NOTE: Often there is one primary leak source and one or more secondary leaks that contribute to the noise condition. Repairing only one of the contributing leak sources may not completely repair the total condition but only reduce the condition.

Drive the vehicle at the speed in which the noise was noticed, or until the noise is heard. Maintain safe and legal speeds.

Many of the waterleak diagnosis tests are also used for the windnoise diagnosis.

Most windnoise is caused either by leaking seals or by misaligned body surfaces. You can diagnose the following types of windnoise with the aid of **CH-39570** chassis ear or **GE-41416** leak detector.

- Wind whistle
- Wind roar
- Wind rush

When moving at highway speeds, air pressure inside the vehicle becomes greater than the air pressure outside. When a leak occurs, the escaping air causes a hiss or a whistle.

Wind roar occurs when air passes over or through an opening between the 2 body surfaces. To correct the condition, adjust the alignment to the body surfaces.

Wind rush occurs when air presses over the vehicles body and is related to the aerodynamics of the vehicle.

Wind whistle and wind roar are repairable. Rule out wind whistle and wind roar before concluding that the wind noise is due to wind rush.

Use the following inspections in order to aid in diagnosing wind whistle or wind roar:

1. Note the details for wind noise:
 - The perceived location
 - The location where the noise is loudest
 - When the noise occurs
 - The vehicle speed
 - The interior fan speed
 - The position of the windows
 - What the noise sounds like
2. Inspect the vehicle for the possible cause of the windnoise.
3. Test drive the vehicle and determine if the windnoise is external or internal.
4. Perform a visual inspection of the following components:
 - Loose fasteners
 - Torn weatherstrips
 - Broken weld joints
 - Sealer and/or adhesive skips

TRACING POWDER OR CHALK TEST

Clean the weatherstrips and the contact surfaces with cleaning solvent.

1. Apply powder or chalk in an unbroken line to the contact surface of the weatherstrip surrounding the perimeter of the suspected areas.
2. Close the panel completely without slamming the panel. Closing the panel completely presses the weatherstrip firmly against the mating surface.
3. Inspect the applied line on the weatherstrip. The applied line is marred where contact is good. A corresponding imprint is on the mating surfaces.
4. Gaps or irregularities in the powder or the chalk line on the mating surfaces indicate the areas with a poor seal.

AIR PRESSURE TEST

1. Mask off both the pressure relief valves.
2. Close all the windows.
3. Turn the vehicles ventilation fan to the on position, with the selector on high speed and in the defrost mode.
4. Unlock and close the doors.
5. Listen for escaping air along the door and the window seals with a stethoscope or a length of heater hose.

SOAP SUDS OR BUBBLE TEST

1. Mask off the pressure relief valves.
2. Close all the windows and the doors.
3. Turn the vehicles ventilation fan to the on position, with the selector on high speed and in the defrost mode.
4. Unlock and close the doors.
5. Apply the soap solution to the potential leak areas.
6. Look for bubbles revealing escaping air.

REPAIR INSTRUCTIONS

EXTERIOR WINDNOISE

WARNING: Refer to Assistant Driving Warning .

Exterior windnoise is louder when the vehicle is driven with one or more windows down. Exterior windnoise occurs when air passes over the body panels, the seams, or the openings. Use the following items during the test drive in order to aid in the detection of leaks:

- Mechanic's stethoscope or heater hose
 - Masking tape-51 mm (2 in) width
 - Strip caulk
 - A water soluble marking pencil
1. While driving, determine the location of the exterior windnoise by lowering one window at a time. If the location corresponds with the condition in step 2, pull over and make a temporary repair with 51 mm (2 in) wide masking tape.
 2. Tape over the gaps and the moldings one at a time. Test between each taping. Taping over the gaps and moldings will correct the condition.
 3. Temporarily repair the condition with masking tape. Adjust the tape when needed.
 4. Continue testing in order to determine if the noise has been eliminated or other leak areas exist.
 5. When all the reported leak conditions are located, make permanent repairs using the proper alignment techniques and the sealing materials.

INTERIOR WINDNOISE

WARNING: Refer to Assistant Driving Warning .

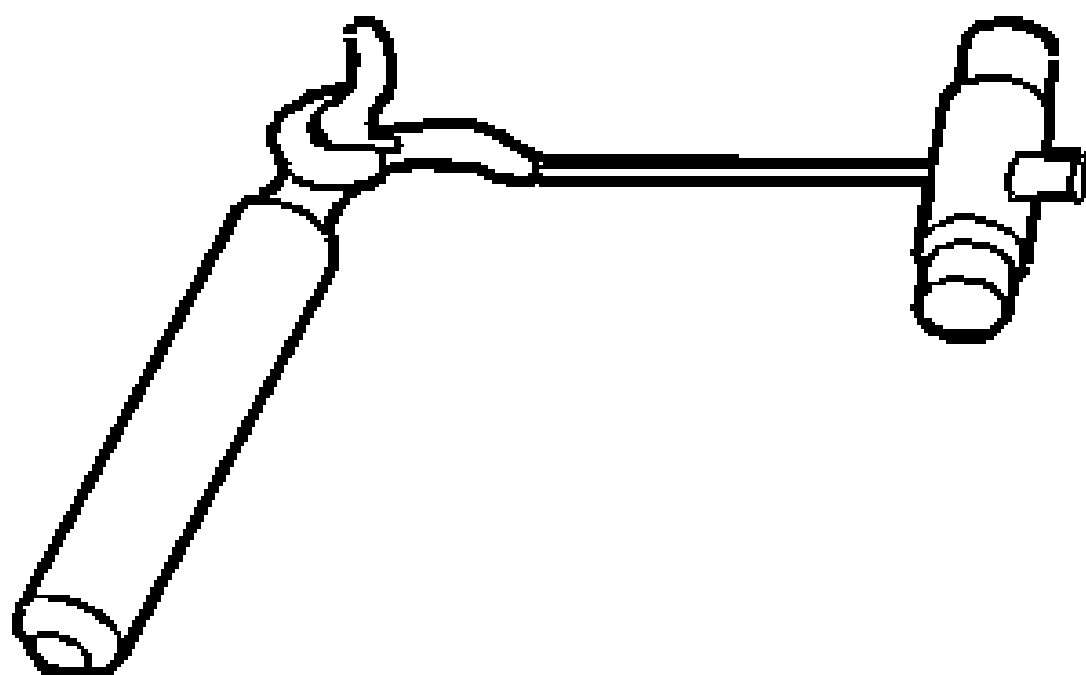
Interior windnoise is not heard when the window is lowered. Interior windnoise is caused by the air leaving the inside of the vehicle through a seal or a seam.

1. Tape over the relief valves to cause added air pressure within the vehicle.
2. Test drive the vehicle and listen for windnoise or a whistle.
3. Pull the vehicle over and make the temporary repairs using masking tape. If you cannot determine the source of the windnoise, perform one or more of the following diagnostic tests:
 - Air Pressure Test
 - Soap Suds or Bubble Test
 - Tracing Powder or Chalk Test

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description
	CH-39570 J-39570 Chassis Ear



GE-41416 J-41416 Ultrasonic Leak Detector

BRAKES

Antilock Brake System - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Brake Pipe Fitting- LF, RF, LR, and RR	18 N.m	13 lb ft
Brake Pipe Fitting- Primary and Secondary		
• ABS	18 N.m	13 lb ft
• ESC	25 N.m	18 lb ft
EBCM/BPMV Bracket Bolt/Nut	22 N.m	16 lb ft
EBCM/BPMV to Mounting Bracket Retaining Bolt	11 N.m	97 lb in
EBCM to BPMV Retaining Bolt	2.8 N.m	25 lb in
Wheel Speed Sensor Retaining Bolt	8.5 N.m	75 lb in
Yaw Sensor Retaining Nut	9 N.m	80 lb in

SCHEMATIC WIRING DIAGRAMS

ANTILOCK BRAKE SYSTEM WIRING SCHEMATICS

Module Power, Ground, and Subsystem References Wiring Schematics

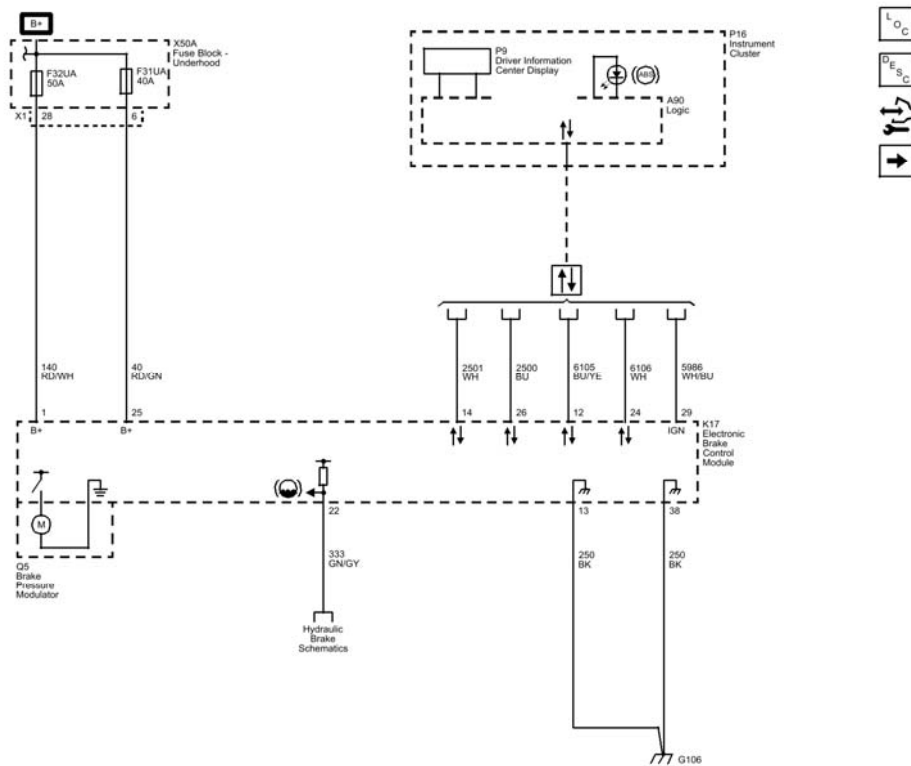


Fig. 1: Module Power, Ground, and Subsystem References Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

Wheel Speed Sensors Wiring Schematics

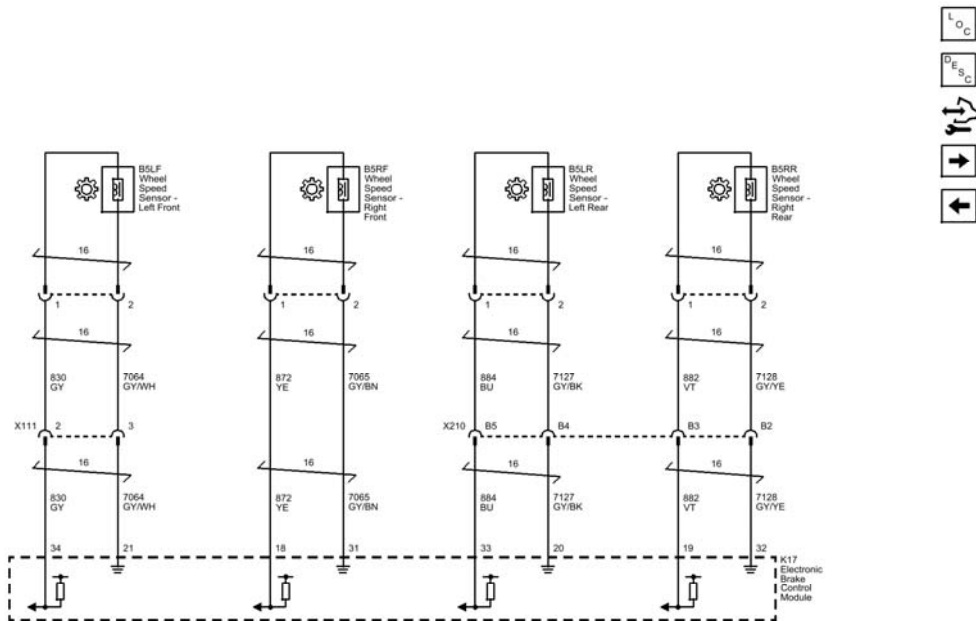


Fig. 2: Wheel Speed Sensors Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

Traction Control Wiring Schematics

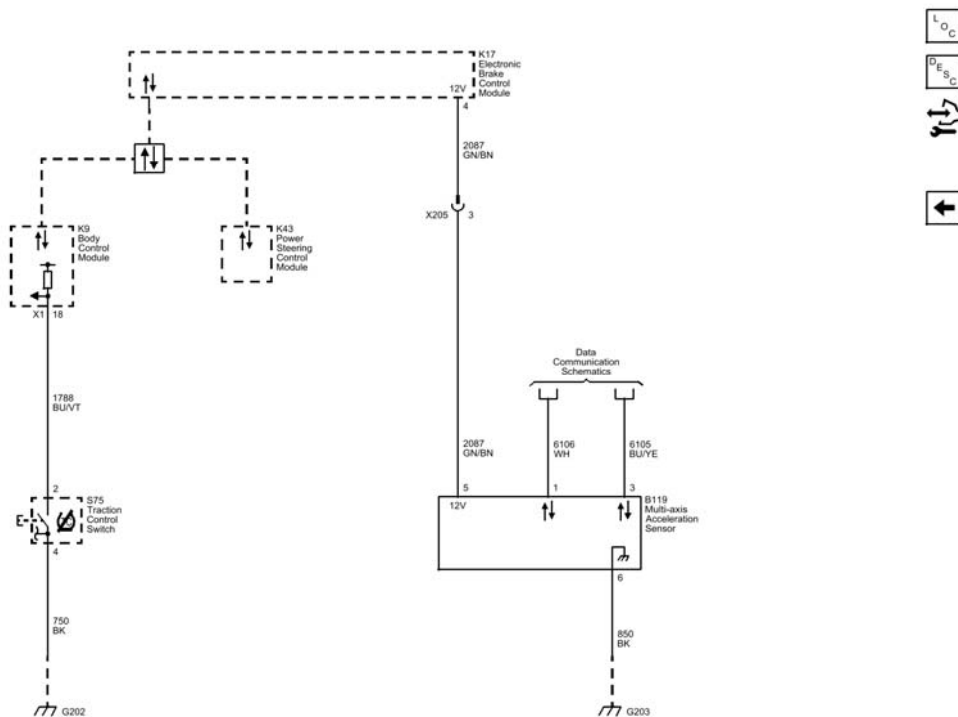


Fig. 3: Traction Control Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC B2745	DTC B2745 02 Traction Control Switch Circuit Short to Ground
	DTC B2745 71 Traction Control Switch Circuit Invalid Data
	DTC C0035 06 Left Front Wheel Speed Sensor Low Voltage/Open
	DTC C0035 0F Left Front Wheel Speed Sensor Circuit Signal Erratic
	DTC C0035 18 Left Front Wheel Speed Sensor Circuit Signal Low Signal Amplitude
	DTC C0035 5A Left Front Wheel Speed Sensor Not Plausible
	DTC C0040 06 Right Front Wheel Speed Sensor Low Voltage/Open

<u>DTC C0035, C0040, C0045, or C0050</u>	DTC C0040 0F Right Front Wheel Speed Sensor Circuit Signal Erratic DTC C0040 18 Right Front Wheel Speed Sensor Circuit Signal Low Signal Amplitude DTC C0040 5A Right Front Wheel Speed Sensor Not Plausible DTC C0045 06 Left Rear Wheel Speed Sensor Low Voltage/Open DTC C0045 0F Left Rear Wheel Speed Sensor Circuit Signal Erratic DTC C0045 18 Left Rear Wheel Speed Sensor Circuit Signal Low Signal Amplitude DTC C0045 5A Left Rear Wheel Speed Sensor Not Plausible DTC C0050 06 Right Rear Wheel Speed Sensor Low Voltage/Open DTC C0050 0F Right Rear Wheel Speed Sensor Circuit Signal Erratic DTC C0050 18 Right Rear Wheel Speed Sensor Circuit Signal Low Signal Amplitude DTC C0050 5A Right Rear Wheel Speed Sensor Not Plausible
<u>DTC C0110</u>	DTC C0110 04 Pump Motor Circuit Open DTC C0110 06 Pump Motor Circuit Low Voltage/Open DTC C0110 61 Pump Motor Stuck
<u>DTC C0131</u>	DTC C0131 00 Traction Control System Pressure Circuit Malfunction DTC C0131 5A Traction Control System Pressure Circuit Not Plausible
<u>DTC C0161</u>	DTC C0161 5A Antilock Brake System Brake Switch Not Plausible DTC C0161 71 Antilock Brake System Brake Switch Invalid Data
<u>DTC C0186, C0187, C0196, or C0287</u>	DTC C0186 Lateral Acceleration Sensor Signal (Inflatable Restraint Sensing and Diagnostic Module) DTC C0187 Multi-Axis Acceleration Sensor Circuit (Electronic Brake Control Module) DTC C0196 Yaw Rate Signal (Inflatable Restraint Sensing and Diagnostic Module and/or Electronic Brake Control Module) DTC C0287 Longitudinal Acceleration Sensor Signal (Inflatable Restraint Sensing and Diagnostic Module and/or Electronic Brake Control Module)
<u>DTC C0201</u>	DTC C0201 00 Antilock Braking System Enable Relay Primary Circuit
	DTC C0242 00 Powertrain Control Module Indicated

<u>DTC C0242 or P0856</u>	Traction Control DTC P0856 Traction Control Torque Request Circuit
<u>DTC C0277</u>	DTC C0277 4B Brake Pedal Position Sensor Circuit Calibration Not Learned
<u>DTC C027C</u>	DTC C027C Front Brake Discs High Temperature
<u>DTC C0292</u>	DTC C0292 1A Multi-Axis Acceleration Sensor Module Circuit Performance - Bias Level Out of Range
<u>DTC C0561</u>	DTC C0561 77 System Disabled Information Stored Engine Speed Out of Range DTC C0561 78 System Disabled Information Stored Acceleration Pedal Position Out of Range DTC C0561 79 System Disabled Information Stored Transmission Gear Invalid Data
<u>DTC C056D</u>	DTC C056D 00 Electronic Control Unit Hardware Malfunction
<u>DTC C056E</u>	DTC C056E 42 Electronic Control Unit Software Calibration Not Programmed DTC C056E 47 Electronic Control Unit Software VIN Not Programmed
<u>DTC C0710</u>	DTC C0710 Steering Wheel Angle Signal

DTC B2745: TRACTION CONTROL SWITCH

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B2745 02

Traction Control Switch Circuit Short to Ground

DTC B2745 71

Traction Control Switch Circuit Invalid Data

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	B2745 02, B2745 71	1	1	B2745 71

Ground	-	1	-	-
1. Traction control switch inoperative				

Circuit/System Description

The Body Control Module monitors the Vehicle Stability Control Switch. When the Traction Control Switch is pressed once, the Body Control Module will request the Electronic Brake Control Module via serial data to disable the traction control. The Electronic Brake Control Module will request the Instrument Cluster via serial data to turn the Traction Control Off Indicator ON to notify the driver of the deactivation.

When the Traction Control Switch is pressed and held for five seconds, the Body Control Module will request the Electronic Brake Control Module to disable the traction control and the electronic stability control. The Electronic Brake Control Module will request the Instrument Cluster via serial data to turn the Traction Control Off and the Stability Control Off Indicator ON to notify the driver of the deactivation.

Conditions for Running the DTC

- Ignition ON.
- Ignition voltage is greater than 8 V.

Conditions for Setting the DTC

B2745 02

The Body Control Module detects a short to ground on the signal circuit.

B2745 71

The Body Control Module detects an erratic signal or invalid serial data from the Traction Control Switch.

Action Taken When the DTC Sets

- The Body Control Module ignores the Traction Control Switch signal input.
- The Electronic Brake Control Module disables the vehicle stability enhancement system for the duration of the ignition cycle.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A DTC will not clear the current status until the next ignition cycle.
- A history DTC will clear once 40 malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation (With FX3), ABS Description and Operation (Without FX3)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON
2. Verify the Instrument Cluster Traction Control indicator turns ON and OFF when commanding the Instrument Cluster All Indicators ON and OFF with a scan tool.
 - **If the indicator does not turn ON and OFF**

Replace the P16 Instrument Cluster.
 - **If the indicator turns ON and OFF**
3. Verify the scan tool Traction Control Switch parameter changes between Active and Inactive while pressing and releasing the S75 Traction Control Switch.
 - **If the parameter does not change**

Refer to Circuit/System Testing.
 - **If the parameter changes**
4. All OK.

Circuit/System Testing

1. Ignition OFF, scan tool disconnected, and all vehicle systems OFF, disconnect the harness connector at the S75 Traction Control Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 4 and ground.

- **If 10 ohms or greater**
 1. Ignition OFF
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
- 3. Ignition ON.
- 4. Verify the scan tool Body Control Module Traction Control Switch parameter is Inactive.
 - **If not Inactive**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal 18 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If Inactive**
- 5. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 4
- 6. Verify the scan tool Traction Control Switch parameter is Active.
 - **If not Active**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If Active**
- 7. Test or replace the S75 Traction Control Switch.

Component Testing

1. Ignition OFF, disconnect the harness connector at the S75 Traction Control Switch.
2. Test for infinite resistance between the signal terminal 2 and the ground terminal 4 with the switch in the open position.
 - **If less than infinite resistance**

Replace the S75 Traction Control Switch.
 - **If infinite resistance**
3. Test for less than 2 ohms between the signal terminal 2 and the ground terminal 4 with the switch in the closed position.
 - **If 2 ohms or greater**

Replace the S75 Traction Control Switch.

- If less than 2 ohms

4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Heater and Air Conditioning Control Replacement (Left Hand Drive)** , **Heater and Air Conditioning Control Replacement (Right Hand Drive)** for Traction Control Switch replacement.
- Refer to **Control Module References** for Body Control Module, Electronic Brake Control Module or Instrument Cluster replacement, programming and setup

DTC C0035, C0040, C0045, OR C0050: WHEEL SPEED SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC C0035 06

Left Front Wheel Speed Sensor Low Voltage/Open

DTC C0035 0F

Left Front Wheel Speed Sensor Circuit Signal Erratic

DTC C0035 18

Left Front Wheel Speed Sensor Circuit Signal Low Signal Amplitude

DTC C0035 5A

Left Front Wheel Speed Sensor Not Plausible

DTC C0040 06

Right Front Wheel Speed Sensor Low Voltage/Open

DTC C0040 0F

Right Front Wheel Speed Sensor Circuit Signal Erratic

DTC C0040 18

Right Front Wheel Speed Sensor Circuit Signal Low Signal Amplitude

DTC C0040 5A

Right Front Wheel Speed Sensor Not Plausible

DTC C0045 06

Left Rear Wheel Speed Sensor Low Voltage/Open

DTC C0045 0F

Left Rear Wheel Speed Sensor Circuit Signal Erratic

DTC C0045 18

Left Rear Wheel Speed Sensor Circuit Signal Low Signal Amplitude

DTC C0045 5A

Left Rear Wheel Speed Sensor Not Plausible

DTC C0050 06

Right Rear Wheel Speed Sensor Low Voltage/Open

DTC C0050 0F

Right Rear Wheel Speed Sensor Circuit Signal Erratic

DTC C0050 18

Right Rear Wheel Speed Sensor Circuit Signal Low Signal Amplitude

DTC C0050 5A

Right Rear Wheel Speed Sensor Not Plausible

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
				C0035 0F, C0035

Left Front Sensor Ignition	C0035 06	C0035 06	-	18, C0035 5A
Left Front Sensor Signal	C0035 06	C0035 06	C0035 06	C0035 0F, C0035 18, C0035 5A
Right Front Sensor Ignition	C0040 06	C0040 06	-	C0040 0F, C0040 18, C0040 5A
Right Front Sensor Signal	C0040 06	C0040 06	C0040 06	C0040 0F, C0040 18, C0040 5A
Left Rear Sensor Ignition	C0045 06	C0045 06	-	C0045 0F, C0045 18, C0045 5A
Left Rear Sensor Signal	C0045 06	C0045 06	C0045 06	C0045 0F, C0045 18, C0045 5A
Right Rear Sensor Ignition	C0050 06	C0050 06	-	C0050 0F, C0050 18, C0050 5A
Right Rear Sensor Signal	C0050 06	C0050 06	C0050 06	C0050 0F, C0050 18, C0050 5A

Component	Condition	DTC Symptom Bytes
Wheel Speed Sensor	- Physical damage - Debris on the wheel speed sensor or the encoder ring - Loose or worn wheel bearing - Loose or improperly mounted sensor - Air gap between the wheel speed sensor and the encoder ring too large - Water intrusion in the wiring harness	0F, 18, or 5A

Circuit/System Description

The wheel speeds are detected by active wheel speed sensors and encoder rings. The encoder ring consists of permanent magnets. Each wheel speed sensor receives ignition voltage from the electronic brake control module and provides an alternating current square wave signal to the electronic brake control module. As the wheel spins, the electronic brake control module uses the frequency of the square wave signal to calculate the wheel speed.

Conditions for Running the DTC

C0035 06, C0040 06, C0045 06, or C0050 06

- Ignition ON.
- Ignition voltage is greater than 8 V.

C0035 0F, C0040 0F, C0045 0F, or C0050 0F

- Ignition ON.
- Ignition voltage is greater than 8 V.
- Vehicle speed is greater than 20 km/h (12 MPH).

C0035 18, C0040 18, C0045 18, or C0050 18

- Ignition ON.
- Ignition voltage is greater than 8 V.
- No other wheel speed circuit DTCs are set.
- At least two other wheel speed circuits are not 0 km/h (0 MPH).

C0035 5A, C0040 5A, C0045 5A, or C0050 5A

- Ignition ON.
- Ignition voltage is greater than 8 V.
- The vehicle speed is greater than 20 km/h (12 MPH).

Conditions for Setting the DTC

C0035 06, C0040 06, C0045 06, or C0050 06

- A short to voltage is detected on a wheel speed signal.
- A short to ground or an open/high resistance is detected on a wheel speed signal.
- A short to ground or an open/high resistance is detected on a wheel speed ignition circuit.

C0035 18, C0040 18, C0045 18, or C0050 18

- One wheel speed is less than 2 km/h (1.2 MPH).
- The remaining wheel speeds are greater than 10 km/h (6.2 MPH) for 0.154 seconds.
- The difference between the remaining wheel speeds are less than 4 km/h (2.5 MPH) from each other for more than 2 minutes.

C0035 0F, C0040 0F, C0045 0F, or C0050 0F

The electronic brake control module detected a rapid variation in the wheel speed. The wheel speed changes 20 km/h (12 MPH) or more in 0.7 seconds. The change must occur 56 times with no more than 0.7 seconds between occurrences.

C0035 5A, C0040 5A, C0045 5A, or C0050 5A

The difference between fastest and slowest wheel speed is greater than 60% for more than 2 minutes.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The traction/stability control indicator turns ON, if equipped with electronic stability control.
- The electronic brake distribution does not function optimally with multiple wheel speed sensor DTCs set.
- The electronic brake control module disables the ABS, the traction control and the stability control for the duration of the ignition cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Diagnostic Aids

- Do not use a magnet to clean the encoder ring.
- Inspect the wheel hub bearing encoder ring for rust or corrosion.
- Inspect the wheel speed sensor for contamination, physical damage, and correct installation.
- If two or more wheel speed sensors are inoperative, diagnose each wheel speed sensor individually.
- If any of the symptom codes 0F, 18 or 5A are set, refer to the Diagnostic Fault Information table for possible mechanical faults or conditions.
- If the customer comments that the ABS indicator is ON only during moist environmental conditions (rain, snow, vehicle wash, etc.), inspect the wheel speed sensor wiring for signs of water intrusion.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation (With FX3), ABS Description and Operation (Without FX3)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Test drive the vehicle in a straight line at a speed greater than 40 km/h (25 MPH).
2. Verify all scan tool Wheel Speed Sensor parameters are within 4 km/h (2.5 MPH) of each other.
 - **If any parameter is not within 4 km/h (2.5 MPH) of each other**

Refer to Circuit/System Testing.

- **If each parameter is within 4 km/h (2.5 MPH) of each other**
3. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connectors at the appropriate B5 Wheel Speed Sensor and the harness connector at the K17 Electronic Brake Control Module, ignition ON.
2. Test for less than 1 V between the appropriate K17 Electronic Brake Control Module harness connector terminals listed below and ground:
 - B5LF Wheel Speed Sensor - Left Front - terminal 34 and terminal 21
 - B5LR Wheel Speed Sensor - Left Rear - terminal 33 and terminal 20
 - B5RF Wheel Speed Sensor - Right Front - terminal 18 and terminal 31
 - B5RR Wheel Speed Sensor - Right Rear - terminal 19 and terminal 32
 - **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**
3. Ignition OFF.
 4. Test for infinite resistance between the K17 Electronic Brake Control Module harness connector terminals listed below and ground:
 - B5LF Wheel Speed Sensor - Left Front - terminal 34 and terminal 21
 - B5LR Wheel Speed Sensor - Left Rear - terminal 33 and terminal 20
 - B5RF Wheel Speed Sensor - Right Front - terminal 18 and terminal 31
 - B5RR Wheel Speed Sensor - Right Rear - terminal 19 and terminal 32
 - **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**
5. Test for less than 2 ohms between the B5 Wheel Speed Sensor harness connector terminal 1 and the K17 Electronic Brake Control Module harness connector terminal listed below:
 - B5LF Wheel Speed Sensor - Left Front - terminal 34

- B5LR Wheel Speed Sensor - Left Rear - terminal 33
- B5RF Wheel Speed Sensor - Right Front - terminal 18
- B5RR Wheel Speed Sensor - Right Rear - terminal 19
- **If 2 ohms or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 ohms**

6. Test for less than 2 ohms between the B5 Wheel Speed Sensor harness connector terminal 2 and the K17 Electronic Brake Control Module harness connector terminal listed below:

- B5LF Wheel Speed Sensor - Left Front - terminal 21
- B5LR Wheel Speed Sensor - Left Rear - terminal 20
- B5RF Wheel Speed Sensor - Right Front - terminal 31
- B5RR Wheel Speed Sensor - Right Rear - terminal 32
- **If 2 ohms or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 ohms**

7. Replace the B5 Wheel Speed Sensor.

8. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

- **If the DTC sets**

Replace the K17 Electronic Brake Control Module.

- **If the DTC does not set**

9. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Front Wheel Speed Sensor Replacement (Right Side), Front Wheel Speed Sensor Replacement (Left Side)**
- **Rear Wheel Speed Sensor Replacement**
- **Control Module References** for Electronic Brake Control Module replacement, programming and setup

DTC C0110: PUMP MOTOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.

- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC C0110 04

Pump Motor Circuit Open

DTC C0110 06

Pump Motor Circuit Low Voltage/Open

DTC C0110 61

Pump Motor Stuck

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ Terminal 1	C0201 00	C0201 00	-	-
Ground Terminal 13	-	C0110 04, C0110 06	-	-
Ground Terminal 38	-	U0121	-	-

Component	Condition	DTCs
Pump Motor	• Wear • Damage • Lock	C0110 61

Circuit/System Description

The pump motor is an integral part of the brake pressure modulator, while the pump motor relay is integral to the electronic brake control module. The pump motor relay is not engaged during normal system operation. When ABS operation is required the electronic brake control module activates the pump motor relay and battery voltage is provided to the pump motor.

Conditions for Running the DTC

C0110 04 or C0110 06

Ignition ON.

C0110 61

- The vehicle speed is greater than 20 km/h (13 MPH), and brake is not applied.
- The test is initiated once per ignition cycle, when the vehicle speed is greater than 15 km/h (9 MPH), and a fault was set on the last ignition cycle.

Conditions for Setting the DTC

C0110 04 or C0110 06

- The ground circuit is open, and the feedback voltage is greater than 5 V for 0.5 seconds, the pump is not activated.
- The electronic brake control module detects a low voltage in the pump motor supply circuit when the feedback voltage is less than 5 V for greater than 500 ms, and the pump motor is not activated.

C0110 61

The pump motor continues to rotate briefly after deactivation creating a feedback voltage. The electronic brake control module sets the DTC if the measured feedback voltage indicates a binding or stalled pump motor.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The traction/stability control indicator turns ON, if equipped with electronic stability control.
- The electronic brake control module disables the ABS, the traction control and the electronic stability control for the duration of the ignition cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation (With FX3), ABS Description and Operation (Without FX3)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON
2. Verify the ABS pump motor turns ON and OFF when commanding the ABS Pump Motor ON and OFF with a scan tool.
 - **If the pump motor does not turn ON and OFF**
 - Refer to Circuit/System Testing.
 - **If the pump motor turns ON and OFF**
3. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the K17 Electronic Brake Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminals listed below and ground:
 - Terminal 13
 - Terminal 38
 - **If 10 ohms or greater**
 1. Ignition OFF
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Ignition ON.
4. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Ignition OFF.
2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the Q5 Brake Pressure Modulator.

- **If the test lamp illuminates**

5. Replace the Q5 Brake Pressure Modulator.
6. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.
 - **If the DTC sets**

Replace the K17 Electronic Brake Control Module.

- **If the DTC does not set**

7. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Brake Pressure Modulator Valve Replacement**
- **Control Module References** for Electronic Brake Control Module replacement, programming and setup

DTC C0131: TRACTION CONTROL SYSTEM PRESSURE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC C0131 00

Traction Control System Pressure Circuit Malfunction

DTC C0131 5A

Traction Control System Pressure Circuit Not Plausible

Circuit/System Description

The electronic brake control module monitors the brake pressure sensor which is integral to the brake pressure modulator. The body control module monitors the brake pedal position sensor signal when the brake pedal is

applied and sends a serial data message to the electronic brake control module indicating the brake pedal position. The electronic brake control module compares the brake pressure to the brake pedal position and uses this information for vehicle stability control.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

C0131 00

The electronic brake control module detects the brake pressure is out of specified range.

C0131 5A

The electronic brake control module does not detect that the master cylinder pressure changed after driving the vehicle at a speed greater than 40 km/h (25 MPH) and performing three brake stops.

Action Taken When the DTC Sets

- The traction/stability control indicator turns ON.
- The electronic brake control module disables the traction/stability or the duration of the ignition cycle, and the ABS remains functional.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Diagnostic Aids

Diagnose all other stop lamp DTCs or Symptoms prior to performing this diagnostic procedure.

Reference Information

Schematic Reference

- **Antilock Brake System Schematics**
- **Exterior Lights Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation (With FX3), ABS Description and Operation (Without FX3)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the stop lamps turn ON and OFF while applying and releasing the brake pedal.
 - **If the stop lamps do not turn ON and OFF**

Refer to **Symptoms - Lighting** .
 - **If the stop lamps turn ON and OFF**
3. Verify the Brake Pedal Position Sensor or the brake pedal are not binding causing residual brake pressure to be detected, while the brake lights operate properly.
 - **If a condition is found**

Repair or replace the appropriate component.
 - **If a condition is not found**
4. Verify the scan tool Brake Pressure Sensor parameter changes from 0 V to 1 V when the brake pedal is applied.
 - **If the Brake Pressure Sensor parameter does not change**
 1. Replace the Q5 Brake Pressure Modulator.
 2. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.
 - If the DTC sets, replace the K17 Electronic Brake Control Module.
 - If the DTC does not set.
 3. All OK.
 - **If the Brake Pressure Sensor parameter changes**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Brake Pressure Modulator Valve Replacement**
- **Control Module References** for Electronic Brake Control Module replacement, programming and setup

DTC C0161: ANTILOCK BRAKE SYSTEM BRAKE SWITCH

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC C0161 5A

Antilock Brake System Brake Switch Not Plausible

DTC C0161 71

Antilock Brake System Brake Switch Invalid Data

Circuit/System Description

When the brake pedal is applied, the body control module sends a serial data message to the electronic brake control module in reference to the brake pedal positions. The electronic brake control module compares the correlation between the brake pedal position and the amount of brake pressure it senses from the brake pressure sensor, which is internal to the brake pressure modulator. It uses this information to control the vehicle during an stability control event.

Conditions for Running the DTC

- Ignition ON.
- Ignition voltage is greater than 8 V.

Conditions for Setting the DTC

- The electronic brake control module detects the brake pedal is not applied when the brake pressure is greater 15 bar (218 PSI) for 3 seconds.
- The electronic brake control module does not detect that the stop lamp switch signal changed after driving the vehicle at a speed greater than 40 km/h (25 MPH) and performing three brake stops.

Action Taken When the DTC Sets

- The traction/stability control indicator off turns ON, if equipped with electronic stability control.

- The electronic brake control module disables the traction/stability for the duration of the ignition cycle, and the ABS remains functional.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Diagnostic Aids

- DTC C0161 may set if the brake pedal is applied while accelerating.
- Diagnose all other stop lamp DTCs or Symptoms prior to performing this diagnostic procedure.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation (With FX3), ABS Description and Operation (Without FX3)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the stop lamps turn ON and OFF while applying and releasing the brake pedal.
 - **If the stop lamps do not turn ON and OFF**

Refer to **Symptoms - Lighting** .

- **If the stop lamps turn ON and OFF**
- 3. Verify the Brake Pedal Position Sensor or the brake pedal are not binding causing residual brake pressure to be detected, while the brake lights operate properly.

- **If a condition is found**

Repair or replace the appropriate component.

- **If a condition is not found**

- 4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

DTC C0186, C0187, C0196, OR C0287: LATERAL ACCELERATION SENSOR/MULTI-AXIS ACCELERATION SENSOR/YAW RATE SIGNAL/LONGITUDINAL ACCELERATION SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC C0186

Lateral Acceleration Sensor Signal (Inflatable Restraint Sensing and Diagnostic Module)

DTC C0187

Multi-Axis Acceleration Sensor Circuit (Electronic Brake Control Module)

DTC C0196

Yaw Rate Signal (Inflatable Restraint Sensing and Diagnostic Module and/or Electronic Brake Control Module)

DTC C0287

Longitudinal Acceleration Sensor Signal (Inflatable Restraint Sensing and Diagnostic Module and/or Electronic Brake Control Module)

For symptom byte information refer to **Symptom Byte List** .

Circuit/System Description

The yaw rate, lateral acceleration and longitudinal acceleration sensors are combined into one multi-axis acceleration sensor, internal to the inflatable restraint sensing and diagnostic module. The multi-axis acceleration sensor communicates with the electronic brake control module via serial data. The electronic brake control module activates the stability control function depending on the multi-axis acceleration sensor input. The inflatable restraint sensing and diagnostic module uses the multi-axis acceleration sensor to determine if the vehicle is in a roll over or near collision incident.

Conditions for Running the DTC

Ignition ON

Conditions for Setting the DTC

C0186 00 or C0187 5A

- The lateral acceleration signal offset is out of the specified range.
- An internal fault in multi-axis acceleration sensor will set this DTC.
- Improperly mounted or loose inflatable restraint sensing and diagnostic module may set this DTC.
- The lateral acceleration signal is not plausible with the yaw rate, the steering wheel angle signal and the vehicle speed.

C0196 5A

- The yaw rate signal is out of the specified range.
- An internal fault in multi-axis acceleration sensor may set DTC C0196 5A.
- Improperly mounted or loose inflatable restraint sensing and diagnostic module may set this DTC.
- The yaw rate signal is not plausible with the lateral acceleration signal, the steering wheel angle sensor signal and the vehicle speed.

C0196 00

The yaw rate signal is out of the specified range.

C0287 00

The longitudinal acceleration signal is out of the specified range.

C0287 5A

- An Internal fault in multi-axis acceleration sensor will set this DTC.
- The longitudinal acceleration signal is not plausible with the vehicle acceleration.

Action Taken When the DTC Sets

- The Air Bag Indicator turns ON.
- The traction/stability control indicator turns ON.

- The electric brake control module disables the stability control and the Hill Start Assist for the duration of the ignition cycle.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation (With FX3), ABS Description and Operation (Without FX3)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC C0186, C0196, or C0287 is not set in the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If any of the DTCs are set**
 Perform the **Vehicle Yaw Sensor Learn**.
 - **If none of the DTCs are set**
2. Verify DTC C0187, C0196, or C0287 is not set in the K17 Electronic Brake Control Module.
 - **If any of the DTCs are set**
 1. Replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

2. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

- If the DTC sets, replace the K17 Electronic Brake Control Module.

- If the DTC does not set

3. All OK.

- **If none of the DTCs are set**

3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for electronic brake control module or inflatable restraint sensing and diagnostic module replacement, programming and setup

DTC C0201: ANTILOCK BRAKING SYSTEM ENABLE RELAY

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC C0201 00

Antilock Braking System Enable Relay Primary Circuit

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ Terminal 1	C0201 00	C0201 00	-	-
Ground Terminal 13	-	C0110 04, C0110 06	-	-
Ground Terminal 38	-	U0121	-	-

Circuit/System Description

Battery positive voltage is supplied to the electronic brake control module at all times through a 40 A fuse located in the underhood fuse block. The electronic brake control module uses this voltage to power the pump motor. The pump motor is an integral part of the brake pressure modulator, while the pump motor relay is integral to the electronic brake control module. The pump motor relay is not engaged during normal system operation. When the ABS, traction/stability operation is required the electronic brake control module activates the pump motor relay and turns the pump motor ON.

Conditions for Running the DTC

- Ignition ON.
- Ignition voltage is greater than 8 V.

Conditions for Setting the DTC

The pump motor supply voltage is less than 4 V.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The traction/stability control indicator turns ON, if equipped with electronic stability control.
- The electronic brake control module disables the ABS, the traction control and the stability control for the duration of the ignition cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation (With FX3), ABS Description and Operation (Without FX3)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF all vehicle systems OFF, disconnect the harness connector at the K17 Electronic Brake Control Module. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between each ground circuit terminal listed below and ground:
 - Terminal 13
 - Terminal 38
 - **If 10 ohms or greater**
 1. Ignition OFF
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Ignition ON.
4. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the Q5 Brake Pressure Modulator.
 - **If the test lamp illuminates**
5. Replace the Q5 Brake Pressure Modulator.
6. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.
 - **If the DTC sets**

Replace the K17 Electronic Brake Control Module.

 - **If the DTC does not set**
7. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Brake Pressure Modulator Valve Replacement**
- **Control Module References** for Electronic Brake Control Module replacement, programming and setup

DTC C0242 OR P0856: POWERTRAIN CONTROL MODULE INDICATED TRACTION CONTROL/TRACTION CONTROL TORQUE REQUEST

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC C0242 00

Powertrain Control Module Indicated Traction Control

DTC P0856

Traction Control Torque Request Circuit

Circuit/System Description

When traction control is active, the Electronic Brake Control Module sends a serial data message to the Engine Control Module requesting torque reduction. When certain Engine Control Module DTCs are set, the Engine Control Module will not be able to perform the torque reduction for traction control. A serial data message is sent to the Electronic Brake Control Module indicating that traction control is not allowed.

Conditions for Running the DTC

Engine running.

Conditions for Setting the DTC

The Engine Control Module detects a fault that prevents it from performing a traction control function and sends a serial data message to the Electronic Brake Control Module indicating that torque reduction is not allowed.

Action Taken When the DTC Sets

- The Traction/stability Control Indicator Off turns ON, if equipped with electronic stability control.
- The Electronic Brake Control Module disables the Traction/stability Control for the duration of the ignition cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation (With FX3), ABS Description and Operation (Without FX3)

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that no other DTCs are set except for C0242 or P0856.
 - **If any other DTCs are set**

Refer to the Diagnostic Trouble Code (DTC) List - Vehicle .

- **If no other DTCs are set**
3. Replace the K20 Engine Control Module.
 4. Verify that DTC C0242 or P0856 does not set while operating the vehicle within the Conditions for Running the DTC.
 - **If DTC C0242 or P0856 sets**

Replace the K17 Electronic Brake Control Module.

- **If DTC C0242 or P0856 does not set**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Electronic Brake Control Module and Engine Control Module replacement, programming and setup

DTC C0277: BRAKE PEDAL POSITION SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC C0277 4B

Brake Pedal Position Sensor Circuit Calibration Not Learned

Circuit/System Description

When the brake pedal is applied, the body control module sends a serial data message to the electronic brake control module in reference to the brake pedal positions. The electronic brake control module compares the correlation between the brake pedal position and the amount of brake pressure it senses from the brake pressure sensor, which is internal to the brake pressure modulator. It uses this information to control the vehicle during an stability control event.

Conditions for Running the DTC

- Brakes Applied.
- Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

- The body control module sends invalid brake pedal position data to the electronic brake control module.
- The DTC may set in the body control module and/or electronic brake control module, when the brake pedal position sensor home position is not learned.

Actions Taken When the DTC Sets

- The ABS indicator is commanded ON.
- The red brake indicator is commanded ON.
- The stop lamps may not activate at the expected brake pedal positions.
- The traction/stability control indicator turns ON, if equipped with electronic stability control.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A DTC will not clear the current status until the next ignition cycle.
- A successful brake pedal position sensor calibration has been performed.
- A history DTC will clear once 40 malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

- **Antilock Brake System Schematics**
- **Exterior Lights Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- **ABS Description and Operation (With FX3), ABS Description and Operation (Without FX3)**
- **Exterior Lighting Systems Description and Operation**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC C0277 is not set in the K9 Body Control Module.
 - **If DTC is set**

Refer to **DTC C0277 or C0890** .
 - **If DTC is not set**
2. Ignition ON
3. Verify the scan tool Body Control Module Brake Pedal Position Sensor Learned Released Position is YES.
 - **If the released position is not YES**

Perform the Brake Pedal Position Sensor Learn. Refer to **Brake Pedal Position Sensor Calibration** .

- **If the released position is YES**

4. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

- **If the DTC sets**

Replace the K17 Electronic Brake Control Module.

- **If the DTC does not set**

5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Electronic Brake Control Module replacement, programming and setup

DTC C027C: FRONT BRAKE DISCS HIGH TEMPERATURE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC C027C

Front Brake Discs High Temperature

For symptom byte information refer to **Symptom Byte List** .

Circuit/System Description

The electronic brake control module monitors how often the traction control or the stability control system activates in order to calculate an estimate of the front brake discs temperature. In most cases the high temperatures are caused by extended traction control activation. If the electronic brake control module calculates that the front brake components temperatures are too high, the electronic brake control module will temporarily suspend the traction control system function until the front brake discs cool down.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

The electronic brake control module detects the calculated temperature of the brake components is higher than 500°C (932°F).

Action Taken When the DTC Sets

- The traction/stability control indicator turns ON.
- The electronic brake control module disables the traction control and stability control for the duration of the ignition cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Diagnostic Aids

DTC C027C does not indicate a malfunction has occurred. This DTC indicates there was excessive traction control or stability control activation that caused the high temperatures.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation (With FX3), ABS Description and Operation (Without FX3)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: Since most occurrences of this DTC are caused by excessive brake usage, review with the customer the conditions under which the DTC set.

1. Allow the brakes to cool down before performing test.
2. Verify that no other DTCs are set.
 - **If any other DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If no other DTCs are set**
- 3. Verify DTC C027C does not set while driving the vehicle under normal braking conditions. Refer to **Brake System Vehicle Road Test** .
 - **If the DTC sets**

Replace the K17 Electronic Brake Control Module.

- **If the DTC does not set**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for electronic brake control module replacement, programming, and setup

DTC C0292: MULTI-AXIS ACCELERATION SENSOR MODULE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC C0292 1A

Multi-Axis Acceleration Sensor Module Circuit Performance - Bias Level Out of Range

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
12 V Reference	U0125, C0292 1A	U0125	-	-

Ground	-	U0125	-	-
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Circuit/System Description

The Lateral Accelerometer and the Yaw Rate Sensors are combined into one sensor called the Multi-axis Acceleration Sensor. The Electronic Brake Control Module supplies a 12 V reference to the Multi-axis Acceleration Sensor. The Multi-axis Acceleration Sensor communicates with the Electronic Brake Control Module via serial data. The module activates the stability control function depending on Multi-axis Acceleration Sensor input.

Conditions for Running the DTC

- Ignition ON.
- Ignition voltage is greater than 8 V.

Conditions for Setting the DTC

The Electronic Brake Control Module detects that the sensor supply voltage feedback indicates that the voltage level is less or greater than 1 V for more than 100 milliseconds.

Action Taken When the DTC Sets

- The Electronic Brake Control Module shuts down the 12 V reference to the multi-axis acceleration sensor.
- The Electronic Brake Control Module disables the vehicle stability enhancement system for the duration of the ignition cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation (With FX3), ABS Description and Operation (Without FX3)

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Verify the B119 Multi-axis Acceleration Sensor is installed correctly.
 - **If loose or incorrect installation**

Correct the installation of the component.
 - **If installed correctly**
2. Ignition OFF, scan tool disconnected, and all vehicle systems OFF, disconnect the harness connector at the B119 Multi-axis Acceleration Sensor. It may take up to 2 minutes for all vehicle systems to power down.
3. Test for less than 5 ohms between the ground circuit terminal 6 and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
4. Ignition ON.
5. Verify that a test lamp illuminates between the 12 V reference circuit terminal 5 and ground.
 - **If the test lamp does not illuminate**
 1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.
 2. Test for infinite resistance between the 12 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the 12 V reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K17 Electronic Brake Control Module.
 - **If the test lamp illuminates**
6. Replace the B119 Multi-axis Acceleration Sensor.
7. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

- **If the DTC sets**

Replace the K17 Electronic Brake Control Module.

- **If the DTC does not set**

8. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Electronic Brake Control Module replacement, programming and setup

DTC C0561: SYSTEM DISABLED INFORMATION STORED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC C0561 77

System Disabled Information Stored Engine Speed Out of Range

DTC C0561 78

System Disabled Information Stored Acceleration Pedal Position Out of Range

DTC C0561 79

System Disabled Information Stored Transmission Gear Invalid Data

Circuit/System Description

The electronic brake control module disables the traction and the stability control when other electronic control modules set DTCs for components that effect the operation of the brake system.

Conditions for Running the DTC

- Engine Running.
- Ignition voltage is greater than 8 V.

Conditions for Setting the DTC

The electronic brake control module receives an invalid serial data message from another module more than ten times.

Action Taken When the DTC Sets

- The ABS system remains functional.
- The electronic brake control module disables the stability control for the entire ignition cycle.

Conditions for Clearing the DTC

- The condition for the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Diagnostic Aids

This DTC indicates there are no problems in the brake system. The body control module, engine control module, and transmission control module should be checked for a possible fault first.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation (With FX3), ABS Description and Operation (Without FX3)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

C0561 77 or C0561 78

1. Ignition ON.
2. Verify there are no other DTCs set.
 - **If any other DTCs are set**

Refer to the **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If no other DTCs are set**
3. Replace the K20 Engine Control Module.
 4. Verify the DTC does not set while operating the vehicle within the conditions for Running the DTC.
 - **If the DTC sets**

Replace the K17 Electronic Brake Control Module.

- **If the DTC does not set**
5. All OK.

C0561 79

1. Ignition ON.
2. Verify there are no other DTCs set.
 - **If any other DTCs are set**

Refer to the **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If no other DTCs are set**
3. Replace the K71 Transmission Control Module.
 4. Verify the DTC does not set while operating the vehicle within the conditions for Running the DTC.
 - **If the DTC sets**

Replace the K17 Electronic Brake Control Module.

- **If the DTC does not set**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Electronic Brake Control Module, Engine Control Module, or Transmission Control Module replacement, programming and setup

DTC C056D: ELECTRONIC CONTROL UNIT HARDWARE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC C056D 00

Electronic Control Unit Hardware Malfunction

Circuit/System Description

The Electronic Brake Control Module detects an internal malfunction.

Conditions for Running the DTC

- Ignition ON.
- Ignition voltage is greater than 8 V.

Conditions for Setting the DTC

The Electronic Brake Control Module detects an internal malfunction.

Action Taken When the DTC Sets

- The ABS Indicator turns ON.
- The red Brake Warning Indicator turns ON.
- The Traction/stability Control Indicator turns ON, if equipped with electronic stability control.
- The Electronic Brake Control Module disables the ABS, and the Traction/stability for the duration of the ignition cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation (With FX3), ABS Description and Operation (Without FX3)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that DTC C056D is not set.
 - **If the DTC is set**

Replace the K17 Electronic Brake Control Module.

- **If the DTC is not set**
2. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Electronic Brake Control Module replacement, programming and setup

DTC C056E: ELECTRONIC CONTROL UNIT SOFTWARE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC C056E 42

Electronic Control Unit Software Calibration Not Programmed

DTC C056E 47

Electronic Control Unit Software VIN Not Programmed

Conditions for Running the DTC

- Ignition ON.
- Ignition voltage is greater than 8 V.

Conditions for Setting the DTC

A new service replacement Electronic Brake Control Module contains a unique manufacturing calibration. This DTC will be current whenever a new Electronic Brake Control Module is installed on a vehicle prior to the Service Programming System (SPS) event. The DTC will remain current until the Electronic Brake Control Module has undergone a successful program. Once the program event is completed, the DTC goes into history and can be cleared. After the DTC is cleared it can not return.

Action Taken When the DTC Sets

- The ABS Indicator turns ON.
- The red Brake Warning Indicator turns ON.
- The Traction/stability Control Indicator turns ON, if equipped with electronic stability control.
- The Electronic Brake Control Module disables the ABS, and the Traction/stability for the duration of the ignition cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation (With FX3), ABS Description and Operation (Without FX3)

Electrical Information Reference

- Circuit Testing
- Connector Repairs

- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that DTC C056E is not set.
 - **If the DTC is set**
 1. Ignition ON
 2. Program the K17 Electronic Brake Control Module.
 3. Verify the DTC does not set after driving the vehicle above 40 km/h (25 MPH).
 - If the DTC sets, replace the K17 Electronic Brake Control Module.
 - If the DTC does not set.
 4. All OK.
 - **If the DTC is not set**
2. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Electronic Brake Control Module replacement, programming and setup

DTC C0710: STEERING WHEEL ANGLE SIGNAL

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC C0710

Steering Wheel Angle Signal

For symptom byte information refer to **Symptom Byte List** .

Circuit/System Description

The steering wheel angle sensor is integrated in the steering column assembly. The steering wheel angle sensor identifies the position and direction of the steering wheel rotation.

The electronic brake control module receives high speed serial data inputs from the steering angle sensor identifying the position and direction of the steering wheel rotation. The electronic brake control module utilizes this signal to calculate the driver intended driving direction.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

C0710 4B

The steering angle sensor is not calibrated.

C0710 5A

- The steering angle signal is out of the specified range.
- The steering angle signal offset is out of the specified range.

C0710 71

The steering angle signal is not plausible with the multi-axis acceleration signal.

Action Taken When the DTC Sets

- The traction/stability control indicator turns ON.
- The electronic brake control module disables the traction control and the electronic stability control for the duration of the ignition cycle.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Diagnostic Aids

- Check and adjust all tires to the stated cold air pressure as identified on the tire placard.
- The car should not pull in either direction causing the steering wheel to be off center while driving in a straight line on a level surface.
- Confirm that all tires are of the proper size and matching brands. If a mis-sized or non-matching brand tire is present, inform the customer that in order for the vehicle stability enhanced system to function normally, tires need to be a uniform size and rolling diameter.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation (With FX3), ABS Description and Operation (Without FX3)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Steering Wheel Angle parameter value constantly changes from +550 to -550° as the steering wheel is turned through its entire range from left to right.
 - **If the parameter does not change**

Calibrate the K43 Power Steering Control Module.
 - **If the parameter changes**
3. Verify that DTC C0710 4B is not set.
 - **If DTC C0710 4B is set**

Perform the **Steering Angle Sensor Centering**.
 - **If DTC C0710 4B is not set**
4. Verify that DTC C0460 is not set.
 - **If DTC C0460 is set**

Refer to **DTC C0460** .
 - **If DTC C0460 is not set**

5. Replace the steering column assembly.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Steering Column Replacement (Electric Power Steering)**
- **Control Module References** for power steering control module replacement, programming and setup.

SYMPTOMS - ANTILOCK BRAKE SYSTEM

NOTE: The following steps must be completed before using the symptom tables.

1. Perform the **Diagnostic System Check - Vehicle** before using the symptom tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data link.
2. Review the system description and operation in order to familiarize yourself with the system functions. Refer to **ABS Description and Operation (With FX3)**, **ABS Description and Operation (Without FX3)**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the ABS. Refer to **Checking Aftermarket Accessories**.
- Inspect the easily accessible or visible system components, for obvious damage or conditions, which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections**.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **ABS Indicator Malfunction**
- **Brake Warning Indicator Malfunction**
- **Traction Control/Stability Control Indicator Malfunction**

ABS INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The Instrument Cluster turns the ABS indicator ON for five seconds after the ignition is turned ON, or when the Electronic Brake Control Module detects a fault and sends a serial data message to the Instrument Cluster commanding the indicator ON.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation (With FX3), ABS Description and Operation (Without FX3)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Ignition ON.
2. Verify that no DTCs are set.
 - **If any DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If no DTCs are set**
3. Verify the Instrument Cluster ABS indicator turns ON and OFF when commanding the All Indicators ON

and OFF with a scan tool.

- **If the ABS indicator does not turn ON and OFF**

Replace the P16 Instrument Cluster.

- **If the ABS indicator turns ON and OFF**

4. Verify the ABS indicator turns off five seconds after the ignition is turned ON.

- **If the ABS indicator does not turn OFF**

Replace the K17 Electronic Brake Control Module.

- **If the ABS indicator turns OFF**

5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Electronic Brake Control Module or Instrument Cluster replacement, programming and setup

TRACTION CONTROL/STABILITY CONTROL INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	B2745 02, B2745 71	1	1	B2745 71
Ground	-	1	-	-
1. Traction control malfunction				

Circuit/System Description

The Instrument Cluster illuminates the Traction/stability Control Indicator, Traction Control Off Indicator and Stability Control Off Indicator for five seconds after the ignition is turned ON. When the Electronic Brake Control Module detects a fault it sends a serial data message to the Instrument Cluster commanding the Traction/stability Control indicator ON.

The Body Control Module monitors the signal circuit from the Traction Control Switch. When the Traction Control Switch is pressed once, the Body Control Module sends a serial data message to the Electronic Brake Control Module to disable the traction control system. When the Traction Control Switch is pressed and held for five seconds, the Body Control Module will request the Electronic Brake Control Module to disable the electronic stability control. The Electronic Brake Control Module will request the Instrument Cluster to turn the Traction Control Off and Stability Control Off Indicator ON to notify the driver of the deactivation.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation (With FX3), ABS Description and Operation (Without FX3)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Ignition ON
2. Verify the Instrument Cluster indicators listed below turn ON and OFF when commanding the All Indicators ON and OFF with a scan tool.
 - Traction Control Off indicator
 - Stability Control Off indicator
 - Traction/stability Control indicator
 - **If the indicator does not turn ON and OFF**

Replace the P16 Instrument Cluster.

- **If the indicator turns ON and OFF**

3. Verify the scan tool Electronic Brake Control Module Traction Control Switch parameter changes between Active and Inactive while pressing and releasing the S75 Traction Control Switch.

- **If the parameter does not change**

Refer to Circuit/System Testing.

- **If the parameter changes**

4. All OK.

Circuit/System Testing

1. Ignition OFF, scan tool disconnected, and all vehicle systems OFF, disconnect the harness connector at the S75 Traction Control Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 ohms between the ground circuit terminal 4 and ground.

- **If 5 ohms or greater**

1. Ignition OFF
2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.

- **If less than 5 ohms**

3. Ignition ON.
4. Verify the scan tool Traction Control Switch parameter is Inactive.

- **If not Inactive**

1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module.
2. Test for infinite resistance between the signal circuit terminal 18 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.

- **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 4.
6. Verify the scan tool Traction Control Switch parameter is Active.

- **If not Active**

1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module, ignition ON.
2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.

- **If Active**

7. Test or replace the S75 Traction Control Switch.

Component Testing

1. Ignition OFF, disconnect the harness connector at the S75 Traction Control Switch.
2. Test for infinite resistance between the signal terminal 2 and the ground terminal 4 with the switch in the open position.
 - **If less than infinite resistance**

Replace the S75 Traction Control Switch.
 - **If infinite resistance**
3. Test for less than 2 ohms between the signal circuit terminal 2 and the ground terminal 4 with the switch in the closed position.
 - **If 2 ohms or greater**

Replace the S75 Traction Control Switch.
 - **If less than 2 ohms**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Heater and Air Conditioning Control Replacement (Left Hand Drive)** , **Heater and Air Conditioning Control Replacement (Right Hand Drive)** for Traction Control Switch replacement.
- Refer to **Control Module References** for Body Control Module, Electronic Brake Control Module or Instrument Cluster replacement, programming and setup

REPAIR INSTRUCTIONS

ANTILOCK BRAKE SYSTEM AUTOMATED BLEED

WARNING: Refer to **Brake Fluid Irritant Warning** .

CAUTION: Refer to **Brake Fluid Effects on Paint and Electrical Components Caution** .

NOTE: Before performing the Antilock Brake System (ABS) Automated Bleed Procedure, first perform a pressure bleed of the base brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** , **Hydraulic Brake System Bleeding (Pressure)** . The automated bleed procedure is recommended when one of the following conditions exists:

- **Base brake system bleeding does not achieve the desired pedal height or feel.**
- **Extreme loss of brake fluid has occurred.**
- **Air ingestion is suspected in the secondary circuits of the hydraulic brake modulator assembly.**

The ABS Automated Bleed Procedure uses a scan tool to cycle the system solenoid valves and run the pump in order to purge any air from the secondary circuits. These circuits are normally closed off and are only opened during system initialization at vehicle start up and during ABS operation. The automated bleed procedure opens these secondary circuits and allows any air trapped in these circuits to flow out toward the brake calipers.

CAUTION: The Auto Bleed Procedure may be terminated at any time during the process by pressing the EXIT button. No further Scan Tool prompts pertaining to the Auto Bleed procedure will be given. After exiting the bleed procedure, relieve bleed pressure and disconnect bleed equipment per manufacturers instructions. Failure to properly relieve pressure may result in spilled brake fluid causing damage to components and painted surfaces.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove all four tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** .
3. Inspect the brake system for leaks and visual damage. Refer to **Symptoms - Hydraulic Brakes** , repair or replace components as needed.
4. Lower the vehicle.
5. Inspect the battery state of charge. Refer to **Battery Inspection/Test** .
6. Install a scan tool.
7. Turn the ignition ON, with the engine OFF.
8. With the scan tool, establish communications with the ABS system. Select Control Functions. Select Automated Bleed from the Control Functions menu.
9. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
10. Following the directions given on the scan tool, pressure bleed the base brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** , **Hydraulic Brake System Bleeding (Pressure)** .
11. Follow the scan tool directions until the desired brake pedal height is achieved.
12. If the bleed procedure is aborted, a malfunction exists. Perform the following steps before resuming the bleed procedure:
 - If a DTC is detected, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** , and diagnose the appropriate DTC.
 - If the brake pedal feels spongy, perform the conventional brake bleed procedure again. Refer to **Hydraulic Brake System Bleeding (Manual)** , **Hydraulic Brake System Bleeding (Pressure)** .
13. When the desired pedal height is achieved, press the brake pedal to inspect for firmness.
14. Lower the vehicle.
15. Remove the scan tool.

16. Install the tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** .
17. Inspect the brake fluid level. Refer to **Master Cylinder Reservoir Filling** .
18. Road test the vehicle while inspecting that the pedal remains high and firm.

STEERING ANGLE SENSOR CENTERING

The steering angle sensor does not require centering often. Centering of the steering angle sensor might be required after certain service procedures are performed. Some of these procedures are as follows:

- Wheel alignment
- Steering gear replacement
- Steering column replacement
- Collision or other physical damage
- Power steering control module replacement
- Electronic brake control module replacement

The steering angle sensor centering procedure can be completed with a scan tool using the following steps:

1. Using the steering wheel, align and center the front wheels forward.
2. Apply the parking brake, or set the transmission in Park.
3. Install the scan tool to the data link connector.
4. Turn the ignition ON, and the engine OFF.
5. With the scan tool select the Power Steering Control Module.
6. Select the Steering Wheel Angle Sensor Centering in the Steering Wheel Angle Sensor Centering Configuration/Reset Functions list.
7. Follow the scan tool directions to complete the learn procedure.
8. Clear any DTCs that may be set.
9. Turn OFF the ignition.

ELECTRONIC BRAKE CONTROL MODULE REPLACEMENT

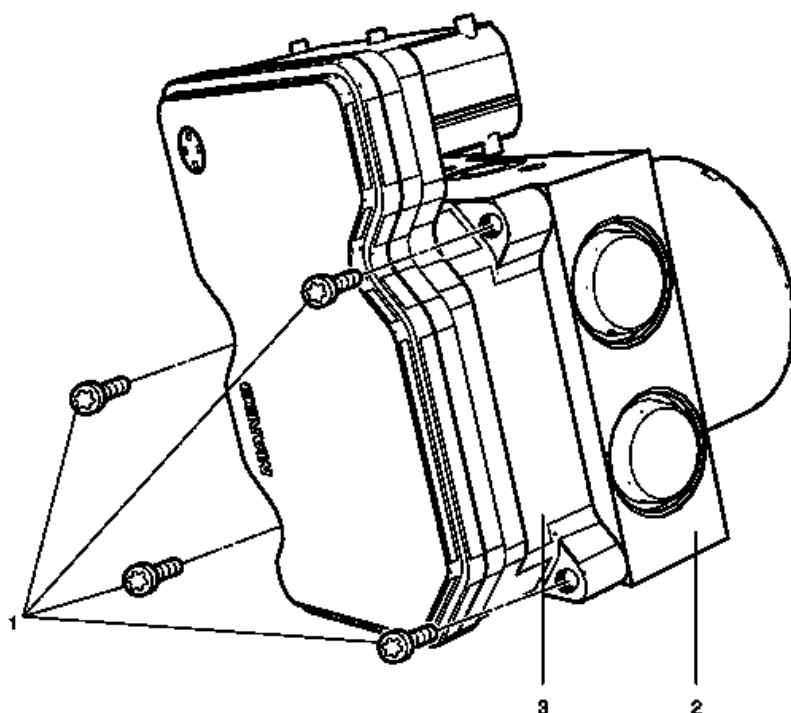


Fig. 4: Electronic Brake Control Module
 Courtesy of GENERAL MOTORS COMPANY

Electronic Brake Control Module Replacement

Callout	Component Name
WARNING: Refer to <u>Brake Fluid Irritant Warning</u> .	
CAUTION: Always connect or disconnect the wiring harness connector from the EBCM/EBTCM with the ignition switch in the OFF position. Failure to observe this precaution could result in damage to the EBCM/EBTCM.	
Preliminary Procedure Remove the EBCM/BPMV assembly from the vehicle. Refer to <u>Brake Pressure Modulator Valve Replacement</u> .	
1	Electronic Brake Control Module Bolt (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2.8 N.m (25 lb in)
2	Brake Pressure Modulator Valve

Electronic Brake Control Module

Procedure

3

1. Separate the EBCM from the BPMV by carefully pulling apart. DO NOT pry the components apart.
2. If a new EBCM is being installed, program the EBCM. Refer to **Control Module References**

BRAKE PRESSURE MODULATOR VALVE REPLACEMENT

Removal Procedure

WARNING: Refer to **Brake Fluid Irritant Warning** .

CAUTION: Always connect or disconnect the wiring harness connector from the EBCM/EBTCM with the ignition switch in the OFF position. Failure to observe this precaution could result in damage to the EBCM/EBTCM.

1. Turn the ignition switch to the OFF position.

NOTE: The area around the EBCM/BPMV assembly must be free from loose dirt to prevent contamination of disassembled ABS components.

2. Clean the electronic brake control module (EBCM) to the brake pressure modulator valve (BPMV) area of any accumulated dirt and foreign material.

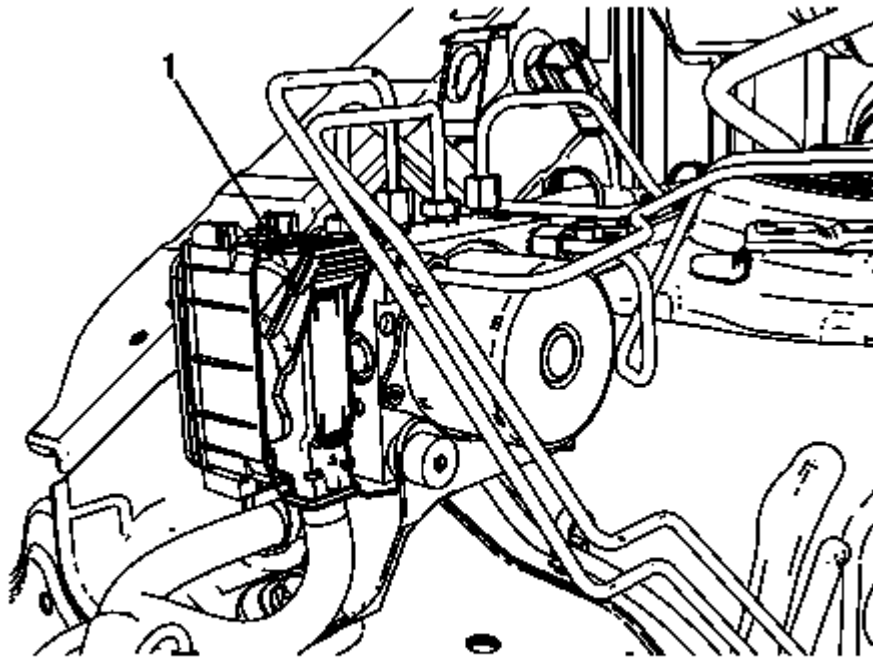


Fig. 5: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the electrical connector (1) from the EBCM.

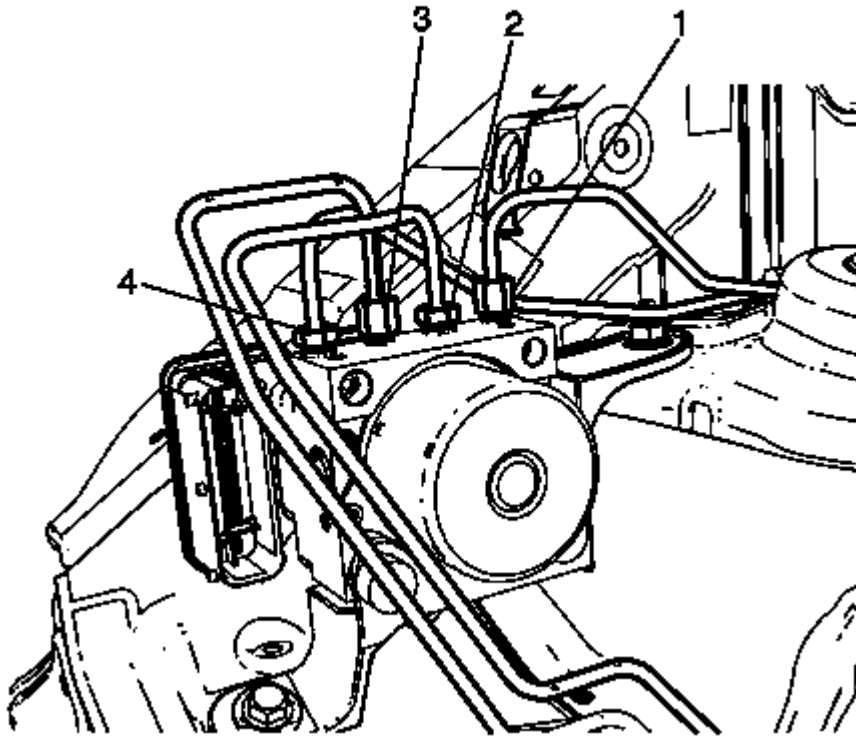


Fig. 6: RF Brake Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the RF brake pipe fitting (1) from the BPMV.

Cap the brake pipe fitting and plug the BPMV outlet port to prevent brake fluid loss and contamination.

5. Disconnect the LR brake pipe fitting (2) from the BPMV.

Cap the brake pipe fitting and plug the BPMV outlet port to prevent brake fluid loss and contamination.

6. Disconnect the RR brake pipe fitting (3) from the BPMV.

Cap the brake pipe fitting and plug the BPMV outlet port to prevent brake fluid loss and contamination.

7. Disconnect the LF brake pipe fitting (4) from the BPMV.

Cap the brake pipe fitting and plug the BPMV outlet port to prevent brake fluid loss and contamination.

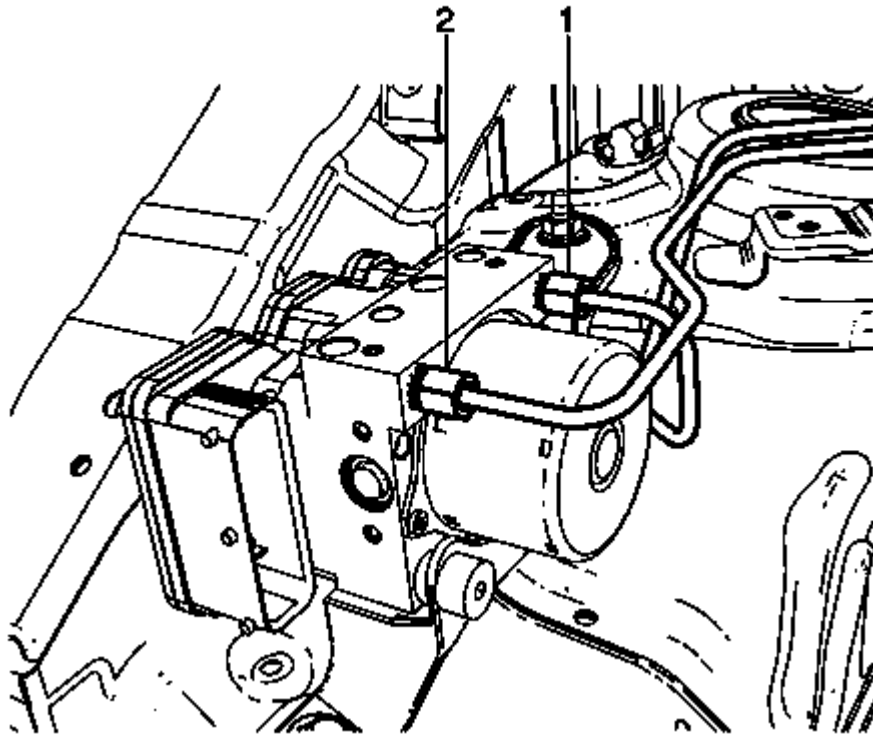


Fig. 7: Master Cylinder Primary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

8. Disconnect the master cylinder primary brake pipe fitting (1) from the BPMV.
Cap the brake pipe fitting and plug the BPMV inlet port to prevent brake fluid loss and contamination.
9. Disconnect the master cylinder secondary brake pipe fitting (2) from the BPMV.
Cap the brake pipe fitting and plug the BPMV inlet port to prevent brake fluid loss and contamination.

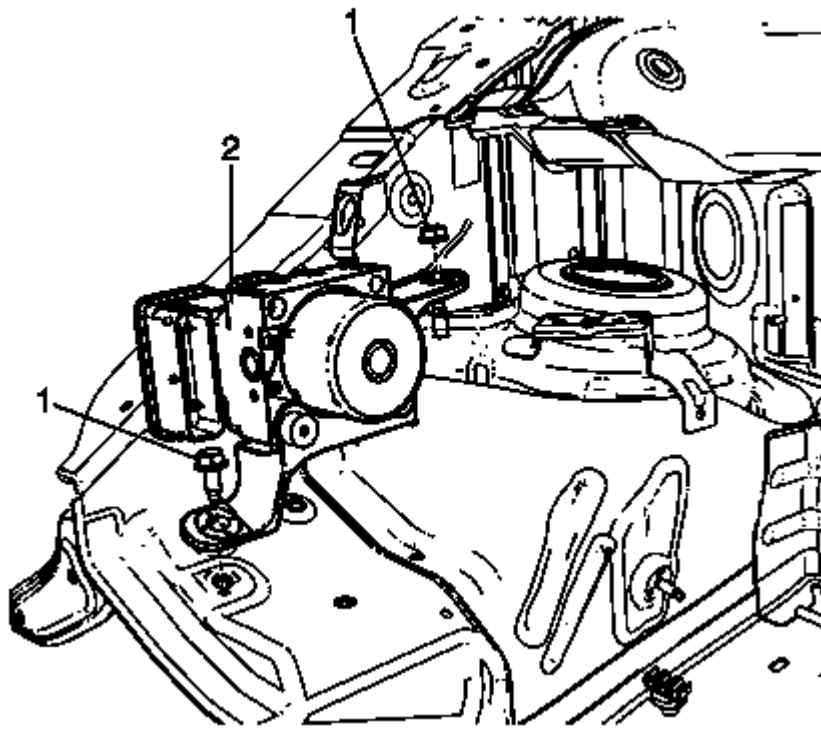


Fig. 8: EBCM/BPMV Bracket Bolt/Nut
Courtesy of GENERAL MOTORS COMPANY

10. Remove the EBCM/BPMV bracket bolt/nut (1).
11. Remove the EBCM/BPMV bracket assembly (2) from the vehicle.

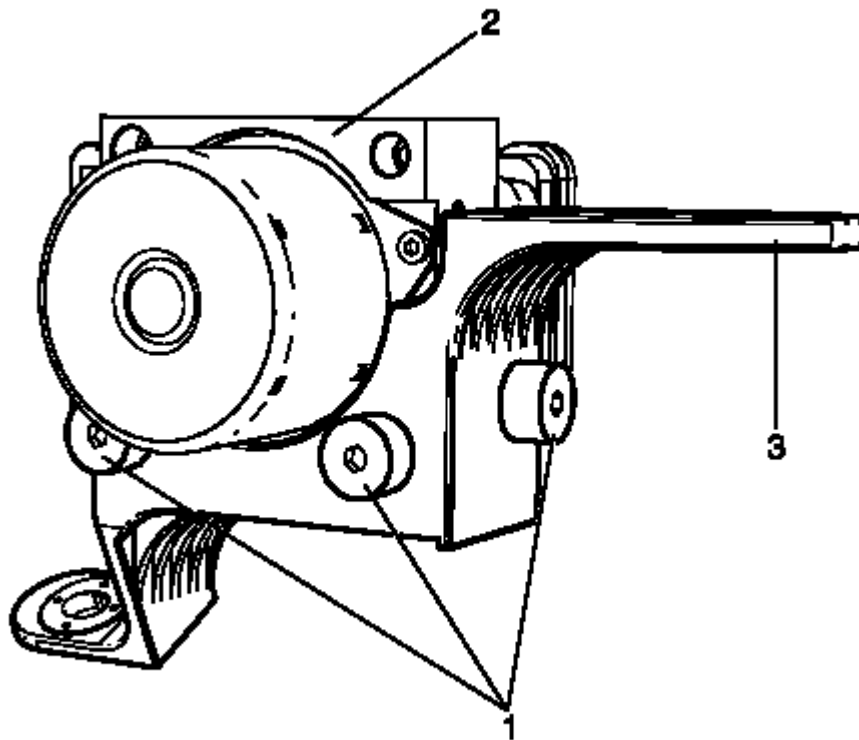


Fig. 9: EBCM/BPMV Assembly And Bracket
Courtesy of GENERAL MOTORS COMPANY

12. Remove the EBCM/BPMV assembly to the EBCM/BPMV assembly bracket retaining bolts (1).
13. Remove the EBCM/BPMV assembly (2) from the bracket (3).
14. If installing a new BPMV, remove the EBCM. Refer to **Electronic Brake Control Module Replacement**.

Installation Procedure

1. If installing a new BPMV, install the EBCM. Refer to **Electronic Brake Control Module Replacement**.

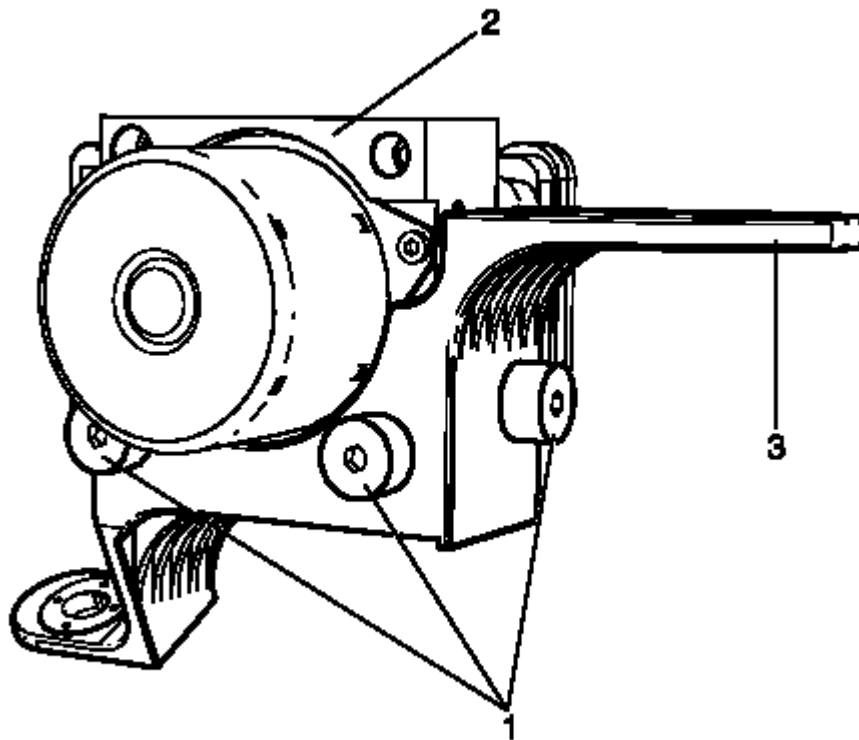


Fig. 10: EBCM/BPMV Assembly And Bracket
Courtesy of GENERAL MOTORS COMPANY

2. Install the EBCM/BPMV assembly (2) to the EBCM/BPMV assembly bracket (3).

CAUTION: Refer to Fastener Caution .

3. Install the EBCM/BPMV assembly to EBCM/BPMV assembly bracket retaining bolts (1) and tighten to 11 N.m (97 lb in).

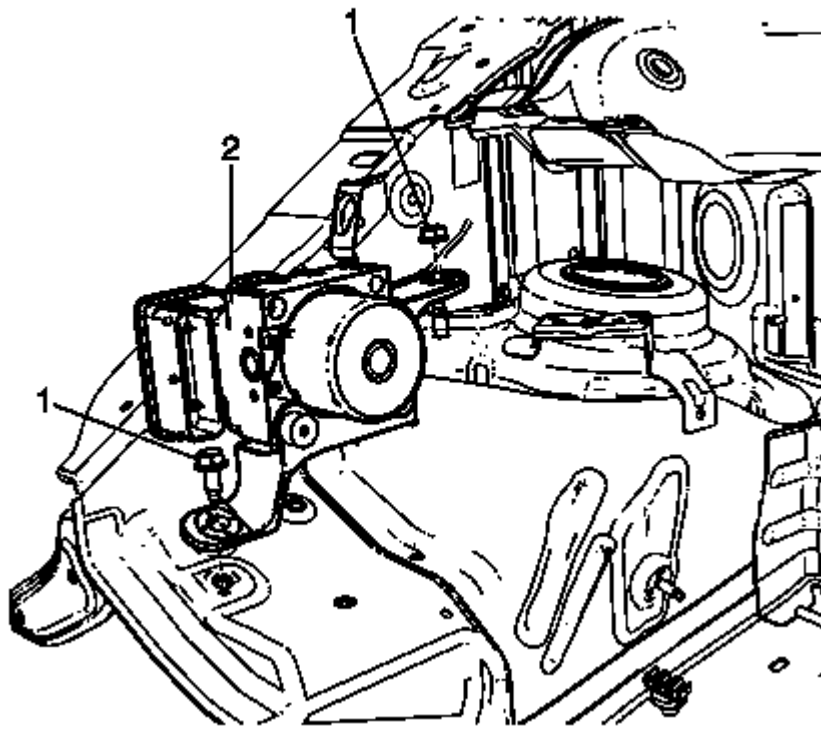


Fig. 11: EBCM/BPMV Bracket Bolt/Nut
Courtesy of GENERAL MOTORS COMPANY

4. Install the EBCM/BPMV bracket assembly (2) to the vehicle.
5. Install the EBCM/BPMV bracket bolt/nut (1) and tighten to 22 N.m (16 lb ft).

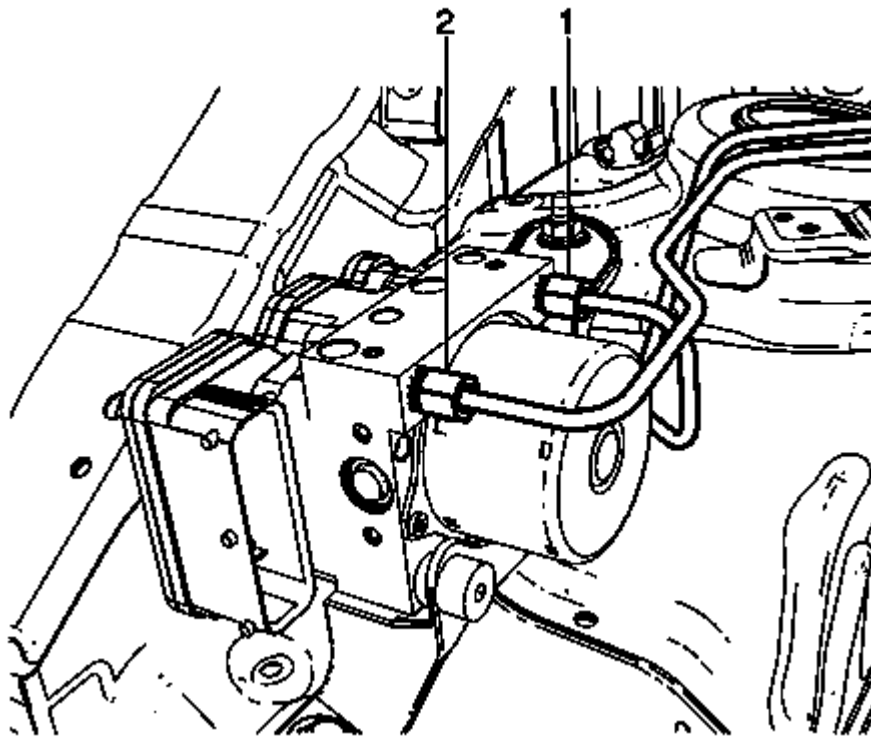


Fig. 12: Master Cylinder Primary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

6. Connect the master cylinder primary brake pipe fitting (1) to the BPMV.

Tighten

- For only ABS, tighten the fitting to 18 N.m (13 lb ft).
- For ESC, tighten the fitting to 25 N.m (18 lb ft).

7. Connect the master cylinder secondary brake pipe fitting (2) to the BPMV.

Tighten

- For only ABS, tighten the fitting to 18 N.m (13 lb ft).
- For ESC, tighten the fitting to 25 N.m (18 lb ft).

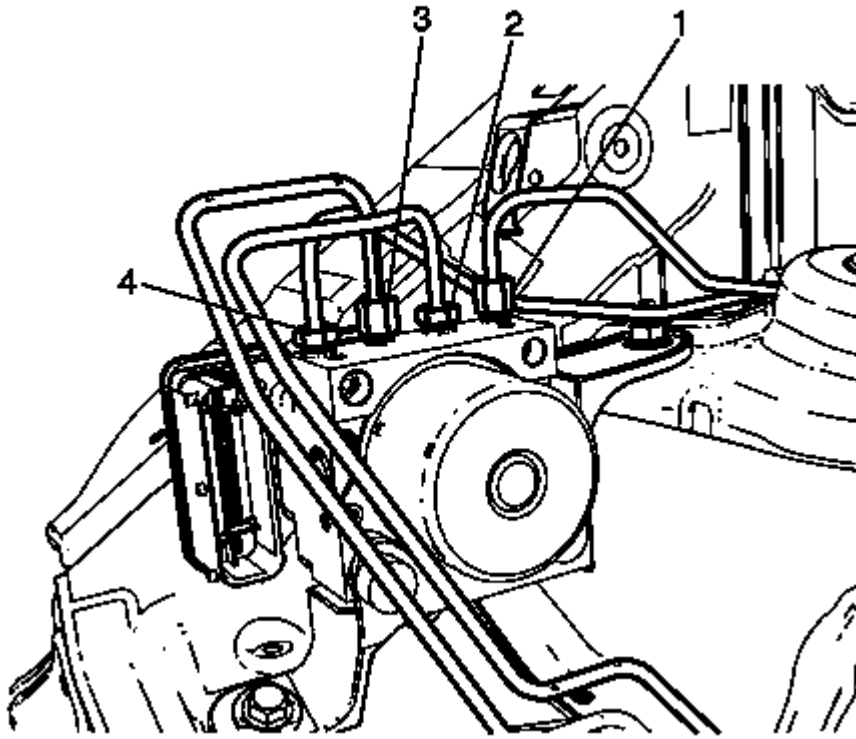


Fig. 13: RF Brake Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

8. Connect the LF brake pipe fitting (4) to the BPMV and tighten to 18 N.m (13 lb ft).
9. Connect the RR brake pipe fitting (3) to the BPMV and tighten to 18 N.m (13 lb ft).
10. Connect the LR brake pipe fitting (2) to the BPMV and tighten to 18 N.m (13 lb ft).
11. Connect the RF brake pipe fitting (1) to the BPMV and tighten to 18 N.m (13 lb ft).

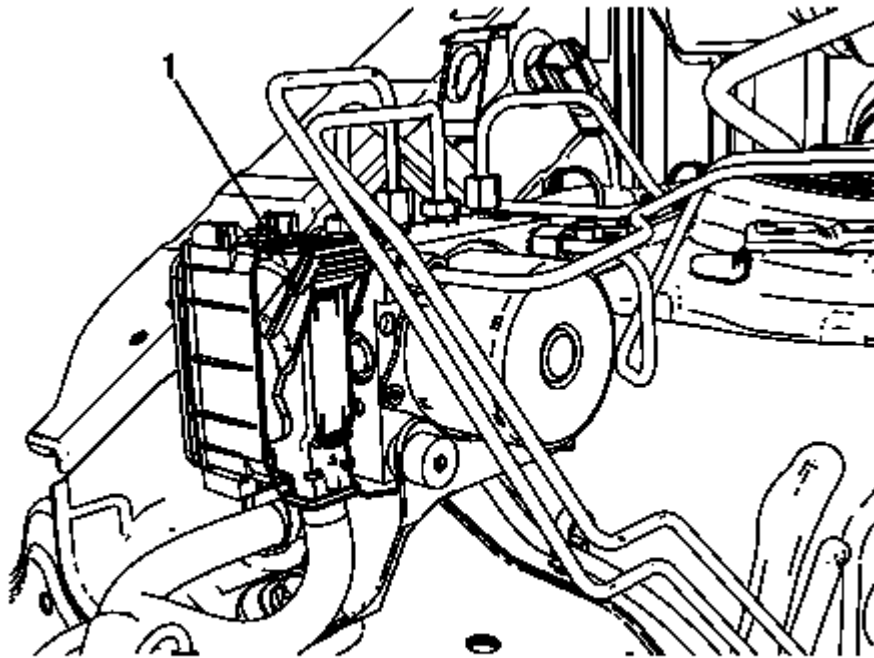


Fig. 14: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

12. Connect the EBCM electrical connector to the EBCM.
13. Bleed the hydraulic brake system. Refer to Hydraulic Brake System Bleeding (Manual) , Hydraulic Brake System Bleeding (Pressure) .
14. Perform the Diagnostic System Check - Vehicle. Refer to Diagnostic System Check - Vehicle .
15. Observe the brake pedal feel after performing the diagnostic system check. If the pedal now feels spongy, air may have been in the secondary hydraulic circuit of the brake modulator which may have been introduced into the primary circuit. If the pedal feels spongy, perform the Antilock Brake System Automated Bleed Procedure. Refer to Antilock Brake System Automated Bleed.

BRAKE PRESSURE MODULATOR VALVE BRACKET REPLACEMENT

Removal Procedure

WARNING: Refer to Brake Fluid Irritant Warning .

CAUTION: Always connect or disconnect the wiring harness connector from the EBCM/EBTCM with the ignition switch in the OFF position. Failure to

observe this precaution could result in damage to the EBCM/EBTCM.

1. Turn the ignition switch to the OFF position.

NOTE: **The area around the EBCM/BPMV assembly must be free from loose dirt to prevent contamination of disassembled ABS components.**

2. Clean the electronic brake control module (EBCM) to the brake pressure modulator valve (BPMV) area of any accumulated dirt and foreign material.

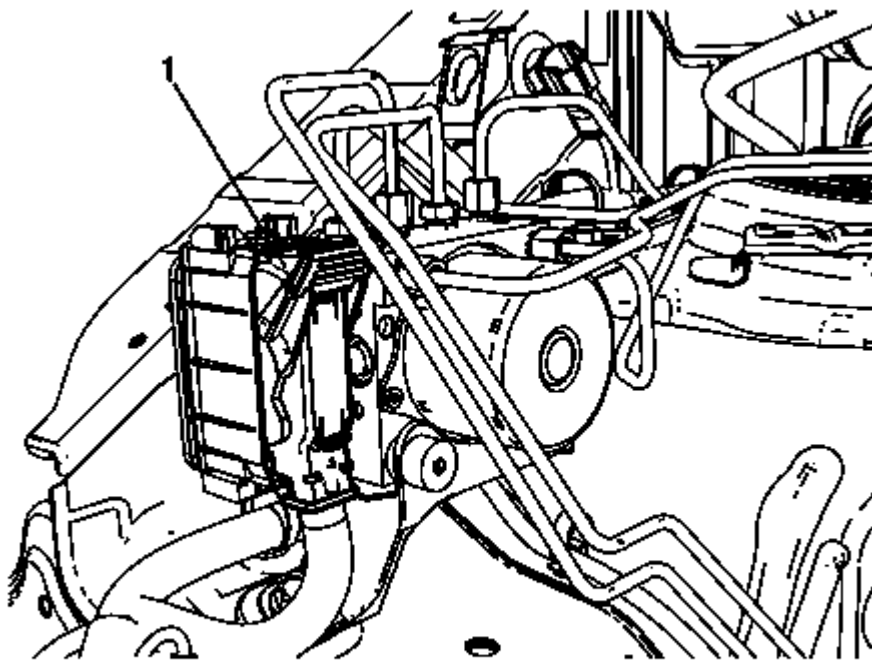


Fig. 15: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the electrical connector (1) from the EBCM.

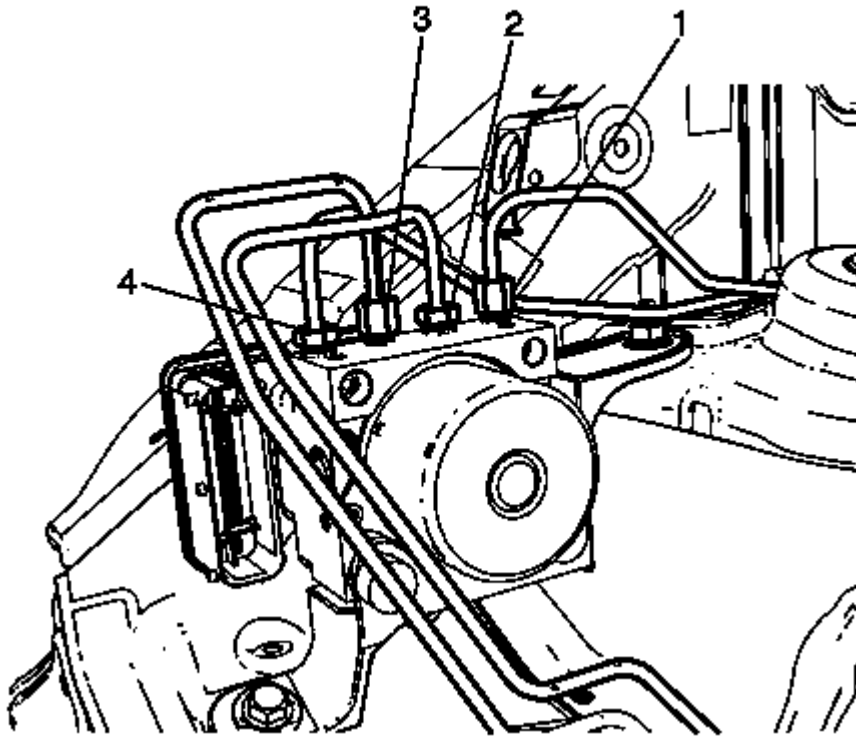


Fig. 16: RF Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the RF brake pipe fitting (1) from the BPMV.

Cap the brake pipe fitting and plug the BPMV outlet port to prevent brake fluid loss and contamination.

5. Disconnect the LR brake pipe fitting (2) from the BPMV.

Cap the brake pipe fitting and plug the BPMV outlet port to prevent brake fluid loss and contamination.

6. Disconnect the RR brake pipe fitting (3) from the BPMV.

Cap the brake pipe fitting and plug the BPMV outlet port to prevent brake fluid loss and contamination.

7. Disconnect the LF brake pipe fitting (4) from the BPMV.

Cap the brake pipe fitting and plug the BPMV outlet port to prevent brake fluid loss and contamination.

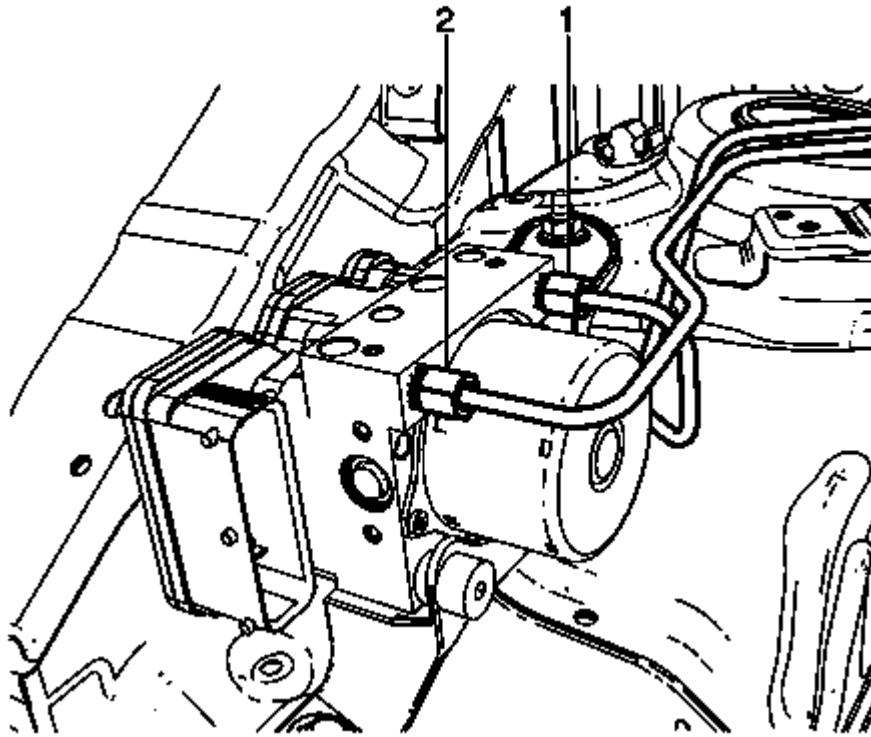


Fig. 17: Master Cylinder Primary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

8. Disconnect the master cylinder primary brake pipe fitting (1) from the BPMV.
Cap the brake pipe fitting and plug the BPMV inlet port to prevent brake fluid loss and contamination.
9. Disconnect the master cylinder secondary brake pipe fitting (2) from the BPMV.
Cap the brake pipe fitting and plug the BPMV inlet port to prevent brake fluid loss and contamination.

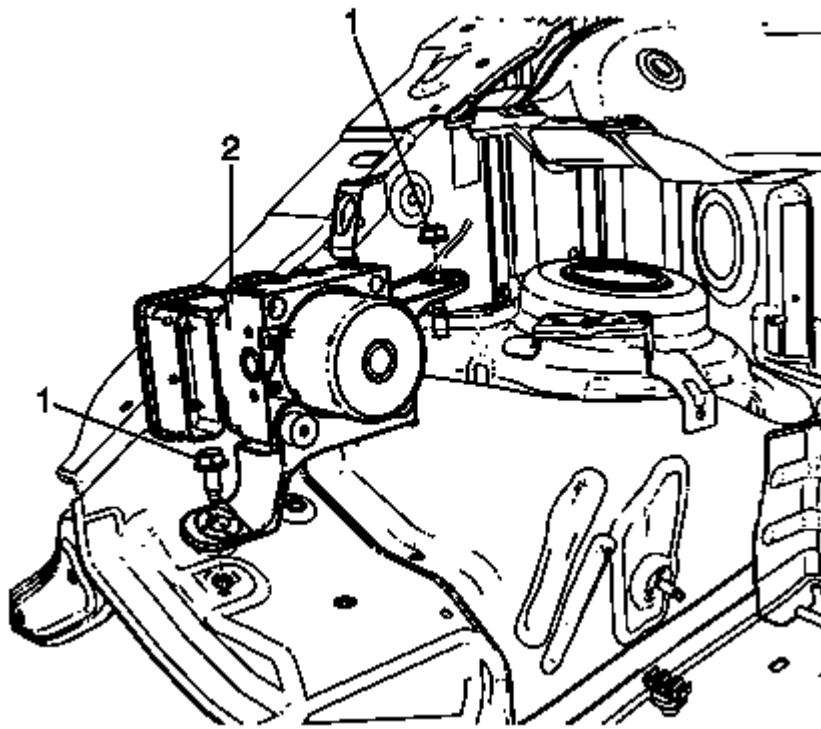


Fig. 18: EBCM/BPMV Bracket Bolt/Nut
Courtesy of GENERAL MOTORS COMPANY

10. Remove the EBCM/BPMV bracket bolt/nut (1).
11. Remove the EBCM/BPMV bracket assembly (2) from the vehicle.

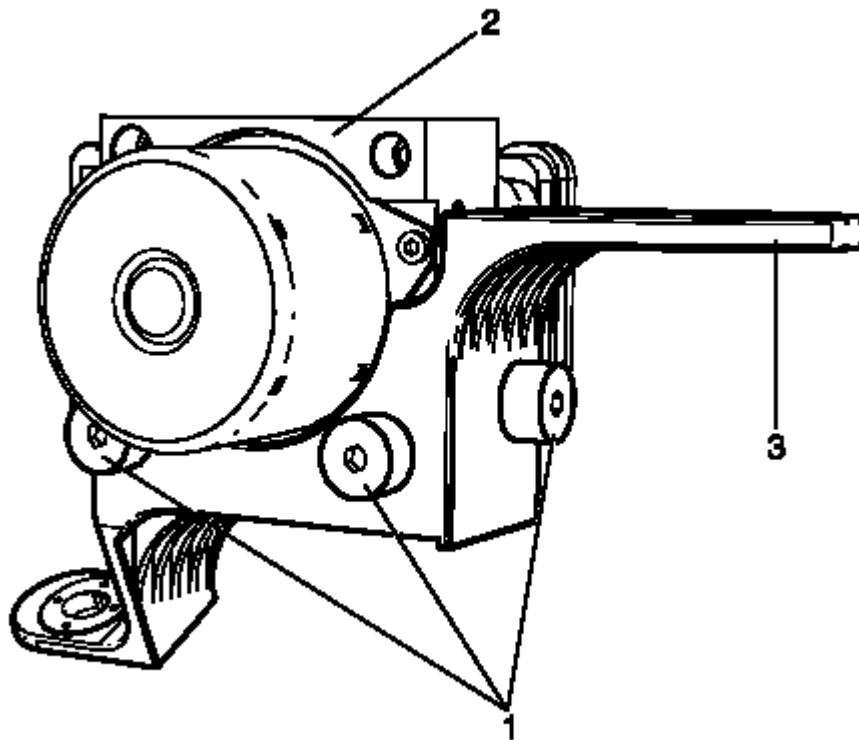


Fig. 19: EBCM/BPMV Assembly And Bracket
Courtesy of GENERAL MOTORS COMPANY

12. Remove the EBCM/BPMV assembly to the EBCM/BPMV assembly bracket retaining bolts (1).
13. Remove the EBCM/BPMV assembly bracket (3) from the EBCM/BPMV assembly (2).

Installation Procedure

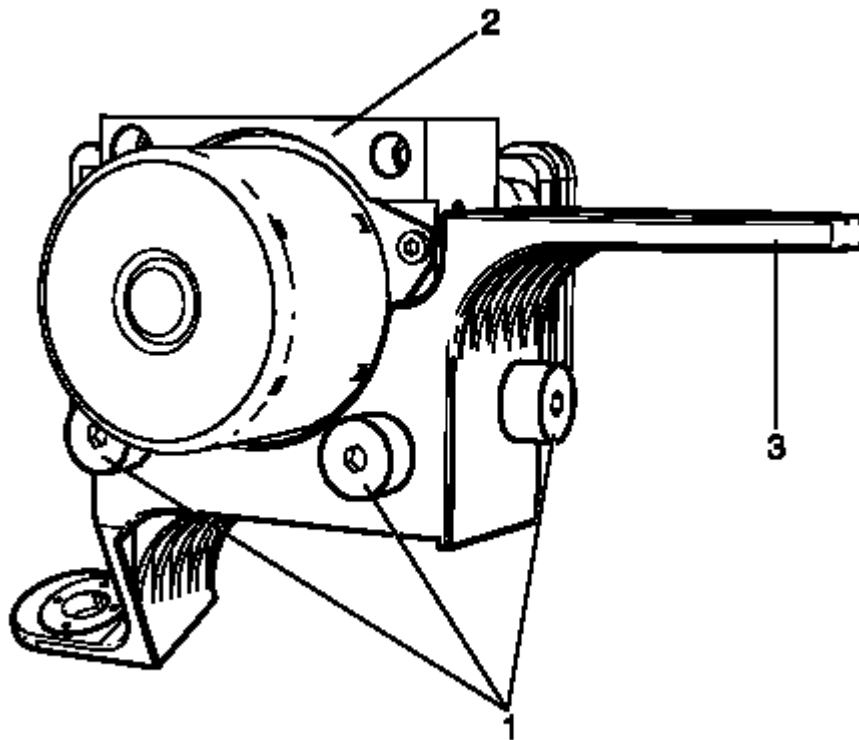


Fig. 20: EBCM/BPMV Assembly And Bracket
Courtesy of GENERAL MOTORS COMPANY

1. Install the EBCM/BPMV assembly bracket (3) to the EBCM/BPMV (2) assembly.

CAUTION: Refer to Fastener Caution .

2. Install the EBCM/BPMV assembly to EBCM/BPMV assembly bracket retaining bolts (1) and tighten to 11 N.m (97 lb in).

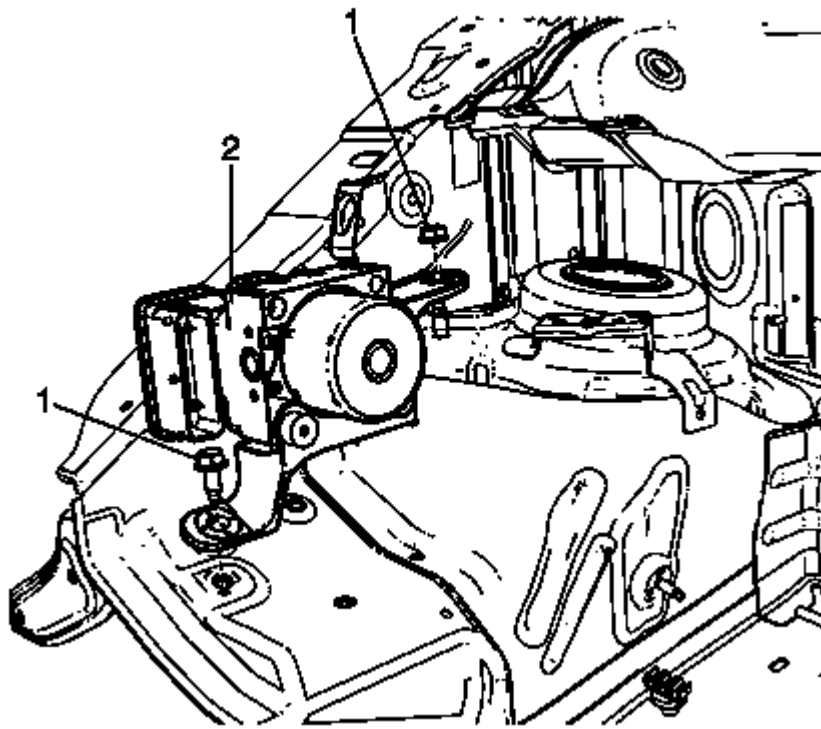


Fig. 21: EBCM/BPMV Bracket Bolt/Nut
Courtesy of GENERAL MOTORS COMPANY

3. Install the EBCM/BPMV bracket assembly (2) to the vehicle.
4. Install the EBCM/BPMV bracket bolt/nut (1) and tighten to 22 N.m (16 lb ft).

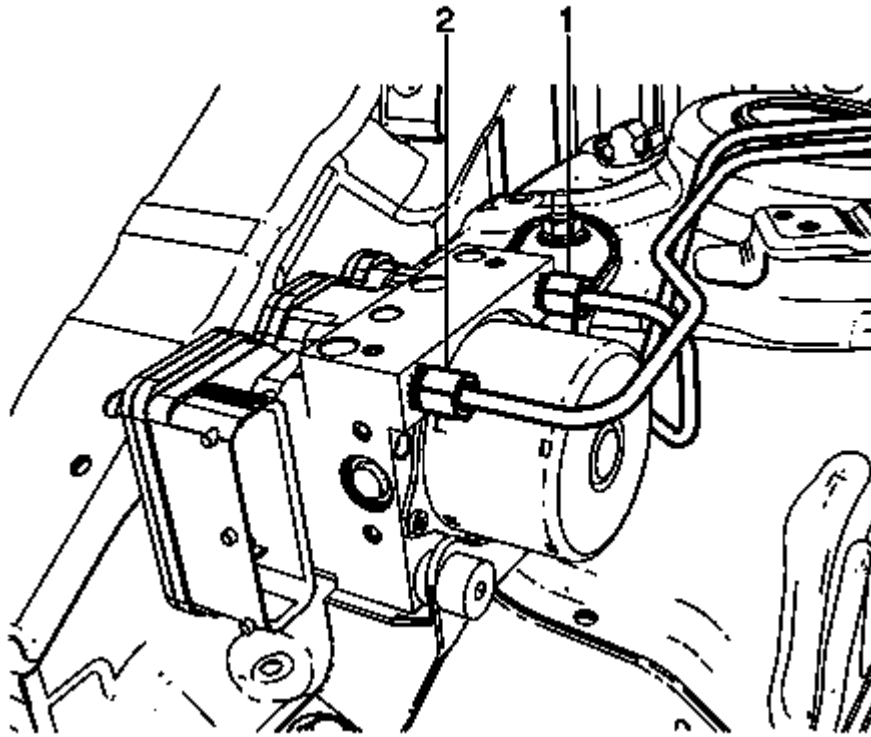


Fig. 22: Master Cylinder Primary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

5. Connect the master cylinder primary brake pipe fitting (1) to the BPMV.

Tighten

- For only ABS, tighten the fitting to 18 N.m (13 lb ft).
- For ESC, tighten the fitting to 25 N.m (18 lb ft).

6. Connect the master cylinder secondary brake pipe fitting (2) to the BPMV.

Tighten

- For only ABS, tighten the fitting to 18 N.m (13 lb ft).
- For ESC, tighten the fitting to 25 N.m (18 lb ft).

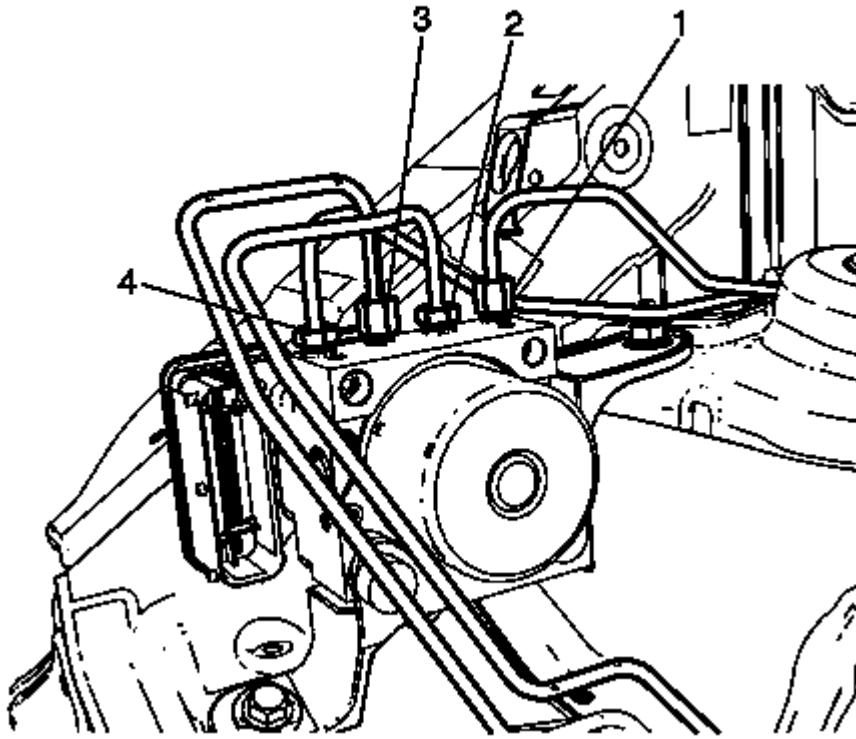


Fig. 23: RF Brake Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

7. Connect the LF brake pipe fitting (4) to the BPMV and tighten to 18 N.m (13 lb ft).
8. Connect the RR brake pipe fitting (3) to the BPMV and tighten to 18 N.m (13 lb ft).
9. Connect the LR brake pipe fitting (2) to the BPMV and tighten to 18 N.m (13 lb ft).
10. Connect the RF brake pipe fitting (1) to the BPMV and tighten to 18 N.m (13 lb ft).

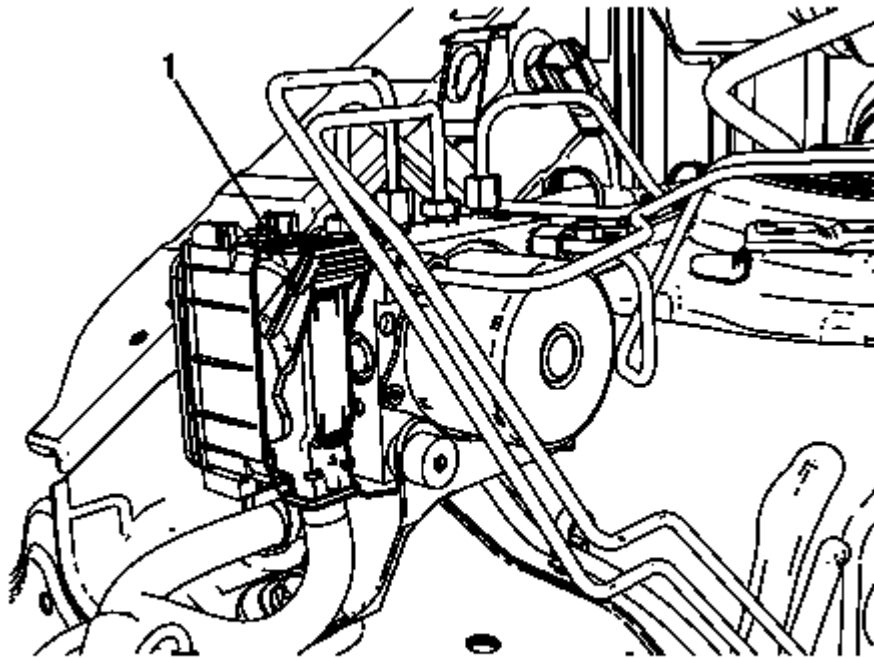


Fig. 24: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

11. Connect the EBCM electrical connector (1) to the EBCM.
12. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** , **Hydraulic Brake System Bleeding (Pressure)** .
13. Perform the Diagnostic System Check - Vehicle. Refer to **Diagnostic System Check - Vehicle** .
14. Observe the brake pedal feel after performing the diagnostic system check. If the pedal now feels spongy, air may have been in the secondary hydraulic circuit of the brake modulator which may have been introduced into the primary circuit. If the pedal feels spongy, perform the Antilock Brake System Automated Bleed Procedure. Refer to **Antilock Brake System Automated Bleed**.

FRONT WHEEL SPEED SENSOR REPLACEMENT (RIGHT SIDE)

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**
2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .

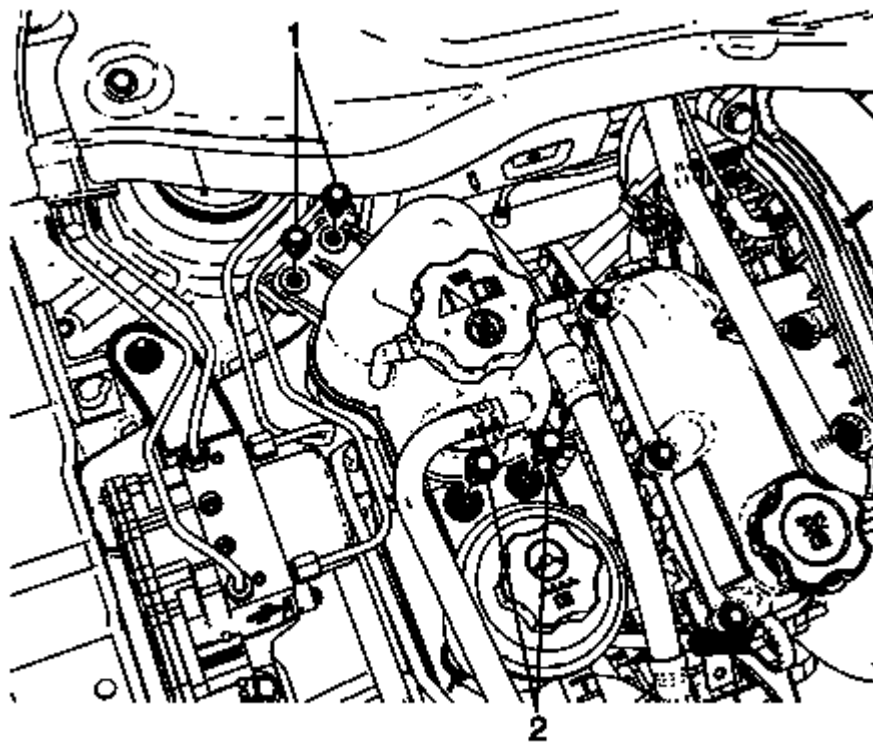


Fig. 25: Radiator Surge Tank Mounting Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Remove the radiator surge tank mounting bolts (1), and detach the radiator surge tank without disconnecting the coolant hose, and position it aside to get a hand access. Refer to **Radiator Surge Tank Replacement (LL0)** , **Radiator Surge Tank Replacement (LFM)** .

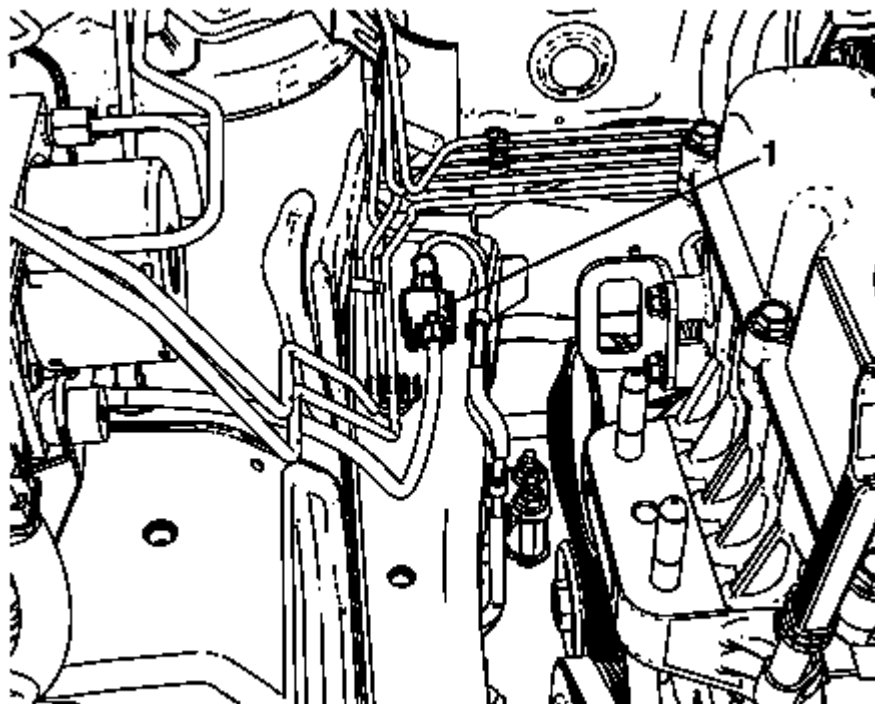


Fig. 26: Wheel Speed Sensor Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the wheel speed sensor electrical connector (1).

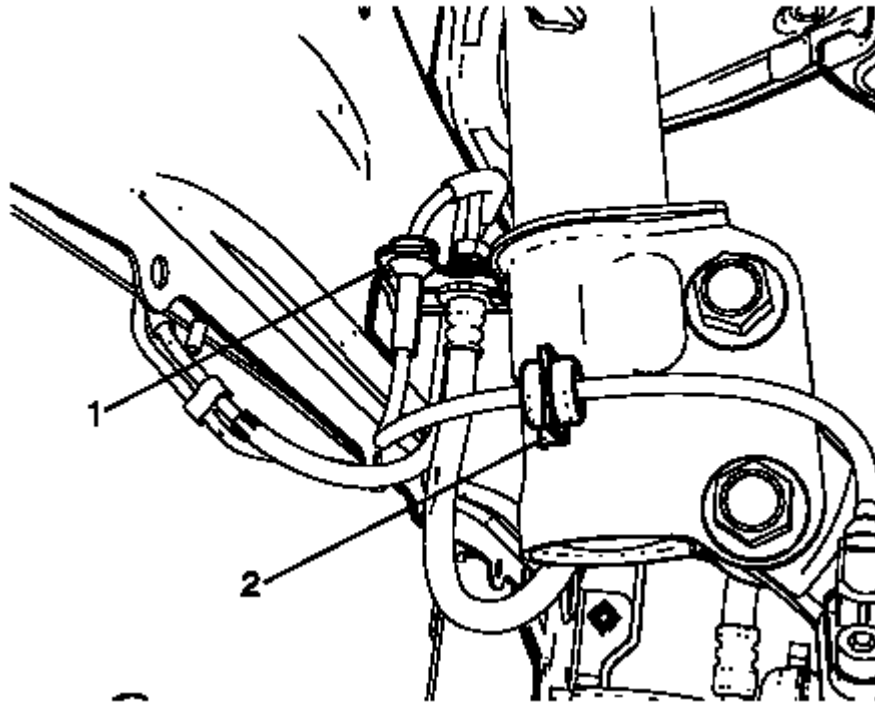


Fig. 27: Body Frame Mounted Bracket
Courtesy of GENERAL MOTORS COMPANY

5. Detach the wheel speed sensor harness from the body frame mounted bracket (1).
6. Detach the wheel speed sensor harness from the front strut mounted bracket (2).

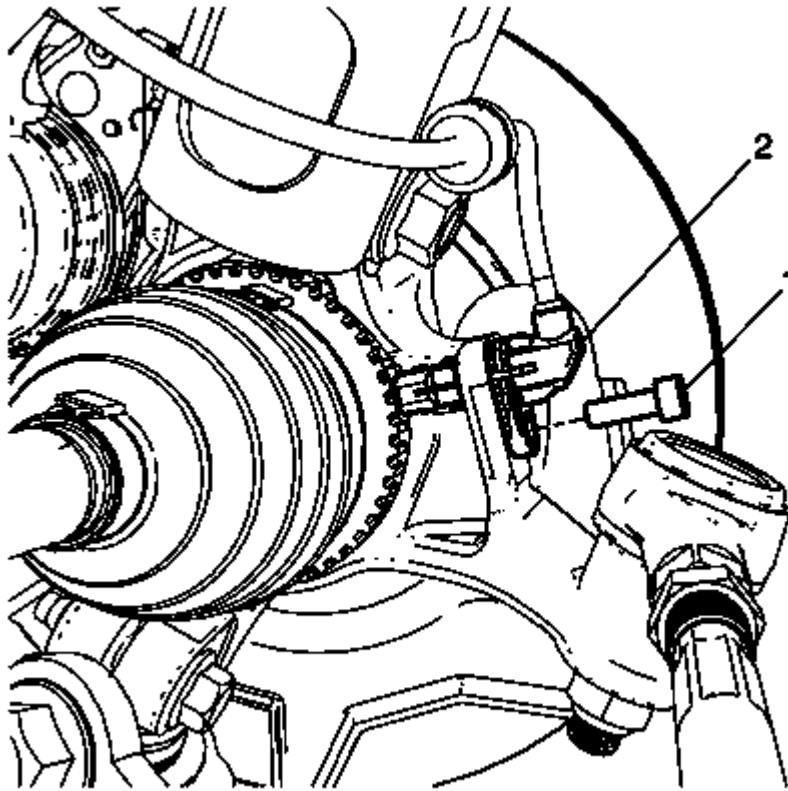


Fig. 28: Wheel Speed Sensor And Knuckle Retaining Bolt
Courtesy of GENERAL MOTORS COMPANY

7. Remove the wheel speed sensor to knuckle retaining bolt (1).
8. Remove the wheel speed sensor (2) from the steering knuckle.

Installation Procedure

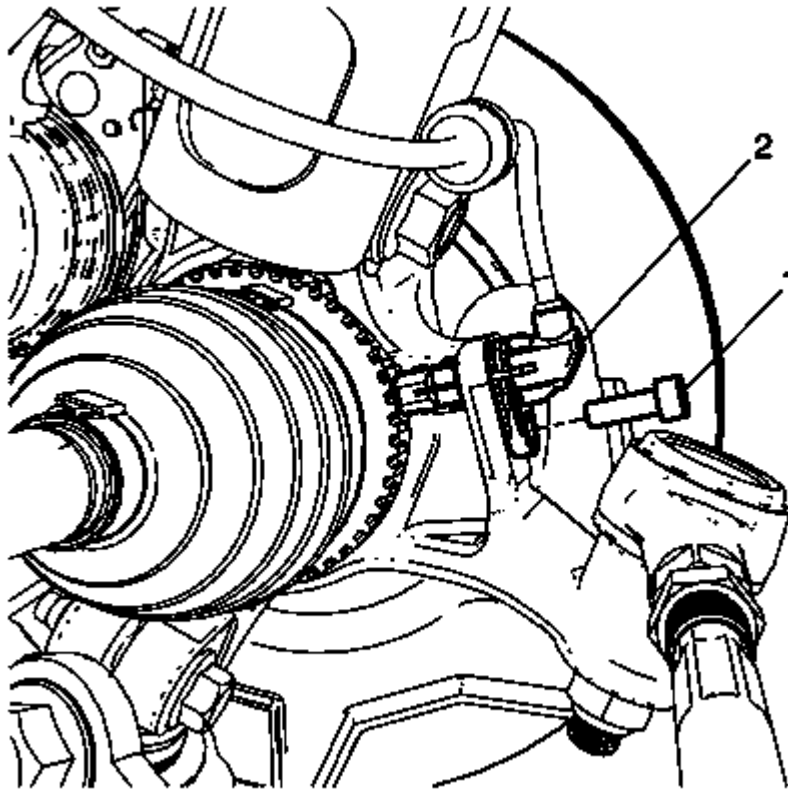


Fig. 29: Wheel Speed Sensor And Knuckle Retaining Bolt
Courtesy of GENERAL MOTORS COMPANY

1. Install the wheel speed sensor (2) to the steering knuckle.

CAUTION: Refer to Fastener Caution .

2. Install the wheel speed sensor to knuckle retaining bolt (1) and tighten to 8.5 (75 lb in).

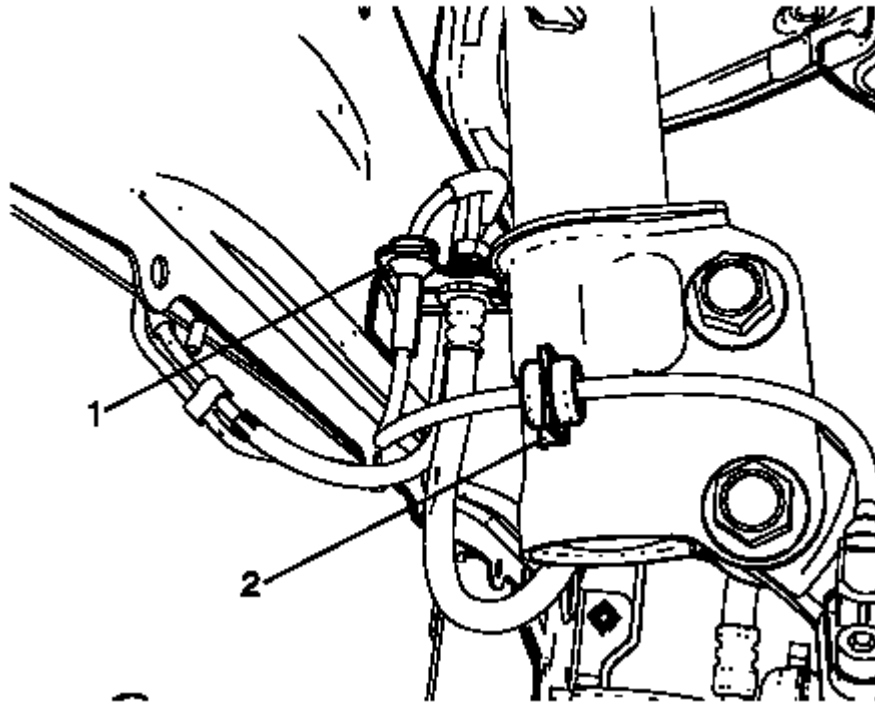


Fig. 30: Body Frame Mounted Bracket
Courtesy of GENERAL MOTORS COMPANY

3. Attach the wheel speed sensor harness to the front strut mounted bracket (2).
4. Attach the wheel speed sensor harness to the body frame mounted bracket (1).

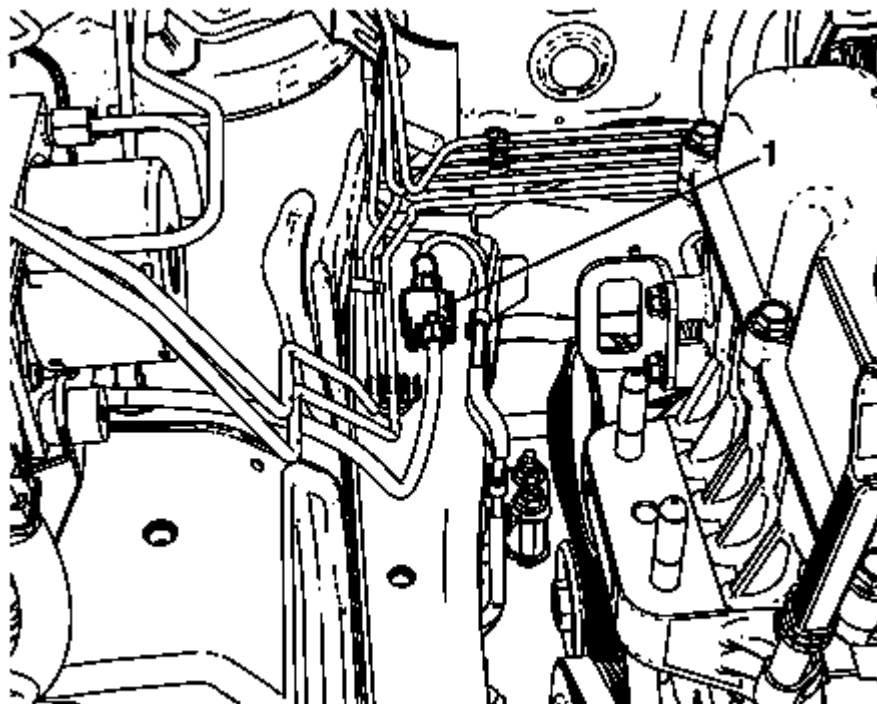


Fig. 31: Wheel Speed Sensor Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

5. Connect the wheel speed sensor electrical connector (1).

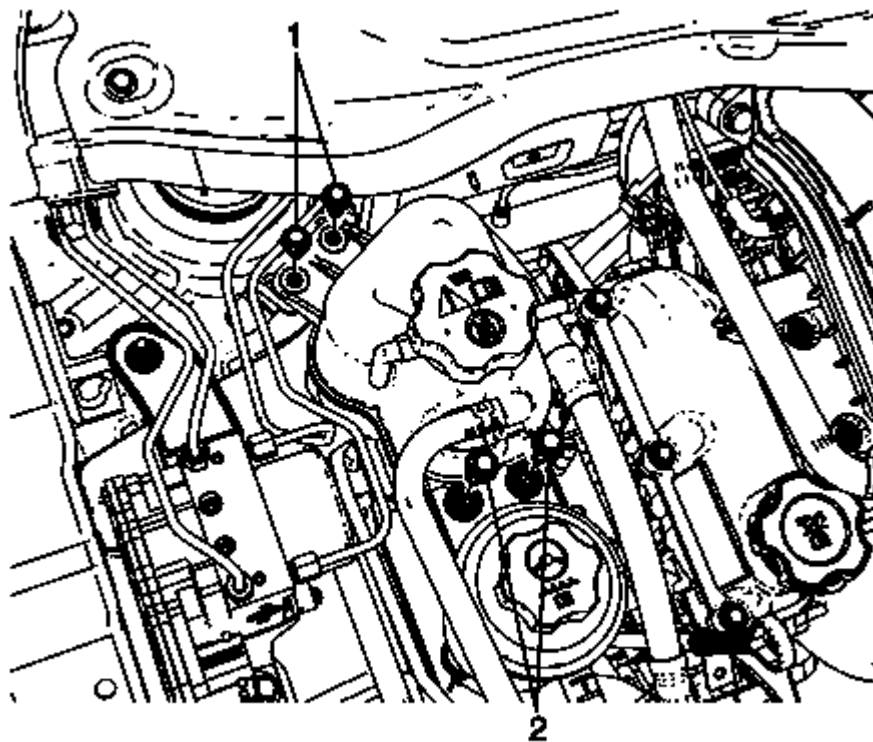


Fig. 32: Radiator Surge Tank Mounting Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Position the radiator surge tank to the original place, and install the radiator tank mounting bolts (1). Refer to **Radiator Surge Tank Replacement (LL0)** , **Radiator Surge Tank Replacement (LFM)** .
7. Install the tire and wheel. Refer to **Tire and Wheel Removal and Installation** .
8. Lower the vehicle.

FRONT WHEEL SPEED SENSOR REPLACEMENT (LEFT SIDE)

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the tire and wheel. Refer to **Tire and Wheel Removal and Installation** .
3. Remove the battery. Refer to **Battery Replacement** .

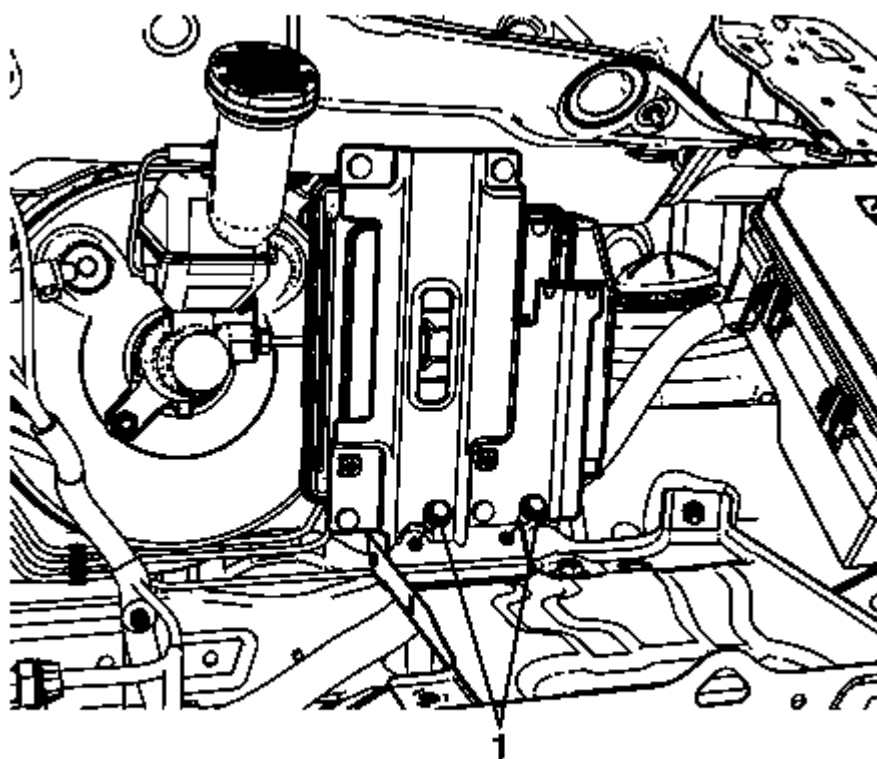


Fig. 33: Engine Control Module (ECM) Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove the ECM bracket bolts (1), and then position the ECM and ECM bracket aside. Refer to **Engine Control Module Replacement** .

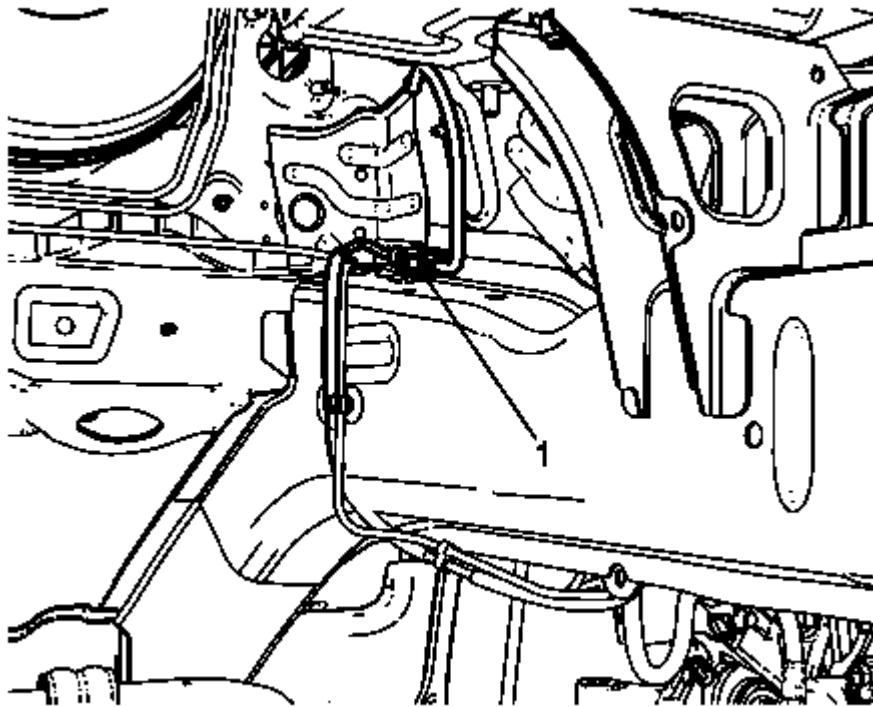


Fig. 34: Wheel Speed Sensor Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect the wheel speed sensor electrical connector (1).

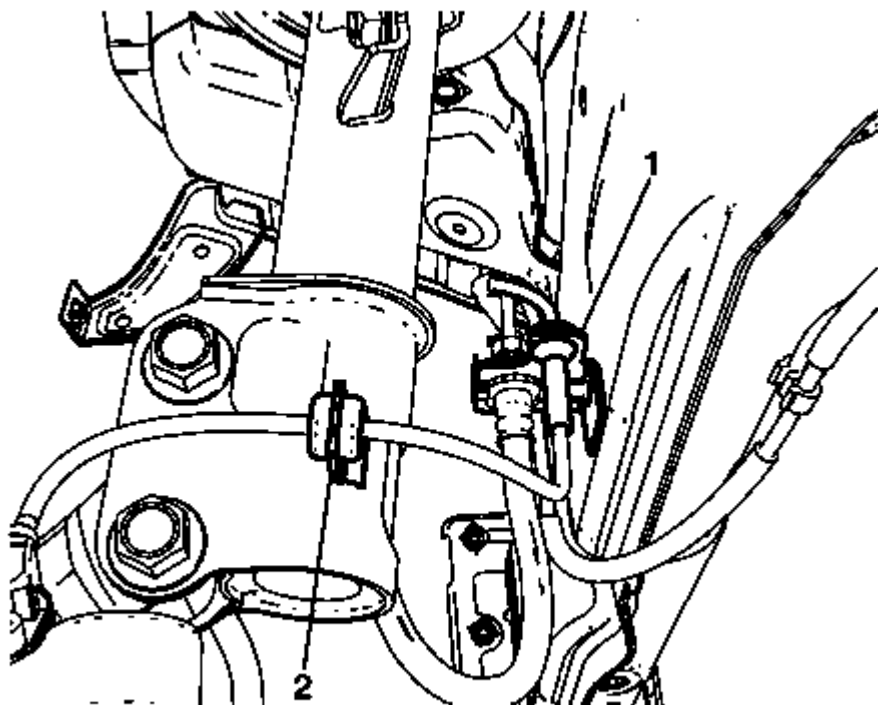


Fig. 35: Wheel Speed Sensor Harness And Body Frame Mounted Bracket
Courtesy of GENERAL MOTORS COMPANY

6. Detach the wheel speed sensor harness from the body frame mounted bracket (1).
7. Detach the wheel speed sensor harness from the front strut mounted bracket (2).

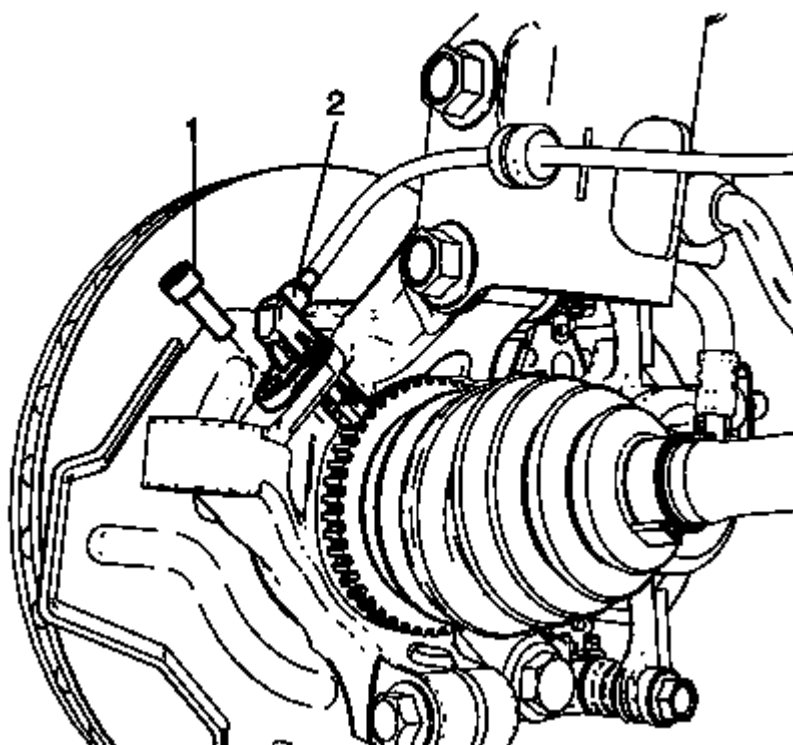


Fig. 36: Wheel Speed Sensor To Knuckle Retaining Bolt
Courtesy of GENERAL MOTORS COMPANY

8. Remove the wheel speed sensor to knuckle retaining bolt (1).
9. Remove the wheel speed sensor (2) from the steering knuckle.

Installation Procedure

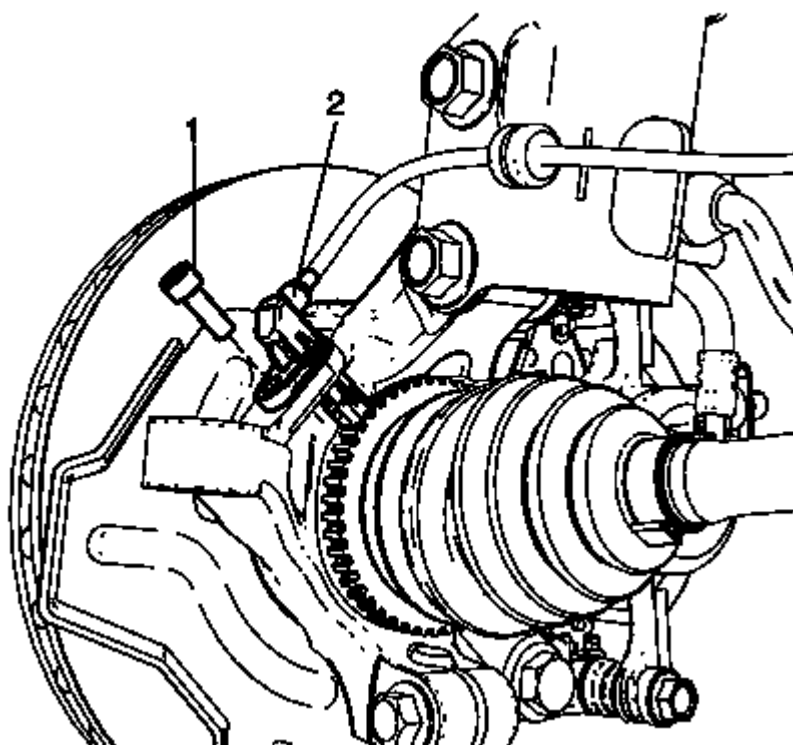


Fig. 37: Wheel Speed Sensor To Knuckle Retaining Bolt
Courtesy of GENERAL MOTORS COMPANY

1. Install the wheel speed sensor (2) to the knuckle.

CAUTION: Refer to Fastener Caution .

2. Install the wheel speed sensor to knuckle retaining bolt (1) and tighten to 8.5 N.m (75 lb in).

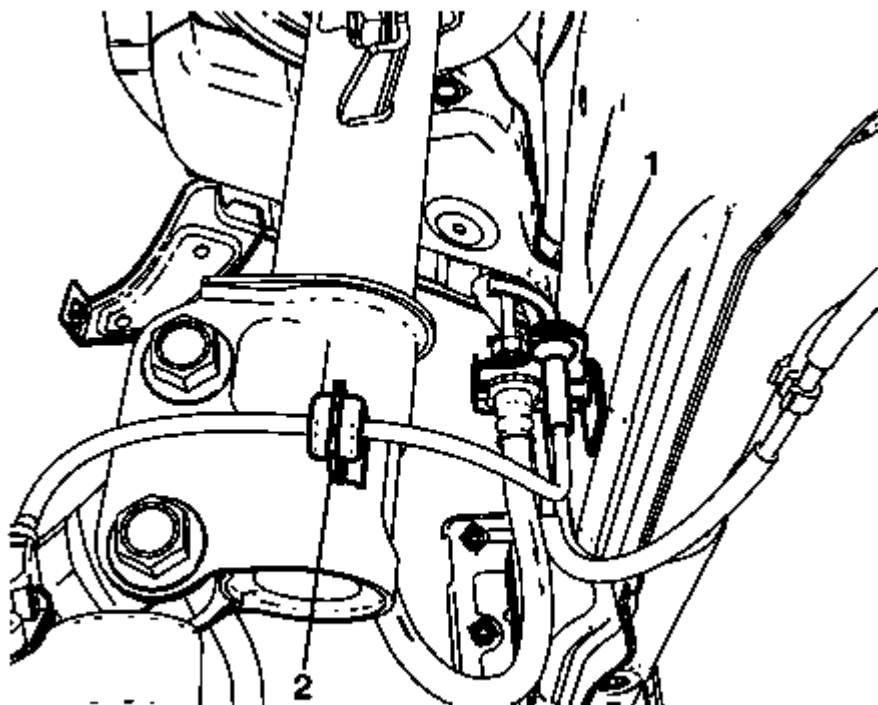


Fig. 38: Wheel Speed Sensor Harness And Body Frame Mounted Bracket
Courtesy of GENERAL MOTORS COMPANY

3. Attach the wheel speed sensor harness to the front strut mounted bracket (2).
4. Attach the wheel speed sensor harness to the body frame mounted bracket (1).

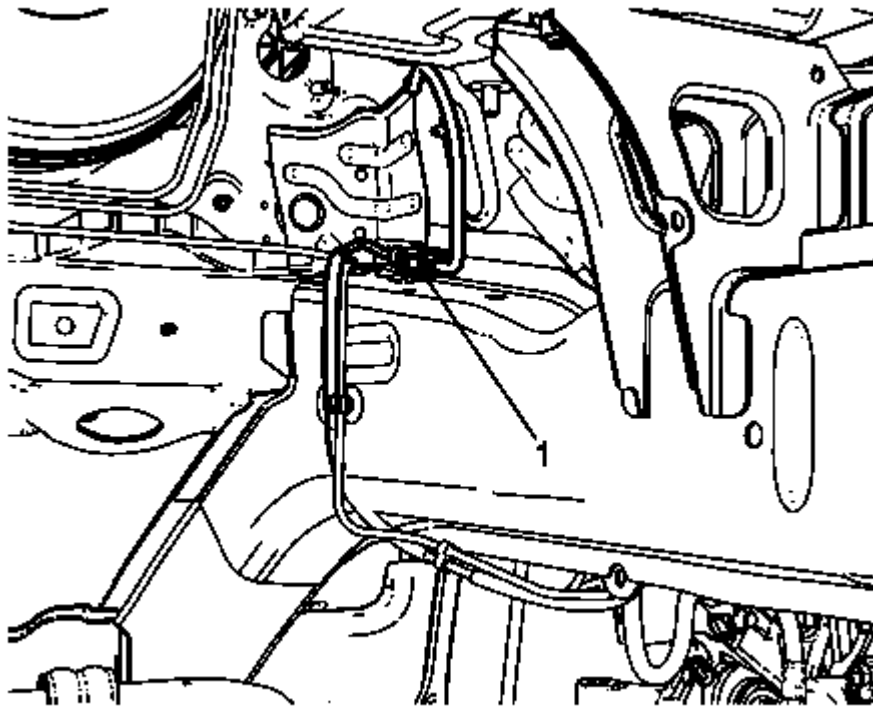


Fig. 39: Wheel Speed Sensor Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

5. Connect the wheel speed sensor electrical connector (1).

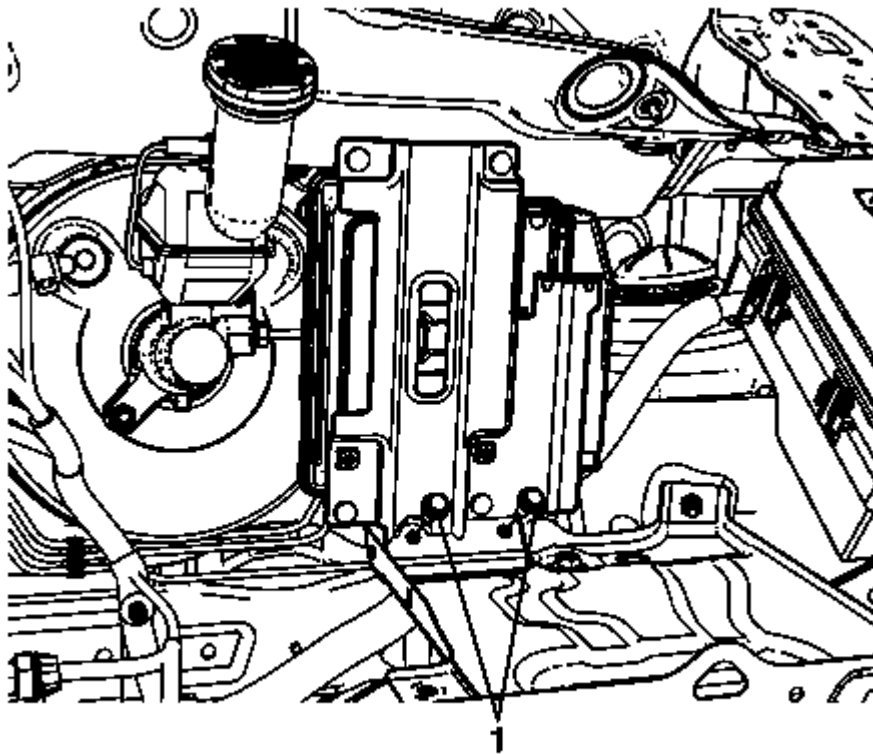


Fig. 40: Engine Control Module (ECM) Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Position the ECM and ECM bracket to the original place, and install the ECM bracket bolts (1). Refer to **Engine Control Module Replacement** .
7. Install the battery. Refer to **Battery Replacement** .
8. Install the tire and wheel. Refer to **Tire and Wheel Removal and Installation** .
9. Lower the vehicle.

REAR WHEEL SPEED SENSOR REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the tire and wheel. Refer to **Tire and Wheel Removal and Installation** .

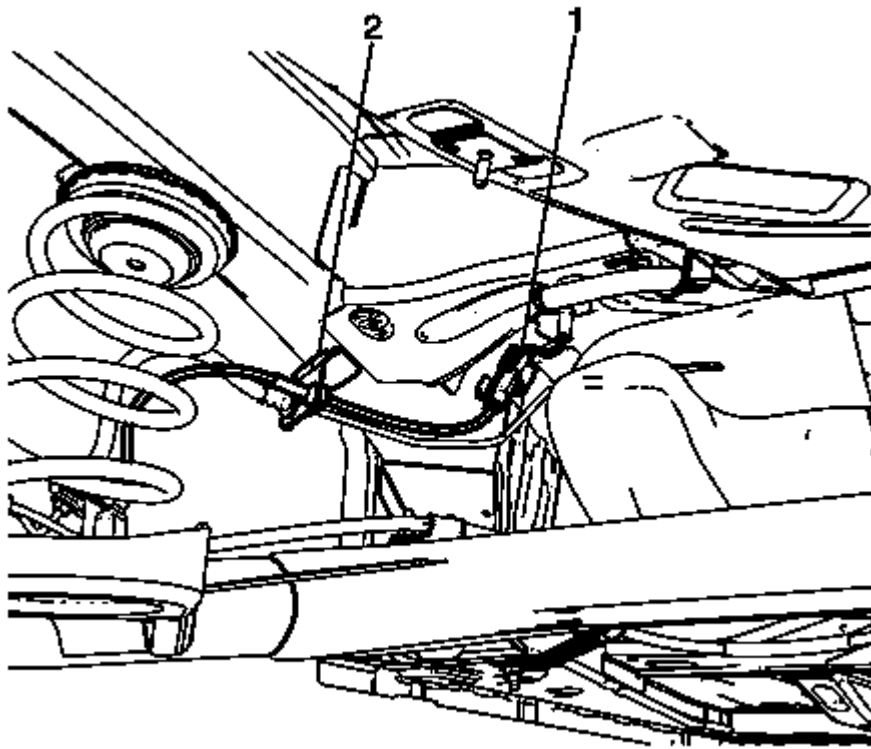


Fig. 41: Wheel Speed Sensor Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the wheel speed sensor electrical connector (1).
4. Detach the wheel speed sensor harness from the body frame mounted bracket (2).

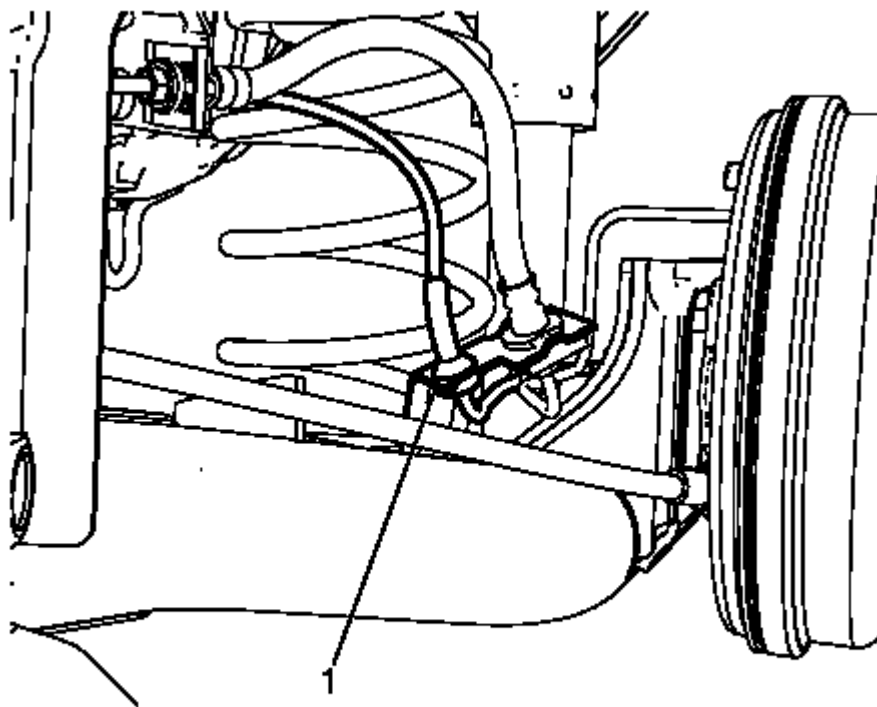


Fig. 42: Wheel Speed Sensor Harness And Rear Axle Mounted Bracket
Courtesy of GENERAL MOTORS COMPANY

5. Detach the wheel speed sensor harness from the rear axle mounted bracket (1).

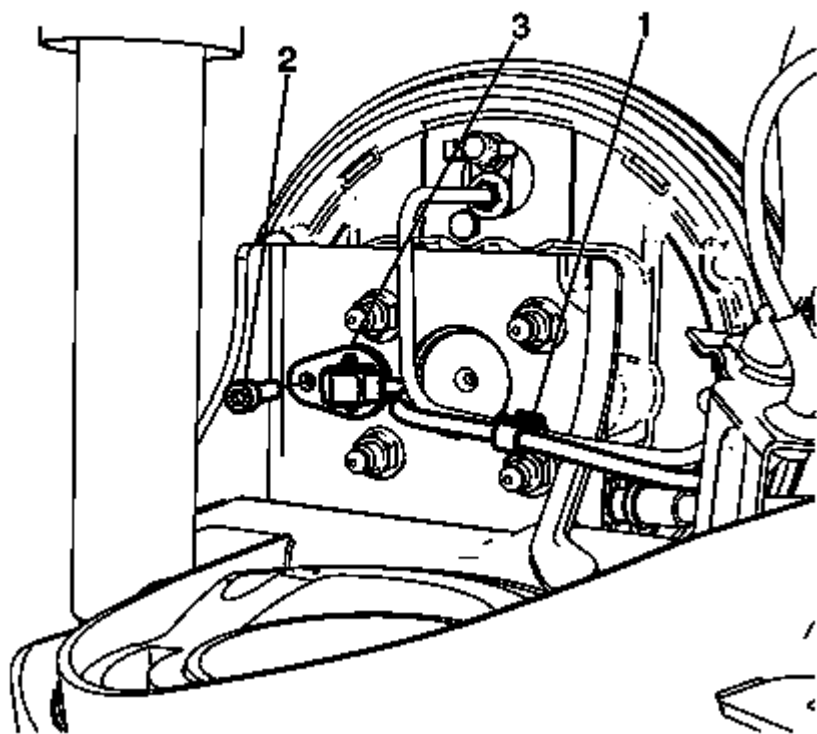


Fig. 43: Retaining Clip

Courtesy of GENERAL MOTORS COMPANY

6. Remove the wheel speed sensor harness from the retaining clip (1).
7. Remove the wheel speed sensor to knuckle retaining bolt (2).
8. Remove the wheel speed sensor (3) from the knuckle.

Installation Procedure

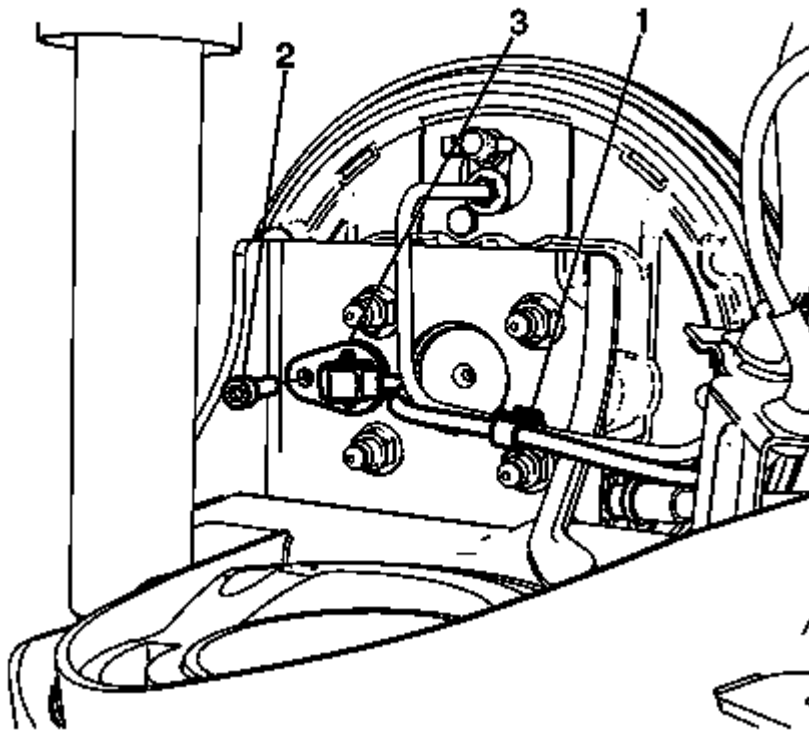


Fig. 44: Retaining Clip

Courtesy of GENERAL MOTORS COMPANY

1. Install the wheel speed sensor (3) to the knuckle.

CAUTION: Refer to Fastener Caution .

2. Install the wheel speed sensor to knuckle retaining bolt (2) and tighten to 8.5 N.m (75 lb in).
3. Install the wheel speed sensor harness to the retaining clip (1).

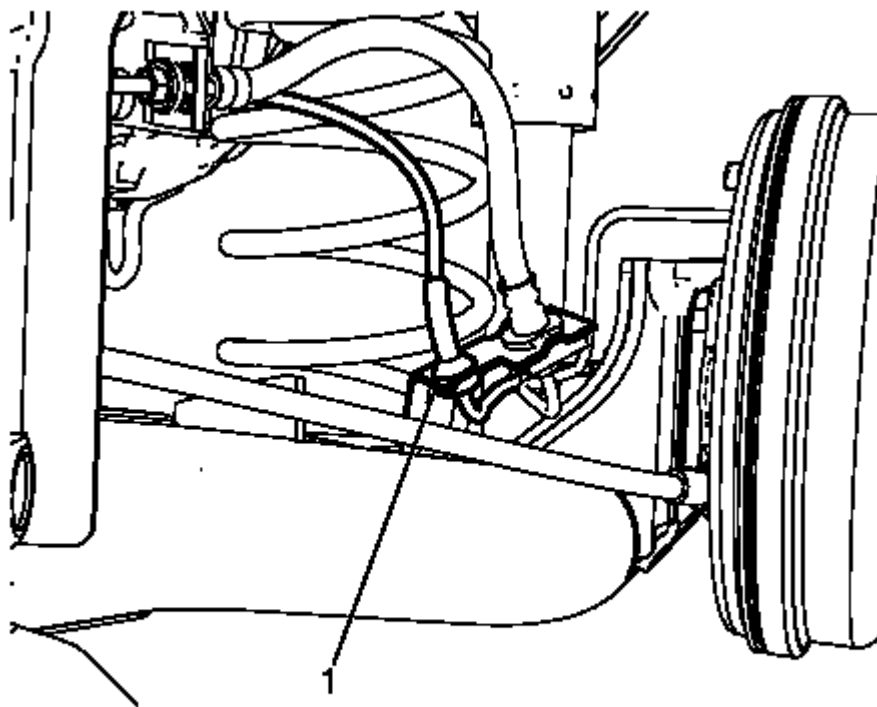


Fig. 45: Wheel Speed Sensor Harness And Rear Axle Mounted Bracket
Courtesy of GENERAL MOTORS COMPANY

4. Attach the wheel speed sensor harness to the rear axle mounted bracket (1).

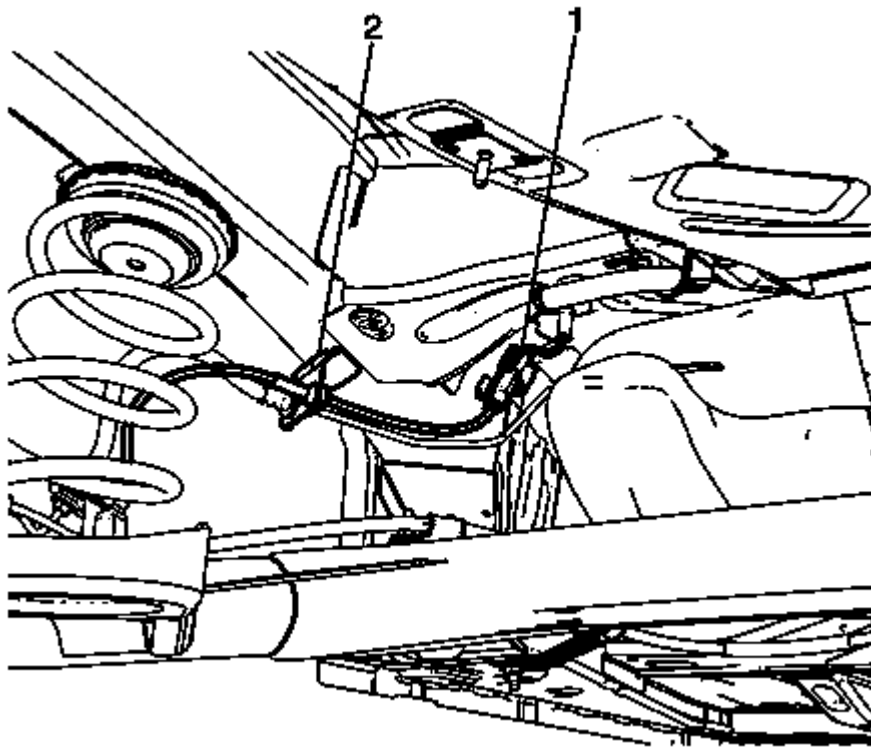


Fig. 46: Wheel Speed Sensor Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

5. Attach the wheel speed sensor harness to from the body frame mounted bracket (2).
6. Connect the wheel speed sensor electrical connector (1).
7. Install the tire and wheel. Refer to **Tire and Wheel Removal and Installation** .
8. Lower the vehicle.

VEHICLE YAW SENSOR LEARN

The yaw sensor does not require calibration often. Calibration of the yaw rate sensor might be required after certain service procedures are performed. Some of these procedures are as follows:

- Electronic brake control module (EBCM) replacement
- Multi-axis acceleration sensor replacement

The yaw rate sensor calibration procedure can be completed with a scan tool using the following steps:

1. Place vehicle on a level surface.
2. Apply the parking brake, or set the transmission in the park (P) position.
3. Install the scan tool to the data link connector.

4. Turn the ignition ON, and the engine OFF.
5. Select Yaw Rate Sensor Reset in the Multi-axis Acceleration Sensor Module Control Functions list.
6. Follow the scan tool directions to complete the calibration procedure.
7. Select Yaw Rate Sensor Learn in the Multi-axis Acceleration Sensor Module Control Functions list.
8. Follow the scan tool directions to complete the calibration procedure.
9. Clear any DTCs that may be set.

VEHICLE YAW SENSOR LEARN

The yaw sensor does not require calibration often. Calibration of the yaw rate sensor might be required after certain service procedures are performed. Some of these procedures are as follows:

- Electronic brake control module (EBCM) replacement
- Multi-axis acceleration sensor replacement

The yaw rate sensor calibration procedure can be completed with a scan tool using the following steps:

1. Place vehicle on a level surface.
2. Apply the parking brake, or set the transmission in the park (P) position.
3. Install the scan tool to the data link connector.
4. Turn the ignition ON, and the engine OFF.
5. Select Yaw Rate Sensor Reset in the Multi-axis Acceleration Sensor Module Control Functions list.
6. Follow the scan tool directions to complete the calibration procedure.
7. Select Yaw Rate Sensor Learn in the Multi-axis Acceleration Sensor Module Control Functions list.
8. Follow the scan tool directions to complete the calibration procedure.
9. Clear any DTCs that may be set.

VEHICLE YAW SENSOR REPLACEMENT

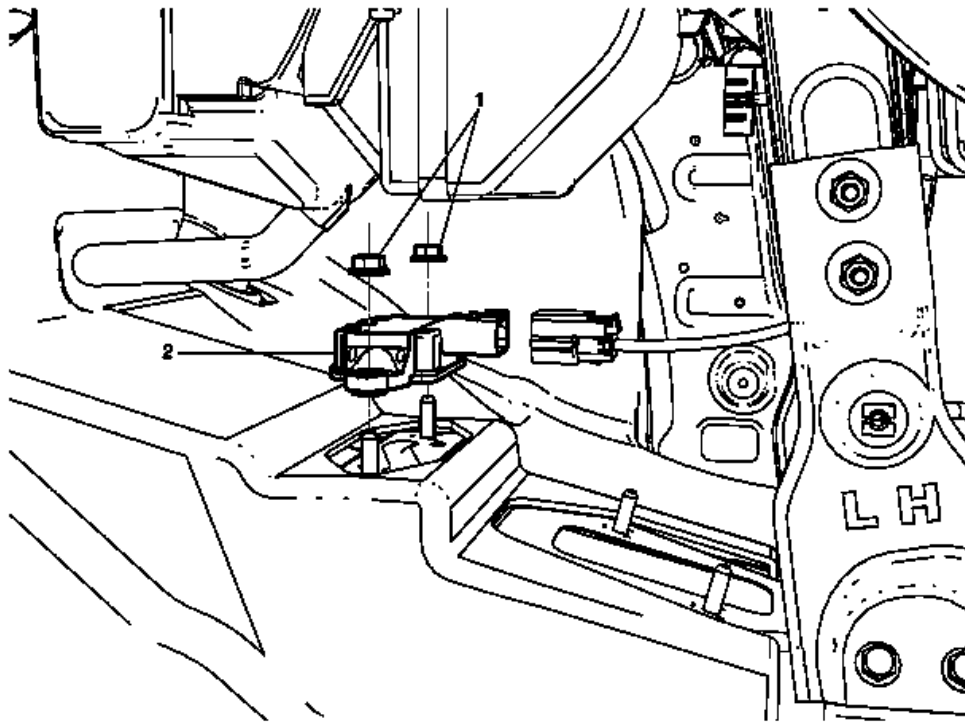


Fig. 47: Vehicle Yaw Sensor
 Courtesy of GENERAL MOTORS COMPANY

Vehicle Yaw Sensor Replacement

Callout	Component Name
Preliminary Procedure Remove the front floor console. Refer to Front Floor Console Replacement .	
1	Vehicle Yaw Sensor Nut (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Vehicle Yaw Sensor Procedure 1. Disconnect the electrical connector 2. After the installation is complete, reset the yaw rate sensor. using the following procedure: • Install a scan tool. • Using the scan tool, calibrate the yaw rate sensor.

DESCRIPTION AND OPERATION

ABS DESCRIPTION AND OPERATION (WITH FX3)

This vehicle is equipped with the MGH 60 Mando electronic stability control antilock brake system. The electronic brake control module and the brake pressure modulator are serviced separately. The brake pressure modulator uses a four circuit configuration to control hydraulic pressure to each wheel independently.

The following vehicle performance enhancement systems are provided.

- ABS
- Electronic brake distribution
- Hill Start Hold
- Traction Control System
- Vehicle Stability Enhancement System

The following components are involved in the operation of the above systems.

- Electronic Brake Control Module-The electronic brake control module controls the system functions and detects failures.
- Brake pressure modulator-The brake pressure modulator contains the hydraulic valves and pump motor that are controlled electrically by the electronic brake control module. The brake pressure modulator uses a four circuit configuration with a diagonal split. The brake pressure modulator directs fluid from the reservoir of the master cylinder to the left front and right rear wheels and fluid from the other reservoir to the right front and left rear wheels. The diagonal circuits are hydraulically isolated so that a leak or malfunction in one circuit will allow continued braking ability on the other.

The brake pressure modulator contains the following components:

- Pump motor
- Inlet valves (one per wheel)
- Outlet valves (one per wheel)
- Two traction control/stability control supply valves
- Two traction control/stability control isolation valves
- Brake pressure sensor
- Wheel speed sensors - The wheel speed sensors are Active sensors that receive a 12-volt power supply voltage from the electronic brake control module and provides an output signal to the module. As the wheel spins, the wheel speed sensor sends the electronic brake control module a DC square wave signal. The electronic brake control module uses the frequency of the square wave signal to calculate the wheel speed.
- Traction Control Switch - The vehicle stability enhancement system and the engine torque reduction function of the traction control system are manually disabled or enabled by pressing the traction control switch.
- Steering Wheel Angle Sensor - The electronic brake control module receives serial data message inputs

from the steering wheel angle sensor. The steering wheel angle signal is used to calculate the driver intended driving direction.

- **Multi-axis Acceleration Sensor** - The yaw rate and lateral acceleration sensors are combined into one multi-axis acceleration sensor, external to the electronic brake control module. The electronic brake control module receives serial data message inputs from the yaw rate and lateral acceleration sensor and activates stability control depending on multi-axis acceleration sensor input.

Initialization Sequence

The electronic brake control module performs one initialization test each ignition cycle. The initialization of the electronic brake control module occurs when both the following conditions occur:

- The vehicle speed is greater than 20 km/h (12 MPH).
- The stop lamp switch is not applied.

The initialization sequence cycles each solenoid valve and the pump motor, as well as the necessary relays, for approximately 1.5 seconds to check component operation. The electronic brake control module sets a DTC if any error is detected. The initialization sequence may be heard and felt while it is taking place, and is considered part of normal system operation.

The electronic brake control module defines a drive cycle as the completion of the initialization sequence.

Antilock Brake System

When wheel slip is detected during a brake application, the ABS enters antilock mode. During antilock braking, hydraulic pressure in the individual wheel circuits is controlled to prevent any wheel from slipping. A separate hydraulic line and specific solenoid valves are provided for each wheel. The ABS can decrease, hold, or increase hydraulic pressure to each wheel brake. The ABS cannot, however, increase hydraulic pressure above the amount which is transmitted by the master cylinder during braking.

During antilock braking, a series of rapid pulsations is felt in the brake pedal. These pulsations are caused by the rapid changes in position of the individual solenoid valves as the electronic brake control module responds to wheel speed sensor inputs and attempts to prevent wheel slip. These pedal pulsations are present only during antilock braking and stop when normal braking is resumed or when the vehicle comes to a stop. A ticking or popping noise may also be heard as the solenoid valves cycle rapidly. During antilock braking on dry pavement, intermittent chirping noises may be heard as the tires approach slipping. These noises and pedal pulsations are considered normal during antilock operation.

Vehicles equipped with ABS may be stopped by applying normal force to the brake pedal. Brake pedal operation during normal braking is no different than that of previous non-ABS systems. Maintaining a constant force on the brake pedal provides the shortest stopping distance while maintaining vehicle stability.

Pressure Hold

The electronic brake control module closes the inlet valve and keeps the outlet valve closed in order to isolate the system when wheel slip occurs. This holds the pressure steady on the brake so that the hydraulic pressure does not increase or decrease.

Pressure Decrease

The electronic brake control module decreases the pressure to individual wheels during a deceleration when wheel slip occurs. The inlet valve is closed and the outlet valve is opened. The excess fluid is stored in the accumulator until the return pump can return the fluid to the master cylinder.

Pressure Increase

The electronic brake control module increases the pressure to individual wheels during a deceleration in order to reduce the speed of the wheel. The inlet valve is opened and the outlet valve is closed. The increased pressure is delivered from the master cylinder.

Electronic Brake Distribution

The electronic brake distribution is a control system that replaces the hydraulic proportioning function of the mechanical proportioning valve in the base brake system. The electronic brake distribution control system is part of the operation software in the electronic brake control module. The electronic brake distribution uses active control with existing ABS in order to regulate the vehicle's rear brake pressure.

The red brake warning indicator is illuminated when the electronic brake distribution function is disabled.

Hill Start Hold

NOTE: The Hill Start Hold feature will not operate if the Stability control is disabled.

Some vehicles are equipped with the Hill Hold Start technology feature. When stopped on a hill, the Hill Start Hold feature prevents the vehicle from rolling before driving off, whether facing uphill or downhill by holding the brake pressure during the transition between when the driver releases the brake pedal and starts to accelerate. The Electronic Brake Control Module calculates the brake pressure, which is needed to hold the vehicle on an incline or grade greater than 5% and locks that pressure for up to two seconds by commanding the appropriate solenoid valves ON and OFF when the brake pedal is released. The stop lamps will stay illuminated during the Hill-Hold operation even though the brake pedal is released, this is considered normal operation.

The Hill Start Hold feature is determined by the electronic brake control module using the following inputs:

- Accelerator pedal position sensor
- Brake pedal position sensor
- Multi-axis acceleration sensor

Traction Control System

When drive wheel slip is noted while the brake is not applied, the electronic brake control module will enter traction control mode.

First, the electronic brake control module requests the engine control module to reduce the amount of torque to the drive wheels via the serial data. The engine control module reduces torque to the drive wheels by retarding spark timing and turning off fuel injectors. The engine control module reports the amount of torque delivered to

the drive wheels via the serial data circuit.

- Pressure hold
- Pressure increase
- Pressure decrease

Vehicle Stability Enhancement System

The vehicle stability enhancement system adds an additional level of vehicle control to the electronic brake control module.

Yaw rate is the rate of rotation about the vehicles vertical axis. The vehicle stability enhancement system is activated when the electronic brake control module determines that the desired yaw rate does not match the actual yaw rate as measured by the yaw rate sensor.

The desired yaw rate is calculated from the following parameters:

- The position of the steering wheel
- The speed of the vehicle
- The lateral acceleration of the vehicle

The difference between the desired yaw rate and the actual yaw rate is the yaw rate error, which is a measurement of over steer or under steer. If the yaw error becomes too large, the electronic brake control module attempts to correct the vehicles yaw rate motion by applying differential braking to the appropriate wheel. The amount of differential braking applied to the left or right front wheel is based on both the yaw rate error and side slip rate error.

The vehicle stability enhancement system activations generally occur during aggressive driving, in turns or on bumpy roads without much use of the accelerator pedal. When braking during vehicle stability enhancement system activation, the pedal pulsations feel different than the ABS pedal pulsations. The brake pedal pulsates at a higher frequency during vehicle stability enhancement system activation.

Driver Information Indicator

Brake Warning Indicator

The instrument cluster turns five brake warning indicator ON when the following occurs:

- The instrument cluster performs the bulb check.
- The electronic brake control module detects some faults, such as more than two wheel speed sensors are defective or the failure relating to the basic brake system occurs and sends a serial data message to the instrument cluster requesting illumination.
- The park brake is engaged or the brake fluid level is low.

ABS Warning Indicator

The instrument cluster turns the ABS warning indicator ON when the following occurs:

- The instrument cluster performs the bulb check.
- The electronic brake control module detects a malfunction which disables the ABS and sends a serial data message to the instrument cluster requesting illumination.

Traction Control System/Stability Control System Warning Indicator

The instrument cluster turns the traction control system/stability control system warning indicator ON when the following occurs:

- The instrument cluster performs the bulb check.
- The electronic brake control module detects a malfunction which disables the traction control or stability control and sends a serial data message to the instrument cluster requesting illumination.

Traction Control System OFF Indicator

The instrument cluster turns the Traction Control Off indicator ON when the following occurs:

- The instrument cluster performs the bulb check.
- The driver manually disables the traction control by pressing the traction control switch one time and releasing it. The body control module and electronic brake control module sends a serial data message to the instrument cluster requesting illumination.
- The electronic brake control module detects a malfunction which disables the traction control and sends a serial data message to the instrument cluster requesting illumination of the Traction Control Off indicator.

Stability Control System OFF Indicator

The instrument cluster turns the Stability Control Off indicator ON when the following occurs:

- The instrument cluster performs the bulb check.
- The driver manually disables the stability control by pressing and holding the traction control switch down for five seconds. The electronic brake control module sends a serial data message to the instrument cluster requesting illumination.
- The electronic brake control module detects a malfunction which disables the stability control system it sends a serial data message to the instrument cluster requesting illumination of the Stability Control Off indicator.

ABS DESCRIPTION AND OPERATION (WITHOUT FX3)

This vehicle is equipped with the MGH 60 Mando antilock brake system. The electronic brake control module and the brake pressure modulator are serviced separately. The brake pressure modulator uses a 4 circuit configuration to control hydraulic pressure to each wheel independently.

The following vehicle performance enhancement systems are provided.

- Antilock brake system (ABS)
- Electronic brake distribution

The following components are involved in the operation of the above systems.

- Electronic brake control module -The electronic brake control module controls the system functions and detects failures.
- Brake pressure modulator -The brake pressure modulator contains the hydraulic valves and pump motor that are controlled electrically by the electronic brake control module. The brake pressure modulator uses a 4 circuit configuration with a diagonal split. The brake pressure modulator directs fluid from the reservoir of the master cylinder to the left front and right rear wheels and fluid from the other reservoir to the right front and left rear wheels. The diagonal circuits are hydraulically isolated so that a leak or malfunction in one circuit will allow continued braking ability on the other.

The brake pressure modulator contains the following components:

- Pump motor
 - Inlet valves (one per wheel)
 - Outlet valves (one per wheel)
- Wheel speed sensor - The wheel speed sensor receives a ignition voltage from the electronic brake control module and provides an output signal to the electronic brake control module. As the wheel spins, the wheel speed sensor sends the electronic brake control module a DC square wave signal. The electronic brake control module uses the frequency of the square wave signal to calculate the wheel speed.

Initialization Sequence

The electronic brake control module performs 1 initialization test each ignition cycle. The initialization of the electronic brake control module occurs when both the following conditions occur:

- The vehicle speed is greater than 20 km/h (12 mph).
- The stop lamp switch is not applied.

The initialization sequence cycles each solenoid valve and the pump motor, as well as the necessary relays, for approximately 1.5 seconds to check component operation. The electronic brake control module sets a DTC if any error is detected. The initialization sequence may be heard and felt while it is taking place, and is considered part of normal system operation.

The electronic brake control module defines a drive cycle as the completion of the initialization sequence.

Antilock Brake System

When wheel slip is detected during a brake application, the ABS enters antilock mode. During antilock braking, hydraulic pressure in the individual wheel circuits is controlled to prevent any wheel from slipping. A separate hydraulic line and specific solenoid valves are provided for each wheel. The ABS can decrease, hold, or increase hydraulic pressure to each wheel brake. The ABS cannot, however, increase hydraulic pressure above the amount which is transmitted by the master cylinder during braking.

During antilock braking, a series of rapid pulsations is felt in the brake pedal. These pulsations are caused by the rapid changes in position of the individual solenoid valves as the electronic brake control module responds to wheel speed sensor inputs and attempts to prevent wheel slip. These pedal pulsations are present only during antilock braking and stop when normal braking is resumed or when the vehicle comes to a stop. A ticking or popping noise may also be heard as the solenoid valves cycle rapidly. During antilock braking on dry pavement, intermittent chirping noises may be heard as the tires approach slipping. These noises and pedal pulsations are considered normal during antilock operation.

Vehicles equipped with ABS may be stopped by applying normal force to the brake pedal. Brake pedal operation during normal braking is no different than that of previous non-ABS systems. Maintaining a constant force on the brake pedal provides the shortest stopping distance while maintaining vehicle stability.

Pressure Hold

The electronic brake control module closes the inlet valve and keeps the outlet valve closed in order to isolate the system when wheel slip occurs. This holds the pressure steady on the brake so that the hydraulic pressure does not increase or decrease.

Pressure Decrease

The electronic brake control module decreases the pressure to individual wheels during a deceleration when wheel slip occurs. The inlet valve is closed and the outlet valve is opened. The excess fluid is stored in the accumulator until the return pump can return the fluid to the master cylinder.

Pressure Increase

The electronic brake control module increases the pressure to individual wheels during a deceleration in order to reduce the speed of the wheel. The inlet valve is opened and the outlet valve is closed. The increased pressure is delivered from the master cylinder.

Electronic Brake Distribution

The electronic brake distribution is a control system that replaces the hydraulic proportioning function of the mechanical proportioning valve in the base brake system. The electronic brake distribution control system is part of the operation software in the electronic brake control module. The electronic brake distribution uses active control with existing ABS in order to regulate the vehicle's rear brake pressure.

The red brake warning indicator is illuminated when the electronic brake distribution function is disabled.

Driver Information Indicator

Brake Warning Indicator

The instrument cluster turns the brake warning indicator ON when the following occurs:

- The instrument cluster performs the bulb check.
- The park brake is engaged or the brake fluid level is low.
- The electronic brake control module detects some faults, such as more than two wheel speed sensors are

defective or the failure relating to the basic brake system occurs and sends a serial data message to the instrument cluster requesting illumination.

ABS Warning Indicator

The instrument cluster turns the ABS warning indicator ON when the following occurs:

- The instrument cluster performs the bulb check.
- The electronic brake control module detects a malfunction which disables the ABS and sends a serial data message to the instrument cluster requesting illumination.

TRANSMISSION

Automatic Transmission - Aisin 80-40LE - Spark

SPECIFICATIONS

TRANSMISSION FLUID TEMPERATURE SENSOR SPECIFICATIONS

Transmission Fluid Temperature Sensor Specifications

Temperature °C	Temperature °F	Minimum Resistance kohms	Nominal Resistance kohms	Maximum Resistance kohms
-30	-22	36.3	44.2	52.1
10	50	5.626	6.465	7.303
110	230	0.224	0.248	0.271
145	293	0.102	0.112	0.121

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Apply Tube Clamp Bolt	5	44 lb in
Automatic Transmission Range Selector Lever Nut	12	106 lb in
Automatic Transmission Wiring Harness Bolt	5	44 lb in
Breather Bracket Bolt	5	44 lb in
Control Valve Body Bolt	11	97 lb in
Control Valve Body Cover Bolt	7	62 lb in
Counter Drive Gear Nut	115	85 lb ft
Drain Plug	17	13 lb ft
Fluid Pressure Test Plug	7	62 lb in
Input Speed Sensor Bolt	5	44 lb in
Manual Detent Spring Bolt	10	89 lb in
Oil Pump Bolt	25	18 lb ft
Oil Reservoir Lock Plate Bolt	5	44 lb in
Output Speed Sensor Bolt	5	44 lb in
Overflow Plug	24	18 lb ft
Parking Lock Pawl Bolt	7	62 lb in
PNP Switch Bolt	5	44 lb in
Selector Control Cable Clamp Bolt	22	16 lb ft
Shift Solenoid Valve Bolt	7	62 lb in
Torque Converter Bolt	60	44 lb ft
Torque Converter Cover Plate Bolt	10	89 lb in

Transmission Bracket Mount to Mount Through Bolt- Rear	80	59 lb ft
Transmission Bracket Mount to Mount Through Nut- Rear	80	59 lb ft
Transmission Case No. 1 Plate Bolt	10	89 lb in
Transmission Case No. 2 Plate Bolt	10	89 lb in
Transmission Control Lever Knob Bolt	3	2 lb in
Transmission Control Module (TCM) Nut	7	62 lb in
Transmission Fluid Temperature (TFT) Sensor Bolt	7	62 lb in
Transmission Fluid Cooler Pipe Bracket Bolt	22	16 lb ft
Transmission Fluid Cooler Pipe Fitting Nut	16	12 lb ft
Transmission Hook Nut	17	13 lb ft
Transmission Housing Bolt	30	22 lb ft
Transmission Lower Bolt	61	44 lb ft
Transmission Lower Nut	61	44 lb ft
Transmission Mount Bolt- Left	95	70 lb ft
Transmission Mount Bracket Bolt- Left	60	44 lb ft
Transmission Mount Nut- Left	95	70 lb ft
Transmission Mount to Body Bolt- Left	50	37 lb ft
Transmission Mount to Frame Bolt- Rear	100	74 lb ft
Transmission Mount to Transmission Bolt- Rear	60	44 lb ft
Transmission Range Selector Lever Cable Bracket Bolt	22	16 lb ft
Transmission Range Selector Lever Cable Grommet Nut	6	53 lb in
Transmission Rear Cover Bolt	25	18 lb ft
Transmission Shift Control Bolt	9	80 lb in
Transmission Shift Control Nut	9	80 lb in
Transmission Upper Bolt	61	44 lb ft

TRANSMISSION GENERAL SPECIFICATIONS

Transmission General Specifications

Application	Specification	
	Metric	English
Maker	AISIN	
Type or Model	80-40LE GEN II	
Gear Ratio - 1st	2.875:1	
Gear Ratio - 2nd	1.568:1	
Gear Ratio - 3rd	1.000:1	
Gear Ratio - 4th	0.697:1	
Reverse	2.300:1	
Final Drive Ratio	4.145:1	
Fluid Type	AW-1	
Oil Capacity	4.7L	5.0 qt

Differential Gear Bearing Race Adjuster Shim Thickness

Application	Specification	
	Metric	English
Mark A	1.8 mm	0.0709 in
Mark B	1.85 mm	0.0728 in
Mark C	1.9 mm	0.0748 in
Mark D	1.95 mm	0.0768 in
Mark E	2 mm	0.787 in
Mark F	2.05 mm	0.0807 in
Mark G	2.08 mm	0.0819 in
Mark H	2.11 mm	0.0831 in
Mark J	2.14 mm	0.0843 in
Mark K	2.17 mm	0.0854 in
Mark L	2.2 mm	0.0866 in
Mark M	2.23 mm	0.0878 in
Mark N	2.26 mm	0.089 in
Mark P	2.29 mm	0.0902 in
Mark Q	2.32 mm	0.0913 in
Mark R	2.35 mm	0.0925 in
Mark S	2.4 mm	0.0945 in
Mark T	2.45 mm	0.0965 in
Mark U	2.5 mm	0.0984 in
Mark V	2.55 mm	0.1004 in
Mark W	2.6 mm	0.1024 in
Mark X	2.65 mm	0.1043 in
Mark Y	2.7 mm	0.1063 in

Counter Driven Gear Bearing Race Adjuster Shim Thickness

Application	Specification	
	Metric	English
Mark 1	1.70 mm	0.0669 in
Mark 2	1.75 mm	0.0689 in
Mark 3	1.80 mm	0.0709 in
Mark 4	1.85 mm	0.0728 in
Mark 5	1.90 mm	0.0748 in
Mark 6	1.93 mm	0.0760 in
Mark 7	1.96 mm	0.0772 in
Mark A	1.99 mm	0.0783 in
Mark B	2.02 mm	0.0795 in
Mark C	2.05 mm	0.0807 in
Mark D	2.08 mm	0.0819 in

Mark E	2.11 mm	0.0831 in
Mark F	2.14 mm	0.0843 in
Mark G	2.17 mm	0.0854 in
Mark H	2.20 mm	0.0866 in
Mark K	2.25 mm	0.0886 in
Mark L	2.30 mm	0.0906 in
Mark M	2.35 mm	0.0925 in
Mark N	2.40 mm	0.0945 in
Mark P	2.45 mm	0.0965 in
Mark Q	2.50 mm	0.0984 in
Mark R	2.55 mm	0.1004 in
Mark S	2.60 mm	0.1024 in
Mark U	2.65 mm	0.1043 in
Mark W	2.70 mm	0.1063 in

TRANSMISSION GEAR RATIO

Transmission Gear Ratio

Gear	Ratio
First	2.875
Second	1.568
Third	1.000
Fourth	0.697
Reverse	2.300
Counter	1.023
Differential	4.052

LINE PRESSURE

Line Pressure

Application	Specification	
	Metric	English
At D Range		
• Idling	0.62-0.77 mPa	90.65-112.40 psi
• Stall	1.45-1.63 mPa	210.31-236.41 psi
At R Range		
• Idling	0.49-0.53 mPa	72.37-78.18 psi
• Stall	1.72-2.08 mPa	250.19-302.40 psi

SCHEMATIC WIRING DIAGRAMS

AUTOMATIC TRANSMISSION CONTROLS WIRING SCHEMATICS

Power, Ground, and Serial Data Wiring Schematics

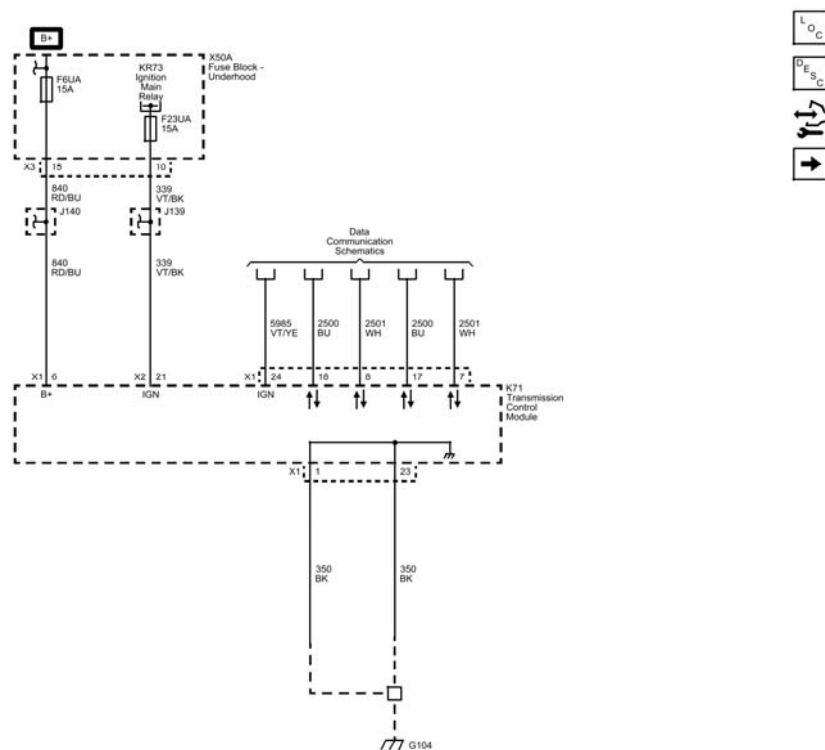


Fig. 1: Power, Ground, and Serial Data Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Speed and Temperature Sensors, Pressure and Shift Controls Wiring Schematics

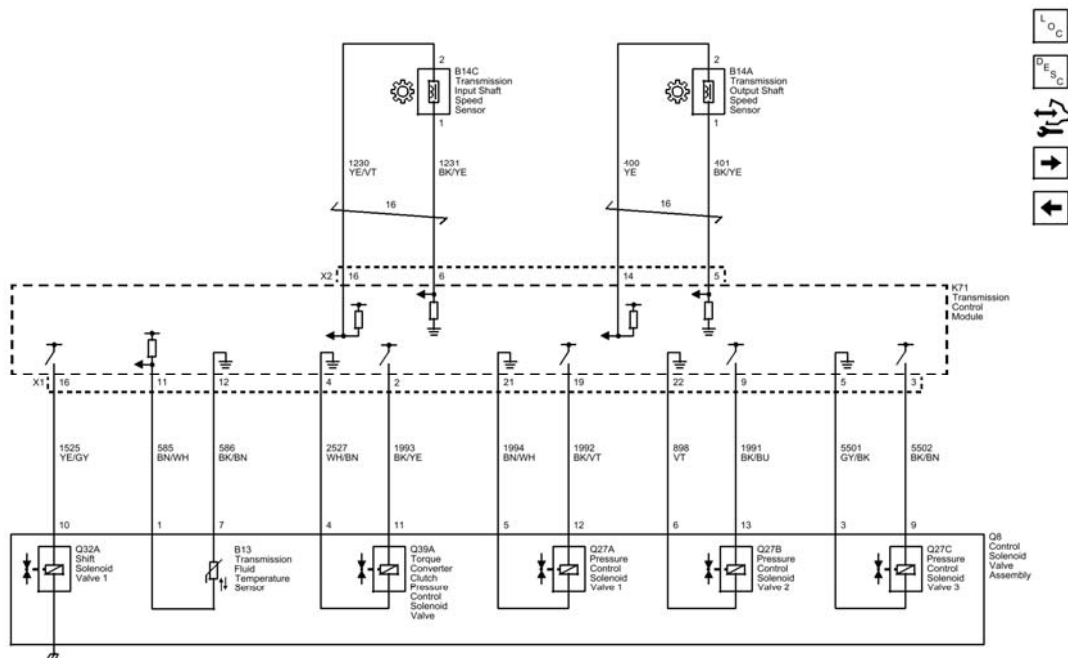


Fig. 2: Speed and Temperature Sensors, Pressure and Shift Controls Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Park/Neutral Position Switch Wiring Schematics



Case and Associated Parts (1 of 2)

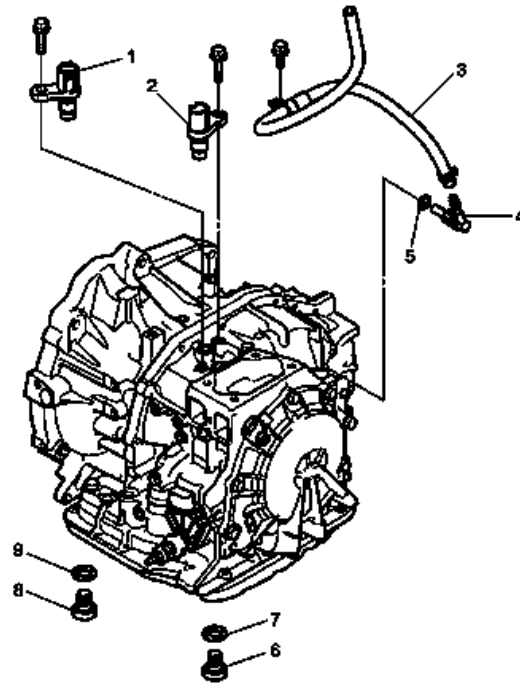


Fig. 4: Case and Associated Parts (1 of 2)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Output Speed Sensor
2	Input Speed Sensor
3	Breather Hose
4	Breather Plug
5	O-Ring
6	Drain Plug
7	Drain Plug Gasket
8	Overflow Plug
9	Overflow Plug Gasket

Case and Associated Parts (2 of 2)

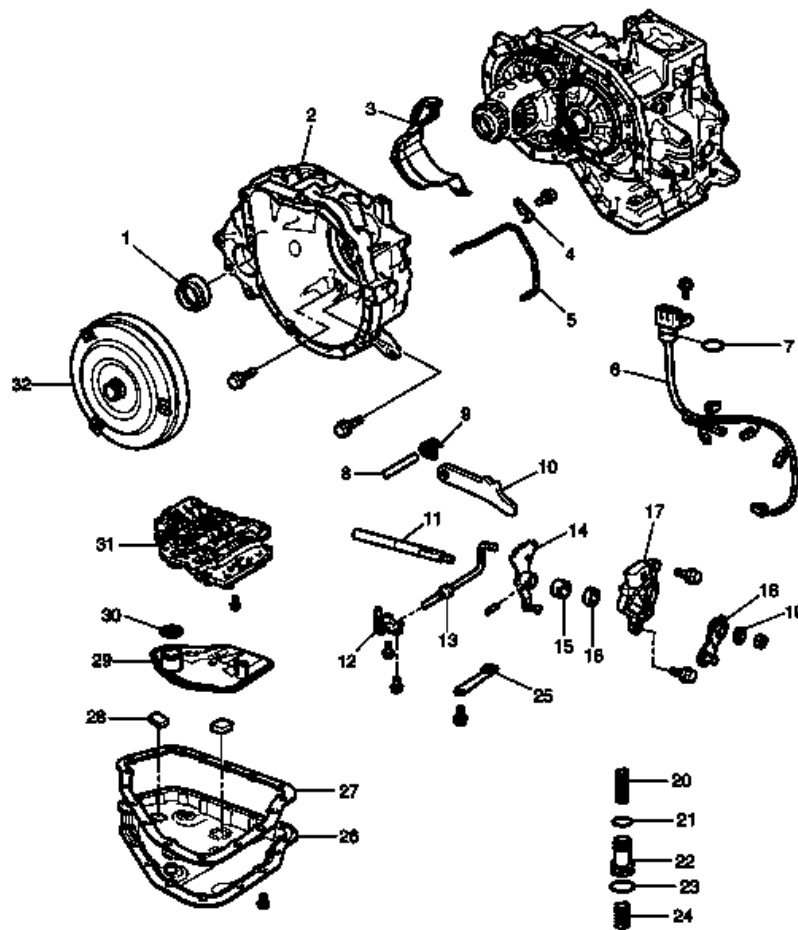


Fig. 5: Case and Associated Parts (2 of 2)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Oil Seal
2	Transmission Housing
3	Oil Reserve Lock Plate
4	Tube Clamp
5	Differential Gear Lube Apply Tube
6	Transmission Wiring Harness
7	O-Ring
8	Parking Lock Pawl Shaft
9	Torsion Spring
10	Parking Lock Pawl
11	Manual Valve Lever Shaft
12	Parking Lock Pawl Bracket
13	Parking Lock Rod
14	Manual Valve Lever

15	Oil Seal
16	Spacer
17	Park/Neutral Position Switch
18	Range Selector Lever
19	Spring Washer
20	Compression Spring
21	O-Ring
22	C3 Accumulator Piston
23	O-Ring
24	Compression Spring
25	Manual Detent Spring
26	Control Valve Body Cover
27	Valve Body Cover Gasket
28	Oil Cleaner Magnet
29	Oil Strainer
30	O-Ring
31	Control Valve Body Assembly
32	Torque Converter

Internal Components

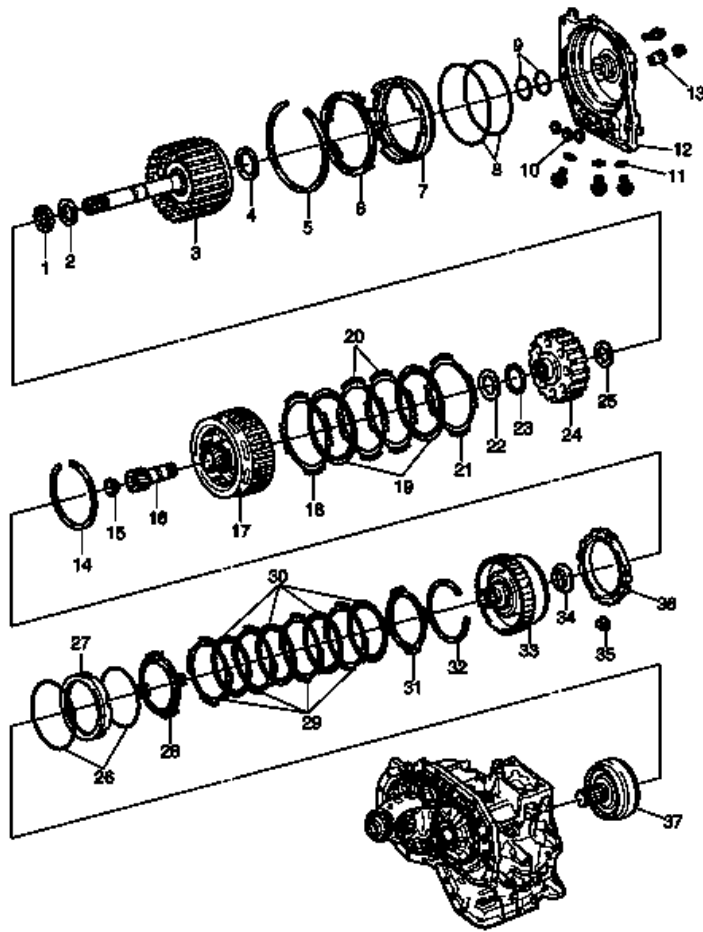


Fig. 6: Exploded View Of Internal Components
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Thrust Needle Roller Bearing
2	Thrust Bearing Race
3	Forward and Reverse Clutch Assembly
4	Thrust Needle Roller Bearing
5	Snap Ring
6	O/D Brake Return Spring
7	O/D Brake Piston
8	O-Ring
9	Oil Seal
10	Apply Gasket
11	O-Ring
12	Transmission Rear Cover
13	Transmission Hook
14	Snap Ring

15	Thrust Bearing Race
16	Front Planetary Sun Gear Assembly
17	Rear Planetary Sun Gear Assembly
18	O/D Brake Flange
19	O/D Brake Disc
20	O/D Brake Plate
21	O/D Brake Flange
22	Thrust Bearing Race
23	Thrust Needle Roller Bearing
24	Forward Clutch Hub
25	Thrust Bearing Race
26	O-Ring
27	1st and Reverse Brake Piston
28	1st and Reverse Brake Return Spring
29	Brake No. 3 Plate
30	Brake No. 3 Disc
31	Brake No. 3 Flange
32	Snap Ring
33	Planetary Gear Assembly
34	Thrust Needle Roller Bearing
35	Outer Race Retainer
36	One-way No. 2 Clutch
37	Planetary Ring Gear

Differential and Oil Pump

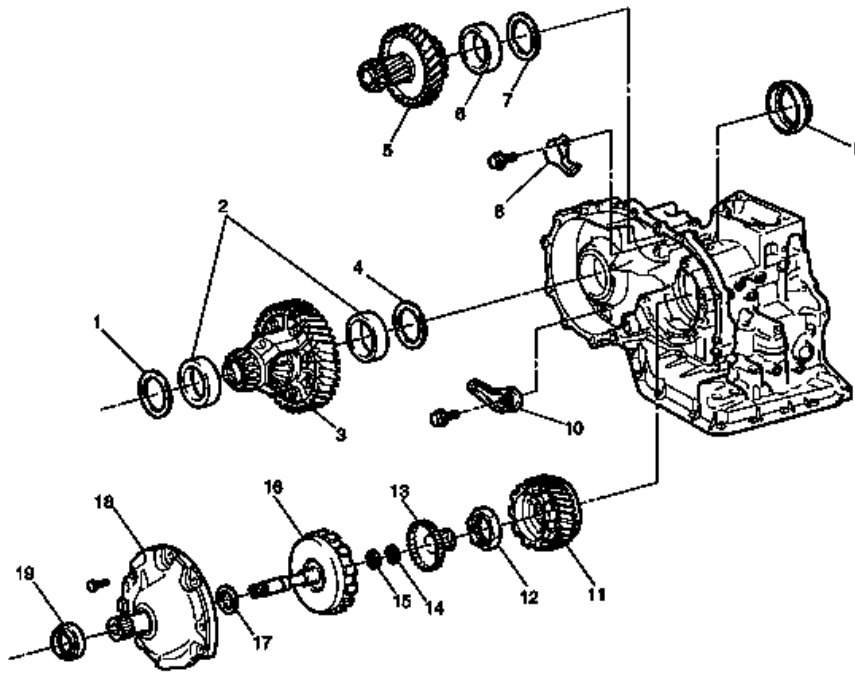


Fig. 7: Exploded View Of Differential and Oil Pump
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Shim
2	Tapered Roller Bearing Outer Race
3	Differential Gear Assembly
4	Shim
5	Counter Driven Gear Assembly
6	Tapered Roller Bearing Outer Race
7	Shim
8	Transmission Case No. 2 Plate
9	Oil Seal
10	Transmission Case No. 2 Plate
11	Counter Drive Gear
12	Nut
13	Direct Clutch Hub
14	Thrust Bearing Race
15	Thrust Needle Roller Bearing
16	Direct Clutch Assembly
17	Thrust Needle Roller Bearing
18	Oil Pump Assembly
19	Oil Seal

Direct Clutch

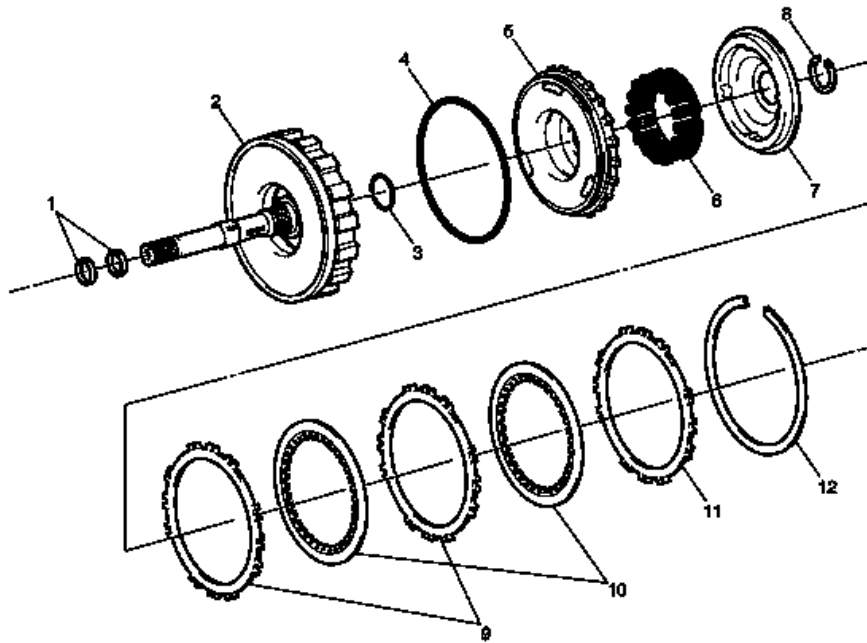


Fig. 8: Exploded View Of Direct Clutch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Input Shaft Oil Seal Ring
2	Input Shaft
3	O-Ring
4	O-Ring
5	Direct Clutch Piston
6	Direct Clutch Return Spring
7	Clutch No. 2 Balancer
8	Snap Ring
9	Brake No. 3 Plate
10	O/D Brake Disc
11	Brake No. 3 Flange
12	Snap Ring

Forward and Reverse Clutch

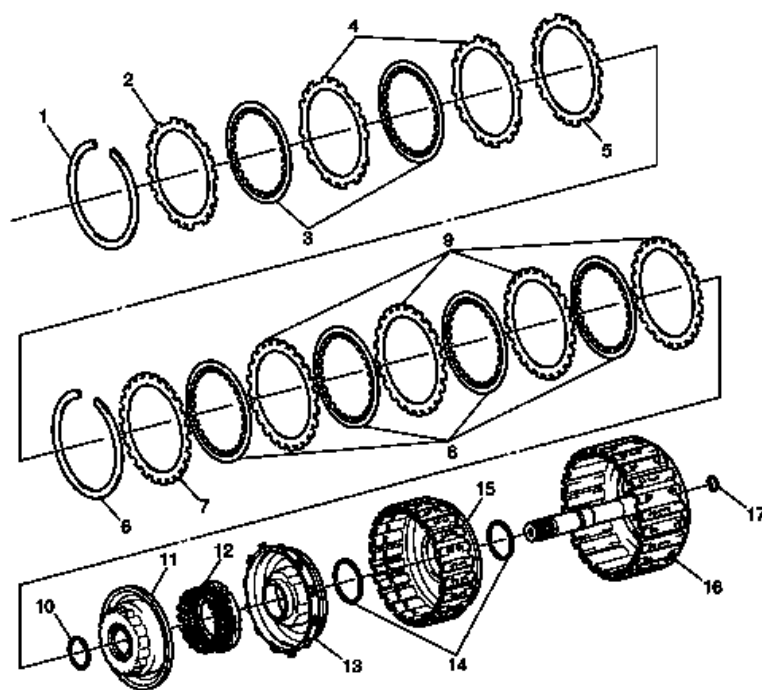


Fig. 9: Exploded View Of Forward and Reverse Clutch
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Snap Ring
2	Reverse Clutch Flange
3	Clutch No. 3 Disc
4	Clutch No. 3 Plate
5	Clutch Cushion Plate
6	Snap Ring
7	Forward Clutch Flange
8	Clutch Disc
9	Clutch No. 1 Plate
10	Snap Ring
11	Clutch No. 1 Balancer
12	Forward Clutch Return Spring
13	Forward Clutch Piston
14	O-Ring
15	Forward Clutch Drum
16	Intermediate Shaft
17	Seal Ring

2nd Coast and 4th Brake

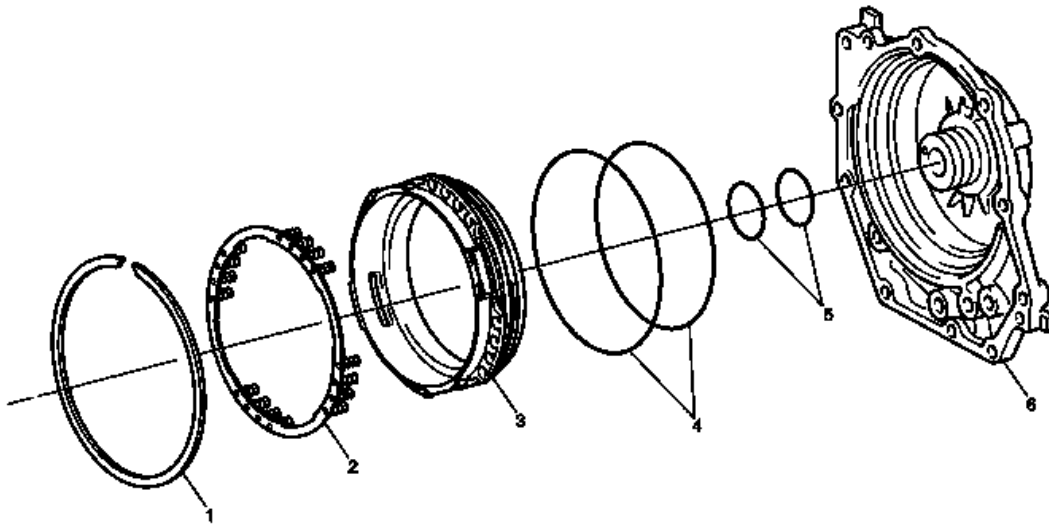


Fig. 10: Exploded View Of 2nd Coast and 4th Brake
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Snap Ring
2	O/D Brake Return Spring
3	O/D Brake Piston
4	O-Ring
5	Seal Ring
6	Transmission Rear Cover

Planetary Gear and One-Way Clutch

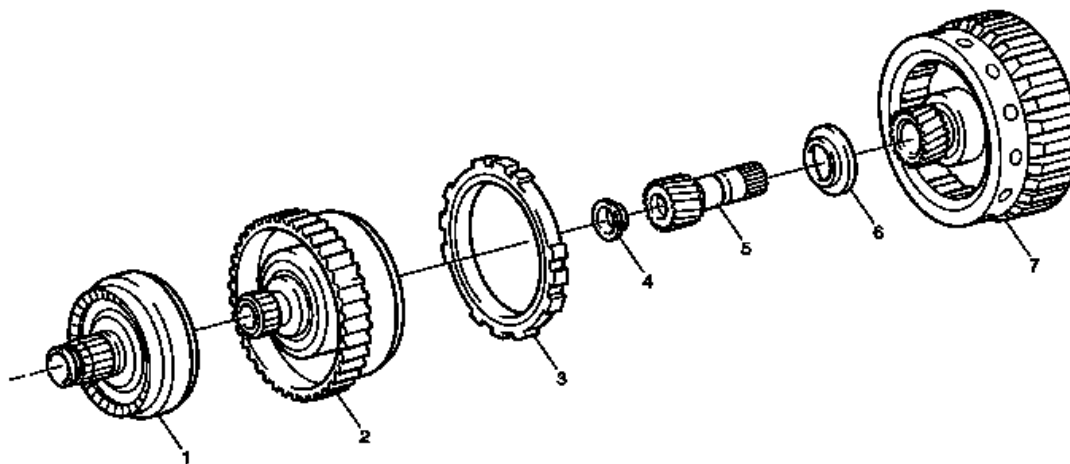


Fig. 11: Exploded View Of Planetary Gear And One-Way Clutch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Planetary Ring Gear
2	Planetary Gear
3	One-Way No. 2 Clutch
4	Thrust Bearing Race
5	Front Planetary Sun Gear
6	Thrust Needle Roller Bearing
7	Rear Planetary Sun Gear

Valve Body

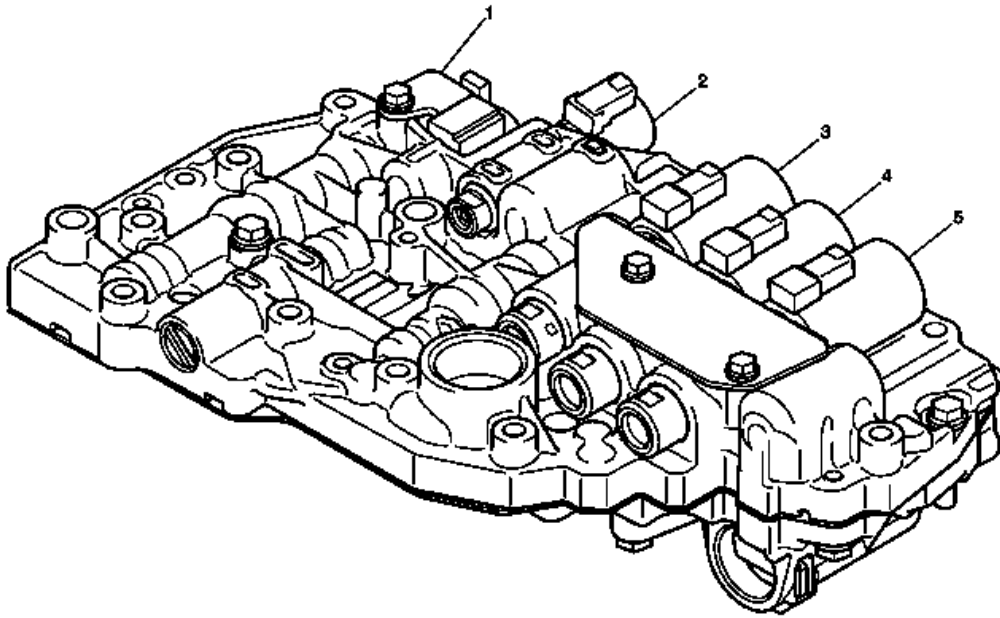


Fig. 12: Pressure Control Solenoid Valve
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Shift Solenoid Valve (S1)
2	Lock-Up Control Solenoid Valve (SLU)
3	Pressure Control Solenoid Valve 3 (SLB1)
4	Pressure Control Solenoid Valve 2 (SLC2)
5	Pressure Control Solenoid Valve 1 (SLC1)

Bearing and Race Installation and Direction

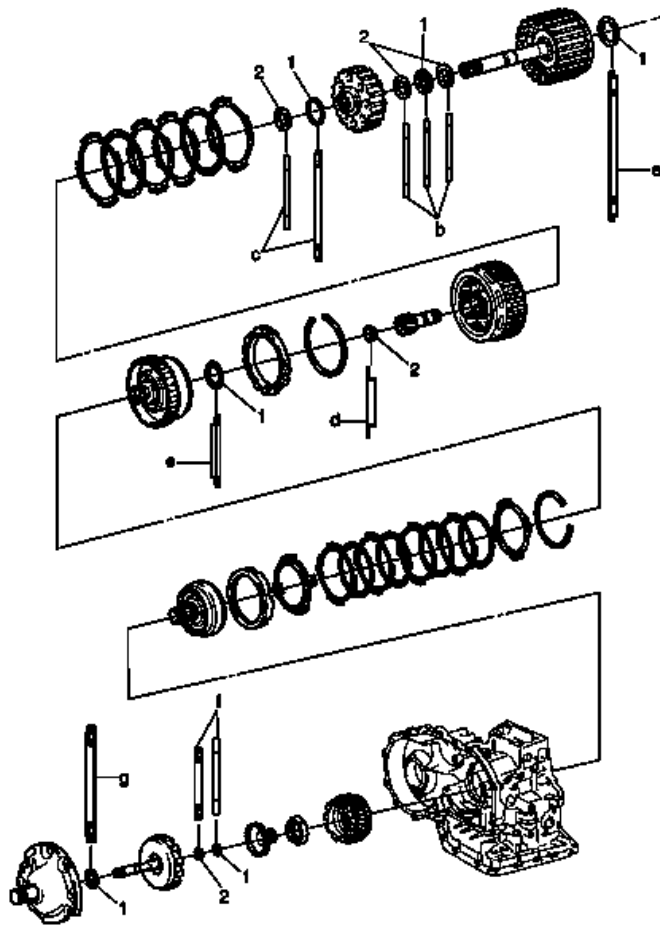


Fig. 13: Exploded View Of Bearing and Race
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Thrust Needle Roller Bearing
2	Thrust Bearing Race

Mark	Front Race Diameter		Thrust Bearing Diameter		Rear Race Diameter	
	Inside	Outside	Inside	Outside	Inside	Outside
a	-	-	43.20 mm (1.701 in)	63.80 mm (2.512 in)	-	-
b	19.30 mm (0.760 in)	30.60 mm (1.205 in)	18.10 mm (0.713 in)	29.60 mm (1.165 in)	18.10 mm (0.713 in)	28.20 mm (1.110 in)
c	35.05 mm (1.380 in)	48.10 mm (1.894 in)	33.30 mm (1.311 in)	46.50 mm (1.831 in)	-	-
d	-	-	-	-	19.30 mm (0.760 in)	29.00 mm (1.142 in)
e	-	-	41.90 mm (1.650 in)	57.50 mm (2.264 in)	-	-

f	-	-	17.80 mm (0.701 in)	30.20 mm (1.189 in)	20.50 mm (0.807 in)	32.60 mm (1.283 in)
g	-	-	32.50 or 32.90 mm (1.280 or 1.295 in)	48.50 mm (1.909 in)	-	-

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC SYSTEM CHECK - AUTOMATIC TRANSMISSION

Circuit Description

The Diagnostic System Check - Automatic Transmission is an organized approach to identify a condition created by an automatic transmission. The Diagnostic System check is the diagnostic starting point for an automatic transmission concern. The Diagnostic System Check directs you to the next logical step for diagnosing a transmission concern. Perform this check only if there is a driveability concern or if you have been directed here from another service information section. Follow the table to help reduce diagnostic time and help prevent unnecessary replacement of good parts.

Diagnostic Aids

NOTE:

- Do not clear the DTC unless directed by a diagnostic procedure. Clearing the DTC will erase all Freeze Frame/Failure Records stored in engine control module (ECM) memory.
- Poor engine performance can sometimes be mis-diagnosed as a transmission concern. In order to avoid unnecessary transmission work, always perform the Diagnostic System Check - Vehicle .
- Use a scan tool that is known to function correctly. If necessary, test the scan tool on another vehicle.
- Ensure the scan tool contains the most current file available.
- The scan tool will display a loss of communication error message under the following conditions:
 - ECM power is interrupted.
 - The ignition switch is turned OFF.
 - The battery voltage level is very low.
 - A poor connection at the diagnostic link connector (DLC).

Test Description

The numbers below refer to the step numbers on the diagnostic table.

1

This step determines if the scan tool is receiving power through the DLC connector.

2

This step determines if the transmission control module (TCM) is transmitting serial data to the DLC and that the serial data circuit is not open or shorted.

3

This step determines if a TCM DTC is current or stored in history.

4

This step determines if the ECM is transmitting serial data to the DLC and that the serial data circuit is not open or shorted.

5

This step determines if an ECM DTC is current or stored in history.

Diagnostic System Check - Automatic Transmission

Step	Action	Yes	No
1	1. Install a scan tool. NOTE: Check for applicable service bulletins before proceeding with this test. Perform this test only if there is a driveability complaint or if you have been directed to this table from another section in the service information. Do not turn ignition OFF when performing this diagnostic procedure. Do not clear the DTCs unless instructed by this diagnostic procedure. 2. Turn ON the ignition, with the engine OFF. Does the scan tool power up?	Go to Step 2	Go to <u>Scan Tool Does Not Power Up</u>
2	Attempt to establish communication with the transmission control module (TCM). Does the scan tool communicate with the TCM?	Go to Step 3	Go to <u>Scan Tool Does Not Communicate with High Speed GMLAN Device</u>
3	Select the TCM DTCs function on the scan tool. Does the scan tool display any TCM DTCs?	Go to <u>Symptoms - Automatic Transmission</u>	Go to Step 4
	Attempt to establish communication with the engine control module (ECM).		Go to <u>Scan Tool Does Not Communicate</u>

4	Does the scan tool communicate with the ECM?	Go to Step 5	<u>with High Speed GMLAN Device</u>
5	Select the ECM DTCs function on the scan tool. Does the scan tool display any ECM DTCs?	Go to <u>Diagnostic Trouble Code (DTC) List - Vehicle</u>	Go to <u>Symptoms - Automatic Transmission</u>

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC P0562 or P0563</u>	DTC P0562 System Voltage Low DTC P0563 System Voltage High
<u>DTC P057B-P057D</u>	DTC P057B Brake Pedal Position Sensor Performance DTC P057C Brake Pedal Position Sensor Circuit Low Voltage DTC P057D Brake Pedal Position Sensor Circuit High Voltage
<u>DTC P0601, P0602, P0604, or P062F</u>	DTC P0601 Control Module Read Only Memory (ROM) Performance DTC P0602 Control Module Not Programmed DTC P0604 Control Module Random Access Memory (RAM) Performance DTC P062F Control Module Long Term Memory Performance
<u>DTC P0705 or P0706</u>	DTC P0705 Transmission Range (TR) Switch Circuit Open DTC P0706 Transmission Range (TR) Switch Circuit Short to Ground
<u>DTC P0711-P0713</u>	DTC P0711 Transmission Fluid Temperature (TFT) Sensor Performance DTC P0712 Transmission Fluid Temperature (TFT) Sensor Circuit Low Voltage DTC P0713 Transmission Fluid Temperature (TFT) Sensor Circuit High Voltage
<u>DTC P0717, P07BF, or P07C0</u>	DTC P0717 Input Speed Sensor Circuit No Signal DTC P07BF Input Speed Sensor Circuit Low Voltage DTC P07C0 Input Speed Sensor Circuit High Voltage
<u>DTC P0722, P077C, or P077D</u>	DTC P0722 Output Speed Sensor Circuit No Signal DTC P077C Output Speed Sensor Circuit Low Voltage DTC P077D Output Speed Sensor Circuit High Voltage
<u>DTC P0731</u>	DTC P0731 1st Gear Ratio Incorrect
	DTC P0741 Torque Converter Clutch (TCC) System

<u>DTC P0741 or P0742</u>	Stuck Off DTC P0742 Torque Converter Clutch (TCC) System Stuck On
<u>DTC P0746 or P0747</u>	DTC P0746 Pressure Control Solenoid Valve 1 Stuck Off DTC P0747 Pressure Control Solenoid Valve 1 Stuck On
<u>DTC P0748, P0962, or P0963</u>	DTC P0748 Pressure Control Solenoid Valve 1 Control Circuit DTC P0962 Pressure Control Solenoid Valve 1 Control Circuit Low Voltage DTC P0963 Pressure Control Solenoid Valve 1 Control Circuit High Voltage
<u>DTC P0751</u>	DTC P0751 Shift Solenoid Valve 1 Performance - Stuck Off
<u>DTC P0776 or P0777</u>	DTC P0776 Pressure Control Solenoid Valve 2 Stuck Off DTC P0777 Pressure Control Solenoid Valve 2 Stuck On
<u>DTC P0778, P0966, or P0967</u>	DTC P0778 Pressure Control Solenoid Valve 2 Control Circuit DTC P0966 Pressure Control Solenoid Valve 2 Control Circuit Low Voltage DTC P0967 Pressure Control Solenoid Valve 2 Control Circuit High Voltage
<u>DTC P0796 or P0797</u>	DTC P0796 Pressure Control Solenoid Valve 3 Stuck Off DTC P0797 Pressure Control Solenoid Valve 3 Stuck On
<u>DTC P0798, P0970, or P0971</u>	DTC P0798 Pressure Control Solenoid Valve 3 Control Circuit DTC P0970 Pressure Control Solenoid Valve 3 Control Circuit Low Voltage DTC P0971 Pressure Control Solenoid Valve 3 Control Circuit High Voltage
<u>DTC P0851 or P0852</u>	DTC P0851 Park/Neutral Position Switch Circuit Low Voltage DTC P0852 Park/Neutral Position Switch Circuit High Voltage
<u>DTC P0973 or P0974</u>	DTC P0973 Shift Solenoid Valve 1 Control Circuit Low Voltage DTC P0974 Shift Solenoid Valve 1 Control Circuit High Voltage
<u>DTC P2534</u>	DTC P2534 Ignition On/Start Switch Circuit Low Voltage
<u>DTC P2537</u>	DTC P2537 Ignition Accessory Switch Circuit Low

	Voltage
<u>DTC P2761, P2763, or P2764</u>	DTC P2761 Torque Converter Clutch (TCC) Pressure Control Solenoid Valve Control Circuit
	DTC P2763 Torque Converter Clutch (TCC) Pressure Control Solenoid Valve Control Circuit High Voltage
	DTC P2764 Torque Converter Clutch (TCC) Pressure Control Solenoid Valve Control Circuit Low Voltage

DTC P0562 OR P0563: SYSTEM VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0562

System Voltage Low

DTC P0563

System Voltage High

Circuit/System Description

The transmission control module (TCM) continuously monitors the Battery Positive Voltage. Improper voltage may cause component damage or be inadequate to operate the transmission control solenoids properly. Improper solenoid operation may cause erratic transmission operation, which may result in internal damage.

Conditions for Running the DTC

- DTC P0717, P07C0, P07BF, U0100, or U0073 is not set.
- Engine speed is greater than 400 RPM for 2 seconds continuously.
- Input shaft speed is greater than 400 RPM for 2 seconds continuously.
- The transmission is not in limp home mode.

Conditions for Setting the DTC

P0562

The TCM detects that battery voltage is less than 9.0 volts for 20 seconds.

P0563

The TCM detects that battery voltage is greater than 18.0 volts for 20 seconds.

Action Taken When the DTC Sets

P0562

- DTC P0562 is a Type D DTC.
- The TCM allows the vehicle to be operated only in the third gear.

P0563

- DTC P0563 is a Type D DTC.
- The TCM allows the vehicle after below 10 km/h (6 mph) to be operated only in the second gear.

Conditions for Clearing the DTC

DTCs P0562 and P0563 are Type D DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

- **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**
- **Diagnostic Trouble Code (DTC) List - Vehicle**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Engine running, verify the transmission control module (TCM) scan tool control module voltage parameter is between 9.0-18.0 volts.

- If not within the specified range, refer to **Charging System Test** before performing Circuit/System Testing.

Circuit/System Testing

NOTE: **You must perform the Circuit/System Verification before proceeding with Circuit/System Testing.**

1. Ignition OFF, disconnect the harness connector at the K71 transmission control module (TCM).
2. Test for less than 1.0 ohm between ground circuit terminal 23 or 1 and ground.
 - If greater than the specified range, test the ground circuit for an open/high resistance.
3. Ignition ON, verify that a test lamp illuminates between the B+ circuit terminal 6 and ground.
 - If the test lamp does not illuminate, test the B+ circuit for a short to ground or an open/high resistance. If the circuit tests normal and the B+ circuit fuse is open, replace the K71 TCM.
4. If all circuits test normal, replace the K71 TCM.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

Control Module References for TCM replacement, setup, and programming

DTC P057B-P057D: BRAKE PEDAL POSITION SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P057B

Brake Pedal Position Sensor Performance

DTC P057C

Brake Pedal Position Sensor Circuit Low Voltage

DTC P057D

Brake Pedal Position Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P057C	P057C	P057D	P057B
5 V Reference	P057C P0651	P057C	P0651	-
Low Reference	-	P057D	P057D	-

Typical Scan Tool Data

Brake Pedal Position Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON. Normal Range: 0.25-4.75 V			
5 V Reference	0 V	0 V	-
Signal	0 V	0 V	5 V
Low Reference	-	5 V	-

Circuit/System Description

The brake pedal position (BPP) sensor is part of the engine brake pedal override feature. The engine control module (ECM) continuously monitors the vehicle speed and the position of the brake pedal. These two main inputs, along with other ECM inputs are used to determine if the vehicle is decelerating at the proper speed and rate with the brake pedal applied. When the engine brake pedal override system is active, the ECM reduces engine torque to assist in reducing vehicle speed.

The BPP sensor is a six wire sensor, and is part of a dual brake position sensor. One BPP Sensor is used for the stop lamps and the other BPP Sensor is used for the engine brake pedal override feature. The BPP Sensor for engine brake pedal override communicates with the ECM. The ECM supplies a 5 V reference circuit, low reference circuit, and signal circuit to the BPP sensor. The BPP sensor sends a voltage signal to the ECM on the signal circuit. The voltage on the signal circuit will vary from a voltage greater than 0.25 V when the brake pedal is released to a voltage less than 4.75 V when the brake pedal is fully applied.

For information on the Stop Lamps side of the BPP Sensor, refer to **Exterior Lighting Systems Description and Operation**.

Conditions for Running the DTC

- Ignition voltage is greater than 10 V.
- DTC runs continuously when above condition is met.

Conditions for Setting the DTC

P057B

The ECM detects that the BPP sensor signal is stuck in a range.

P057C

BPP sensor voltage is less than 0.25 V for 1 s.

P057D

BPP sensor voltage is greater than 4.75 V for 1 s.

Action Taken When the DTC Sets

- P057B, P057C, and P057D are Type A DTCs.
- Engine torque is reduced to 50% of available engine torque during brake torque management.
- Brake torque management is active at 25 kPa (3.7 PSI) of brake apply pressure.

Conditions for Clearing the DTC

P057B, P057C, and P057D are Type A DTCs

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **Inline Harness Connector End Views**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC P0641, P0651, P0697, or P06A3 is not set.
 - **If any of the DTCs are set**

Refer to **Brake Pedal Position Sensor Learn**.

- **If none of the DTCs are set**
3. Transmission in Park, and service brake pedal released.
 4. Verify the scan tool Brake Pedal Position Sensor parameter in the ECM displays greater than 0.25 V.
 - **If 0.25 V or less**

Refer to Circuit/System Testing.

- **If greater than 0.25 V**
5. Verify the scan tool Brake Pedal Position Sensor parameter voltage changes as the brake pedal is applied and displays less than 4.75 V when the brake pedal is fully applied.
 - **If the voltage does not change, or is greater than 4.74 V**

Refer to Circuit/System Testing.

- **If the voltage changes and less than 4.75 V**
6. Verify the scan tool Brake Pedal Position Sensor Learned Release Position parameter is within 0.1 V of the Brake Pedal Position Sensor parameter when the brake pedal is fully released.
 - **If difference is greater than 0.1 V**

Perform the **Brake Pedal Position Sensor Learn**.

- **If difference is 0.1 V or less**
7. Verify the Brake Pedal Position Sensor parameter transitions smoothly without any spikes or dropouts when slowly applying and releasing the brake pedal.
 - **If parameter does not transition smoothly or has spikes or dropouts**

Refer to Circuit/System Testing.

- **If parameter transitions smoothly and there are no spikes or dropouts**
8. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
 9. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

10. All OK.

Circuit/System Testing

NOTE: You must perform the Circuit/System Verification first.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B22 Brake Pedal Position Sensor. It may take up to 2 minutes for all vehicle systems to power down.

NOTE: All terminal references are for the vehicle harness brake pedal position sensor connector.

2. Test for less than 10 ohms between the low reference circuit terminal 6 and ground.
 - **If 10 ohms or greater**
 1. Disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If less than 10 ohms**
3. Ignition ON.
4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 5 and ground.
 - **If less than 4.8 V**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
 3. Test for less than 2 ohms in the 5 V reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If greater than 5.2 V**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If between 4.8-5.2 V**
5. Verify the scan tool Brake Pedal Position Sensor parameter is less than 0.25 V.
 - **If 0.25 V or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
 2. Test for less than 0.25 V between the signal circuit terminal 4 and ground.

- If 0.25 V or greater, repair the short to voltage on the circuit.
- If less than 0.25 V, replace the K20 Engine Control Module.
- **If less than 0.25 V**
- 6. Install a 3 A fused jumper wire between the signal circuit terminal 4 and the 5 V reference circuit terminal 5.
- 7. Verify the scan tool Brake Pedal Position Sensor parameter is greater than 4.8 V.
 - **If 4.8 V or less**
 1. Ignition OFF, remove the jumper wire, and disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal 4 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If greater than 4.8 V**
- 8. Replace the B22 Brake Pedal Position Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- Perform the **Brake Pedal Position Sensor Learn** following the replacement of the ECM or BPP sensor, or any repair that effects the BPP sensor alignment.
- **Brake Pedal Position Sensor Replacement**
- Refer to **Control Module References** for engine control module replacement, programming, and setup.

DTC P0601, P0602, P0604, OR P062F: CONTROL MODULE MEMORY

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0601

Control Module Read Only Memory (ROM) Performance

DTC P0602

Control Module Not Programmed

DTC P0604

Control Module Random Access Memory (RAM) Performance

DTC P062F

Control Module Long Term Memory Performance

Circuit/System Description

This diagnostic applies to internal microprocessor integrity conditions within the transmission control module (TCM) system. This diagnostic also addresses if the TCM is not programmed.

Conditions for Running the DTC

The ignition is ON, or the engine is operating.

Conditions for Setting the DTC

P0601

The TCM detects that the checksum calculation does not match the expected checksum.

P0602

The TCM is identified as not programmed.

P0604

The TCM detects a random access memory (RAM) read/write error.

P062F

The TCM detects an incorrect copy of non-volatile memory.

Action Taken When the DTC Sets

P0601

- DTC P0601 is Type A DTC.
- The TCM allows the vehicle after below 10 km/h (6 mph) to be operated only in the second gear.

P0602

- DTC P0602 is Type C DTC.

- The TCM allows the vehicle after below 10 km/h (6 mph) to be operated only in the second gear.

P0604

- DTC P0604 is Type B DTC.
- The TCM allows the vehicle after below 10 km/h (6 mph) to be operated only in the second gear.

P062F

- DTC P062F is a Type A DTC.
- The TCM uses the default value as the initial value for EEPROM.

Conditions for Clearing the DTC

P0601 and P062F

DTCs P0601 and P062F are Type A DTCs.

P0602

DTC P0602 is a Type C DTC.

P0604

DTC P0604 is a Type B DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON, observe the DTC information with a scan tool. Verify that DTC P0602 does not fail this ignition cycle.
 - If DTC P0602 failed this ignition, reprogram the K71 TCM. Refer to **Control Module References** . If DTC P0602 resets, replace the K71 TCM.
2. Observe the DTC information with a scan tool. Verify that DTCs P0601, P0604, and P062F do not set this ignition cycle.
 - If any of the DTCs P0601, P0604, or P062F are set this ignition cycle, replace the K71 TCM.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Transmission Adaptive Learn**
- **Control Module References** for TCM replacement, setup, and programming

DTC P0705 OR P0706: TRANSMISSION RANGE (TR) SWITCH

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0705

Transmission Range (TR) Switch Circuit Open

DTC P0706

Transmission Range (TR) Switch Circuit Short to Ground

Circuit/System Description

The transmission range (TR) switch is installed on the transmission case. The TR switch transmits the information which range includes the shift lever of the automatic transmission (A/T) to TCM by combination of a position circuit terminal. The TR switch input/output circuitry consists starter circuit (ST+, ST-), ground (GND) and position signal (P, R, N, D, 2, L). Each gear range position (P, R, N, D, 2, L) corresponds to a particular voltage (12 volts) within the TCM.

Conditions for Running the DTC

P0705

- The ignition is ON, or the engine is operating.
- The transmission is not in limp home mode.

P0706

- The ignition is ON, or the engine is operating.
- The transmission is not in limp home mode.

Conditions for Setting the DTC

P0705

The TCM detects that the TR switch circuit is open for 2 seconds.

P0706

The TCM detects that the TR switch circuit is shorted to ground for 5 seconds.

Action Taken When the DTC Sets

- DTCs P0705 and P0706 are Type B DTCs.
- The TCM allows the vehicle after below 10 km/h (6 mph) to be operated only in the third gear.

Conditions for Clearing the DTC

DTCs P0705 and P0706 are Type B DTCs.

Diagnostic Aids

Shift Position	X2 1 [R] - Ground	X2 7 [D] - Ground	X2 8 [N] - Ground	X2 18 [L]- Ground	X2 19 [2] - Ground	X2 20 [P] - Ground
P position	No continuity	No continuity	No continuity	No continuity	No continuity	Continuity
R position	Continuity	No continuity	No continuity	No continuity	No continuity	No continuity
N position	No continuity	No continuity	Continuity	No continuity	No continuity	No continuity
D position	No continuity	Continuity	No continuity	No continuity	No continuity	No continuity
2 position	No continuity	No continuity	No continuity	No continuity	Continuity	No continuity
L position	No continuity	No continuity	No continuity	Continuity	No continuity	No continuity

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

- **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**
- **Diagnostic Trouble Code (DTC) List - Vehicle**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Ignition ON, observe the scan tool Transmission Range Switch parameter while slowly moving the gear shift lever from Park and through all ranges. Verify the gear shift lever position matches the scan tool parameter.

- If not within the specified value, adjust the shift control cable or the B81 park/neutral position switch.

Circuit/System Testing

1. Ignition OFF, disconnect the X2 harness connector from K71 Transmission Control Module.
2. Inspect the resistance between each terminal of X2 harness connector and ground. Refer to Diagnostic Aids.
 - If not within the specified value, Inspect the wiring harness for short or open and replace it if needed.
3. Inspect the B81 park/neutral position switch. Refer to **Park/Neutral Position Switch Inspection**.
 - If not within the specified value, replace the B81 park/neutral position switch.
4. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
 - If the DTC resets, replace the K71 Transmission Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Park/Neutral Position Switch Replacement**
- **Transmission Adaptive Learn**
- Perform the **Control Module References** for TCM replacement, setup, and programming.

DTC P0711-P0713: TRANSMISSION FLUID TEMPERATURE (TFT) SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0711

Transmission Fluid Temperature (TFT) Sensor Performance

DTC P0712

Transmission Fluid Temperature (TFT) Sensor Circuit Low Voltage

DTC P0713

Transmission Fluid Temperature (TFT) Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0712	P0713	P0713	P0711
Ground	-	P0713	P0713	P0711

Circuit/System Description

The transmission fluid temperature (TFT) sensor, which is integrated with the automatic transmission wiring harness, is installed on the front valve body. It directly detects the oil temperature within the hydraulic pressure control circuit and transmits a signal based on that temperature to the TCM. In response to changes in oil temperature, the TCM controls gear shifting for smooth shifting across a wide range of temperatures.

Conditions for Running the DTC

P0711

- DTC P0705 or P0706 is not set.
- The transmission is not in limp home mode.
- The transmission oil temperature is less than 20°C (68°F) at initialization.
- The transmission oil temperature is between -55 to +200°C (-67 to +392°F).
- The vehicle speed has been greater than 40 km/h (24 mph) at least once.

P0712

- Ignition ON.
- Battery voltage is between 10.2-18.0 volts.

P0713

- The transmission is not in limp home mode.

- The drive time is greater than 60 seconds.

Conditions for Setting the DTC

P0711

The automatic transmission fluid temperature is less than 20°C (68°F) after 10 minutes driving or more.

P0712

The automatic transmission fluid temperature is more than 200°C (392°F) for 10 seconds or more after consecutive 6 times.

P0713

The automatic transmission fluid temperature is lower than -55°C (-67°F) for 1 second or more after consecutive 12 times.

Action Taken When the DTC Sets

- DTC P0711, P0712, and P0713 are Type A DTCs.
- The TCM will default the transmission oil temperature to 80°C (176°F).
- No self learning control
- No lock-up slip control
- No neutral control

Conditions for Clearing the DTC

DTCs P0711, P0712, and P0713 are Type A DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Component Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Perform the **Transmission Fluid Level and Condition Check** to verify correct fluid level.
2. Engine idling at operating temperature, observe the scan tool Transmission Fluid Temperature parameter. The reading should be between -40 to +215°C (-40 to +488°F) and change.
3. Operate the vehicle at about 60 km/h (37 mph) for 10 min. Verify the scan tool Transmission Fluid Temperature parameter varies by more than 2°C (3.5°F) to verify that the sensor is not stuck.

Circuit/System Testing

Operate the vehicle within the conditions for running and setting the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Component Testing

Static Test

1. Ignition OFF, remove the K71 Transmission Control Module.
2. Ignition OFF, test for infinite resistance between the low reference circuit terminal 7 and ground.
 - If less than the specified range, replace the wiring harness.
3. Ignition OFF, test for infinite resistance between the signal circuit terminal 1 and ground.
 - If less than the specified range, replace the wiring harness.
4. Test for infinite resistance between each terminal and the low reference circuit terminal 7 and also to the signal circuit terminal 1.
 - If less than the specified range, replace the wiring harness.
5. Test for the resistance between the B13 transmission fluid temperature sensor signal circuit terminal 1 and the low reference circuit terminal 7. Refer to **Transmission Fluid Temperature Sensor Specifications** for the resistance values.
 - If not within the specified range, replace the wiring harness.
6. If the circuit test normal, replace the K71 Transmission Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Automatic Transmission Wiring Harness Replacement**
- **Transmission Adaptive Learn**
- **Control Module References** for TCM replacement, setup, and programming

DTC P0717, P07BF, OR P07C0: INPUT SPEED SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0717

Input Speed Sensor Circuit No Signal

DTC P07BF

Input Speed Sensor Circuit Low Voltage

DTC P07C0

Input Speed Sensor Circuit High Voltage

Circuit/System Description

The input speed sensor (ISS) is installed in the transmission case. The ISS detects the revolution speed of the intermediate shaft C2 drum (2) as the input shaft speed. These signals are transmitted to the TCM. Based on those signals, the TCM controls engine torque, shift timing, and lock-up.

Conditions for Running the DTC

P0717

- DTC P0705, P0706, P0722, P0748, P0778, P077C, P077D, P0798, P0962, P0963, P0966, P0967, P0970, P0971, P0973, or P0974 is not set.
- The output speed is 300 RPM or greater.
- The current gear is 2nd gear or greater.
- The transmission is not in limp home mode.
- The transmission range is D, 2, or L.

P07BF

- Ignition ON.
- Battery voltage is between 10.2-18.0 volts.

P07C0

- Ignition ON.
- Battery voltage is between 10.2-18.0 volts.

Conditions for Setting the DTC

P0717

The TCM detects no pulse signal from input speed sensor when there are 38 pulses from the output speed sensor, 500 occurrences.

P07BF

The voltage signal is less than 0.2 V for 100 msec over 10 times.

P07C0

The voltage signal is more than 2.7 V for 100 msec over 10 times.

Action Taken When the DTC Sets

- DTCs P0717, P07BF, and P07C0 are Type A DTCs.
- The TCM allows the vehicle after below 10 km/h (6 mph) to be operated only in the second gear.

Conditions for Clearing the DTC

DTCs P0717, P07BF, and P07C0 are Type A DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**

- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

- **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**
- **Diagnostic Trouble Code (DTC) List - Vehicle**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Engine idling, observe the scan tool Transmission ISS parameter while varying the engine speed. The Transmission ISS parameter should change with the engine speed and not drop out.
2. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions you observed from the Freeze Frame/Failure Records data.

Circuit/System Testing

1. Ignition OFF, disconnect the input speed sensor wiring harness.
2. Ignition ON, Test for 9-12 volts between the high and low signal circuits, from the TCM.
 - If not within the specified range, replace the K71 TCM.
3. If the circuits test normal, test or replace the B14C input speed sensor.

Component Testing

1. Test the input speed sensor wiring. There should not be an open, short to ground, or a short together condition.
 - If one of the above conditions is found, repair the circuit.
2. If all circuits test normal, replace the B14C input speed sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Input Speed Sensor Replacement**
- **Transmission Adaptive Learn**
- **Control Module References** for TCM replacement, setup, and programming

DTC P0722, P077C, OR P077D: OUTPUT SPEED SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0722

Output Speed Sensor Circuit No Signal

DTC P077C

Output Speed Sensor Circuit Low Voltage

DTC P077D

Output Speed Sensor Circuit High Voltage

Circuit/System Description

The output speed sensor (OSS) is installed in the transmission case. The OSS detects the revolution speed of the counter drive gear (4) as the output shaft speed. These signals are transmitted to the TCM. Based on those signals, the TCM controls engine torque, shift timing, and lock-up.

Conditions for Running the DTC

P0722

- DTC P0705, P0706, P0717, P07C0, P07BF, P0748, P0778, P0798, P0962, P0963, P0966, P0967, P0970, P0971, P0973, or P0974 is not set.
- The output speed is 300 RPM or greater.
- The transmission is not in limp home mode.
- The transmission range is D, 2, or L.

P077C

- Ignition ON.
- Battery voltage is between 10.2-18.0 volts.

P077D

- Ignition ON.
- Battery voltage is between 10.2-18.0 volts.

Conditions for Setting the DTC

P0722

The TCM detects no pulse signal from output speed sensor when there are 13 pulses from the input speed sensor, 500 occurrences.

P077C

Voltage signal is less than 0.2 V for 100 msec over 10 times.

P077D

Voltage signal is greater than 2.7 V for 100 msec over 10 times.

Action Taken When the DTC Sets

P0722

- DTC P0722 is a Type A DTC.
- The TCM allows the vehicle after below 10 km/h (6 mph) to be operated only in the fourth gear.

P077C and P077D

- DTCs P077C and P077D are Type A DTCs.
- The TCM allows the vehicle after below 10 km/h (6 mph) to be operated only in the second gear.

Conditions for Clearing the DTC

DTCs P0722, P077C, and P077D are Type A DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**

- **Wiring Repairs**

DTC Type Reference

- **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**
- **Diagnostic Trouble Code (DTC) List - Vehicle**

Scan Tool Reference

Control Module References for scan information.

Circuit/System Verification

1. Operate the vehicle at 16-32 km/h (10-20 mph) while observing the scan tool Transmission OSS parameter. The Transmission OSS should vary with the vehicle speed and not drop out.
2. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observe from the Freeze Frame/Failure Records data.

Circuit/System Testing

1. Ignition OFF, disconnect the output speed sensor wiring harness.
2. Ignition ON, Test for 9-12 volts between the high and low signal circuits, from TCM.
 - If not within the specified range, replace the K71 TCM.
3. If the circuits test normal, test or replace the B14A output speed sensor.

Component Testing

1. Test the output speed sensor wiring. There should not be an open, short to ground, or a short together condition.
 - If one of the above conditions is found, repair the circuit.
2. If all circuits test normal, replace the B14A output speed sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Output Speed Sensor Replacement**
- **Transmission Adaptive Learn**
- **Control Module References** for TCM replacement, setup, and programming

DTC P0731: 1ST GEAR RATIO

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0731

1st Gear Ratio Incorrect

Circuit/System Description

The pressure control solenoids (SLC1, SLC2) are installed on the front valve body. The solenoids linearly control hydraulic pressure in response to signals output from the transmission control module (TCM).

According to the combination of the pressure control solenoids (SLC1, SLC2), the transmission shifts from 1st gear into 4th gear and vice versa and line pressure control is done at the same time. As a fail-safe function, if any pressure control solenoid abnormality occurs, the TCM will disable the current to the solenoids.

The lock-up control solenoid (SLU) is installed on the valve body. It linearly controls lock-up clutch hydraulic pressure based on engine RPM, throttle opening degree signals, input speed sensor signals, and output speed sensor signals. This results in control of lock-up. As a fail-safe function, if any abnormality occurs in the lock-up control solenoid (SLU), then the TCM will shut off the current to the solenoid.

Conditions for Running the DTC

- The transmission range is D, 2, or L.
- The transmission oil temperature is -20°C (-4°F) or greater.
- The current gear is 1st gear with engine brake.
- The output speed is greater than 500 RPM.
- The engine torque is more than 0 (0 lb ft).

Conditions for Setting the DTC

- Calculation of actual gear ratio for 1st gear with engine brake is not correct.
- (Output shaft speed times current gear ratio) minus input shaft speed is greater than 400 RPM for 1 second after consecutive 5 times.

Action Taken When the DTC Sets

- DTC P0731 is a Type D DTC.
- No self learning control
- No up slope mode

Conditions for Clearing the DTC

DTC P0731 is a Type D DTC.

Diagnostic Aids

Ensure the transmission fluid level, color and odor is correct and there are no leaks. If there are any other transmission DTCs set, diagnose those first.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Transmission Component and System Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data. Ignition ON, observe the DTC information with a scan tool.

Circuit/System Testing

1. Perform the line pressure check. Refer to **Line Pressure Check**.
2. Perform the transmission fluid check. Refer to **Transmission Fluid Level and Condition Check**.

3. Remove the control valve body and test the pressure control solenoid valve (SLC1, SLC2, or SLU) for 5.0-5.6 ohms at 20°C (68°F).
 - If not within the specified range, replace the control valve body.
4. If all circuits and components test normal, replace the transmission.

Component Testing

Test the solenoid valve (SLC1, SLC2, or SLU) at 20°C (68°F), for 5.0-5.6 ohms across the solenoid.

- If not within the specified range, replace the control valve body.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Control Valve Body Replacement**
- **Transmission Replacement**
- **Transmission Adaptive Learn**
- **Control Module References** for TCM replacement, setup and programming

DTC P0741 OR P0742: TORQUE CONVERTER CLUTCH (TCC)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0741

Torque Converter Clutch (TCC) System Stuck Off

DTC P0742

Torque Converter Clutch (TCC) System Stuck On

Diagnostic Fault Information

Component	Condition	DTCs
Valve Body Assembly	• Incorrect transmission fluid level • Clogged hydraulic system • Plugged or restricted passages	P0741, P0742

	• Gasket leaking	
Torque Converter	• Incorrect transmission fluid level • Clogged hydraulic system • Mechanically stuck in the applied position • Gasket leaking	P0741, P0742

Circuit/System Description

The transmission control module (TCM) controls the torque converter clutch (TCC) lock up pressure control solenoid valve. The solenoid directs the hydraulic fluid for TCC apply and release. When the TCC is released, the engine is coupled by fluid to the transmission.

Conditions for Running the DTC

P0741

- DTC P0973, P0974, P2761, P2763, or P2764 is not set.
- The transmission range is D, 2, or L.
- Range equals D, 2, or L for 8 seconds.
- Engine torque is more than 0 (0 lb ft).
- The engine speed is less than 4000 RPM.
- Transmission oil temperature is 20°C (68°F) or greater.

P0742

- DTC P0973, P0974, P2761, P2763, or P2764 is not set.
- The transmission range is D, 2, or L.
- Range equals D, 2, or L for 8 seconds.
- Engine torque is more than 60 (44 lb ft).
- The engine speed is between 1000-3000 RPM.
- Transmission oil temperature is 20°C (68°F) or greater.

Conditions for Setting the DTC

P0741

Engine speed minus input speed is more than 100 RPM for 2 seconds after consecutive 6 times.

P0742

Engine speed minus input speed is less than 30 RPM for 2 seconds after consecutive 2 times.

Action Taken When the DTC Sets

P0741

- DTC P0741 is a Type B DTC.
- No self learning control.
- No lock-up control.
- No lock-up slip control.

P0742

- DTC P0742 is a Type C DTC.
- No self learning control.
- No up slip control.

Conditions for Clearing the DTC

- DTC P0741 is a Type B DTC.
- DTC P0742 is a Type C DTC.

Diagnostic Aids

Ensure the transmission fluid level, color and odor is correct and there are no leaks. If there are any other transmission DTCs set, diagnose those first.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Description and Operation

Transmission Component and System Description

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Operate the vehicle in drive with the calculated throttle position greater than 8% and ensure TCC is commanded ON and OFF a minimum of 5 times.

- Verify the DTC does not reset. If the DTC resets and no other DTC is set, go to Circuit/System Testing.
- If any other DTC is set, diagnose that DTC first.

Circuit/System Testing

1. Perform the line pressure check. Refer to **Line Pressure Check**.
2. Perform the transmission fluid check. Refer to **Transmission Fluid Level and Condition Check**.
3. Test the shift solenoid valve for 11-15 ohms at 20°C (68°F).
 - If not within the specified range, replace the Q32A shift solenoid valve 1.
4. Remove the control valve body and test the Q39A TCC control solenoid valve (SLU) for 5.0-5.6 ohms at 20°C (68°F).
 - If not within the specified range, replace the control valve body.
5. If all circuits and components test normal, replace the transmission.

Component Testing

1. Test the Q32A shift solenoid valve 1, at 20°C (68°F), for 11-15 ohms across the solenoid.
 - If not within the specified range, replace the Q32A shift solenoid valve 1.
2. Test the Q39A TCC control solenoid valve (SLU), at 20°C (68°F), for 5.0-5.6 ohms across the solenoid.
 - If not within the specified range, replace the control valve body.
3. Inspect the torque converter assembly for damage or discoloration.
 - If you find a torque converter assembly concern, replace the torque converter assembly as necessary.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **1-2 Shift Solenoid Valve Replacement**
- **Control Valve Body Replacement**
- **Transmission Replacement**
- **Transmission Adaptive Learn**
- **Control Module References** for TCM replacement, setup, and programming

DTC P0746 OR P0747: PRESSURE CONTROL SOLENOID VALVE 1

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0746

Pressure Control Solenoid Valve 1 Stuck Off

DTC P0747

Pressure Control Solenoid Valve 1 Stuck On

Circuit/System Description

C1 pressure control solenoid (SLC1) is part of the valve body. SLC1 linearly control hydraulic pressure in response to signals output from the transmission control module (TCM), and the C1 clutch is controlled directly. Through this, it controls operating hydraulic pressure to the clutch and brakes for smooth shifting. According to the combination of other pressure control solenoids (SLC2, SLB1), the transmission shifts from 1st gear into 4th gear and vice versa and line pressure control is done at the same time. As a fail-safe function, if any pressure control solenoid abnormality occurs, the TCM will disable the current to the solenoids.

Conditions for Running the DTC

P0746

Fail Case 1

- The transmission is not in limp home mode.
- The transmission oil temperature is -20°C (-4°F) or greater.
- The transmission range is D, 2, or L.
- The current gear is 2nd or 3rd gear.
- The output speed is 500 RPM or greater.

Fail Case 2

- The transmission is not in limp home mode.
- The transmission oil temperature is -20°C (-4°F) or greater.
- The transmission range is D, 2, or L.
- The current gear is 4th gear.

- The output speed is 250 RPM or greater.
- The engine torque is more than 60 (44 lb ft).

Fail Case 3

- The transmission is not in limp home mode.
- The transmission oil temperature is 0°C (32°F) or greater.
- The transmission range is D, 2, or L.
- The current gear is 1st, 2nd, or 3rd gear.
- The current lock up is OFF.
- Engine speed minus input speed is less than 150 RPM.
- Input speed is greater than output speed times 1st gear ratio plus 400 RPM.
- The output speed is 500 RPM or less.

P0747

Fail Case 1

- The transmission is not in limp home mode.
- The transmission oil temperature is -20°C (-4°F) or greater.
- The transmission range is D, 2, or L.
- The output speed is greater than 300 RPM.
- The command pressure to engage is greater than 245 kpa (36 psi).
- The estimated turbine torque is more than 30 (22 lb ft) or less than -20 (-15 lb ft).

Fail Case 2 and 3

- The transmission is not in limp home mode.
- The transmission oil temperature is -20°C (-4°F) or greater.
- The transmission range is D, 2, or L.
- The output speed is greater than 250 RPM.
- The current gear is 4th gear.
- The estimated turbine torque is more than 30 (22 lb ft) or less than -20 (-15 lb ft).

Conditions for Setting the DTC

P0746

Fail Case 1

- Calculation of actual gear ratio for current gear (2nd or 3rd) is not correct.
- Input shaft speed minus output shaft speed times current gear ratio is greater than 400 RPM for 1 second

after consecutive 5 times.

Fail Case 2

- Calculation of actual gear ratio for 4th gear is correct.
- Input shaft speed minus output shaft speed times current gear ratio is less than 115 RPM for 1 second after consecutive 5 times.

Fail Case 3

- Calculation of actual gear ratio for current gear (1st, 2nd, or 3rd) is not correct.
- The time is different by difference between actual gear ratio and current gear ratio.

P0747

Fail Case 1

- The beginning of 2-4 or 3-4 shift is not detected.
- The Input speed change does not occur.

Fail Case 2

- Calculation of actual gear ratio for 4th gear is not correct.
- Input shaft speed minus output shaft speed times 2nd gear ratio is less than 230 RPM for 0.5 second after consecutive 5 times.

Fail Case 3

- Calculation of actual gear ratio for 4th gear is not correct.
- Input shaft speed minus output shaft speed times 3rd gear ratio is less than 150 RPM for 0.5 second after consecutive 5 times.

Action Taken When the DTC Sets

P0746

- DTC P0746 is a Type B DTC.
- The TCM allows the vehicle after below 10 km/h (6 mph) to be operated only in the second or fourth gear.

P0747

- DTC P0747 is a Type B DTC.
- The TCM allows the vehicle after below 10 km/h (6 mph) to be operated only in the second gear.

Conditions for Clearing the DTC

DTCs P0746 and P0747 are Type B DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- **Electronic Component Description**
- **Transmission Component and System Description**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data. Ignition ON, observe the DTC information with a scan tool.

Circuit/System Testing

1. Perform the line pressure check. Refer to **Line Pressure Check**.
2. Perform the transmission fluid check. Refer to **Transmission Fluid Level and Condition Check**.
3. Remove the control valve body and test the Q27A pressure control solenoid valve 1 (SLC1) for 5.0-5.6 ohms at 20°C (68°F).
 - If not within the specified range, replace the control valve body.

4. If all circuits and components test normal, replace the transmission.

Component Testing

Test the Q27A pressure control solenoid valve 1 (SLC1), at 20°C (68°F), for 5.0-5.6 ohms across the solenoid.

- If not within the specified range, replace the control valve body.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Control Valve Body Replacement**
- **Transmission Replacement**
- **Transmission Adaptive Learn**
- **Control Module References** for TCM replacement, setup and programming

DTC P0748, P0962, OR P0963: PRESSURE CONTROL SOLENOID VALVE 1

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0748

Pressure Control Solenoid Valve 1 Control Circuit

DTC P0962

Pressure Control Solenoid Valve 1 Control Circuit Low Voltage

DTC P0963

Pressure Control Solenoid Valve 1 Control Circuit High Voltage

Circuit/System Description

C1 pressure control solenoid (SLC1) is part of the valve body. SLC1 linearly controls hydraulic pressure in response to signals output from the transmission control module (TCM), and the C1 clutch is controlled directly. Through this, it controls operating hydraulic pressure to the clutch and brakes for smooth shifting.

According to the combination of other pressure control solenoids (SLC2, SLB1), the transmission shifts from

1st gear into 4th gear and vice versa and line pressure control is done at the same time.

As a fail-safe function, if any pressure control solenoid abnormality occurs, the TCM will disable the current to the solenoids.

Conditions for Running the DTC

P0748

- The battery voltage is greater than 10.5 volts for 500 msec.
- The feedback current is less than 1358 mA.
- The transmission is not in limp home mode.
- DTC P0962 or P0963 is not set.

P0962

The transmission is not in limp home mode.

P0963

The transmission is not in limp home mode.

Conditions for Setting the DTC

P0748

Deviation between commanded current and feedback current.

P0962

The TCM detects at least 5 times less than 20 mA current consumption of the SLC1 control circuit for 100 msec.

P0963

The TCM detects at least 5 times more than 1358 mA current consumption of the SLC1 control circuit for 100 msec.

Action Taken When the DTC Sets

P0748 and P0962

- DTC P0748 and P0962 are Type A DTCs.
- The TCM allows the vehicle to be operated only in the third gear.

P0963

- DTC P0963 is a Type A DTC.
- The TCM allows the vehicle after below 10 km/h (6 mph) to be operated only in the second gear.

Conditions for Clearing the DTC

DTCs P0748, P0962, and P0963 are Type A DTCs.

Diagnostic Aids

When attempting to set solenoid electrical DTCs, ensure the TCM is warmed up and the transmission is operated in 2nd gear long enough to ensure a 3°C (5°F) increase in TCM substrate temperature. This will place the TCM under the optimal conditions to test solenoid electrical DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Description and Operation

- **Electronic Component Description**
- **Transmission Component and System Description**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ensure the transmission fluid temperature is between 50-80°C (122-176°F).

2. Operate the vehicle in 2nd gear long enough to ensure at least a 3°C (5°F) rise in transmission fluid temperature, then operate the vehicle in Park for 5 s.
3. Observe the scan tool Pressure Control Solenoid Valve 1 Current parameter, the reading should be between 0.1-1.1 A.
 - If the parameter is not within specified range or if the DTC resets, go to Circuit/System Testing.

Circuit/System Testing

1. Ignition OFF, disconnect the automatic transmission (AT) wiring harness at the transmission.
2. Test for 5.0-5.6 ohms at 20°C (68°F) between the low reference circuit terminal 13 and the voltage supply circuit terminal 6.
 - If not within the specified range, remove the control valve body to test the Q27A pressure control solenoid valve 1 (SLC1).
3. Inspect the Q27A pressure control solenoid valve 1 (SLC1) for 5.0-5.6 ohms at 20°C (68°F).
 - If not within the specified range, replace the control valve body.
 - If within the specified range, replace the AT wiring harness.
4. If all circuits test normal, replace the K71 Transmission Control Module.

Component Testing

Test the Q27A pressure control solenoid valve 1 (SLC1), at 20°C (68°F), for 5.0-5.6 ohms across the solenoid.

- If not within the specified range, replace the control valve body.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Control Valve Body Replacement**
- **Transmission Adaptive Learn**
- **Automatic Transmission Wiring Harness Replacement**
- **Control Module References** for TCM replacement, setup and programming

DTC P0751: SHIFT SOLENOID VALVE 1

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0751

Shift Solenoid Valve 1 Performance - Stuck Off

Circuit/System Description

Shift solenoid (SS) valve 1 turns ON and OFF in response to signals output from the TCM. According to ON or OFF status of SS valve 1, the 1st gear engine brake operates or manual shift mode occurs. As a fail-safe function, if any shift solenoid abnormality occurs, the TCM will disable the current to the solenoids.

Conditions for Running the DTC

- The transmission range is D, 2, or L.
- The transmission oil temperature is -20°C (-4°F) or greater.
- The current gear is 1st gear with engine brake.
- The output speed is 250 RPM or greater.
- The engine torque is 60 (44 lb ft) or greater.
- The input speed is 6000 RPM or less.

Conditions for Setting the DTC

- Calculation of actual gear ratio for 1st gear with engine brake is not correct.
- Input shaft speed minus (output shaft speed times 3rd gear ratio) is less than 150 RPM for 1 second after consecutive 5 times.

Action Taken When the DTC Sets

- DTC P0751 is a Type C DTC.
- No self learning control
- No up slope mode
- To be operated in the second gear when 1st gear with engine brake condition (via L or I range) is required.

Conditions for Clearing the DTC

P0751

DTC P0751 is a Type C DTC.

Diagnostic Aids

Ensure the transmission fluid level, color and odor is correct and there are no leaks. If there are any other transmission DTCs set, diagnose those first.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- **Electronic Component Description**
- **Transmission Component and System Description**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data. Ignition ON, observe the DTC information with a scan tool.

Circuit/System Testing

1. Perform the line pressure check. Refer to **Line Pressure Check**.
2. Perform the transmission fluid check. Refer to **Transmission Fluid Level and Condition Check**.
3. Test the Q32A shift solenoid valve, at 20°C (68°F), for 11-15 ohms.
 - If not within the specified range, replace the Q32A shift solenoid valve.
4. Inspect the control valve body for a stuck valve, debris, or damage.
 - If any malfunction is found, replace the control valve body.
5. If all circuits and components test normal, replace the transmission.

Component Testing

Test the Q32A shift solenoid valve, at 20°C (68°F), for 11-15 ohms across the solenoid.

- If not within the specified range, replace the Q32A shift solenoid valve.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Automatic Transmission Wiring Harness Replacement**

- **Control Valve Body Replacement**
- **Transmission Replacement**
- **Control Module References** for TCM replacement, setup, and programming
- **Transmission Adaptive Learn**

DTC P0776 OR P0777: PRESSURE CONTROL SOLENOID VALVE 2

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0776

Pressure Control Solenoid Valve 2 Stuck Off

DTC P0777

Pressure Control Solenoid Valve 2 Stuck On

Circuit/System Description

C2 pressure control solenoid (SLC2) is part of the valve body. SLC2 linearly controls hydraulic pressure in response to signals output from the transmission control module (TCM), and the C2 clutch is controlled directly. Through this, it controls operating hydraulic pressure to the clutch and brakes for smooth shifting. According to the combination of other pressure control solenoids (SLC1, SLB1), the transmission shifts from 1st gear into 4th gear and vice versa and line pressure control is done at the same time.

As a fail-safe function, if any pressure control solenoid abnormality occurs, the TCM will disable the current to the solenoids.

Shift solenoid (SS) valve 1 turns ON and OFF in response to signals output from the TCM. According to ON or OFF status of SS valve 1, the 1st gear engine brake operates or manual shift mode occurs. As a fail-safe function, if any shift solenoid abnormality occurs, the TCM will disable the current to the solenoids.

Conditions for Running the DTC

P0776

Fail Case 1

- The transmission is not in limp home mode.
- The transmission oil temperature is -20°C (-4°F) or greater.

- The transmission range is D, 2, or L.
- The current gear is 3rd or 4th gear.
- The output speed is 500 RPM or greater.

Fail Case 2

- The transmission is not in limp home mode.
- The transmission oil temperature is -20°C (-4°F) or greater.
- The transmission range is D, 2, or L.
- The current gear is 2nd gear.
- The output speed is 250 RPM or greater.
- The engine torque is 60 (44 lb ft) or greater.

Fail Case 3

- The transmission is not in limp home mode.
- The transmission oil temperature is -20°C (-4°F) or greater.
- The transmission range is D, 2, or L.
- The current gear is 1st gear.
- The output speed is 250 RPM or greater.
- The engine torque is 60 (44 lb ft) or greater.
- The input speed is 6000 RPM or less.

P0777

Fail Case 1

- The transmission is not in limp home mode.
- The transmission oil temperature is -20°C (-4°F) or greater.
- The transmission range is D, 2, or L.
- The output speed is greater than 300 RPM.
- The command pressure to engage is greater than 196 kpa (28 psi).
- The estimated turbine torque is more than 30 (22 lb ft) or less than -20 (-15 lb ft).

Fail Case 2

- The transmission is not in limp home mode.
- The transmission oil temperature is -20°C (-4°F) or greater.
- The transmission range is D, 2, or L.
- The output speed is greater than 300 RPM.
- When the estimated turbine torque without inertia is less than 40 (30 lb ft), the command pressure to

engage is greater than 294 kpa (43 psi).

- When the estimated turbine torque without inertia is greater than 40 (30 lb ft), the command pressure to engage is greater than 196 kpa (28 psi).
- The estimated turbine torque is more than 30 (22 lb ft) or less than -20 (-15 lb ft).

Fail Case 3

- The transmission is not in limp home mode.
- The transmission oil temperature is -20°C (-4°F) or greater.
- The transmission range is D, 2, or L.
- The current gear is 1st gear.
- The output speed is 250 RPM or greater.
- The engine torque is 60 (44 lb ft) or greater.
- Input speed is 6000 RPM or less.

Fail Case 4 and 5

- The transmission is not in limp home mode.
- The transmission oil temperature is -20°C (-4°F) or greater.
- The transmission range is D, 2, or L.
- The output speed is 250 RPM or greater.
- The current gear is 2nd gear.
- The estimated turbine torque is more than 30 (22 lb ft) or less than -20 (-15 lb ft).

Conditions for Setting the DTC

P0776

Fail Case 1

- Calculation of actual gear ratio for current gear (3rd or 4th) is not correct.
- Input shaft speed minus output shaft speed times current gear ratio is greater than 400 RPM for 1 second after consecutive 5 times.

Fail Case 2

- Calculation of actual gear ratio for 2nd gear is correct.
- Input shaft speed minus output shaft speed times current gear ratio is less than 230 RPM for 1 second after consecutive 5 times.

Fail Case 3

- Calculation of actual gear ratio for 1st gear is correct.

- Input shaft speed minus output shaft speed times current gear ratio is less than 400 RPM for 1 second after consecutive 5 times.

P0777

Fail Case 1

- The beginning of 1-2 shift is not detected.
- The input speed change does not occur.

Fail Case 2

- The beginning of 3-2 or 4-2 shift is not detected.
- The input speed change does not occur.

Fail Case 3

- Calculation of actual gear ratio for 1st gear is not correct.
- Input shaft speed minus output shaft speed times 3rd gear ratio is less than 150 RPM for 1 second after consecutive 5 times.

Fail Case 4

- Calculation of actual gear ratio for 2nd gear is not correct.
- Input shaft speed minus output shaft speed times 3rd gear ratio is less than 150 RPM for 0.5 second after consecutive 5 times.

Fail Case 5

- Calculation of actual gear ratio for 2nd gear is not correct.
- Input shaft speed minus output shaft speed times 4th gear ratio is less than 115 RPM for 0.5 second after consecutive 5 times.

Action Taken When the DTC Sets

P0776

- DTC P0776 is a Type B DTC.
- The TCM allows the vehicle after below 10 km/h (6 mph) to be operated only in the second gear.

P0777

- DTC P0777 is a Type B DTC.
- The TCM allows the vehicle after below 10 km/h (6 mph) to be operated only in the third gear.

Conditions for Clearing the DTC

DTCs P0776 and P0777 are Type B DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- **Electronic Component Description**
- **Transmission Component and System Description**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data. Ignition ON, observe the DTC information with a scan tool.

Circuit/System Testing

Dynamic Test

1. Perform the line pressure check. Refer to **Line Pressure Check**.
2. Perform the transmission fluid check. Refer to **Transmission Fluid Level and Condition Check**.

3. Test the Q32A shift solenoid valve for 11-15 ohms at 20°C (68°F).
 - If not within the specified range, replace the Q32A shift solenoid valve.
4. Remove the control valve body and test the Q27B pressure control solenoid valve 2 (SLC2) for 5.0-5.6 ohms at 20°C (68°F).
 - If not within the specified range, replace the control valve body.
5. If all circuits and components test normal, replace the transmission.

Component Testing

Shift Solenoid

Test the Q32A shift solenoid valve, at 20°C (68°F), for 11-15 ohms across the solenoid.

- If not within the specified range, replace the Q32A shift solenoid valve.

Pressure Control Solenoid (SLC2)

Test the Q27B pressure control solenoid valve 2 (SLC2), at 20°C (68°F), for 5.0-5.6 ohms across the solenoid.

- If not within the specified range, replace the control valve body.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **1-2 Shift Solenoid Valve Replacement**
- **Control Valve Body Replacement**
- **Transmission Replacement**
- **Transmission Adaptive Learn**
- **Control Module References** for TCM replacement, setup and programming

DTC P0778, P0966, OR P0967: PRESSURE CONTROL SOLENOID VALVE 2

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0778

Pressure Control Solenoid Valve 2 Control Circuit

DTC P0966

Pressure Control Solenoid Valve 2 Control Circuit Low Voltage

DTC P0967

Pressure Control Solenoid Valve 2 Control Circuit High Voltage

Circuit/System Description

C2 pressure control solenoid (SLC2) is part of the valve body. SLC2 linearly controls hydraulic pressure in response to signals output from the transmission control module (TCM), and the C2 clutch is controlled directly. Through this, it controls operating hydraulic pressure to the clutch and brakes for smooth shifting. According to the combination of other pressure control solenoids (SLC1, SLB1), the transmission shifts from 1st gear into 4th gear and vice versa and line pressure control is done at the same time.

As a fail-safe function, if any pressure control solenoid abnormality occurs, the TCM will disable the current to the solenoids.

Conditions for Running the DTC

P0778

- The battery voltage is greater than 10.5 volts for 500 msec.
- The feedback current is less than 1358 mA.
- The transmission is not in limp home mode.
- DTC P0966 or P0967 is not set.

P0966

The transmission is not in limp home mode.

P0967

The transmission is not in limp home mode.

Conditions for Setting the DTC

P0778

Deviation between commanded current and feedback current.

P0966

The TCM detects at least 5 times less than 20 mA current consumption of the SLC2 control circuit for 100 msec.

P0967

The TCM detects at least 5 times more than 1358 mA current consumption of the SLC2 control circuit for 100 msec.

Action Taken When the DTC Sets

P0778 and P0966

- DTCs P0778 and P0966 are Type A DTCs.
- The TCM allows the vehicle to be operated only in the third gear.

P0967

- DTC P0967 is a Type A DTC.
- The TCM allows the vehicle after below 10 km/h (6 mph) to be operated only in the second or third gear.

Conditions for Clearing the DTC

DTCs P0778, P0966, and P0967 are Type A DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Description and Operation

- **Electronic Component Description**
- **Transmission Component and System Description**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ensure the transmission fluid temperature is between 50-80°C (122-176°F).
2. Operate the vehicle in 2nd gear long enough to ensure at least a 3°C (5°F) rise in transmission fluid temperature, then operate the vehicle in Park for 5 s.
3. Observe the scan tool Pressure Control Solenoid Valve 2 Current parameter, the reading should be between 0.1-1.1 A.
 - If the parameter is not within specified range or if the DTC resets, go to Circuit/System Testing.

Circuit/System Testing

1. Ignition OFF, disconnect the automatic transmission (AT) wiring harness at the transmission.
2. Test for 5.0-5.6 ohms at 20°C (68°F) between the low reference circuit terminal 12 and the voltage supply circuit terminal 5.
 - If not within the specified range, remove the control valve body to test the Q27B pressure control solenoid valve 2 (SLC2).
3. Inspect the Q27B pressure control solenoid valve 2 (SLC2) for 5.0-5.6 ohms at 20°C (68°F).
 - If not within the specified range, replace the control valve body.
 - If within the specified range, replace the AT wiring harness.
4. If all circuits test normal, replace the K71 Transmission Control Module.

Component Testing

Test the Q27B pressure control solenoid valve 2 (SLC2), at 20°C (68°F), for 5.0-5.6 ohms across the solenoid.

- If not within the specified range, replace the control valve body.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Control Valve Body Replacement**
- **Transmission Adaptive Learn**
- **Automatic Transmission Wiring Harness Replacement**
- **Control Module References** for TCM replacement, setup and programming

DTC P0796 OR P0797: PRESSURE CONTROL SOLENOID VALVE 3

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0796

Pressure Control Solenoid Valve 3 Stuck Off

DTC P0797

Pressure Control Solenoid Valve 3 Stuck On

Circuit/System Description

B1 pressure control solenoid (SLB1) is part of the valve body. SLB1 linearly controls hydraulic pressure in response to signals output from the transmission control module (TCM), and the B1 brake is controlled directly. Through this, it controls operating hydraulic pressure to the clutch and brakes for smooth shifting. According to the combination of other pressure control solenoids (SLC1, SLB1), the transmission shifts from 1st gear into 4th gear and vice versa and line pressure control is done at the same time.

As a fail-safe function, if any pressure control solenoid abnormality occurs, the TCM will disable the current to the solenoids.

Conditions for Running the DTC

P0796

Fail Case 1

- The transmission is not in limp home mode.
- The transmission oil temperature is -20°C (-4°F) or greater.
- The transmission range is D, 2, or L.
- The current gear is 2nd or 4th gear.
- The output speed is 500 RPM or greater.

Fail Case 2

- The transmission is not in limp home mode.
- The transmission oil temperature is -20°C (-4°F) or greater.
- The transmission range is D, 2, or L.
- The current gear is 3rd gear.
- The output speed is 250 RPM or greater.
- The engine torque is 60 (44 lb ft) or greater.

Fail Case 3

- The transmission is not in limp home mode.
- The transmission oil temperature is -20°C (-4°F) or greater.
- The transmission range is D, 2, or L.
- The current gear is 1st gear.
- The output speed is 250 RPM or greater.
- The engine torque is 60 (44 lb ft) or greater.
- The input speed is 6000 RPM or less.

P0797

Fail Case 1

- The transmission oil temperature is -20°C (-4°F) or greater.
- The transmission range is D, 2, or L.
- The output speed is greater than 300 RPM.
- The command pressure to engage is greater than 196 kpa (28 psi).
- The estimated turbine torque is more than 30 (22 lb ft) or less than -20 (-15 lb ft).

Fail Case 2

- The transmission oil temperature is -20°C (-4°F) or greater.
- The transmission range is D, 2, or L.
- The output speed is greater than 300 RPM.
- The command pressure to engage is greater than 245 kpa (36 psi).
- The estimated turbine torque is more than 30 (22 lb ft) or less than -20 (-15 lb ft).

Fail Case 3

- The transmission oil temperature is -20°C (-4°F) or greater.
- The transmission range is D, 2, or L.
- The output speed is greater than 300 RPM.
- The engine torque is 60 (44 lb ft) or greater.
- When the estimated turbine torque without inertia is less than 40 (30 lb ft), the command pressure to engage is greater than 294 kpa (43 psi).
- When the estimated turbine torque without inertia is greater than 40 (30 lb ft), the command pressure to engage is greater than 196 kpa (28 psi).
- The estimated turbine torque is more than 30 (22 lb ft) or less than - 20 (-15 lb ft).

Fail Case 4

- The transmission is not in limp home mode.
- The transmission oil temperature is -20°C (-4°F) or greater.
- The transmission range is D, 2, or L.
- The current gear is 1st gear with engine brake.
- The output speed is 250 RPM or greater.
- The engine torque is 60 (44 lb ft) or greater.
- Input speed is 6000 RPM or less.

Fail Case 5

- The transmission is not in limp home mode.
- The transmission oil temperature is -20°C (-4°F) or greater.
- The transmission range is D, 2, or L.
- The current gear is 1st gear.
- The output speed is 250 RPM or greater.
- The engine torque is 60 (44 lb ft) or greater.
- Input speed is 6000 RPM or less.

Fail Case 6 and 7

- The transmission is not in limp home mode.
- The transmission oil temperature is -20°C (-4°F) or greater.
- The transmission range is D, 2, or L.
- The current gear is 3rd gear.
- The output speed is 250 RPM or greater.
- The estimated turbine torque is more than 30 (22 lb ft) or less than -20 (-15 lb ft).

Conditions for Setting the DTC

P0796

Fail Case 1

- Calculation of actual gear ratio for current gear (2nd or 4th) is not correct.
- Input shaft speed minus output shaft speed times current gear ratio is greater than 400 RPM for 1 second after consecutive 5 times.

Fail Case 2

- Calculation of actual gear ratio for 3rd gear is correct.
- Input shaft speed minus output shaft speed times current gear ratio is less than 150 RPM for 1 second after consecutive 5 times.

Fail Case 3

- Calculation of actual gear ratio for 1st gear is correct.
- Input shaft speed minus output shaft speed times current gear ratio is less than 400 RPM for 1 second after consecutive 5 times.

P0797

Fail Case 1

- The beginning of 1-3 shift is not detected.
- The input speed change does not occur.

Fail Case 2

- The beginning of 2-3 shift is not detected.
- The input speed change does not occur.

Fail Case 3

- The beginning of 4-3 shift is not detected.
- The input speed change does not occur.

Fail Case 4

- Calculation of actual gear ratio for 1st gear with engine brake is not correct.
- Input shaft speed minus output shaft speed times 2nd gear ratio is less than 230 RPM for 0.5 second after consecutive 5 times.

Fail Case 5

- Calculation of actual gear ratio for 1st gear is not correct.
- Input shaft speed minus output shaft speed times 2nd gear ratio is less than 230 RPM for 1 second after consecutive 5 times.

Fail Case 6

- Calculation of actual gear ratio for 3rd gear is not correct.
- Input shaft speed minus output shaft speed times 2nd gear ratio is less than 230 RPM for 0.5 second after consecutive 5 times.

Fail Case 7

- Calculation of actual gear ratio for 3rd gear is not correct.
- Input shaft speed minus output shaft speed times 4th gear ratio is less than 115 RPM for 0.5 second after

consecutive 5 times.

Action Taken When the DTC Sets

P0796

- DTC P0796 is a Type B DTC.
- The TCM allows the vehicle after below 10 km/h (6 mph) to be operated only in the third gear.

P0797

- DTC P0797 is a Type B DTC.
- The TCM allows the vehicle after below 10 km/h (6 mph) to be operated only in the second gear.

Conditions for Clearing the DTC

DTCs P0796 and P0797 are Type B DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- **Electronic Component Description**
- **Transmission Component and System Description**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data. Ignition ON, observe the DTC information with a scan tool.

Circuit/System Testing

1. Perform the line pressure check. Refer to **Line Pressure Check**.
2. Perform the transmission fluid check. Refer to **Transmission Fluid Level and Condition Check**.
3. Remove the control valve body and test the Q27C pressure control solenoid valve (SLB1) for 5.0-5.6 ohms at 20°C (68°F).
 - If not within the specified range, replace the control valve body.
4. If all circuits and components test normal, replace the transmission.

Component Testing

Test the Q27C pressure control solenoid valve (SLB1), at 20°C (68°F), for 5.0-5.6 ohms across the solenoid.

- If not within the specified range, replace the control valve body.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Control Valve Body Replacement**
- **Transmission Replacement**
- **Transmission Adaptive Learn**
- **Control Module References** for TCM replacement, setup and programming

DTC P0798, P0970, OR P0971: PRESSURE CONTROL SOLENOID VALVE 3

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0798

Pressure Control Solenoid Valve 3 Control Circuit

DTC P0970

Pressure Control Solenoid Valve 3 Control Circuit Low Voltage

DTC P0971

Pressure Control Solenoid Valve 3 Control Circuit High Voltage

Circuit/System Description

B1 pressure control solenoid (SLB1) is part of the valve body. SLB1 linearly controls hydraulic pressure in response to signals output from the transmission control module (TCM), and the B1 brake is controlled directly. Through this, it controls operating hydraulic pressure to the clutch and brakes for smooth shifting. According to the combination of other pressure control solenoids (SLC1, SLB1), the transmission shifts from 1st gear into 4th gear and vice versa and line pressure control is done at the same time. As a fail-safe function, if any pressure control solenoid abnormality occurs, the TCM will disable the current to the solenoids.

Conditions for Running the DTC

P0798

- The battery voltage is greater than 10.5 volts for 500 msec.
- The feedback current is less than 1358 mA.
- The transmission is not in limp home mode.
- DTCs P0970 and P0971 are not set.

P0970

The transmission is not in limp home mode.

P0971

The transmission is not in limp home mode.

Conditions for Setting the DTC

P0798

Deviation between commanded current and feedback current.

P0970

The TCM detects at least 5 times less than 20 mA current consumption of the SLB1 control circuit for 100 msec..

P0971

The TCM detects at least 5 times more than 1358 mA current consumption of the SLB1 control circuit for 100 msec.

Action Taken When the DTC Sets

P0798 and P0970

- DTCs P0798 and P0970 are Type A DTCs.
- The TCM allows the vehicle to be operated only in the third gear.

P0971

- DTC P0971 is a Type A DTC.
- The TCM allows the vehicle after below 10 km/h (6 mph) to be operated only in the second or third gear.

Conditions for Clearing the DTC

DTCs P0798, P0970, and P0971 are Type A DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

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Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Description and Operation

- **Electronic Component Description**
- **Transmission Component and System Description**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ensure the transmission fluid temperature is between 50-80°C (122-176°F).
2. Operate the vehicle in 2nd gear long enough to ensure at least a 3°C (5°F) rise in transmission fluid temperature, then operate the vehicle in Park for 5 s.
3. Observe the scan tool Clutch Pressure Control Solenoid Valve 3 Current parameter, the reading should be between 0.1-1.1 A.
 - If the parameter is not within specified range or if the DTC resets, go to Circuit/System Testing.

Circuit/System Testing

1. Ignition OFF, disconnect the automatic transmission (AT) wiring harness at the transmission.
2. Test for 5.0-5.6 ohms at 20°C (68°F) between the low reference circuit terminal 11 and the voltage supply circuit terminal 4.
 - If not within the specified range, remove the control valve body to test the Q27C pressure control solenoid valve 3 (SLB1).
3. Inspect the Q27C pressure control solenoid valve 3 (SLB1) for 5.0-5.6 ohms at 20°C (68°F).
 - If not within the specified range, replace the control valve body.
 - If within the specified range, replace the AT wiring harness.
4. If all circuits test normal, replace the K71 Transmission Control Module.

Component Testing

Test the Q27C pressure control solenoid valve 3 (SLB1), at 20°C (68°F), for 5.0-5.6 ohms across the solenoid.

- If not within the specified range, replace the control valve body.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Control Valve Body Replacement**
- **Transmission Adaptive Learn**
- **Automatic Transmission Wiring Harness Replacement**
- **Control Module References** for TCM replacement, setup and programming

DTC P0851 OR P0852: PARK/NEUTRAL POSITION SWITCH

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.

- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0851

Park/Neutral Position Switch Circuit Low Voltage

DTC P0852

Park/Neutral Position Switch Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0851	P0852	P0852	-

Typical Scan Tool Data

Park/Neutral Position Switch

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Operating Conditions: Engine running, normal operating temperature			
Parameter Normal Range: 12 Volts = In-Gear, 0 Volts = Park/Neutral			
Park/Neutral Signal	Park/Neutral	In-Gear	In-Gear

Circuit/System Description

The transmission range (TR) switch, also known as the park/neutral position (PNP) switch, is installed on the transmission case. The TR switch sends the transmission gear range information to the TCM by combination of position circuit terminal inputs. The Park/Neutral Signal is also sent from the park/neutral switch directly to the engine control module (ECM) and is used for engine start enable.

Conditions for Running the DTC

- Ignition voltage is between 11-18 volts.
- No VSS faults exist.
- No communication faults between TCM and ECM.

Conditions for Setting the DTC

P0851

The ECM detects the gear is in park or neutral while the gear position is indicated to be In-Gear.

P0852

The ECM detects the gear is not in park or neutral while the gear position from TCM is park or neutral.

Action Taken When the DTC Sets

DTCs P0851 and P0852 are Type C DTCs.

Conditions for Clearing the DTC

DTCs P0851 and P0852 are Type C DTCs.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

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Electrical Information Reference

- **Circuit Testing**
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- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. If there are any other transmission related DTCs set, diagnose those DTCs first. Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
2. Ignition ON.

3. Verify the scan tool Park/Neutral Position Switch parameter in the ECM data list changes between Park/Neutral and In-Gear when moving the gear shift lever from Park, to Reverse and through all the ranges.

- **If the parameter does not change**

Refer to Circuit/System Testing.

- **If the parameter changes**

4. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B81 Park/Neutral Position Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 1 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Ignition ON.
4. Verify the scan tool Park/Neutral Position Switch parameter is In-Gear.
 - **If not In-Gear**
 1. Ignition OFF, disconnect the X1 harness connector at the K20 ECM.
 2. Test for infinite resistance between the signal circuit terminal 4 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 ECM.
 - **If In-Gear**
5. Install a 3 A fused jumper wire between the signal circuit terminal 4 and the ground circuit terminal 1.
6. Verify the scan tool Park/Neutral Position Switch parameter is Park/Neutral.
 - **If not Park/Neutral**
 1. Ignition OFF, disconnect the X1 harness connector at the K20 ECM, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 ECM.
 - **If Park/Neutral**

7. Test or replace the B81 Park/Neutral Position Switch.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Park/Neutral Position Switch Replacement**
- **Control Module References** for ECM replacement, setup, and programming

DTC P0973 OR P0974: SHIFT SOLENOID VALVE 1

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0973

Shift Solenoid Valve 1 Control Circuit Low Voltage

DTC P0974

Shift Solenoid Valve 1 Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Shift Solenoid Valve 1 Control	P0973	P0974	P0974	-

Circuit/System Description

Shift solenoid (SS) valve 1 turns ON and OFF in response to signals output from the TCM. According to ON or OFF status of SS valve 1, the 1st gear engine brake operates or manual shift mode occurs. As a fail-safe function, if any shift solenoid abnormality occurs, the TCM will disable the current to the solenoids.

Conditions for Running the DTC

P0973

- Solenoid valve 1 driver outputs ON signal.
- The transmission is not in limp home mode.
- The time after the command of shift solenoid (S1) changed is 10 msec.

P0974

- Solenoid valve 1 driver outputs OFF signal.
- The transmission is not in limp home mode.
- The time after the command of shift solenoid (S1) changed is 10 msec.

Conditions for Setting the DTC

P0973

The TCM detects an OFF signal of the Shift Solenoid Valve 1 circuit when the Shift Solenoid Valve 1 is commanded ON for 100 msec continuously after 5 times.

P0974

The TCM detects an ON signal of the Shift Solenoid Valve 1 circuit when the Shift Solenoid Valve 1 is commanded OFF for 100 msec continuously after 5 times.

Action Taken When the DTC Sets

- DTCs P0973 and P0974 are Type A DTCs.
- The TCM allows the vehicle after below 10 km/h (6 mph) to be operated only in the second gear.

Conditions for Clearing the DTC

DTCs P0973 and P0974 are Type A DTCs.

Diagnostic Aids

When attempting to set solenoid electrical DTCs, ensure the control solenoid valve assembly is warmed up and the transmission is operated long enough to ensure a 3°C (5°F) increase in temperature. This will place the TCM in the optimal conditions to test solenoid electrical DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Description and Operation

- **Electronic Component Description**
- **Transmission Component and System Description**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ensure the transmission fluid temperature is between 50-80°C (122-176°F).
2. Operate the vehicle in 2nd gear long enough to ensure at least a 3°C (5°F) rise in oil temperature.
3. Place the gear selector in Reverse for 5 s and then idle vehicle for 5 s.
4. Observe the scan tool data Shift Solenoid Valve 1 parameter. The parameter should display ON.

Circuit/System Testing

1. Ignition OFF, disconnect the automatic transmission (AT) wiring harness at the transmission.
2. Test for 11-15 ohms at 20°C (68°F) between the shift solenoid control circuit terminal 10 and ground.
 - If not within the specified range, test the wiring harness for internal short, or interruption. If the circuit test normal, replace the Q32A shift solenoid valve 1.
3. Test for infinite resistance between each terminal and the shift solenoid control circuit terminal 10.
 - If less than the specified range, replace the wiring harness.
4. If all circuits test normal, test the Q32A shift solenoid valve 1 and replace it if the malfunction is found. Verify the DTC does not reset.
 - If the DTC resets, replace the K71 Transmission Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **1-2 Shift Solenoid Valve Replacement**
- **Transmission Adaptive Learn**
- **Automatic Transmission Wiring Harness Replacement**
- **Control Module References** for TCM replacement, setup, and programming

DTC P2534: IGNITION ON/START SWITCH

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P2534

Ignition On/Start Switch Circuit Low Voltage

Circuit/System Description

The transmission control module (TCM) continuously monitors the ignition voltage circuit. A low ignition voltage reading at the TCM will cause DTC P2534 to set.

Conditions for Running the DTC

- DTC U0073 or U0100 is not set
- Battery Voltage is 9.0 volts or greater.
- Engine running is ON.
- TCM can receive frame ECM
- TCM does not receive "BUS OFF" state from CAN controller.

Conditions for Setting the DTC

The TCM detects that ignition voltage is less than 0.2 times battery voltage for 20 seconds.

Action Taken When the DTC Sets

- DTC P2534 is a Type A DTC.
- The TCM allows the vehicle to be operated only in the third gear.

Conditions for Clearing the DTC

DTC P2534 is a Type A DTC.

Diagnostic Aids

A charging system malfunction may cause variances in system voltage and set voltage related DTCs. Refer to **Charging System Test** .

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

- **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**
- **Diagnostic Trouble Code (DTC) List - Vehicle**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Engine running, verify the transmission control module (TCM) scan tool ignition 1 signal parameter is greater than 8.68 volts.

- If not greater than the specified range, refer to **Charging System Test** before performing Circuit/System Testing.

Circuit/System Testing

NOTE: **You must perform the Circuit/System Verification before proceeding with Circuit/System Testing.**

1. Ignition OFF, disconnect the X1 harness connector at the K71 TCM.
2. Test for less than 1.0 ohm between ground circuit terminal 23 or 1 and ground.
 - If greater than the specified value, test the ground circuit for an open/high resistance.
3. Ignition ON, verify that a test lamp illuminates between the ignition circuit terminal 21 and ground.
 - If the test lamp does not illuminate, test the ignition circuit for a short to ground or an open/high resistance. If the circuit tests normal and the ignition circuit fuse is open, replace the K71 TCM.
4. If all circuits test normal, replace the K71 TCM.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

Control Module References for TCM replacement, setup, and programming

DTC P2537: IGNITION ACCESSORY SWITCH

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P2537

Ignition Accessory Switch Circuit Low Voltage

Circuit/System Description

The transmission control module (TCM) continuously monitors the ignition accessory voltage circuit. A low ignition accessory voltage reading at the TCM will cause DTC P2537 to set.

Conditions for Running the DTC

- DTC U0073 or U0140 is not set.
- Ignition ON.

Conditions for Setting the DTC

The TCM detects that ignition accessory voltage is less than 0.2 times battery voltage for 20 seconds.

Action Taken When the DTC Sets

DTC P2537 is a Type D DTC.

Conditions for Clearing the DTC

DTC P2537 is a Type D DTC.

Diagnostic Aids

A charging system malfunction may cause variances in system voltage and set voltage related DTCs. Refer to **Charging System Test** .

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

- **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**
- **Diagnostic Trouble Code (DTC) List - Vehicle**

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

Engine running, verify the transmission control module (TCM) scan tool ignition 1 signal parameter is greater than 8.68 volts.

- If not greater than the specified range, refer to **Charging System Test** before performing Circuit/System Testing.

Circuit/System Testing

NOTE: **You must perform the Circuit/System Verification before proceeding with Circuit/System Testing.**

1. Ignition OFF, disconnect the X1 harness connector at the K71 TCM.
2. Test for less than 1.0 ohm between ground circuit terminal 23 or 1 and ground.
 - If greater than the specified value, test the ground circuit for an open/high resistance.
3. Ignition ON, verify that a test lamp illuminates between the ignition accessory circuit terminal 24 and ground.
 - If the test lamp does not illuminate, test the ignition accessory circuit for a short to ground or an open/high resistance. If the circuit tests normal and the ignition accessory circuit fuse is open, replace the K71 TCM.

4. If all circuits test normal, replace the K71 TCM.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

Control Module References for TCM replacement, setup, and programming

DTC P2761, P2763, OR P2764: TORQUE CONVERTER CLUTCH (TCC) PRESSURE CONTROL SOLENOID

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P2761

Torque Converter Clutch (TCC) Pressure Control Solenoid Valve Control Circuit

DTC P2763

Torque Converter Clutch (TCC) Pressure Control Solenoid Valve Control Circuit High Voltage

DTC P2764

Torque Converter Clutch (TCC) Pressure Control Solenoid Valve Control Circuit Low Voltage

Circuit/System Description

The lock-up control solenoid (SLU) is installed on the valve body. It linearly controls lock-up clutch hydraulic pressure based on engine RPM, throttle opening degree signals, input speed sensor signals, and output speed sensor signals. This results in control of lock-up. As a fail-safe function, if any abnormality occurs in the lock-up control solenoid (SLU), then the TCM will shut off the current to the solenoid.

Conditions for Running the DTC

P2761

- The battery voltage is greater than 10.5 volts for 500 msec.
- The feedback current is less than 1358 mA.
- The transmission is not in limp home mode.
- DTCs P2762 and P2763 are not set.

P2763

The transmission is not in limp home mode.

P2764

The transmission is not in limp home mode.

Conditions for Setting the DTC

P2761

Deviation is between commanded current and feedback current.

P2763

The TCM detects at least 5 times more than 1358 mA current consumption of the SLU control circuit for 100 msec.

P2764

The TCM detects at least 5 times less than 20 mA current consumption of the SLU control circuit for 100 msec.

Action Taken When the DTC Sets

P2761

- DTC P2761 are Type A DTC.
- The TCM allows the vehicle to be operated only in the third gear.

P2763 and P2764

- DTCs P2763 and P2764 are Type B DTCs.
- No self learning function
- No lock-up control
- No lock-up slip control
- No neutral control
- No up slope mode

Conditions for Clearing the DTC

P2761

DTC P2761 is a Type A DTC.

P2763 and P2764

DTCs P2763 and P2764 are Type B DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

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Description and Operation

- **Electronic Component Description**
- **Transmission Component and System Description**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ensure the transmission fluid temperature is between 50-80°C (122-176°F).
2. Operate the vehicle in 2nd gear long enough to ensure at least a 3°C (5°F) rise in transmission fluid temperature, then operate the vehicle in Park for 5 s.
3. Observe the scan tool data TCC Pressure Control Solenoid Valve Current parameter, the reading should be between 0.1-1.1 A.

Circuit/System Testing

1. Ignition OFF, disconnect the automatic transmission (AT) wiring harness at the transmission.
2. Test for 5.0-5.6 ohms at 20°C (68°F) between the low reference circuit terminal 9 and the voltage supply circuit terminal 3.

- If not within the specified range, remove the control valve body to test the Q39A TCC pressure control solenoid valve (SLU).
- 3. Inspect the Q39A TCC pressure control solenoid valve (SLU) for 5.0-5.6 ohms at 20°C (68°F).
 - If not within the specified range, replace the control valve body.
 - If within the specified range, replace the AT wiring harness.
- 4. If all circuits test normal, replace the K71 Transmission Control Module.

Component Testing

Test the Q39A TCC pressure control solenoid valve (SLU), at 20°C (68°F), for 5.0-5.6 ohms across the solenoid.

- If not within the specified range, replace the control valve body.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Control Valve Body Replacement**
- **Transmission Adaptive Learn**
- **Automatic Transmission Wiring Harness Replacement**
- **Control Module References** for TCM replacement, setup, and programming

SYMPTOMS - AUTOMATIC TRANSMISSION

On-Vehicle Repair Matrix

Symptom	Possible Cause
No Move or Slip In Drive	• Drive Plate Runout • Shift Solenoid (S1) • TCM • Shift Cable or PNP Switch Misadjustment • Lack of ATF, Burnt Smell of ATF • Water Mix, Wrong ATF • Torque Converter • Valve Body • Transmission Internal Parts
No Move or Slip In Reverse	• Drive Plate Runout • Shift Solenoid (S1) • C2 Pressure Control Solenoid (SLC2) • TCM • Shift Cable or PNP Switch Misadjustment

	• Lack of ATF, Burnt Smell of ATF • Water Mix, Wrong ATF • Torque Converter • Valve Body • Transmission Internal Parts
Slip On Acceleration	• Shift Solenoid (S1) • C1 Pressure Control Solenoid (SLC1) • C2 Pressure Control Solenoid (SLC2) • B1 Pressure Control Solenoid (SLB1) • Lock Up Control Solenoid (SLU) • TCM • Shift Cable or PNP Switch Misadjustment • Lack of ATF, Burnt Smell of ATF • Water Mix, Wrong ATF • Torque Converter • Valve Body • Transmission Internal Parts
Time Lag Shifting from Neutral to Drive	• Input Speed Sensor • C1 Pressure Control Solenoid (SLC1) • Lock Up Control Solenoid (SLU) • TCM • Lack of ATF, Burnt Smell of ATF • Water Mix, Wrong ATF • Valve Body • Transmission Internal Parts
Time Lag Shifting from Neutral to Reverse	• Input Speed Sensor • TCM • Lack of ATF, Burnt Smell of ATF • Water Mix, Wrong ATF • Valve Body • Transmission Internal Parts
No Engine Start	• PNP Switch • Shift Cable or PNP Switch Misadjustment
	• Engine Malfunction • C1 Pressure Control Solenoid (SLC1) • C2 Pressure Control Solenoid (SLC2) • TCM

Engine Stalls Shifting from Neutral to Drive or Neutral to Reverse	• Shift Cable or PNP Switch Misadjustment • Oil Cooler Pipe • Torque Converter • Valve Body • Transmission Internal Parts
Engine Stalls from Slow Down	• Engine Malfunction • C1 Pressure Control Solenoid (SLC1) • C2 Pressure Control Solenoid (SLC2) • TCM • Shift Cable or PNP Switch Misadjustment • Oil Cooler Pipe • Torque Converter • Valve Body • Transmission Internal Parts
Poor Acceleration	• Engine Malfunction • C1 Pressure Control Solenoid (SLC1) • C2 Pressure Control Solenoid (SLC2) • B1 Pressure Control Solenoid (SLB1) • Accelerator Effective Position Validity • Lack of ATF, Burnt Smell of ATF • Water Mix, Wrong ATF • Torque Converter • Valve Body • Transmission Internal Parts
No Up Shift or No Down Shift from 1st to 2nd Gear or 2nd to 1st Gear	• Engine Malfunction • Battery Voltage Low or High • Input Speed Sensor • Output Speed Sensor • PNP Switch • TFT Sensor • C1 Pressure Control Solenoid (SLC1) • C2 Pressure Control Solenoid (SLC2) • B1 Pressure Control Solenoid (SLB1) • TCM • Accelerator Effective Position Validity • Lack of ATF, Burnt Smell of ATF • Water Mix, Wrong ATF

	• Valve Body • Transmission Internal Parts
No Up Shift or No Down Shift from 2nd to 3rd Gear or 3rd to 2nd Gear	• Engine Malfunction • Battery Voltage Low or High • Input Speed Sensor • Output Speed Sensor • PNP Switch • TFT Sensor • Shift SSolenoid (S1) • C1 Pressure Control Solenoid (SLC1) • C2 Pressure Control Solenoid (SLC2) • B1 Pressure Control Solenoid (SLB1) • TCM • Accelerator Effective Position Validity • Lack of ATF, Burnt Smell of ATF • Water Mix, Wrong ATF • Valve Body • Transmission Internal Parts
No Up Shift or No Down Shift from 3rd to 4th Gear or 4th to 3rd Gear	• Engine Malfunction • Battery Voltage Low or High • Input Speed Sensor • Output Speed Sensor • PNP Switch • TFT Sensor • C1 Pressure Control Solenoid (SLC1) • C2 Pressure Control Solenoid (SLC2) • B1 Pressure Control Solenoid (SLB1) • TCM • Accelerator Effective Position Validity • Lack of ATF, Burnt Smell of ATF • Water Mix, Wrong ATF • Valve Body • Transmission Internal Parts
	• Battery Voltage Low or High • Input Speed Sensor • Output Speed Sensor • TFT Sensor

No Up Shift or No Down Shift from No Lock Up On or No Lock Up Off	• Lock Up Control Solenoid (SLU) • Brake Switch • TCM • Accelerator Effective Position Validity • Torque Converter • Valve Body • Transmission Internal Parts
No Up Shift or No Down Shift from No Engine Braking	• Battery Voltage Low or High • Shift Solenoid (S1) • C1 Pressure Control Solenoid (SLC1) • C2 Pressure Control Solenoid (SLC2) • B1 Pressure Control Solenoid (SLB1) • Lock Up Control Solenoid (SLU) • TCM • Lack of ATF • Valve Body • Transmission Internal Parts
No Lock Down	• C1 Pressure Control Solenoid (SLC1) • C2 Pressure Control Solenoid (SLC2) • TCM • Accelerator Effective Position Validity
Erratic Shift	• C1 Pressure Control Solenoid (SLC1) • C2 Pressure Control Solenoid (SLC2) • TCM • Accelerator Effective Position Validity
Shift Lever Hard/Weak	• Shift Cable or PNP Switch Misadjustment • Transmission Internal Parts
Oil Leak from Breather	• Oil Cooler Pipe • Transmission Internal Parts
Oil Leak Between Engine and T/M Housing	• Engine Malfunction • Drive Plate Runout • Oil Seal • O-Ring • Torque Converter
Oil Leak from Differential Oil Seal	Oil Seal
Oil Leak from Manual Shaft Oil Seal	Oil Seal
Oil Leak from T/M Housing, Oil Pan Rear Case,	

T/M Case	FIPG, Gasket
Oil Leak from O-Ring-Sensor, T/M Wiring Harness	O-Ring
Oil Leak from Oil Cooler Pipe	• Oil Cooler Pipe Misinstallation or Damage • O-Ring
Harsh Shift From Neutral to Drive	• Engine Malfunction • Engine and T/M Mounting • Suspension Malfunction • Battery Voltage Low or High • PNP Switch • TFT Sensor • C1 Pressure Control Solenoid (SLC1) • C2 Pressure Control Solenoid (SLC2) • TCM • Engine Speed Status • Engine Coolant Temperature Validity • Lack of ATF, Burnt Smell of ATF • Water Mix, Wrong ATF • Valve Body • Transmission Internal Parts
Harsh Shift From Neutral to Reverse	• Engine Malfunction • Engine and T/M Mounting • Suspension Malfunction • Battery Voltage Low or High • PNP Switch • TFT Sensor • C1 Pressure Control Solenoid (SLC1) • C2 Pressure Control Solenoid (SLC2) • TCM • Engine Speed Status • Engine Coolant Temperature Validity • Lack of ATF, Burnt Smell of ATF • Water Mix, Wrong ATF • Valve Body • Transmission Internal Parts
	• Engine Malfunction • Engine and T/M Mounting

Harsh Shift During Shift Up	• Battery Voltage Low or High • TFT Sensor • C1 Pressure Control Solenoid (SLC1) • C2 Pressure Control Solenoid (SLC2) • B1 Pressure Control Solenoid (SLB1) • Lock Up Control Solenoid (SLU) • TCM • Engine Coolant Temperature Validity • Lack of ATF, Burnt Smell of ATF • Water Mix, Wrong ATF • Valve Body • Transmission Internal Parts
Harsh Shift During Coast Down	• Engine and T/M Mounting • Battery Voltage Low or High • TFT Sensor • C1 Pressure Control Solenoid (SLC1) • C2 Pressure Control Solenoid (SLC2) • B1 Pressure Control Solenoid (SLB1) • Lock Up Control Solenoid (SLU) • TCM • Engine Coolant Temperature Validity • Lack of ATF, Burnt Smell of ATF • Water Mix, Wrong ATF • Valve Body • Transmission Internal Parts
Harsh Shift During Kick Down	• Engine and T/M Mounting • Battery Voltage Low or High • TFT Sensor • C1 Pressure Control Solenoid (SLC1) • C2 Pressure Control Solenoid (SLC2) • B1 Pressure Control Solenoid (SLB1) • Lock Up Control Solenoid (SLU) • TCM • Engine Coolant Temperature Validity • Lack of ATF, Burnt Smell of ATF • Water Mix, Wrong ATF • Valve Body

	• Transmission Internal Parts
Harsh Shift During Acceleration On, Off-No Up, Down Shift	• Engine Malfunction • Engine and T/M Mounting • Suspension Malfunction
Vibration While Idling	• Engine Malfunction • Drive Plate Runout • Engine and T/M Mounting • Exhaust Pipe Resonance • Drive Shaft Runout or Rattle • Interference with Drive Train and Body • Suspension Malfunction
Vibration While Driving	• Engine Malfunction • Drive Plate Runout • Engine and T/M Mounting • Exhaust Pipe Resonance • Drive Shaft Runout or Rattle • Tire Unbalance • Interference with Drive Train and Body • Suspension Malfunction
Noise While Idling	• Engine Malfunction • Engine and T/M Mounting • Exhaust Pipe Resonance • Interference with Drive Train and Body • Suspension Malfunction • Oil Cooler Pipe Resonance • Burnt Smell of ATF • Water Mix, Wrong ATF
Noise During Garage Shift	• Engine Malfunction • Engine and T/M Mounting • Exhaust Pipe Resonance • Drive Shaft Runout or Rattle • Burnt Smell of ATF • Water Mix, Wrong ATF • Transmission Internal Parts
	• Engine Malfunction • Engine and T/M Mounting

Noise While Driving	• Exhaust Pipe Resonance • Drive Shaft Runout or Rattle • Tire Unbalance • Interference with Drive Train and Body • Suspension Malfunction • Transmission Internal Parts
Noise During Up Shift or Down Shift	• Engine Malfunction • Engine and T/M Mounting • Exhaust Pipe Resonance • Tire Unbalance • Interference with Drive Train and Body • Suspension Malfunction • Burnt Smell of ATF • Water Mix, Wrong ATF • Transmission Internal Parts
Noise While Acceleration On or Off	• Engine Malfunction • Engine and T/M Mounting • Exhaust Pipe Resonance • Tire Unbalance • Interference with Drive Train and Body • Suspension Malfunction • Transmission Internal Parts

BRAKE PEDAL POSITION SENSOR LEARN

Brake Pedal Position Sensor Learn is a procedure for the ECM to determine the position of the brake pedal position (BPP) sensor when the brake pedal is in the released position.

NOTE: **The Brake Pedal Position Sensor Learn procedure is required when the following service procedures have been performed:**

- An Engine Control Module Replacement
- A BPP Sensor Replacement
- Any repair procedure that effects the BPP Sensor alignment

1. Install a scan tool.
2. Monitor the ECM for DTCs with a scan tool. If other DTCs are set, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** for the applicable DTC that set.
3. Navigate to the scan tool Brake Pedal Position Sensor Learn command by selecting the following:

1. Module Diagnosis
2. Engine Control Module
3. Configuration/Reset Functions
4. Learn Functions
5. Brake Pedal Position Sensor Learn
4. Ignition ON, Engine OFF, transmission in Park, brake pedal in the fully released position, select Learn.
5. Verify Brake Pedal Position Sensor and Brake Pedal Position Sensor Learned Home Position are within 1 Volts.
6. Select Exit.

TRANSMISSION FLUID LEVEL AND CONDITION CHECK

CAUTION: Use correct transmission fluid only. Failure to use the proper fluid may result in transmission internal damage.

1. The vehicle must be on a flat surface.
2. Move the selector lever into park (P) position.
3. Start the engine.
4. Wait until transmission temperature reaches 35°C (95°F).

NOTE: Do not raise the temperature by performing a stall test.

5. Move through the selector lever positions with the foot brake depressed. Switch the selector lever from position P to L and back to P. Hold each position for at least 2 seconds. Repeat this process twice.

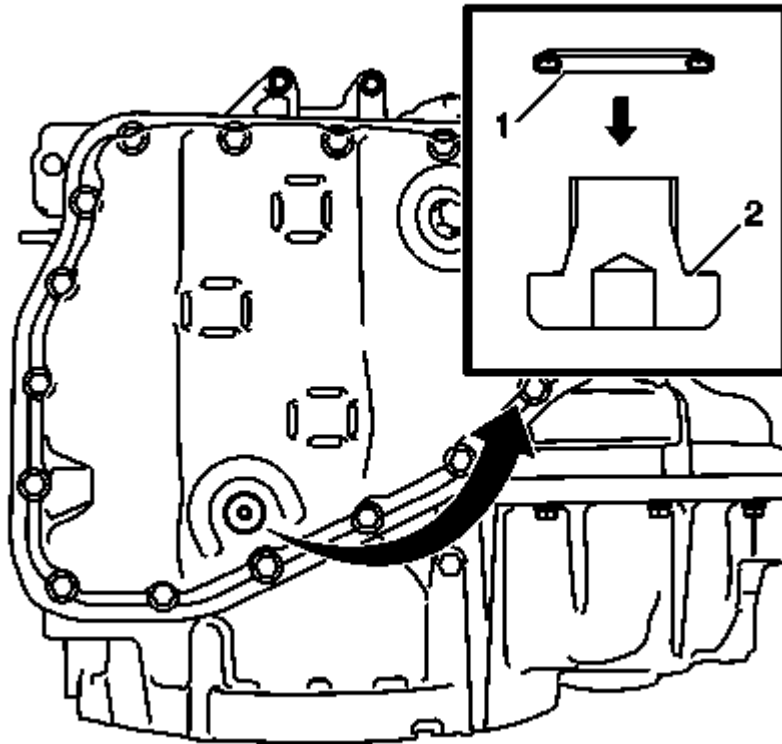


Fig. 14: View Of Plug Gasket

Courtesy of GENERAL MOTORS COMPANY

6. Check the transmission fluid temperature with the diagnostic tool.
 1. If the transmission fluid temperature has reached about 35 -45°C (95-113°F), raise the vehicle.
 2. Remove the overflow plug (2). Remove and DISCARD the plug gasket (1).
 3. If the fluid is flowing as a steady stream, wait until the fluid begins to drip. If no fluid comes out, add the fluid until it drips out.
 4. If the fluid drips out (a drip per 1 second) from overflow hole, install the overflow plug (2) with a NEW gasket (1) and tighten to 24 (18 lb ft).
7. Lower the vehicle.

NOTE:

- In case of insufficient ATF, the oil pump will suck in air, causing the line pressure to decrease. This causes the clutch to slide, resulting in malfunctions such as a burned clutch.
- In case of excessive ATF, the gears in the transmission will agitate the ATF, causing bubbling and malfunctions such as deterioration. If the vehicle is driven under this condition, the ATF level increases and ATF may blow out of the breather.

8. Switch off the engine.

LINE PRESSURE CHECK

Special Tools

- **J-21867** Pressure Gauge
- **J-21867-50** Transmission Line Pressure Adapter

The line pressure test can inspect the working condition inside the automatic transmission (A/T) by measuring line pressure in drive (D)/reverse (R) range and idle/stall condition.

(1) D-Range

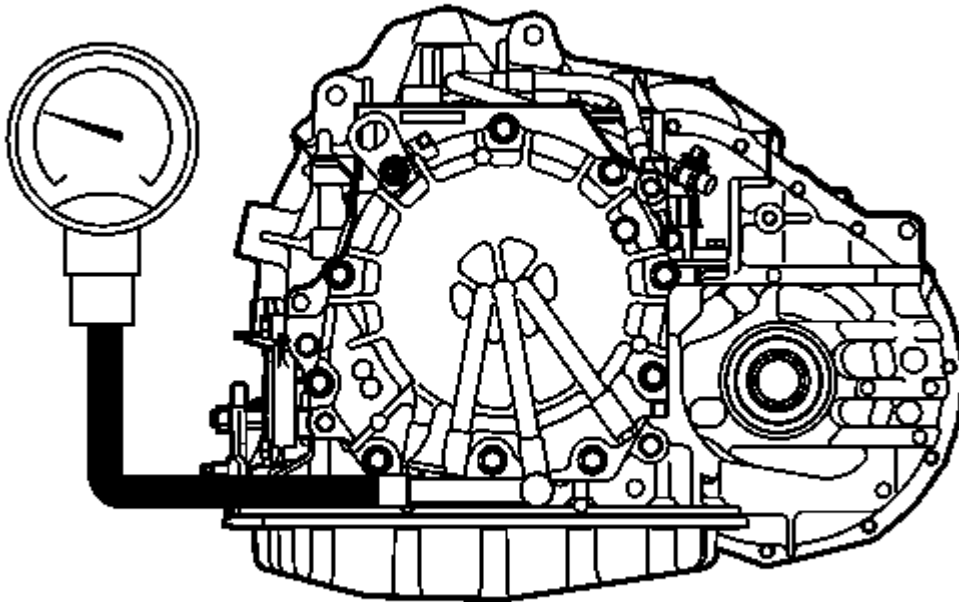


Fig. 15: Measuring Line Pressure In Drive (D - Range)
Courtesy of GENERAL MOTORS COMPANY

(2) R-Range

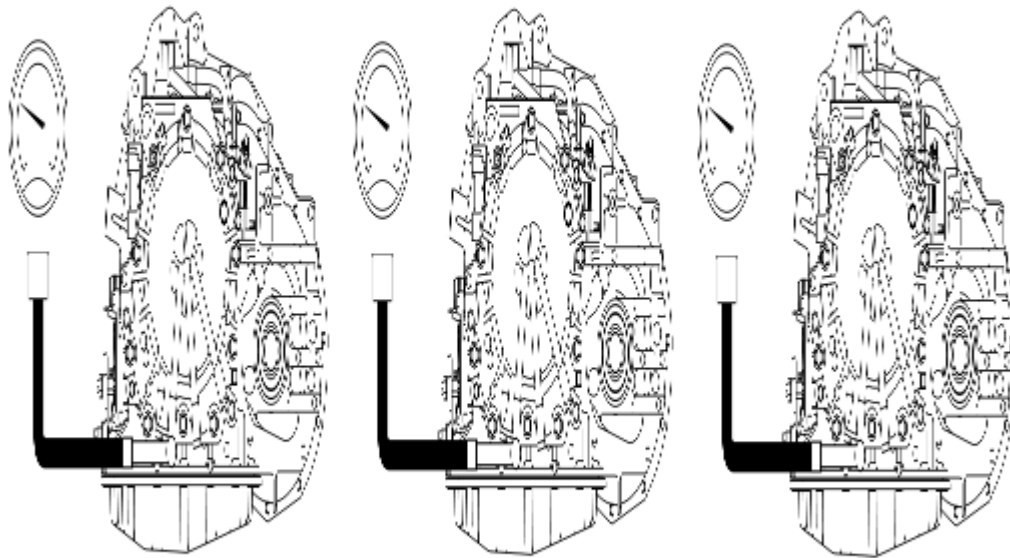


Fig. 16: Measuring Line Pressure In Drive (R - Range)
Courtesy of GENERAL MOTORS COMPANY

1. Wedge the 4 wheels and apply the parking brake fully. Lock the vehicle in place.
2. Install **J-21867** and **J-21867-50** to the test hole.

NOTE:

- **Make sure to take 3 measurements and use the average value.**
- **Do not continuously run longer than 5 seconds. Extreme increasing of oil temperature may occur.**

3. Start the engine.
4. Fully press on the brake pedal with the left foot, shift into drive (D) or reverse (R) range and measure the line pressure at idle/stall condition.

Specifications

- The engine idle line pressure in drive (D) is 0.62-0.77 mPa (90.65-112.40 psi).
 - The engine idle line pressure in reverse (R) is 0.49-0.53 mPa (72.37-78.18 psi).
 - The engine stall line pressure in drive (D) is 1.45-1.63 mPa (210.31-236.41 psi).
 - The engine stall line pressure in reverse (R) is 1.72-2.08 mPa (250.19-302.40 psi).
-

Test Results	Assumed Cause
Lower than standards in both drive (D) and reverse (R)	• Pressure control solenoid (SLC1 or SLC2) failure • Primary regulator valve failure • Oil pump failure • Leak from hydraulic circuit of drive (D) or reverse (R) range
Higher than standards only in drive (D)	• Pressure control solenoid (SLC1 or SLC2) failure • Primary regulator valve failure
Lower than standards only in drive (D)	• Hydraulic pressure circuit failure of drive (D) range • Forward clutch (C1) failure
Lower than standards only in reverse (R)	• Hydraulic pressure circuit of reverse (R) range • Reverse clutch (C3) failure • 1st and reverse brake (B3) failure

ROAD TEST

Purpose

The road test is to diagnose the failure symptom accurately and check the failure symptom after procedure.

Conditions

Make sure to perform the road test under the following conditions:

- The oil temperature before the road test is 50-80°C (122-176°F).
- Perform the road test after the engine inspection and adjustment.
- The air conditioning, lights etc. are turned off.

Procedure

Item	Procedure
Shift Function - Drive (D) Position	During the normal driving, check that the transmission shifts from 1st to 2nd gear, 2nd to 3rd gear, and then 3rd to 4th gear.
Amount of Shift Shock While Driving	During the normal driving, check for the smooth upshifting.
Kick-Down Function	• Check downshifting by performing kick-down for each gear. • Check the amount of shift shock during kick-down.
Operation of the Engine Brake	Check the operation of the engine brake in 1st gear when in manual mode.
Shifting Point When the Accelerator Pedal Is Fully Depressed	With the shift lever in the drive (D) position, fully depress the accelerator pedal to check if the point at which the transmission upshifts from 1st to 2nd gear matches the specified shift point.
	Check that it is possible to shift into every gear when the shift lever is

Manual Shift Control Function	in the manual mode position.
Lock-Up Control Function	Check that the engine speed does not change dramatically when slightly depressing the accelerator pedal while driving on a flat road at a speed that lock-up is in effect.
Park (P) Position Operation	Stop the vehicle on a slope (of about 5% or 3° or more), move the shift lever to the park (P) position, then release the parking brake and check that the vehicle does not move.
Oil Leak	After a road test, inspect each part and check that there are no oil leaks.

STALL SPEED TEST

Purpose

The purpose of the stall test is to inspect the overall performance of the automatic transmission (A/T) and the engine by measuring the stall speed in drive (D) and reverse (R) range.

Procedure

NOTE:

- Make sure to take 3 measurements and use the average value.
- Do not continuously run longer than 5 seconds. Extreme increasing of oil temperature may occur.
- In case of A/T with N control, when applying the accelerator pedal with braking (stall test), the forward clutch is engaged because N control is off.

Therefore, you must feel a slight driving force, however it isn't abnormal.

1. Wedge the 4 wheels and apply the parking brake fully. Lock the vehicle in place.
2. Start the engine.
3. Fully press on the brake pedal with the left foot.
4. Shift into drive (D) or reverse (R) range, fully press on the accelerator pedal with the right foot and quickly check the maximum engine rpm.

Specification

The standard stall speed is 2600 RPM.

Test Results	Assumed Cause
Lower than standards in both drive (D) and reverse (R)	• Less engine power • Torque converter one-way clutch slipping
Higher than standards only in drive (D)	• Low line pressure ◦ C1 Pressure control solenoid (SLC1) failure ◦ Primary regulator valve failure • Valve body failure

	○ C1 Pressure control solenoid (SLC1) hydraulic pressure system failure ● Forward clutch (C1) slipping ● One-way clutch (F2) failure
Higher than standards only in reverse (R)	● Low line pressure ○ C2 Pressure control solenoid (SLC2) failure ○ Primary regulator valve failure ● Valve body failure ○ C2 Pressure control solenoid (SLC2) hydraulic pressure system failure ● Reverse clutch (C3) slipping ● 1st and reverse brake (B3) slipping
Higher than standards in both drive (D) and reverse (R)	● Low line pressure ○ C1 Pressure control solenoid (SLC1) failure ○ C2 Pressure control solenoid (SLC2) failure ○ Primary regulator valve failure ● Oil pump failure ● Oil strainer clogging

ENGAGEMENT DELAY TEST

Purpose

Time lag is when a shock can be felt when shifting from neutral (N) to drive (D) and neutral (N) to reverse (R) while the engine is idling.

Procedure

- IMPORTANT:**
- **Make sure to take 3 measurements and use the average value.**
 - **When performing the test in succession, make sure to leave 1 minute intervals.**

1. Wedge the 4 wheels and apply the parking brake fully. Lock the vehicle in place.
2. Start the engine.
3. Depress the brake pedal and let the engine idle.
4. Using a stop watch, measure the time lag from the moment when the shift lever is shifted from neutral (N) to drive (D) and from neutral (N) to reverse (R), until slight shock can be felt.

Specifications

- The time lag from neutral (N) to drive (D) is less than 1.5 seconds.

- The time lag from neutral (N) to reverse (R) is less than 1.5 seconds.

Test Results	Assumed Cause
Longer than standards when shifting from neutral (N) to drive (D)	• Valve body failure ◦ C1 Pressure control solenoid (SLC1) hydraulic pressure system failure ◦ C2 Pressure control solenoid (SLC2) hydraulic pressure system failure • Forward clutch (C1) slipping • One-way clutch (F2) failure • Oil pump failure • Oil strainer clogging
Longer than standards when shifting from neutral (N) to reverse (R)	• Valve body failure ◦ C1 Pressure control solenoid (SLC1) hydraulic pressure system failure ◦ C2 Pressure control solenoid (SLC2) hydraulic pressure system failure ◦ Shift Solenoid (S1) hydraulic pressure system failure • Reverse clutch (C3) slipping • 1st and reverse brake (B3) slipping • Oil pump failure • Oil strainer clogging

CASE POROSITY REPAIR

WARNING: Refer to Eye Protection Warning .

1. Determine the leak area. Refer to Automatic Transmission Fluid Leaks.

WARNING: The epoxy adhesive may cause skin irritations and eye damage. Read and follow all of the information on the container label as provided by the manufacturer.

2. Clean the leak area with the solvent. Air dry.
3. Mix a sufficient amount of epoxy cement following the manufacturer's recommendations.
4. While the transaxle case is hot, apply epoxy cement with a clean, dry soldering acid brush.
5. Allow the epoxy cement to dry for 3 hours before starting the engine.

AUTOMATIC TRANSMISSION FLUID LEAKS

General Method

1. Verify that the material leaking is transaxle fluid.
2. Thoroughly clean the suspected leak area.
3. Allow the transaxle to reach the normal operating temperature of 176-194°F (80-90°C).
4. Park the vehicle over a clean paper or a clean cardboard.
5. Turn the engine OFF and look for fluid spots on the paper.
6. Make the necessary repairs to correct that leak.

Powder Method

1. Thoroughly clean the suspected leak area.
2. Apply an aerosol type powder, such as foot powder, to the suspected leak area.
3. Allow the transaxle to reach the normal operating temperature of 176-194°F (80-90°C).
4. Turn the engine OFF.
5. Inspect the suspected leak area and trace the leak path through the powder to find the source of the leak.
6. Make the necessary repairs to correct the leak. Once the leak point is found, the source of the leak must be determined and repaired.

TRANSMISSION ADAPTIVE LEARN

The purpose of the transmission adaptive learn procedure is to improve the shift quality.

Perform the transmission adaptive learn procedure after any of the following service procedures:

- Transmission Control Module (TCM) replacement
- TCM calibration change
- Control valve body replacement
- Transmission overhaul
- Transmission replacement

NOTE: **Do not make the stall test to raise up the transmission fluid temperature.**

1. Drive the vehicle to warm the transmission fluid until 50-80°C (122-176°F). The adaptive learn procedure will not work unless the transmission fluid is the correct temperature.
2. Perform the following steps for the garage shift learning.
 1. With the vehicle stationary, depress the brake and keep the shift lever in neutral (N) for 3 seconds.
 2. Move the shift lever from neutral (N) into drive (D) and maintain this condition for 3 seconds.
 3. Repeat the above step five times.
 4. Repeat the five times in the same way for reverse (R).
3. Perform the following steps for the gear shift control learning.
 1. Drive in drive (D) with the throttle opening between 25-35% until 4th gear and a vehicle speed of

80 km/h (50 mph) or higher is reached.

2. Release the accelerator pedal and coast and bring the vehicle to a stop within 60 seconds.
3. Repeat the above step ten times.
4. Check that the variable speed shock and shift shock have decreased compared to the conditions before learning.

INPUT SPEED SENSOR INSPECTION

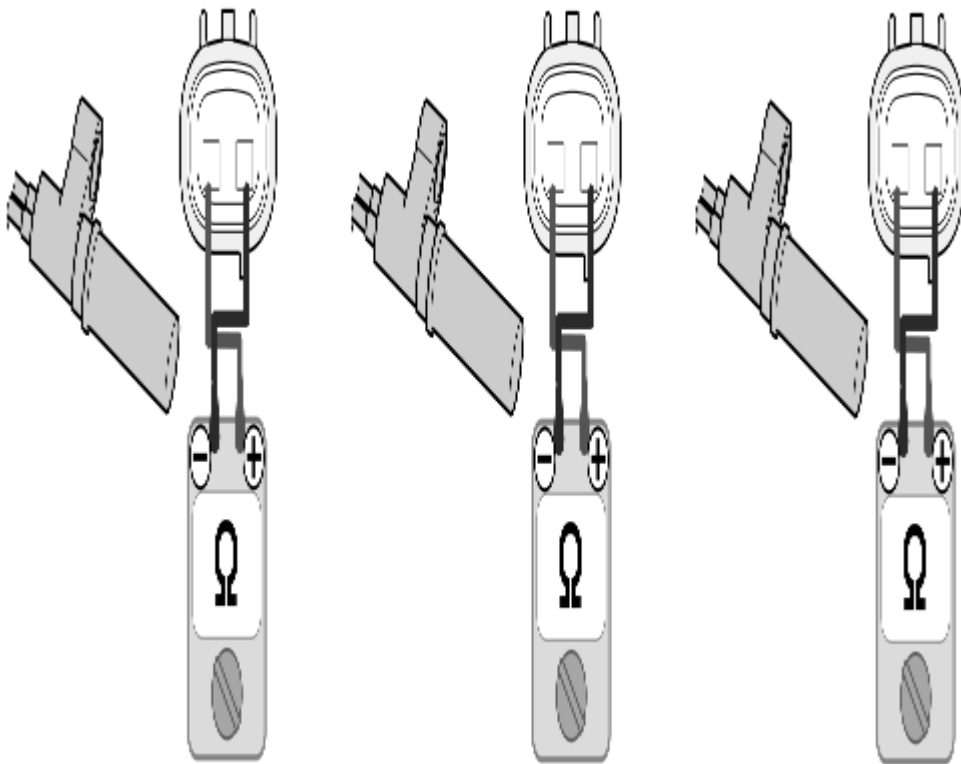


Fig. 17: Input Speed Sensor Inspection 1
Courtesy of GENERAL MOTORS COMPANY

Inspection 1

NOTE: Do not damage the input speed sensor and terminals.

With a tester, test for the continuity between the terminals of the input speed sensor.

Specification

Continuity

NOTE: When measuring the resistance between the terminals, 100 kohms or more may be detected. However, this is not due to a malfunction.

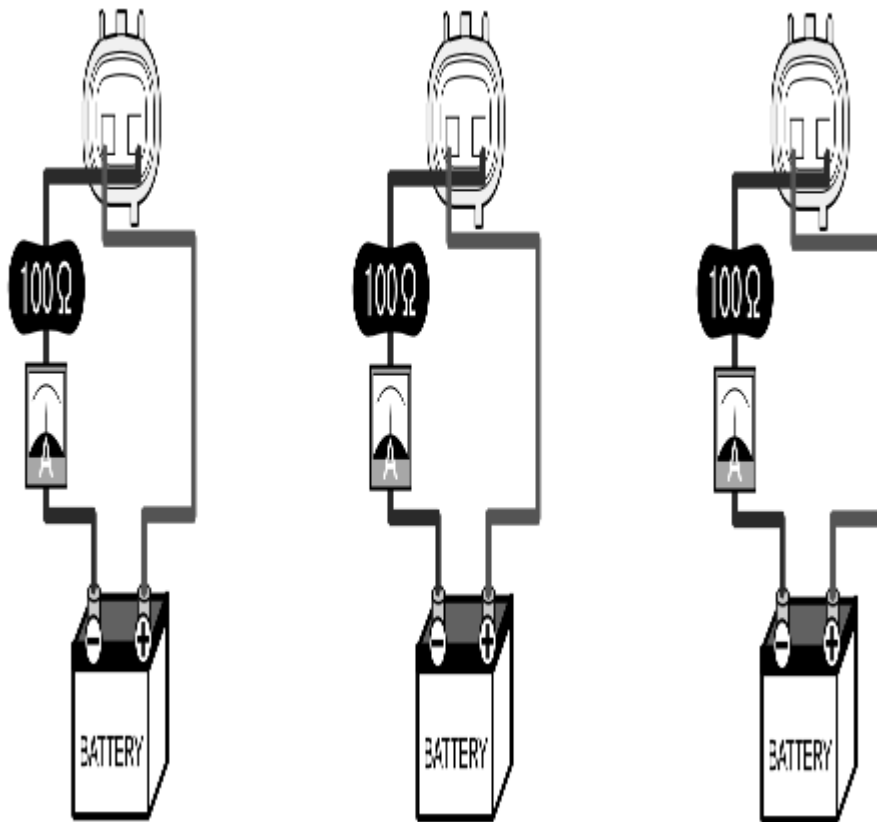


Fig. 18: Input Speed Sensor Inspection 2
Courtesy of GENERAL MOTORS COMPANY

Inspection 2

1. Remove the input speed sensor.
2. Connect a positive lead from the battery to terminal 2 and a negative lead with a resistor of 100 ohms and ammeter to terminal 1.

NOTE: Do not damage the input speed sensor and terminals.

3. Measure the currenxy value when shaking metal hards (magnetic material) back and forth in front of the sensor (less than 5 mm).

Specifications

- The current of signal, HIGH is 12-16 mA.
- The current of signal, LOW is 4-8 mA.

OUTPUT SPEED SENSOR INSPECTION

Inspection 1

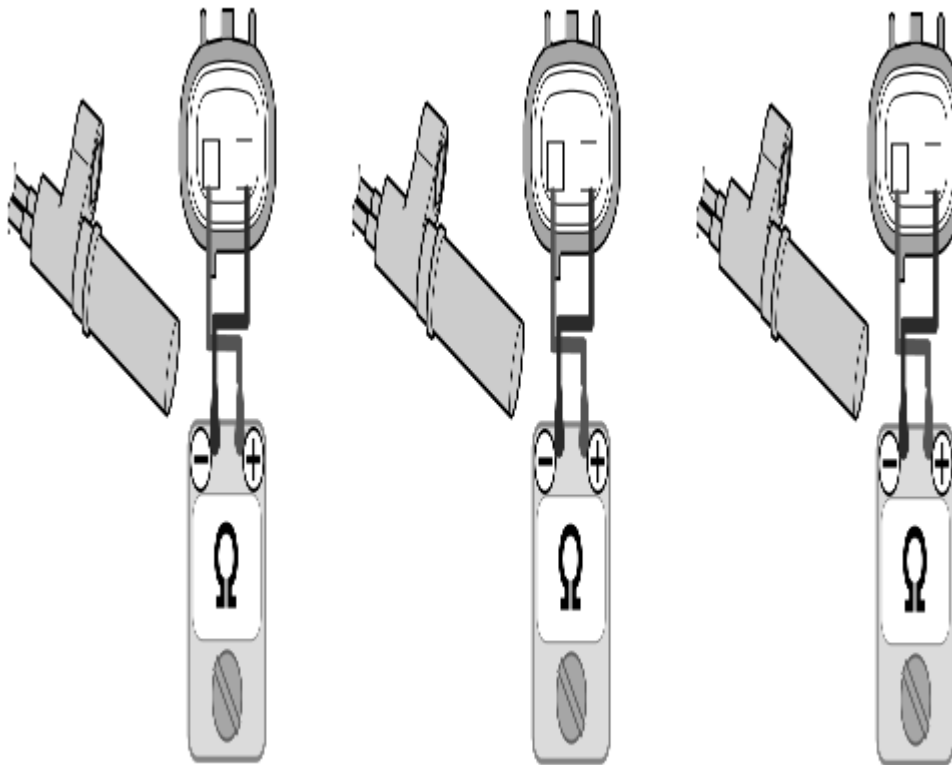


Fig. 19: Output Speed Sensor Inspection 1
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage the output speed sensor and terminals.

With a tester, test for continuity between the terminals of the output speed sensor.

Specification

Continuity

NOTE: When measuring the resistance between the terminals, 100 kohms or more may be detected. However, this is not due to a malfunction.

Inspection 2

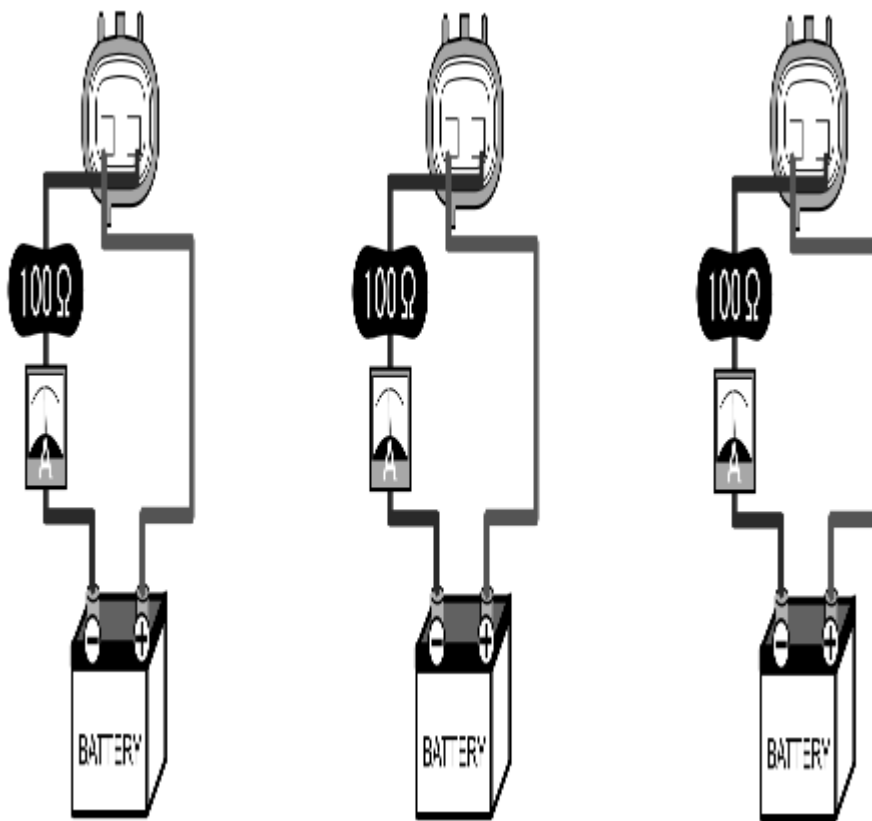


Fig. 20: Output Speed Sensor Inspection 2
Courtesy of GENERAL MOTORS COMPANY

1. Remove the output speed sensor.
2. Connect a positive lead from the battery to terminal 2 and a negative lead with a resistor of 100ohms and ammeter to terminal 1.

NOTE: Do not damage the output speed sensor and terminals.

3. Measure the currenxy value when shaking metal hards (magnetic material) back and forth in front of the sensor (less than 5 mm).

Specification

- The current of signal, HIGH is 12-16 mA.
- The current of signal, LOW is 4-8 mA.

PARK/NEUTRAL POSITION SWITCH INSPECTION

1. Disconnect the park/neutral position (PNP) switch connector.
2. Using a tester, check for continuity between the terminals from the switch.

3. Check that continuity is as specified in the table.

Park/Neutral Position Switch Inspection

Shift Position	Start (+) terminal 4 - Start (-) terminal 5	P terminal (6) - ground terminal (2)	R terminal (1) - ground terminal (2)	N terminal (9) - ground terminal (2)	D terminal (7) - ground terminal (2)	2 terminal (3) - ground terminal (2)	L terminal (8) - ground terminal (2)
P Position	Continuity	Continuity	No Continuity	No Continuity	No Continuity	No Continuity	No Continuity
R Position	No Continuity	No Continuity	Continuity	No Continuity	No Continuity	No Continuity	No Continuity
N Position	Continuity	No Continuity	No Continuity	Continuity	No Continuity	No Continuity	No Continuity
D Position	No Continuity	No Continuity	No Continuity	No Continuity	Continuity	No Continuity	No Continuity
2 Position	No Continuity	No Continuity	No Continuity	No Continuity	No Continuity	Continuity	No Continuity
L Position	No Continuity	No Continuity	No Continuity	No Continuity	No Continuity	No Continuity	Continuity

PRESSURE CONTROL SOLENOID VALVE INSPECTION

Inspection 1

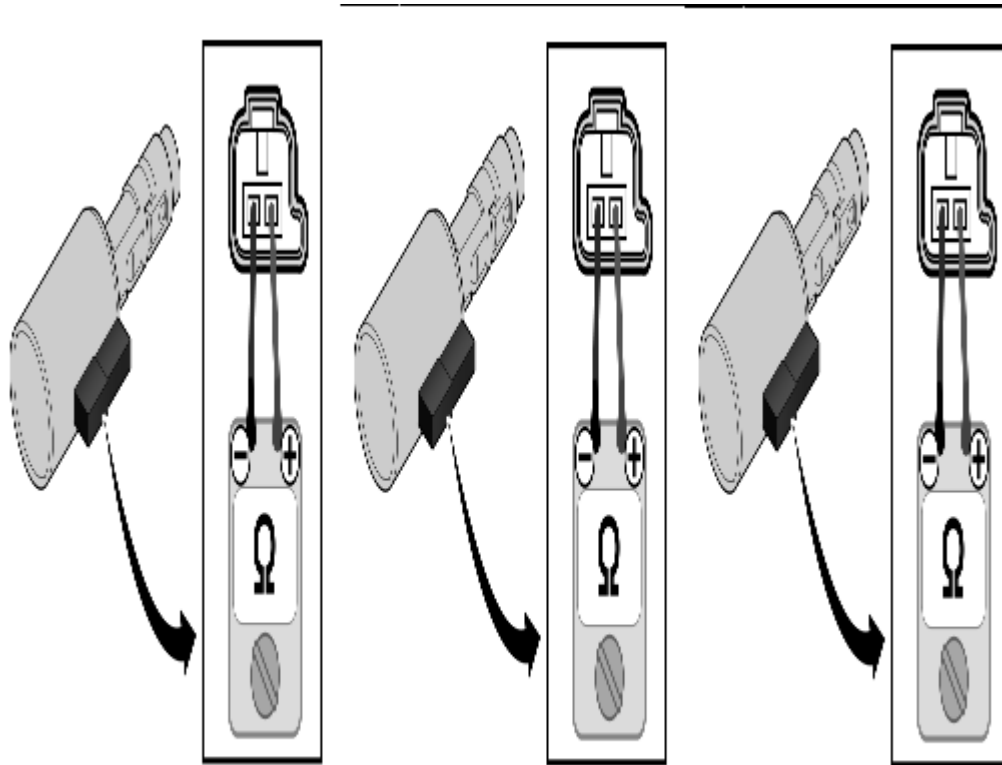


Fig. 21: Pressure Control Solenoid Valve Inspection 1
Courtesy of GENERAL MOTORS COMPANY

1. Remove the control valve body cover.
2. Remove the control valve body.

NOTE:

- Do not remove the pressure control solenoid from the valve body.
- Do not apply any impact to the solenoid.

3. With a tester, measure the resistance between terminal 1 and 2 of each solenoid.

Specification

The resistance at 20°C (68°F) is between 5.0-5.6 ohms.

Inspection 2

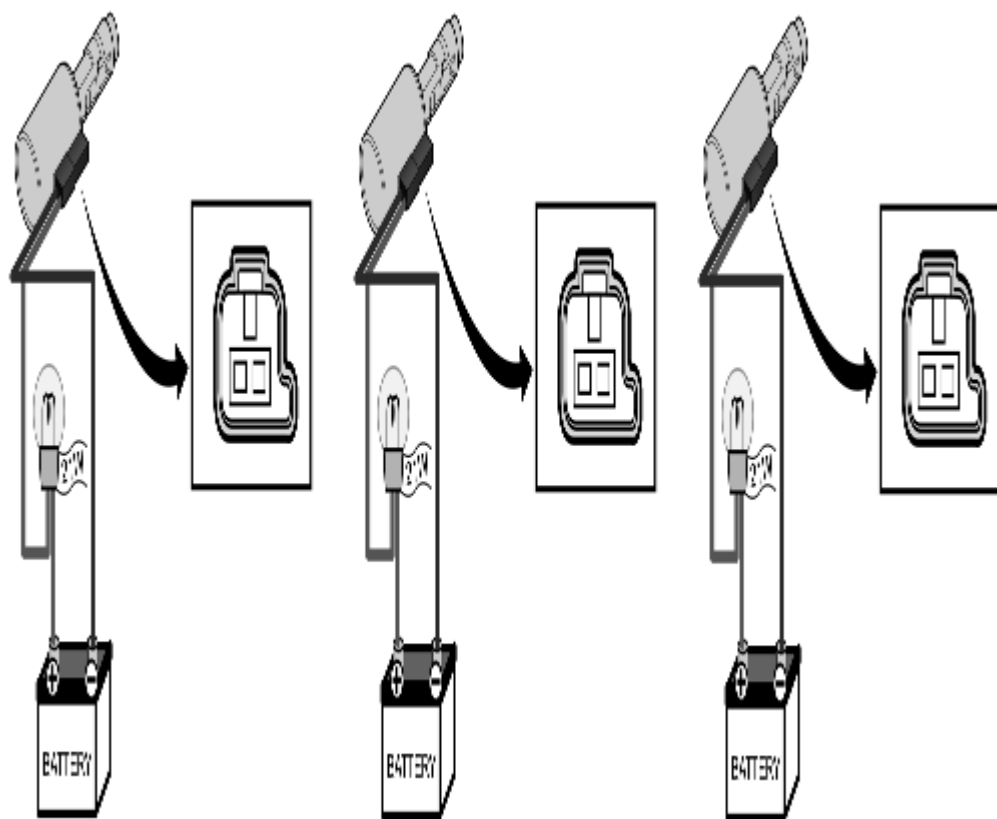


Fig. 22: Pressure Control Solenoid Valve Inspection 2
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- Do not apply any impact to the solenoid.
- Do not damage the terminals.

Connect a positive lead with a bulb (12-21 w), from the battery to terminal 1 of each solenoid and connect a negative lead to terminal 2, and then check that the solenoid operates.

TRANSMISSION FLUID TEMPERATURE SENSOR INSPECTION

Inspection 1

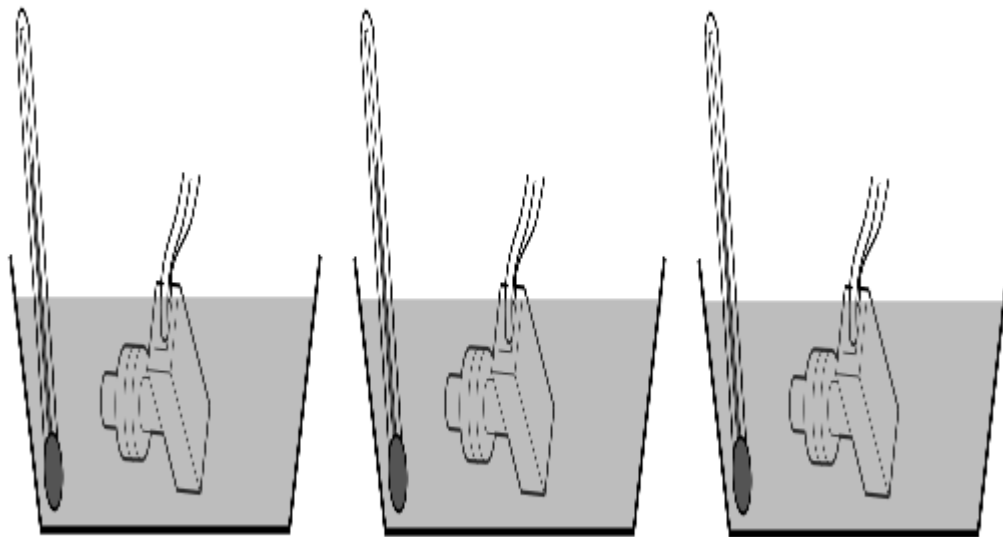


Fig. 23: Transmission Fluid Temperature (TFT) sensor
Courtesy of GENERAL MOTORS COMPANY

1. Warm up ATF and insert the transmission fluid temperature (TFT) sensor in ATF.
2. Measure the resistance between terminals 1 and 7 of the TFT connector at 10°C (50°F) and 110°C (230°F).
3. If the resistance measurement of 10°C (50°F) is not between 5.626-7.303 kohms, replace the TFT sensor.
4. If the resistance measurement of 110°C (230°F) is not between 0.224-0.271 kohms, replace the TFT sensor.

Inspection 2

With a tester, check for continuity between each of the connector terminal combinations as the specification.

Specification

Continuity between the terminal 1 (OT) or 7 (OTG) and ground is no.

REPAIR INSTRUCTIONS - ON VEHICLE

AUTOMATIC TRANSMISSION RANGE SELECTOR LEVER REPLACEMENT

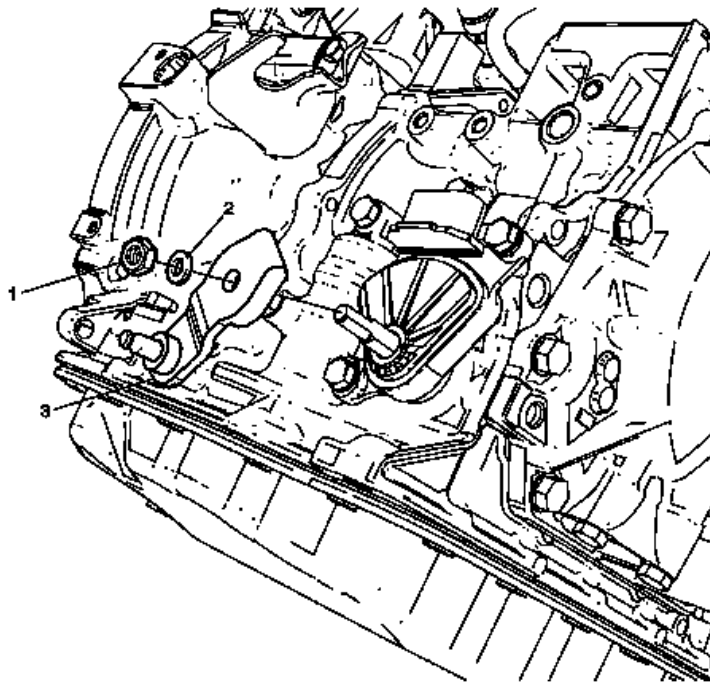


Fig. 24: Automatic Transmission Range Selector Lever Fastener
 Courtesy of GENERAL MOTORS COMPANY

Automatic Transmission Range Selector Lever Replacement

Callout	Component Name
Preliminary Procedures 1. Ensure that the shift control range select lever is in the park (P) position. 2. Remove the front bumper fascia opening lower cover. Refer to Front Bumper Fascia Opening Lower Cover Replacement . 3. Disconnect the shift control cable from the transmission range selector lever. 4. Depress the shift control cable retainer clip tabs and remove the shift control cable from the shift control cable bracket.	
1	Automatic Transmission Range Selector Lever Fastener CAUTION: Refer to <u>Fastener Caution</u> . Tighten 12 (106 lb in)
2	Automatic Transmission Range Selector Lever Washer
3	Automatic Transmission Range Selector Lever

RANGE SELECTOR LEVER CABLE REPLACEMENT

Removal Procedure

1. Set the park brake and chock the wheels.
2. Remove the air cleaner assembly. Refer to [Air Cleaner Assembly Replacement](#).

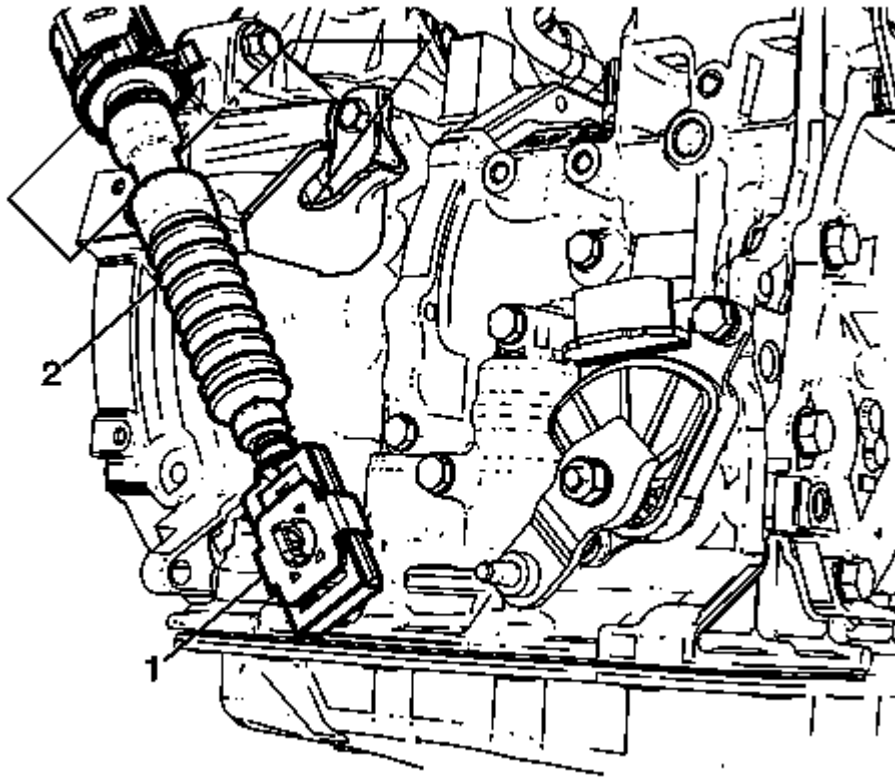


Fig. 25: Transmission Range Selector Lever Cable
Courtesy of GENERAL MOTORS COMPANY

3. Position the transmission manual shift lever into the park position.
4. Disconnect the transmission range selector lever cable terminal (1) from the transmission range selector lever.
5. Press the retainer clip tabs inward in order to release the transmission range selector lever cable (2) from the cable bracket.

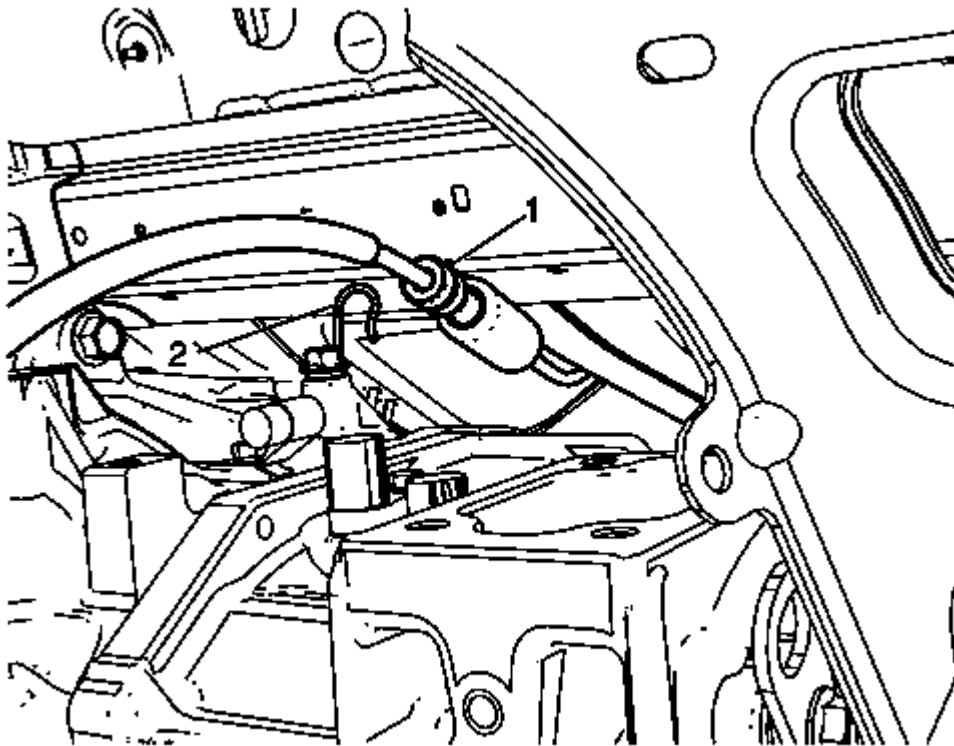


Fig. 26: Cable Clamp And Cable
Courtesy of GENERAL MOTORS COMPANY

6. Disconnect the cable (1) from the cable clamp (2).
7. Remove the console. Refer to **Front Floor Console Replacement** .

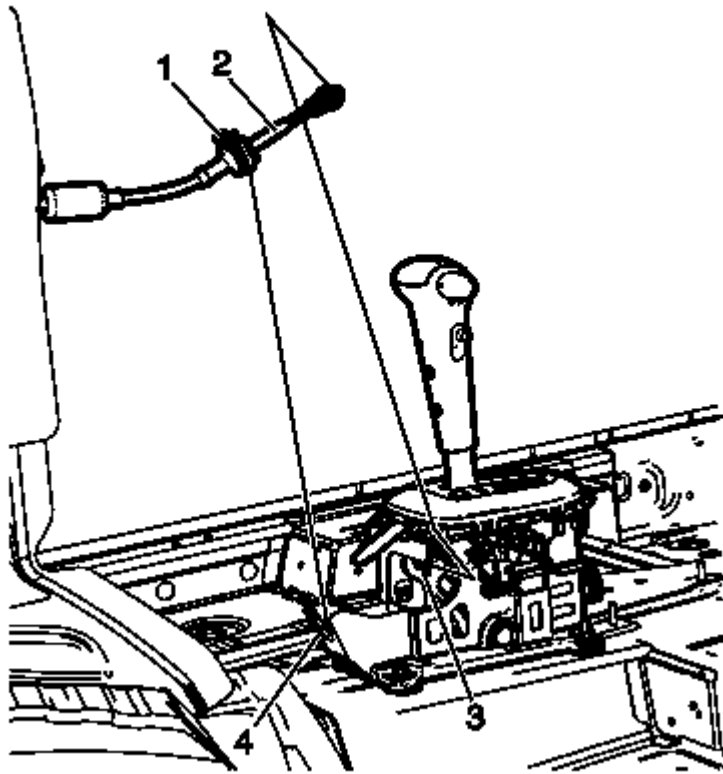


Fig. 27: Transmission Range Selector Lever Cable Terminal And Shift Lever Pin
Courtesy of GENERAL MOTORS COMPANY

8. Disconnect the transmission range selector lever cable terminal (2) from the shift lever pin (3).
9. Release the transmission range selector lever cable retainer (1) and remove the transmission range selector cable from the transmission control lever base (4).

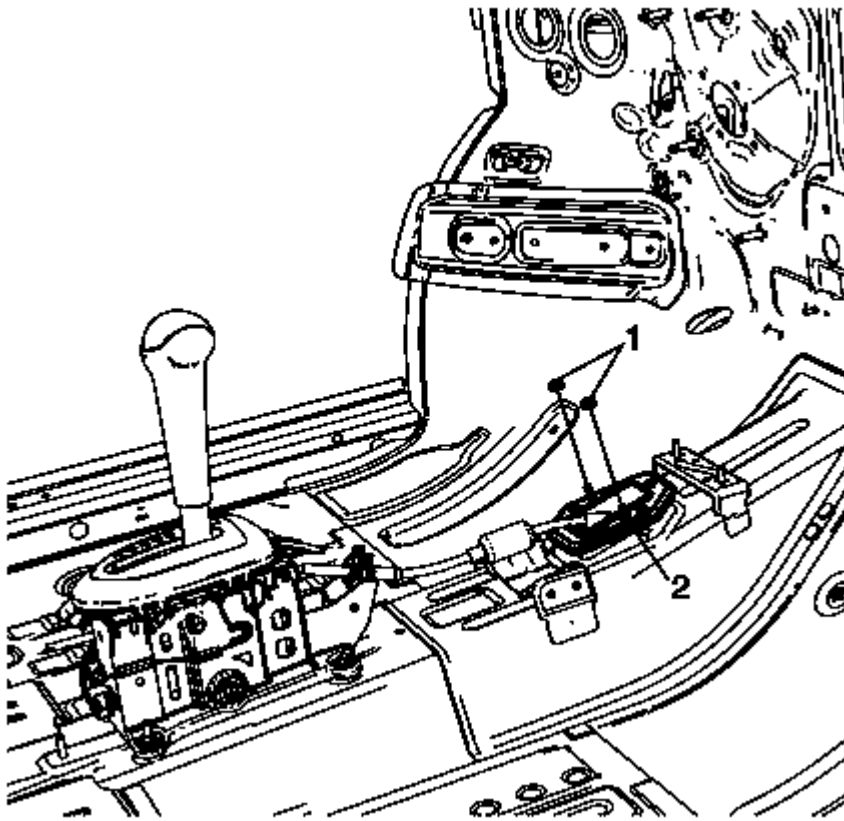


Fig. 28: Transmission Range Selector Lever Cable Grommet Nuts
Courtesy of GENERAL MOTORS COMPANY

10. Remove the transmission range selector lever cable grommet nuts (1).
11. Remove the transmission range selector lever cable grommet (2).
12. Remove the transmission range selector lever cable from the vehicle.

Installation Procedure

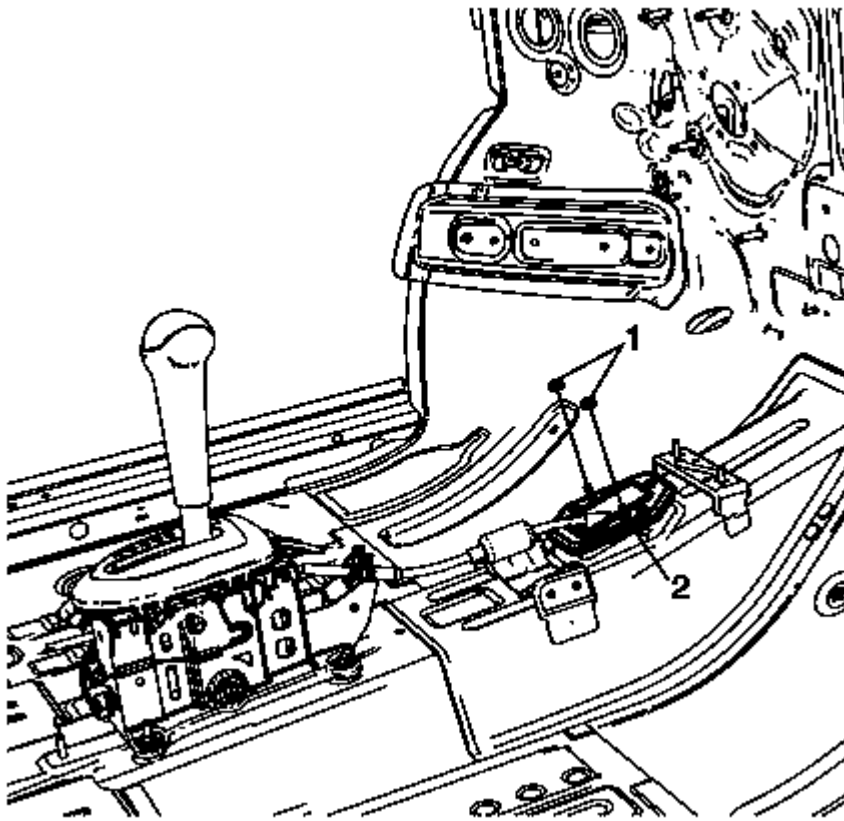


Fig. 29: Transmission Range Selector Lever Cable Grommet Nuts
Courtesy of GENERAL MOTORS COMPANY

1. Verify that the transmission manual shift lever is in the park position.
2. Install the transmission range selector lever cable to the vehicle.
3. Install the transmission range selector lever cable grommet (2).

CAUTION: Refer to Fastener Caution .

4. Install the transmission range selector lever cable grommet nuts (1) and tighten to 6 (53 lb in).

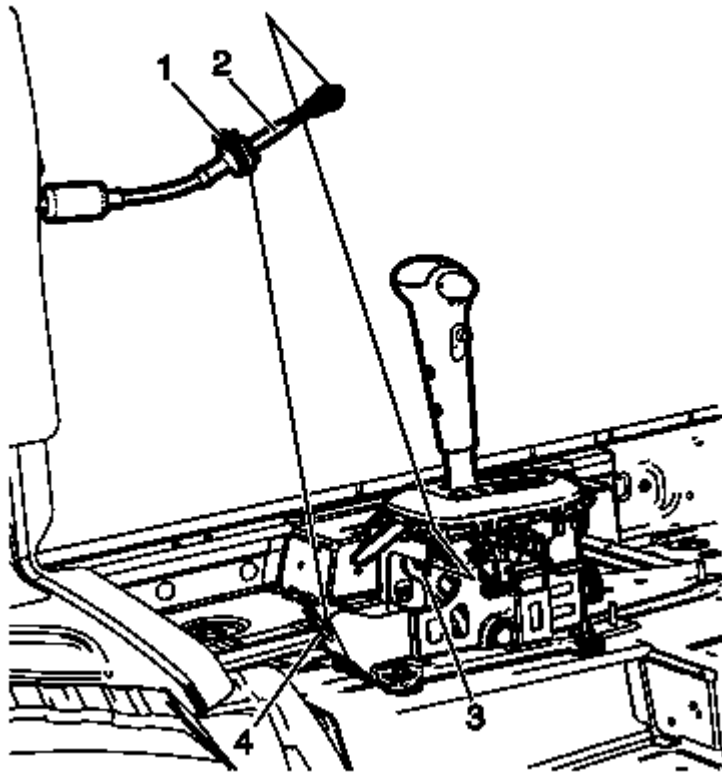


Fig. 30: Transmission Range Selector Lever Cable Terminal And Shift Lever Pin
Courtesy of GENERAL MOTORS COMPANY

5. Install the transmission range selector lever cable to the transmission control lever base. Insure the cable retainer (1) is fully secured to the transmission control lever base (4).
6. Connect the transmission range selector lever cable terminal (2) to the shift lever pin (3).
7. Install the console. Refer to **Front Floor Console Replacement** .

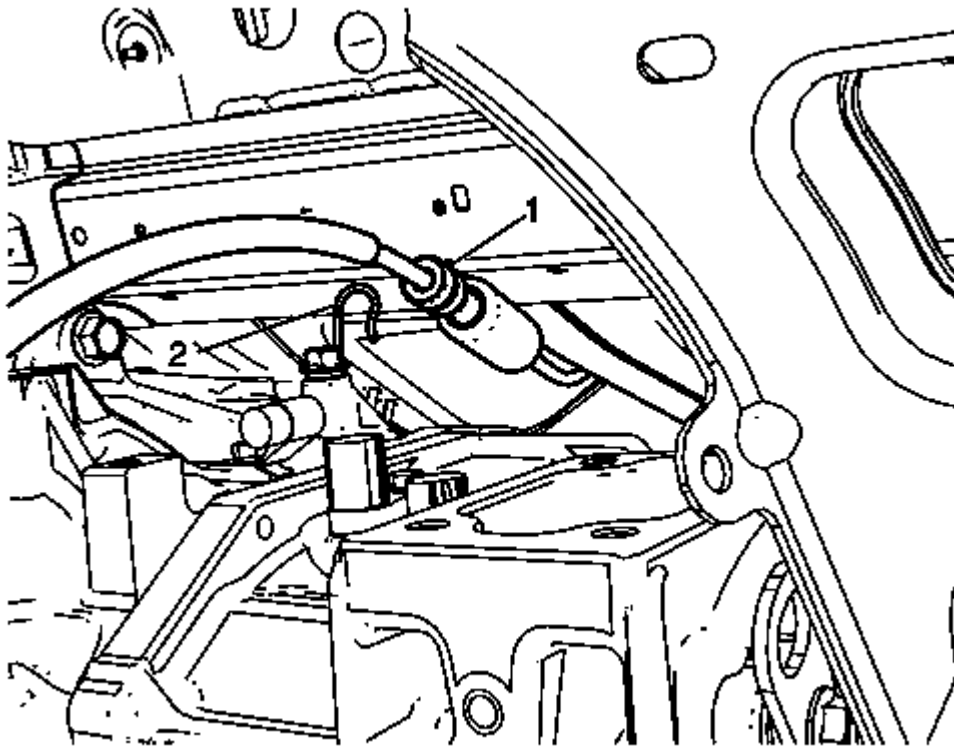


Fig. 31: Cable Clamp And Cable

Courtesy of GENERAL MOTORS COMPANY

8. Connect the cable (1) from the cable clamp (2).

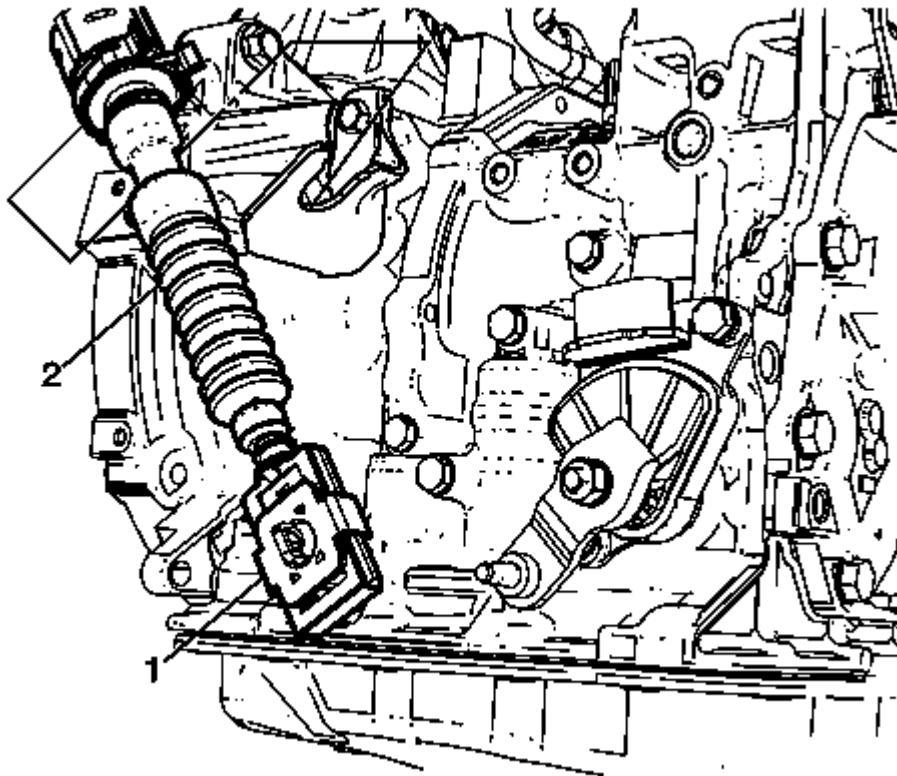


Fig. 32: Transmission Range Selector Lever Cable
Courtesy of GENERAL MOTORS COMPANY

9. Install the transmission range selector lever cable (2) to the cable bracket.
10. Connect the transmission range selector lever cable terminal (1) to the transmission range selector lever.
11. Adjust the automatic transmission range selector lever cable. Refer to **Range Selector Lever Cable Adjustment**.
12. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement**.

RANGE SELECTOR LEVER CABLE ADJUSTMENT

NOTE: Adjust the automatic transmission range selector cable while the transmission and the gear selector are in the Park position only. Failure to do so may cause miss-adjustment.

1. Set the park brake and chock the wheels.
2. Remove the front bumper fascia opening lower cover. Refer to **Front Bumper Fascia Opening Lower Cover Replacement**.
3. Verify the transmission range select lever is in the park (P) position.
4. Verify the transmission manual shift lever is in the P position.

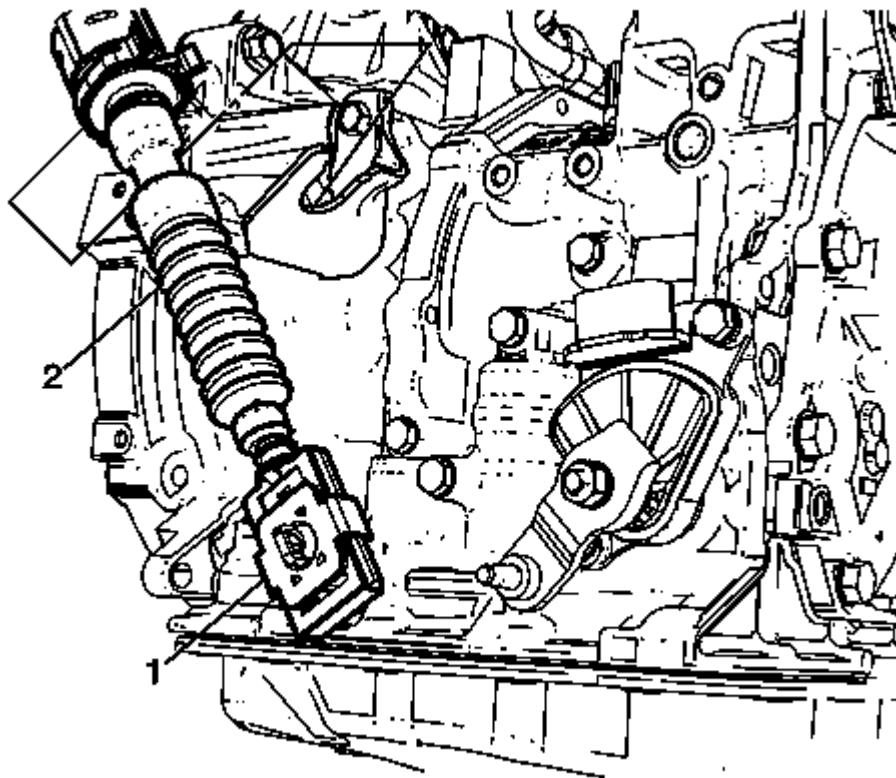


Fig. 33: Transmission Range Selector Lever Cable
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect the transmission range selector lever cable terminal (1) from the transmission range selector lever.
6. Press the retainer clip tabs inward in order to release the transmission range selector lever cable (2) from the cable bracket.

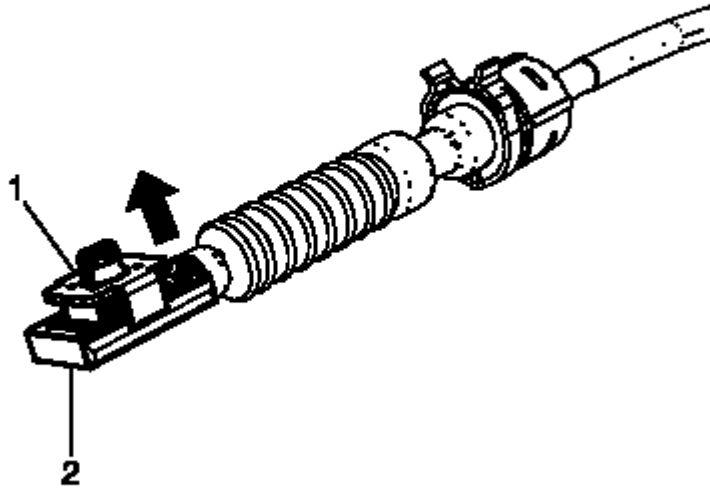


Fig. 34: Cable Adjuster And Cable Adjuster Guide
Courtesy of GENERAL MOTORS COMPANY

7. Pull up on the cable adjuster (1) from the cable adjuster guide (2).

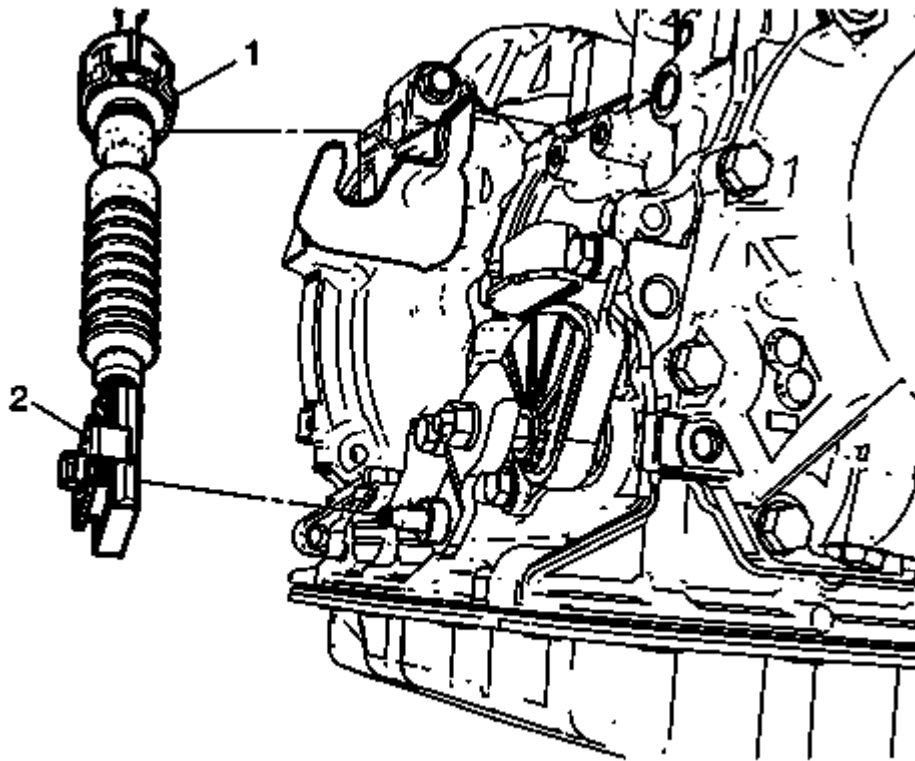


Fig. 35: Transmission Range Selector Lever Cable
Courtesy of GENERAL MOTORS COMPANY

8. Install the transmission range selector lever cable (1) to the cable bracket.
9. Connect the range selector lever cable adjuster (2) to the transmission range selector lever pin.

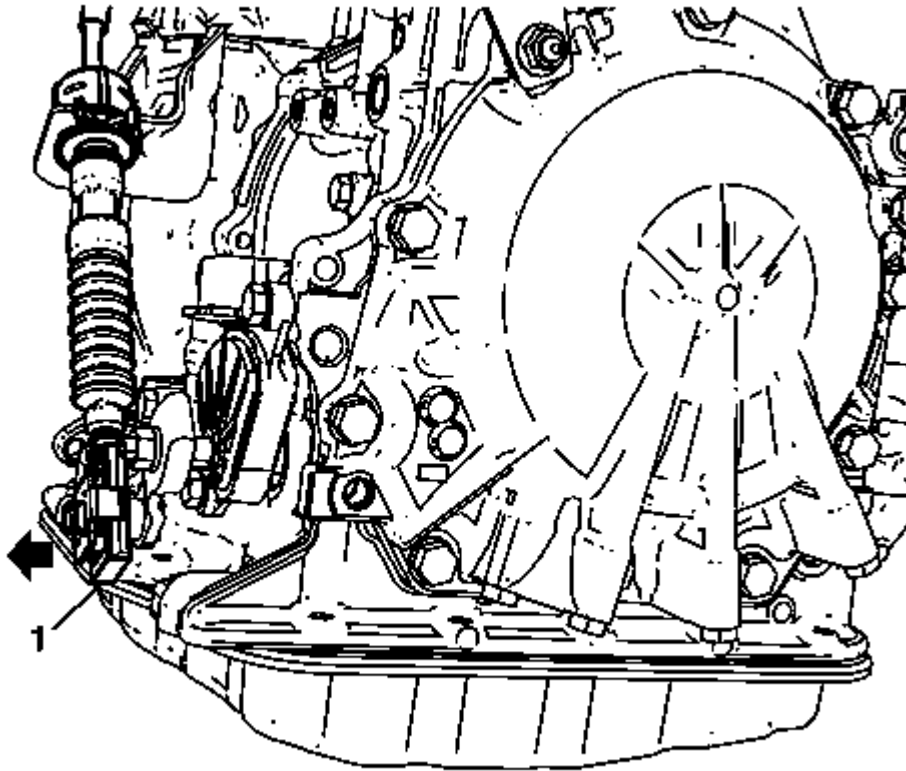


Fig. 36: Cable Adjuster Guide

Courtesy of GENERAL MOTORS COMPANY

10. Pull up on the cable adjuster guide (1) to secure in place.
11. Install the front bumper fascia opening lower cover. Refer to **Front Bumper Fascia Opening Lower Cover Replacement** .
12. Check the transmission range select lever in all gear selections for proper operation.

RANGE SELECTOR LEVER CABLE BRACKET REPLACEMENT

Removal Procedure

1. Set the park brake and chock the wheels.
2. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .

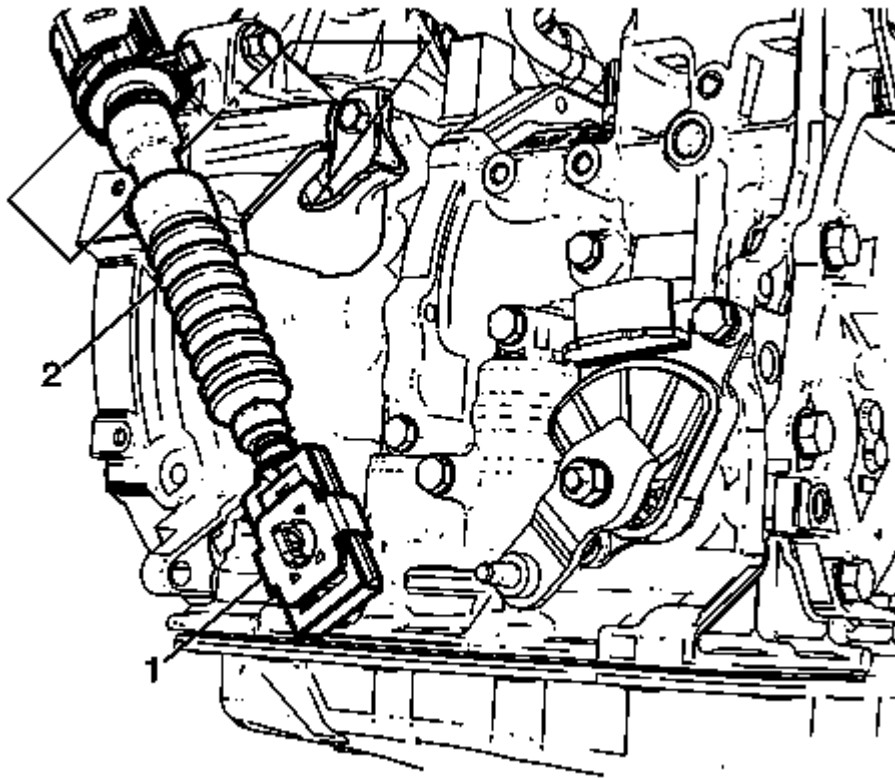


Fig. 37: Transmission Range Selector Lever Cable
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the transmission range selector lever cable terminal (1) from the range selector lever.
4. Disconnect the range selector lever cable (2) from the range selector lever cable bracket.

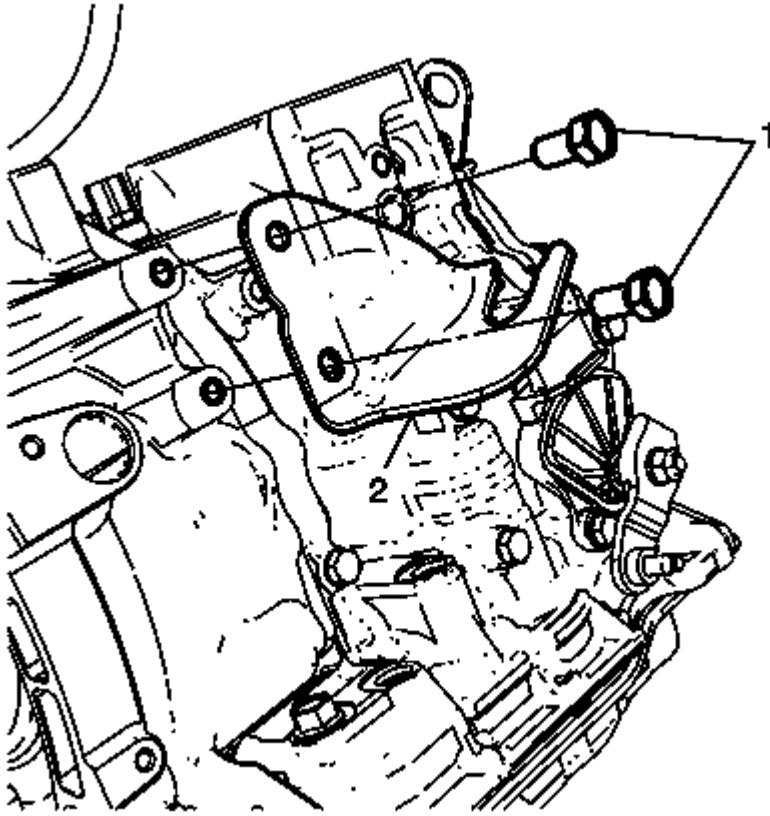


Fig. 38: Transmission Range Selector Cable Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the transmission range selector cable bracket bolts (1).
6. Remove the transmission range selector cable bracket (2).

Installation Procedure

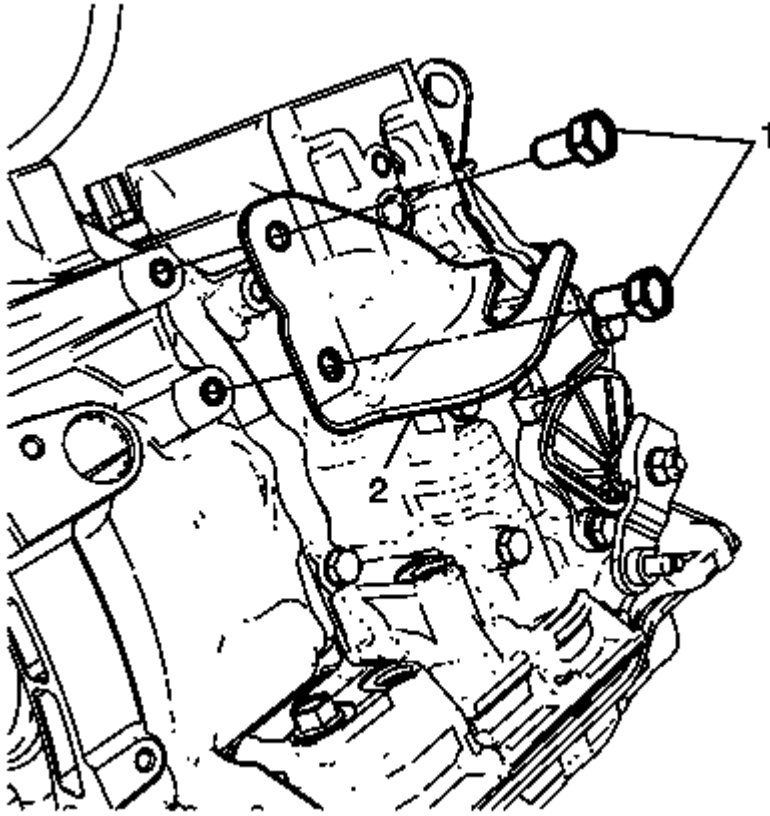


Fig. 39: Transmission Range Selector Cable Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the transmission range selector cable bracket (2).

CAUTION: Refer to Fastener Caution .

2. Install the transmission range selector lever cable bracket bolts (1) and tighten to 22 (16 lb ft).

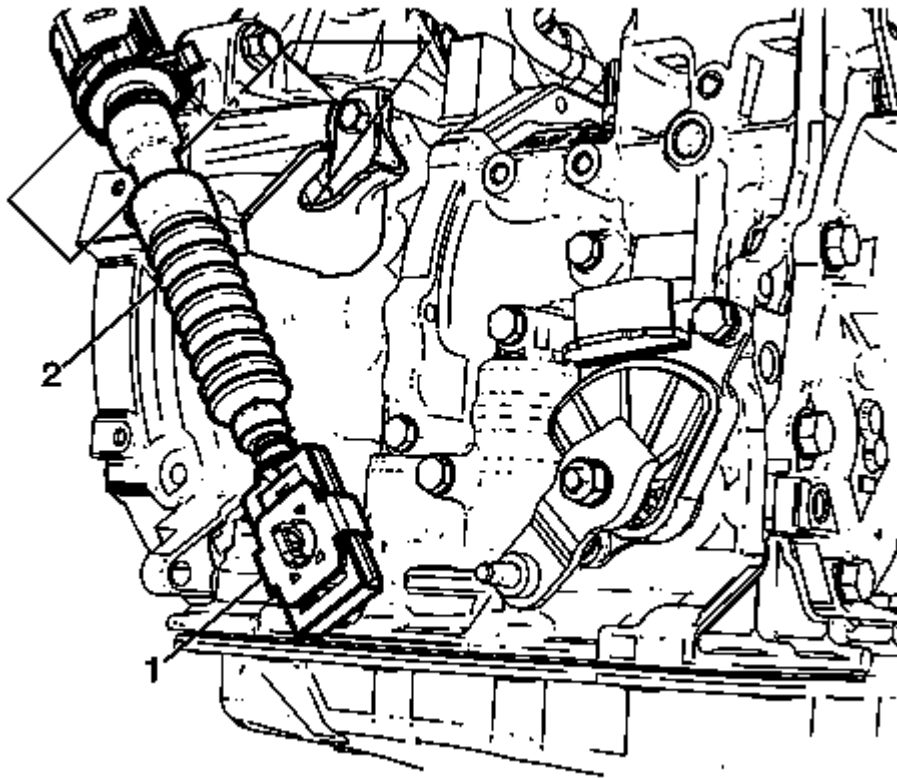


Fig. 40: Transmission Range Selector Lever Cable
Courtesy of GENERAL MOTORS COMPANY

3. Connect the range selector lever cable (2) to the range selector lever cable bracket.
4. Connect the transmission range selector lever cable terminal (1) to the range selector lever.
5. Check the range selector lever cable adjustment. Refer to **Range Selector Lever Cable Adjustment**.
6. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .

TRANSMISSION CONTROL LEVER KNOB REPLACEMENT

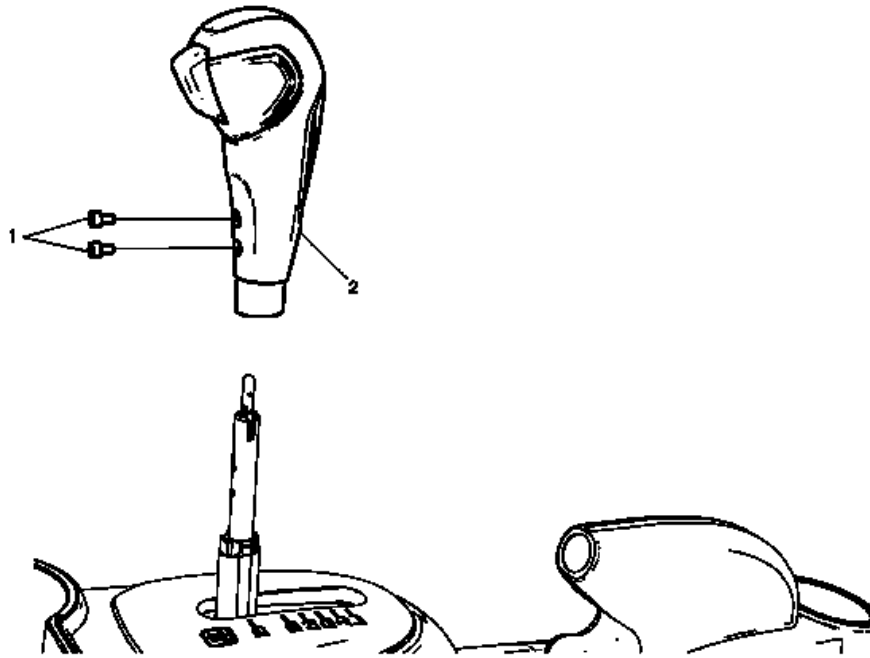


Fig. 41: Transmission Control Lever Knob
 Courtesy of GENERAL MOTORS COMPANY

Transmission Control Lever Knob Replacement

Callout	Component Name
1	Transmission Control Lever Knob Fastener (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 3 (27 lb in)
2	Transmission Control Lever Knob Procedure Remove the transmission control lever knob from the transmission control.

TRANSMISSION CONTROL REPLACEMENT

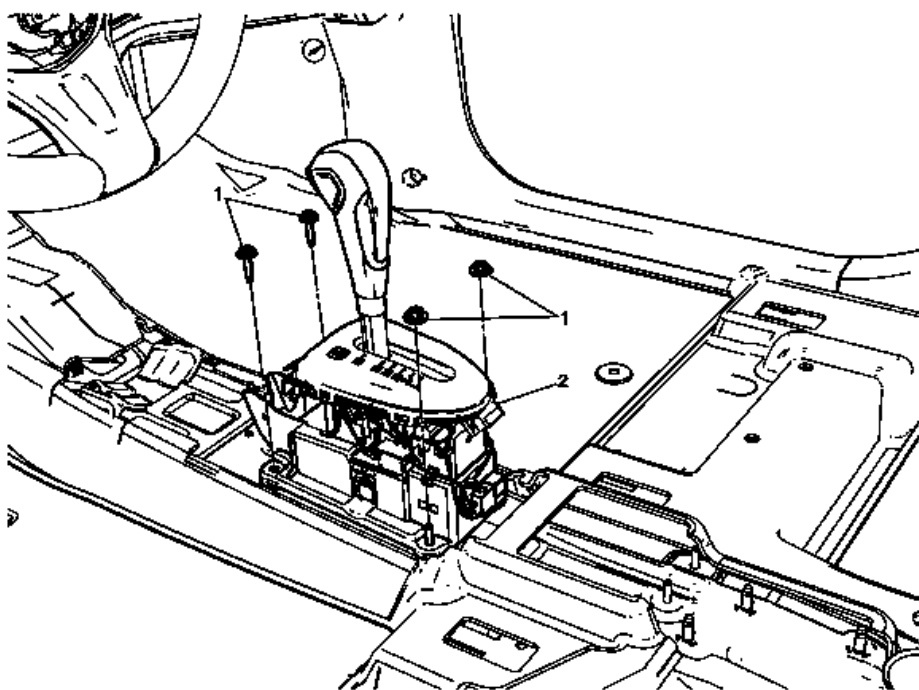


Fig. 42: Transmission Control
 Courtesy of GENERAL MOTORS COMPANY

Transmission Control Replacement

Callout	Component Name
Preliminary Procedure Remove floor console. Refer to Front Floor Console Replacement .	
1	Transmission Control Fastener (Qty: 4) CAUTION: Refer to Fastener Caution . Procedure 1. Remove the clips on the wiring harness and disconnect the shift control electrical connector. 2. Disconnect the shift control cable. Tighten 9 (80 lb in)
2	Transmission Control

PARK/NEUTRAL POSITION SWITCH REPLACEMENT

Special Tool

DT-45404 Transmission Indicator Alignment Tool

Removal Procedure

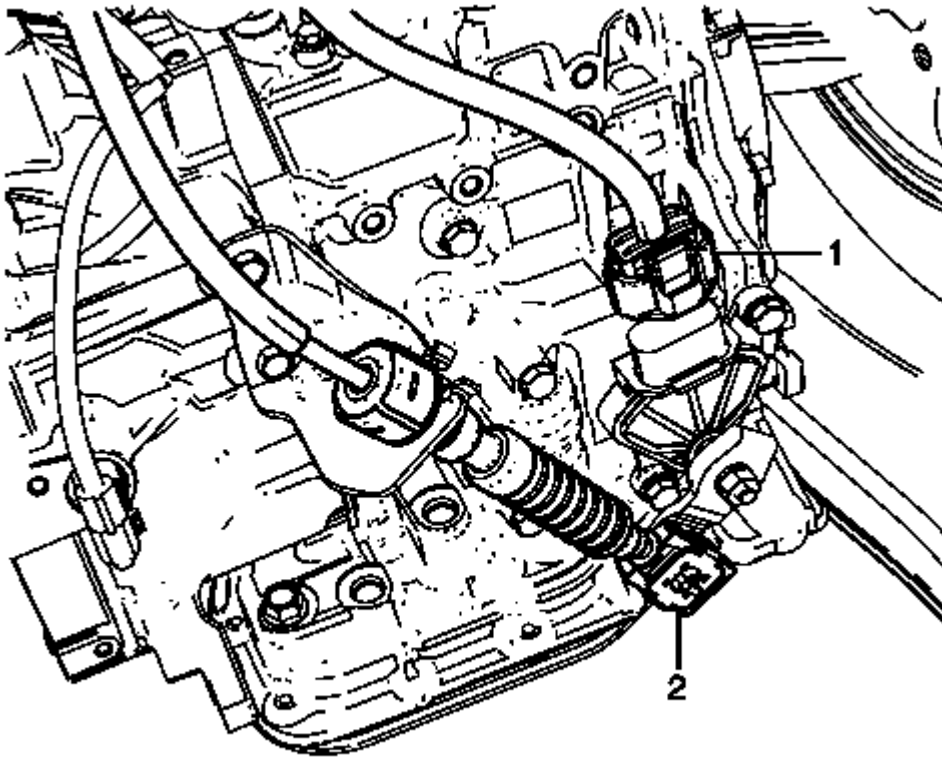


Fig. 43: Negative Battery Cable

Courtesy of GENERAL MOTORS COMPANY

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
2. Remove the front bumper fascia opening lower cover. Refer to **Front Bumper Fascia Opening Lower Cover Replacement** .
3. Disconnect the park/neutral position (PNP) switch electrical connector (1).
4. Disconnect the transmission range selector lever cable terminal (2) from the transmission range selector lever.

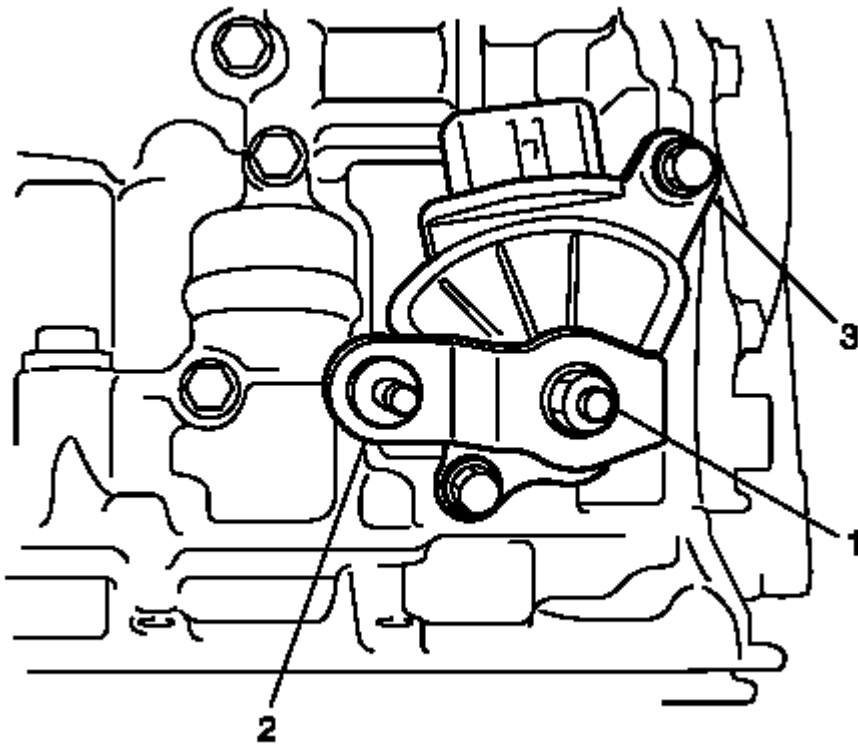


Fig. 44: Spring Washer And Control Shaft Lever
Courtesy of GENERAL MOTORS COMPANY

5. Remove the nut (1), spring washer and control shaft lever (2).
6. Remove the 2 bolts (3).
7. Remove and DISCARD the PNP switch.

Installation Procedure

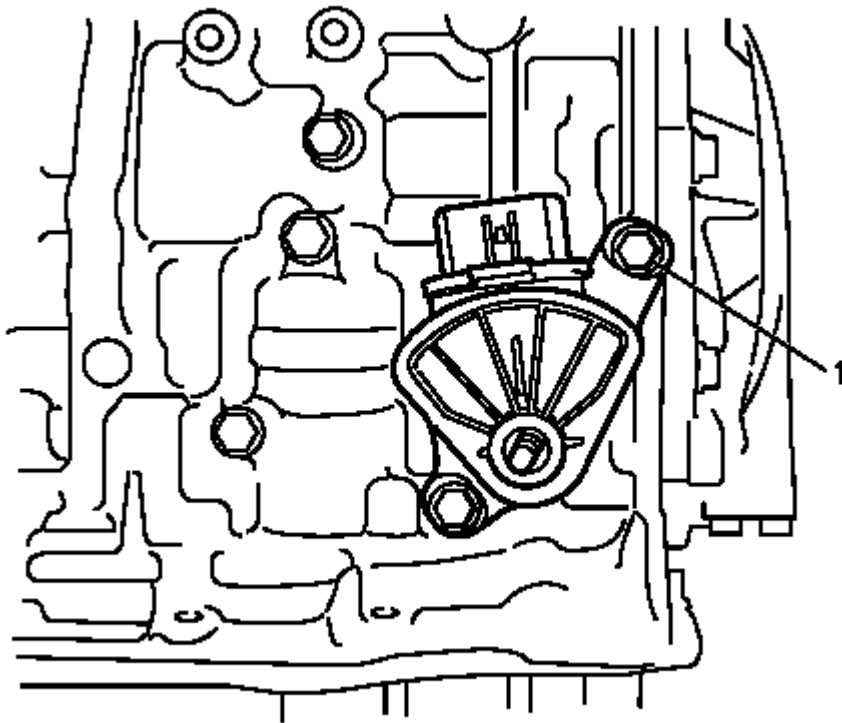


Fig. 45: Park/Neutral Position (PNP) Switch
Courtesy of GENERAL MOTORS COMPANY

NOTE: The park/neutral position (PNP) switch is inserted into the manual valve lever shaft by press fitting. Do NOT reuse the PNP switch once the switch is removed from the shaft. The used PNP switch may cause detection failure of position since the holding part of the used switch is deformed.

1. Install a NEW park/neutral position (PNP) switch onto the manual valve lever shaft and temporarily install the 2 bolts (1).

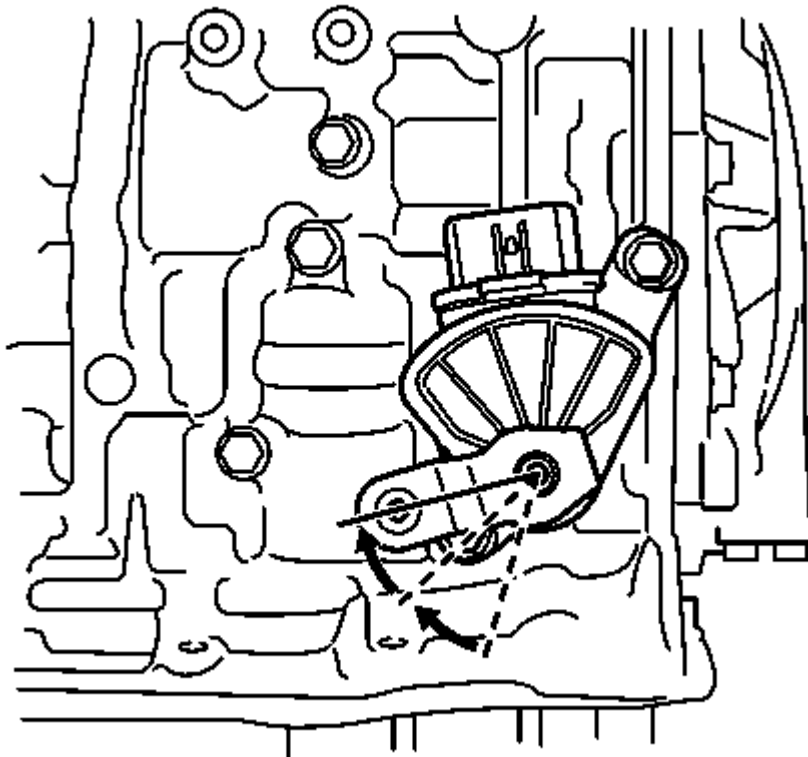


Fig. 46: View Of Range Selector Lever
Courtesy of GENERAL MOTORS COMPANY

2. Install the range selector lever temporarily and move to N (neutral) position.
3. Remove the range selector lever.

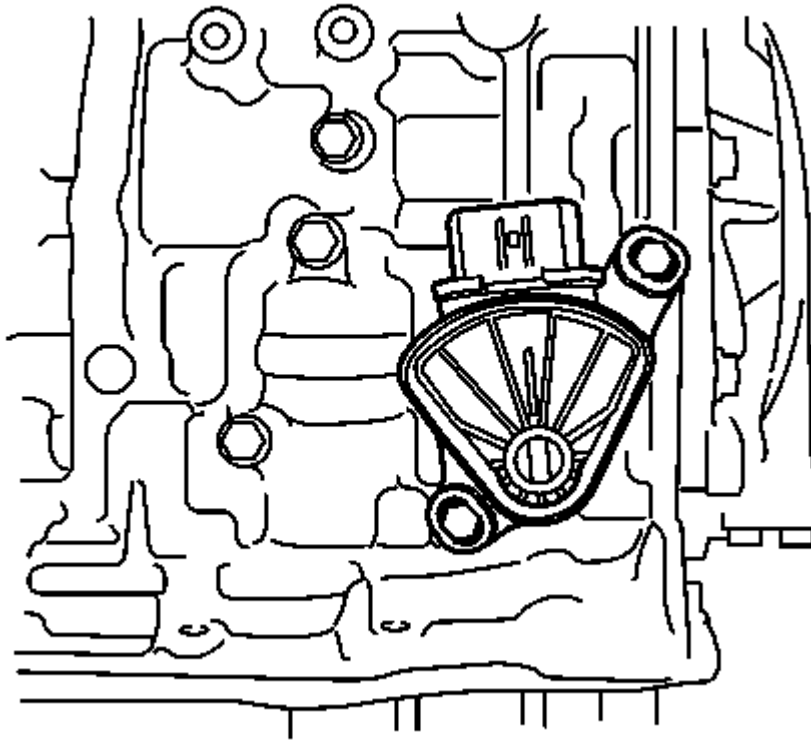


Fig. 47: Selector Lever Shaft With Neutral Basic Line
Courtesy of GENERAL MOTORS COMPANY

4. Install **DT-45404** transmission indicator alignment tool to the manual shaft
5. Align the groove on the switch with the indicator line on DT-45404.

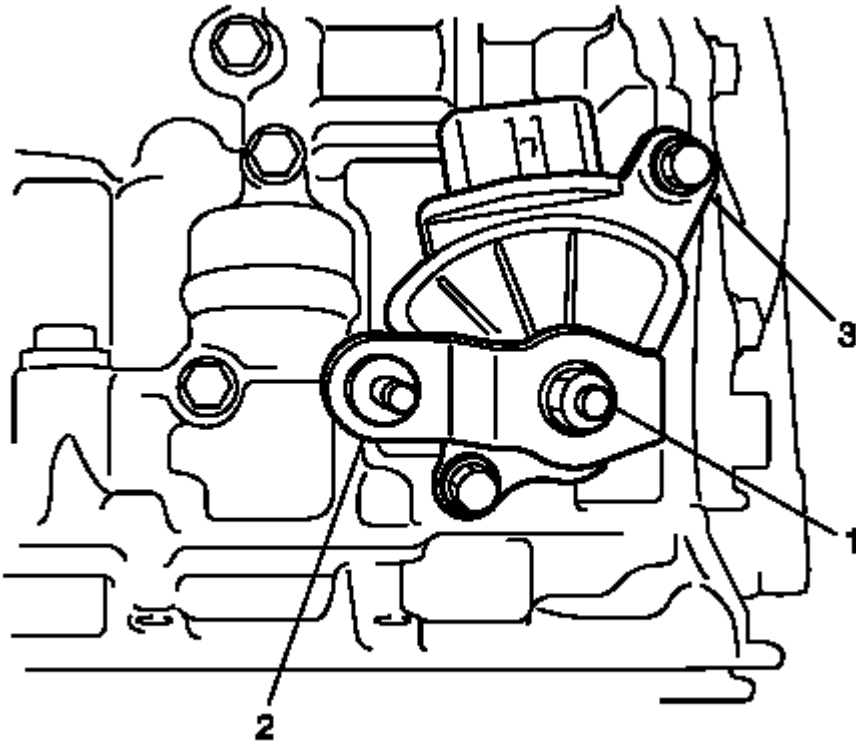


Fig. 48: Spring Washer And Control Shaft Lever
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

6. Install the 2 PNP switch bolts (3) and tighten to 5 (44 lb in).
7. Remove DT-45404 from the manual shaft.
8. Install the range selector lever (2), washer and nut (1) and tighten to 12 (106 lb in).

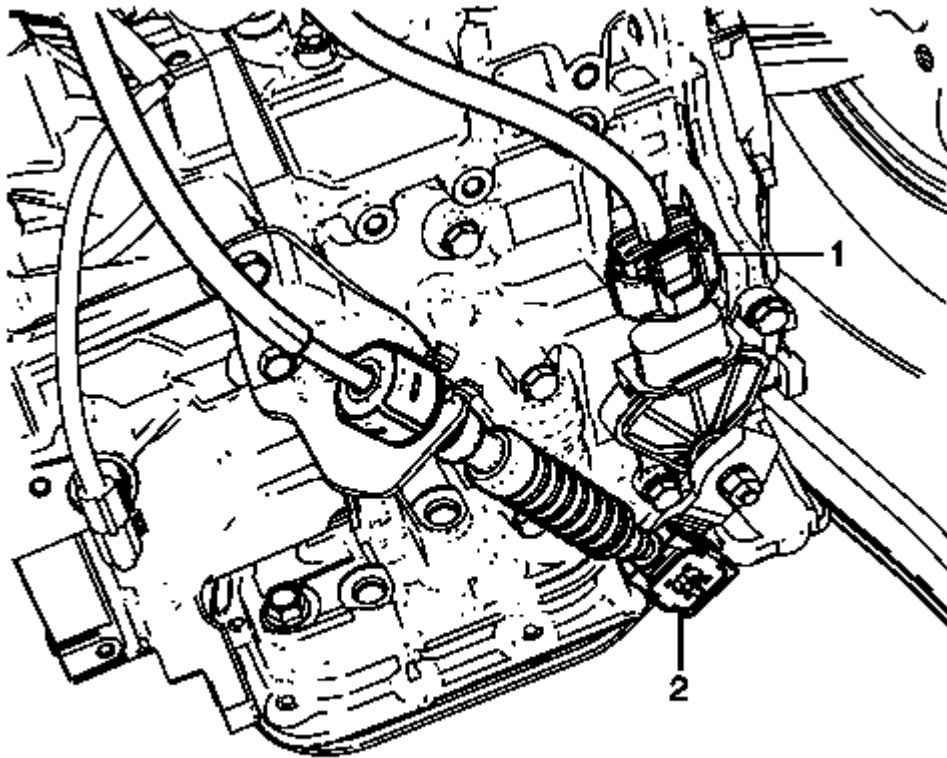


Fig. 49: Negative Battery Cable

Courtesy of GENERAL MOTORS COMPANY

9. Connect the transmission range selector lever cable terminal (2) to the transmission range selector lever.
10. Connect the park/neutral position (PNP) switch electrical connector (1).
11. Adjust the selector lever cable. Refer to **Range Selector Lever Cable Adjustment**.
12. Install the front bumper fascia opening lower cover. Refer to **Front Bumper Fascia Opening Lower Cover Replacement**.
13. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection**.
14. Verify that the engine starts in neutral (N) position.

AUTOMATIC TRANSMISSION FLUID AND FILTER REPLACEMENT

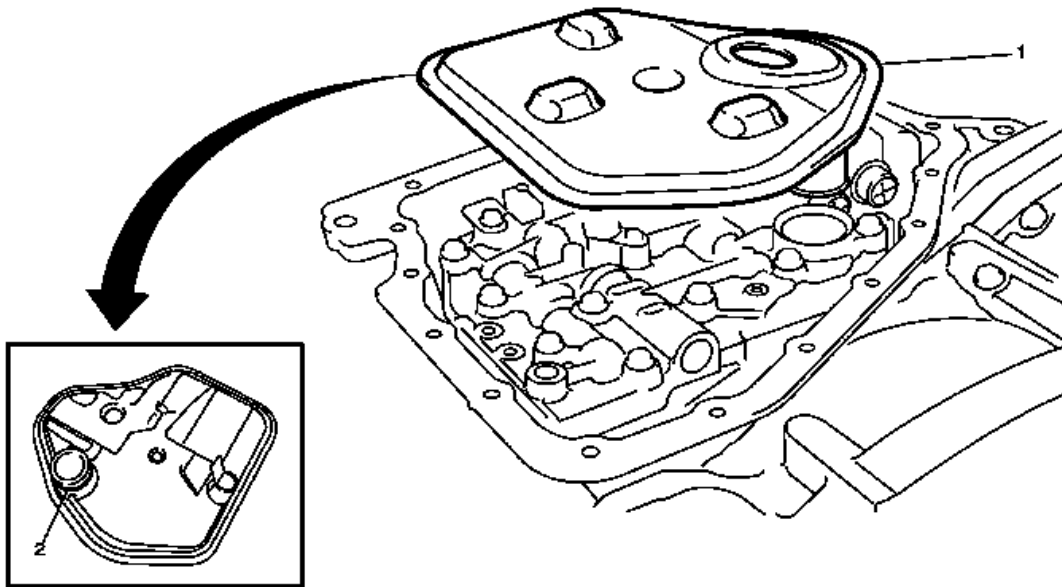


Fig. 50: Automatic Transmission Fluid And Filter
 Courtesy of GENERAL MOTORS COMPANY

Automatic Transmission Fluid and Filter Replacement

Callout	Component Name
Preliminary Procedure	
Remove the control valve body cover. Refer to <u>Control Valve Body Cover Replacement</u> .	
1	Oil Strainer
2	O-Ring TIP: Do not reuse the O-ring.

TRANSMISSION FLUID DRAIN AND FILL

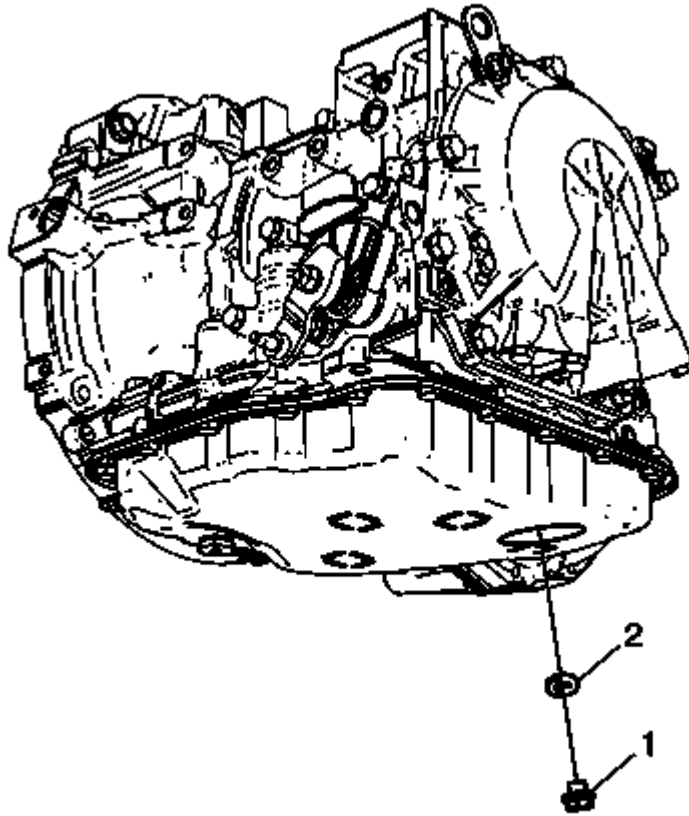


Fig. 51: Transmission Fluid Drain And Fill
Courtesy of GENERAL MOTORS COMPANY

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the drain plug (1) and drain transmission fluid into a suitable container while the engine is stopped.
3. Remove the gasket (2) from the drain plug.
4. Install the NEW gasket (2) to the drain plug.

CAUTION: Refer to Fastener Caution .

5. Install the drain plug (1) and tighten to 17 (13 lb ft).
6. Lower the vehicle.

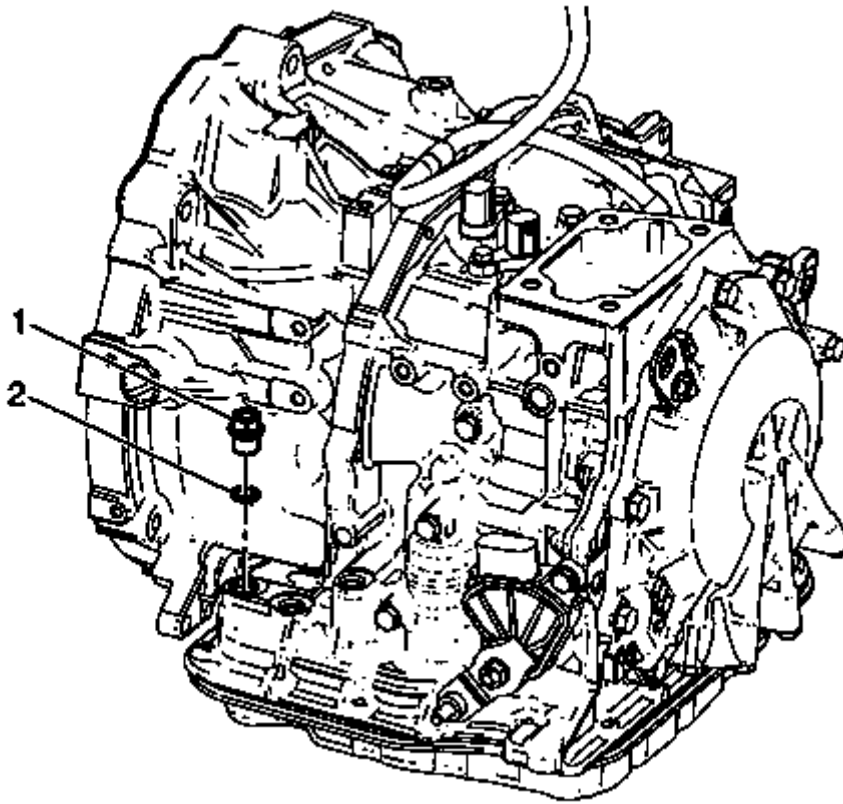


Fig. 52: Fill Plug And Seal

Courtesy of GENERAL MOTORS COMPANY

7. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
8. Remove the range selector lever cable bracket. Refer to **Range Selector Lever Cable Bracket Replacement**.
9. Remove the fill plug (1) and seal (2).
10. Fill the transmission to the proper level with the correct fluid. Refer to **Transmission General Specifications**.
11. Install the fill plug (1) with NEW seal (2) and tighten to 30 (22 lb ft).
12. Install the range selector lever cable bracket. Refer to **Range Selector Lever Cable Bracket Replacement**.
13. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
14. Check the ATF level. Refer to **Transmission Fluid Level and Condition Check**.

TRANSMISSION FLUID COOLER PIPE CONNECTOR REPLACEMENT - RADIATOR

Removal Procedure

1. Drain the cooling system. Refer to **Cooling System Draining and Filling** .
2. Remove the transaxle oil cooler hoses from the oil cooler fittings on the radiator. Refer to **Transmission**

Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection.

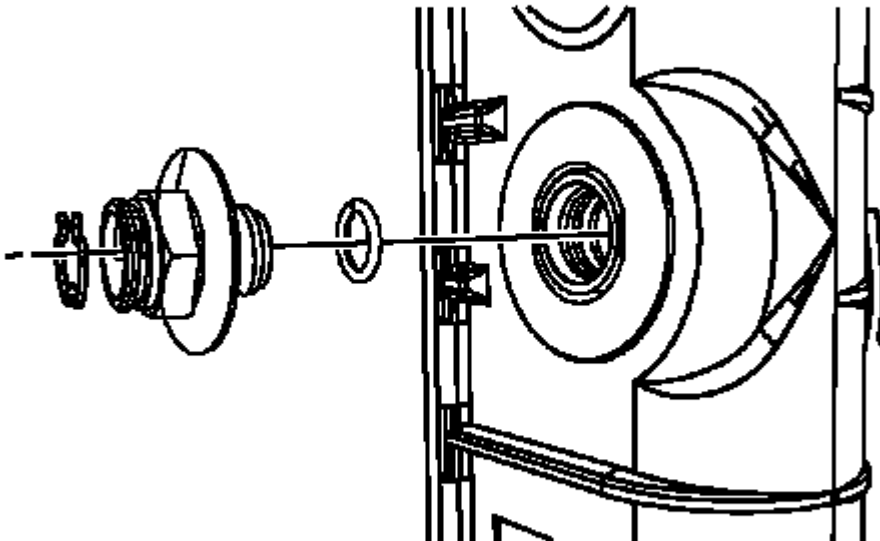


Fig. 53: View Of Oil Cooler Fitting At Radiator
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not remove the upper and lower transaxle oil cooler fittings from the radiator at the same time other wise the transaxle oil cooler will fall inside the radiator end tank.

3. Remove the oil cooler fitting from the radiator.

Installation Procedure

1. Inspect the new O-ring seals for cracks, cuts or damage. Replace if necessary.

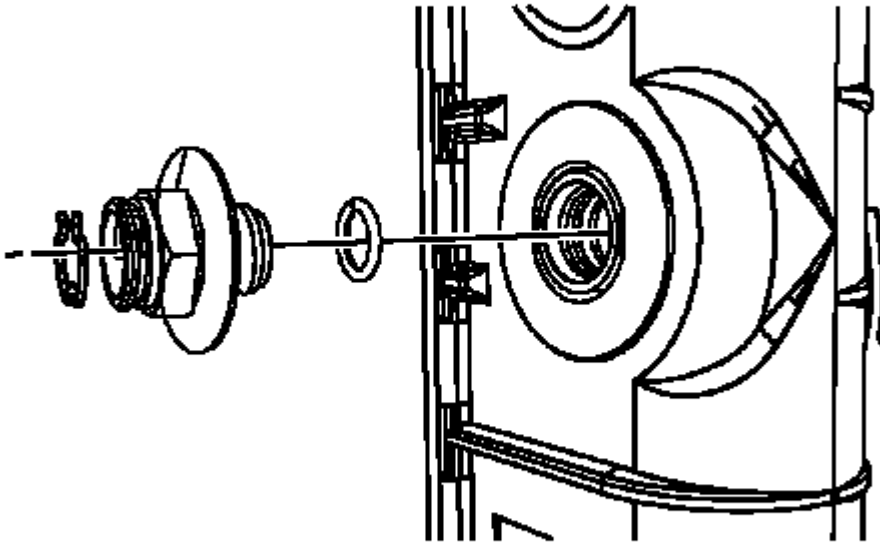


Fig. 54: View Of Oil Cooler Fitting At Radiator
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

NOTE: The correct thread engagement is critical. Cross-threaded fittings can achieve proper tightness and still leak.

2. Install the oil cooler fitting to the radiator and tighten to 20 (15 lb ft).
3. Install the transaxle oil cooler hoses to the oil cooler fittings on the radiator. Refer to Transmission Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection.
4. Fill the cooling system. Refer to Cooling System Draining and Filling .
5. Adjust the transmission fluid level.
6. Inspect for fluid leaks.

TRANSMISSION FLUID COOLER HOSE/PIPE QUICK-CONNECT FITTING DISCONNECTION AND CONNECTION

Removal Procedure

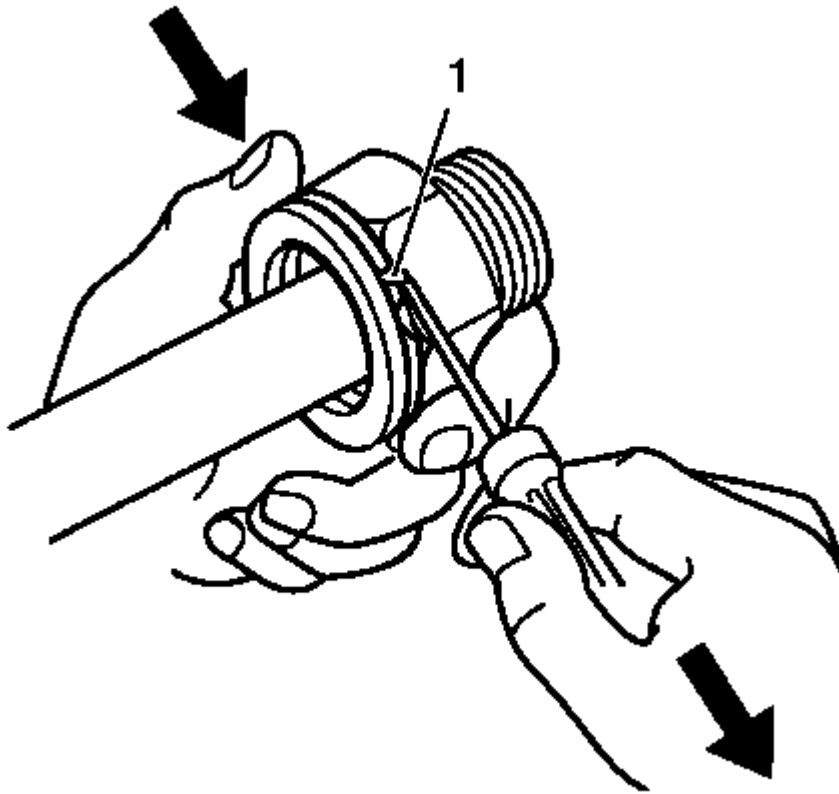


Fig. 55: Automatic Transmission Oil Cooler Fitting Retaining Ring
Courtesy of GENERAL MOTORS COMPANY

NOTE: Perform the following procedure when removing the retaining rings and cooler lines from the quick connect fittings located on the radiator and/or the transmission.

1. Pull the plastic cap back from the quick connect fitting and down along the cooler line about 5 cm (2 in).
2. Using a bent-tip screwdriver, pull on one of the open ends of the retaining ring (1) in order to rotate the retaining ring around the quick connect fitting until the retaining ring is out of position and can be completely removed.
3. Remove the retaining ring from the quick connect fitting.
4. Discard the retaining ring.

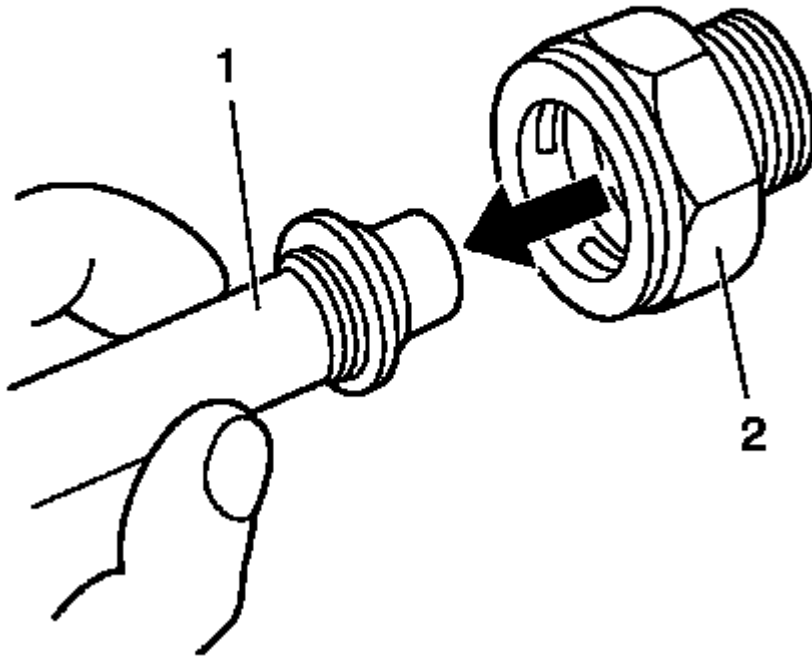


Fig. 56: Automatic Transmission Cooler Line
Courtesy of GENERAL MOTORS COMPANY

5. Pull the cooler line (1) straight out from the quick connect fitting (2).

Installation Procedure

NOTE:

- Do not reuse any of the existing oil lines or oil line fittings if there is excessive corrosion.
- Do not reuse any of the existing retaining rings that were removed from the existing quick connect fittings. Install new retaining rings.
- Ensure the following procedures are performed when installing the new retaining rings onto the fittings.

1. Install a new retaining ring into the quick connect fitting using the following procedure:

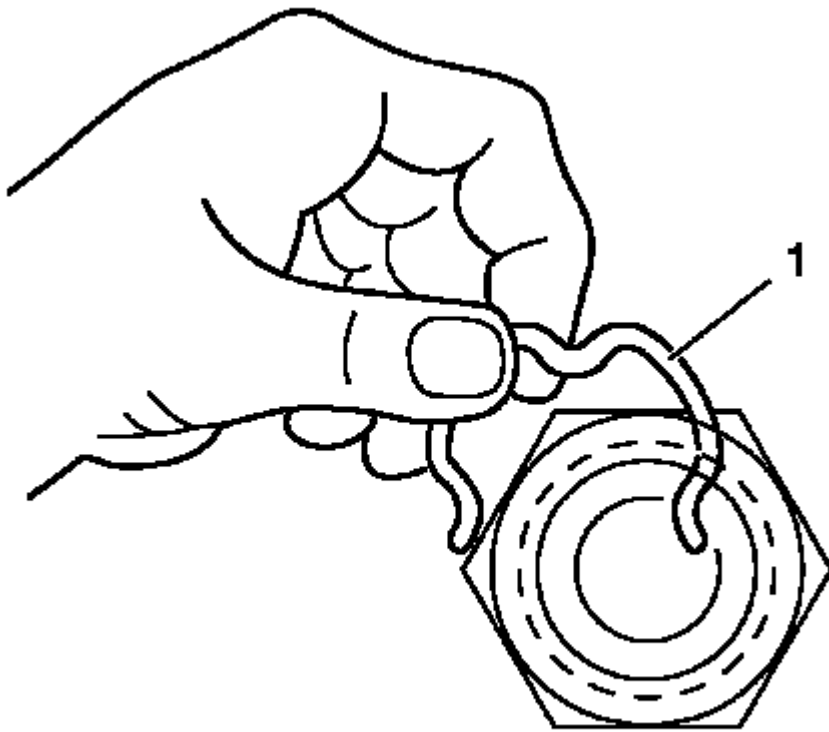


Fig. 57: Automatic Transmission Oil Cooler Fitting Retaining Ring
Courtesy of GENERAL MOTORS COMPANY

2. Hook one of the open ends of the retaining ring (1) in one of the slots in the quick connect fitting.

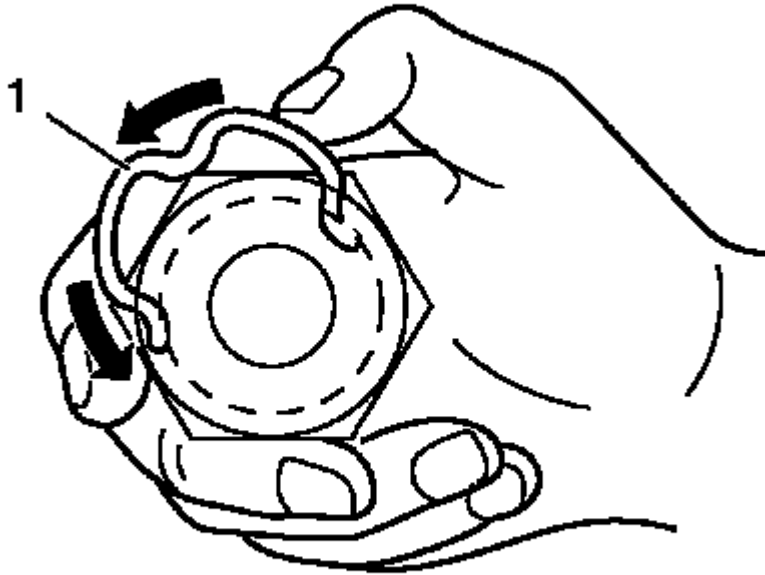


Fig. 58: Rotating Automatic Transmission Oil Cooler Fitting Retaining Ring
Courtesy of GENERAL MOTORS COMPANY

3. Rotate the retaining ring (1) around the fitting until the retaining ring is positioned with all three ears through the three slots on the fitting.

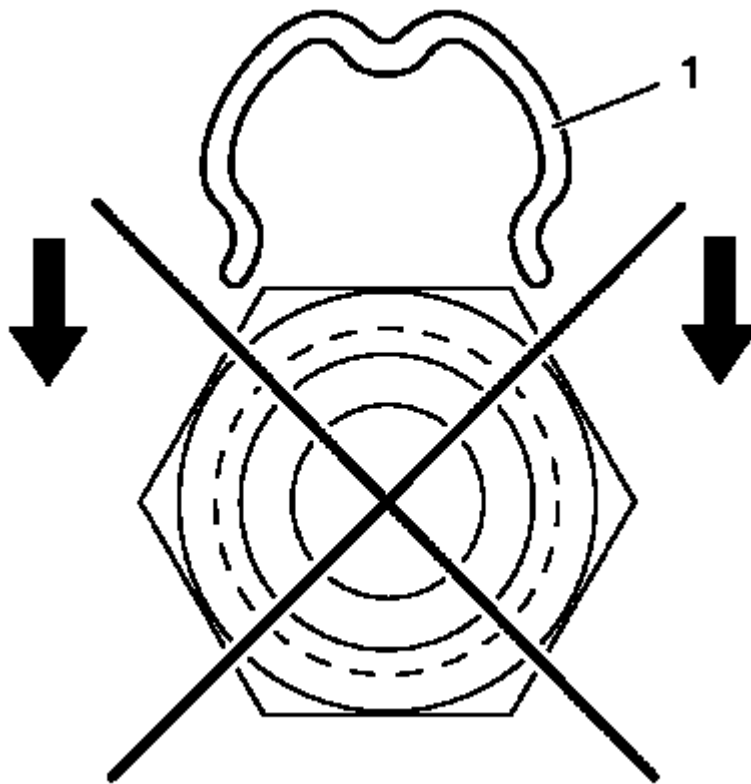


Fig. 59: Automatic Transmission Oil Cooler Fitting Retaining Ring Caution
Courtesy of GENERAL MOTORS COMPANY

4. Do not install the new retaining ring (1) onto the fitting by pushing the retaining ring.

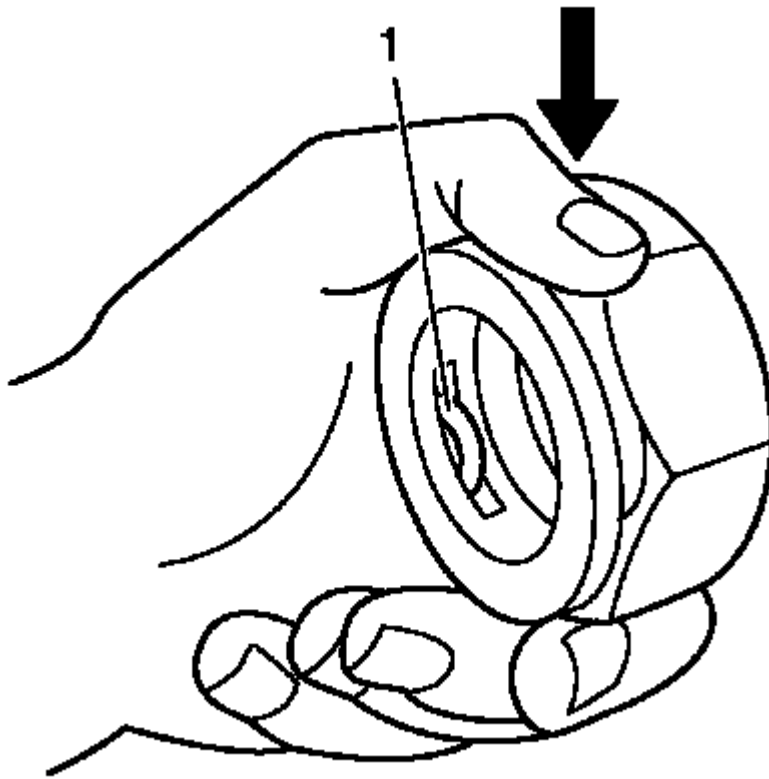


Fig. 60: Retaining Ring Ears

Courtesy of GENERAL MOTORS COMPANY

5. Ensure that the three retaining ring ears are seen from inside the fitting (1) and that the retaining ring moves freely in the fitting slots.

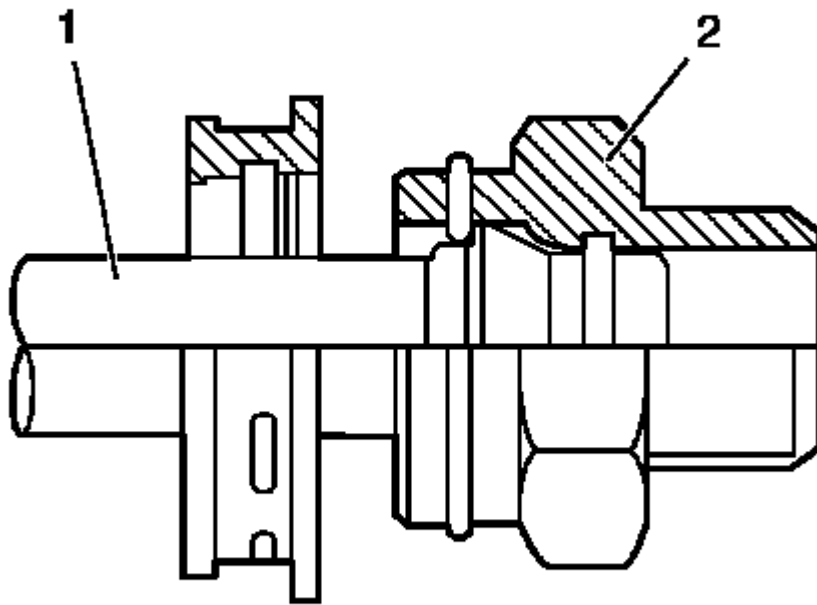


Fig. 61: Cutaway View Of Automatic Transmission Oil Cooler Fitting
Courtesy of GENERAL MOTORS COMPANY

6. Install the cooler line (1) into the quick connect fitting (2).
7. Insert the cooler line end into the quick connect fitting until a click is either heard or felt.

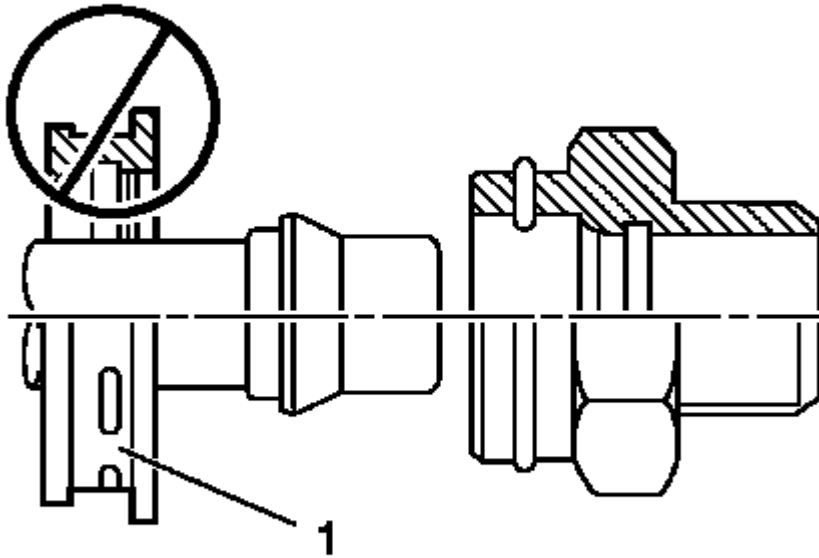


Fig. 62: Automatic Transmission Oil Cooler Line And Fitting Caution
Courtesy of GENERAL MOTORS COMPANY

8. Do not use the plastic cap (1) on the cooler line in order to install the cooler line into the fitting.
9. Pull back sharply on the cooler line in order to ensure that the cooler line is fastened into the quick connect fitting.

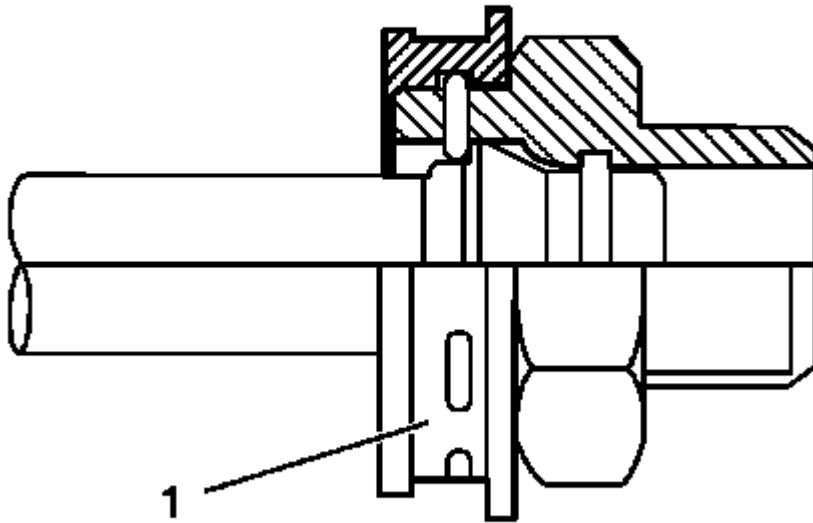


Fig. 63: Automatic Transmission Oil Cooler Fitting Plastic Cap
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not manually depress the retaining clip when installing the plastic cap.

10. Position (snap) the plastic cap (1) onto the fitting. Do not manually depress the retaining ring when installing the plastic cap onto the quick connect fitting.
11. Ensure that the plastic cap is fully seated against the fitting.

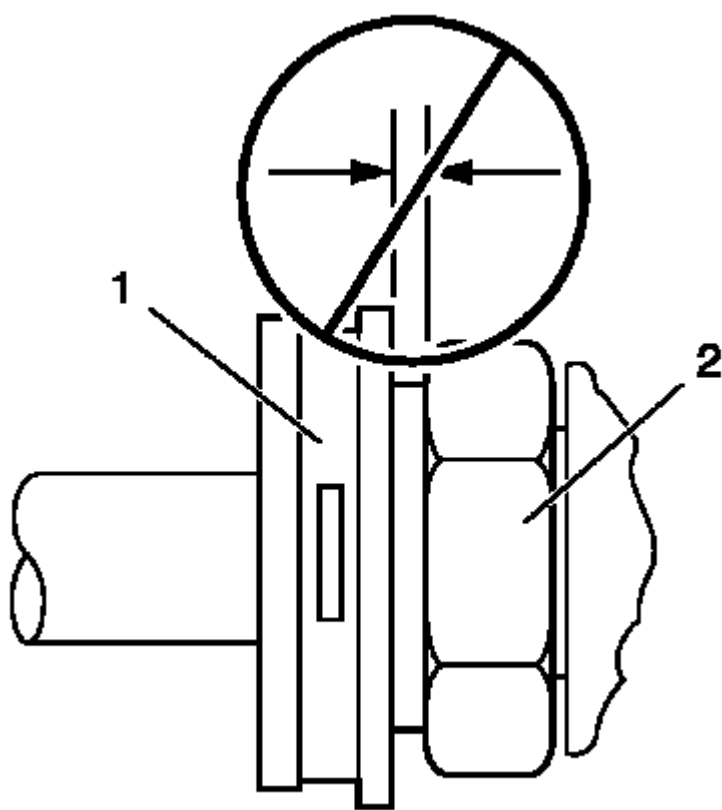


Fig. 64: Automatic Transmission Oil Cooler Fitting Plastic Cap Caution
Courtesy of GENERAL MOTORS COMPANY

12. Ensure that no gap is present between the plastic cap (1) and the fitting (2).

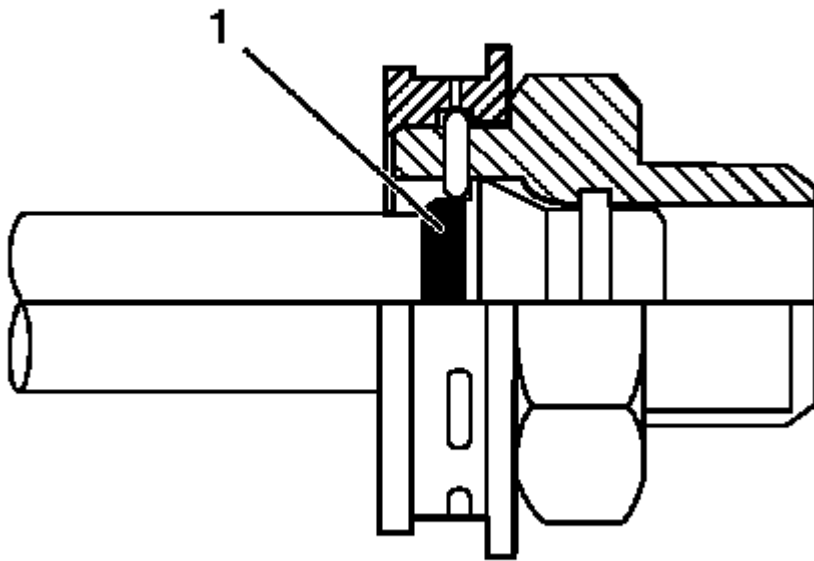


Fig. 65: Yellow Identification Band
Courtesy of GENERAL MOTORS COMPANY

13. Ensure that the yellow identification band (1) on the tube is hidden within the quick connect fitting.

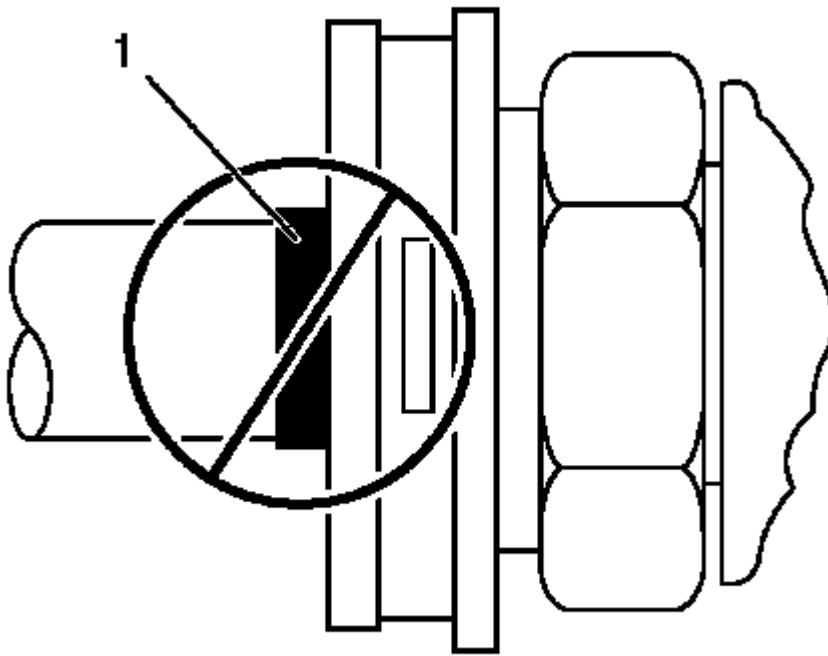


Fig. 66: Yellow Identification Band Caution
Courtesy of GENERAL MOTORS COMPANY

14. A hidden yellow identification band (1) indicates proper joint seating.
15. Fill the transmission to the proper level. Refer to **Transmission Fluid Level and Condition Check.**

AUTOMATIC TRANSMISSION FLUID PRESSURE TEST HOLE PLUG REPLACEMENT

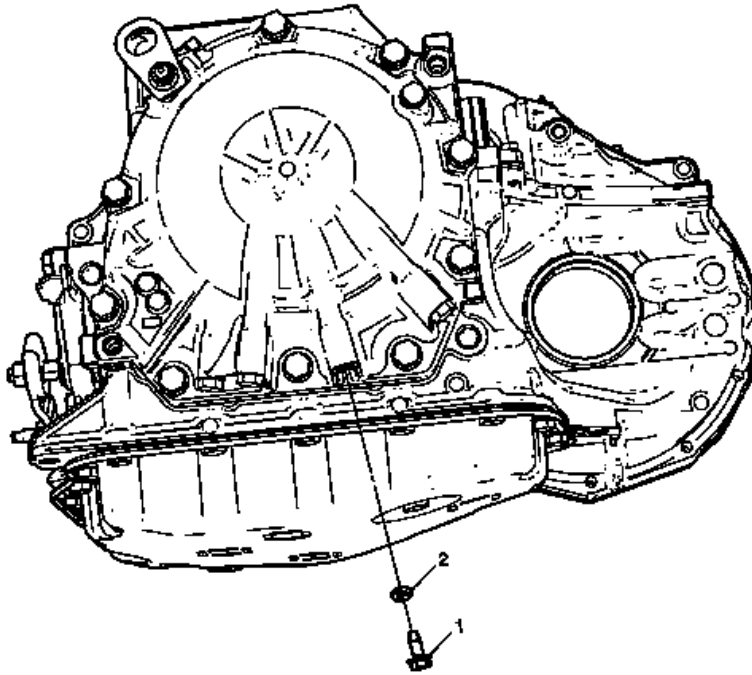


Fig. 67: Automatic Transmission Fluid Pressure Test Hole Plug
 Courtesy of GENERAL MOTORS COMPANY

Automatic Transmission Fluid Pressure Test Hole Plug Replacement

Callout	Component Name
1	Fluid Pressure Test Plug CAUTION: Refer to <u>Fastener Caution</u> . Tighten 7 (62 lb in)
2	O-Ring TIP: Do not reuse the O-ring.

INPUT SPEED SENSOR REPLACEMENT

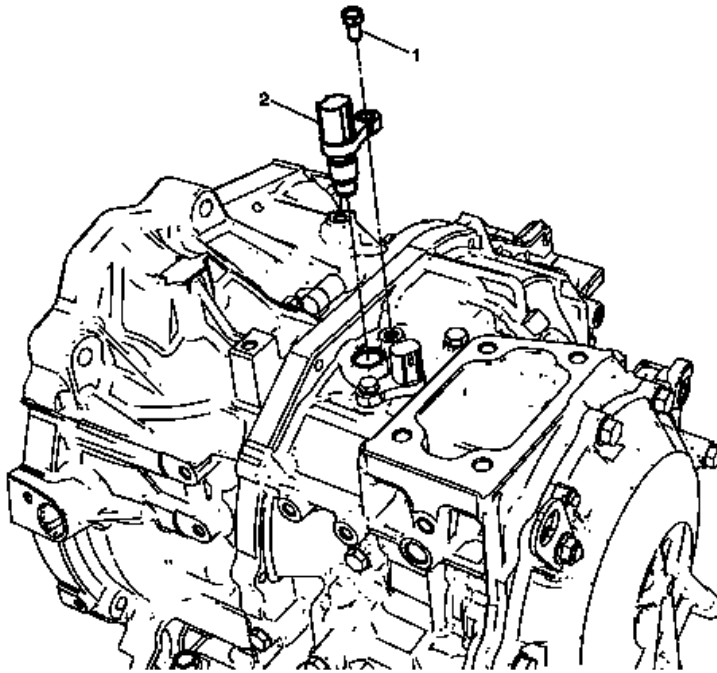


Fig. 68: Input Speed Sensor
 Courtesy of GENERAL MOTORS COMPANY

Input Speed Sensor Replacement

Callout	Component Name
Preliminary Procedures 1. Disconnect the battery negative cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> 2. Remove the air cleaner assembly. Refer to <u>Air Cleaner Assembly Replacement</u> .	
1	Input Speed Sensor Bolt (Qty: 1) CAUTION: Refer to <u>Fastener Caution</u> . Procedure Disconnect the input speed sensor electrical connector. Tighten 5 (44 lb in)
2	Input Speed Sensor

OUTPUT SPEED SENSOR REPLACEMENT

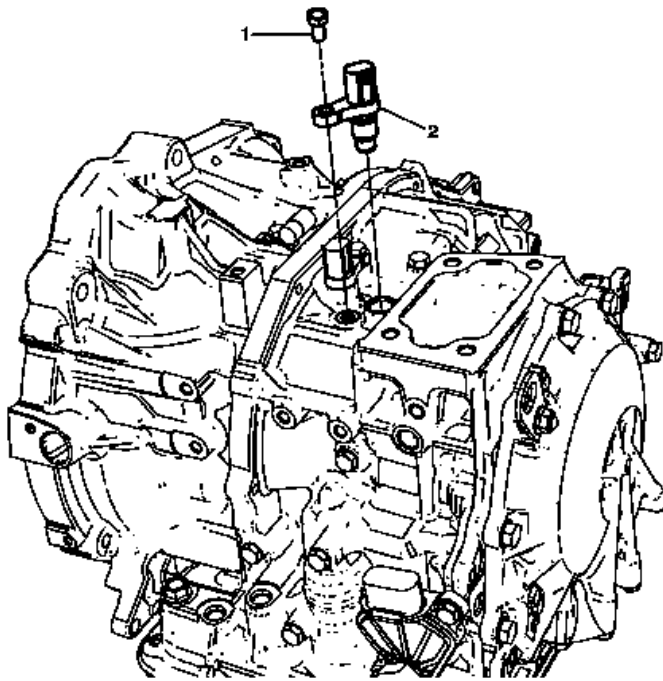


Fig. 69: Output Speed Sensor
 Courtesy of GENERAL MOTORS COMPANY

Output Speed Sensor Replacement

Callout	Component Name
Preliminary Procedure 1. Disconnect the battery negative cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Remove the air cleaner assembly. Refer to <u>Air Cleaner Assembly Replacement</u> .	
1	Output Speed Sensor Bolt (Qty: 1) CAUTION: Refer to <u>Fastener Caution</u> . Procedure Disconnect the output speed sensor electrical connector. Tighten 5 (44 lb in)
2	Output Speed Sensor

1-2 SHIFT SOLENOID VALVE REPLACEMENT

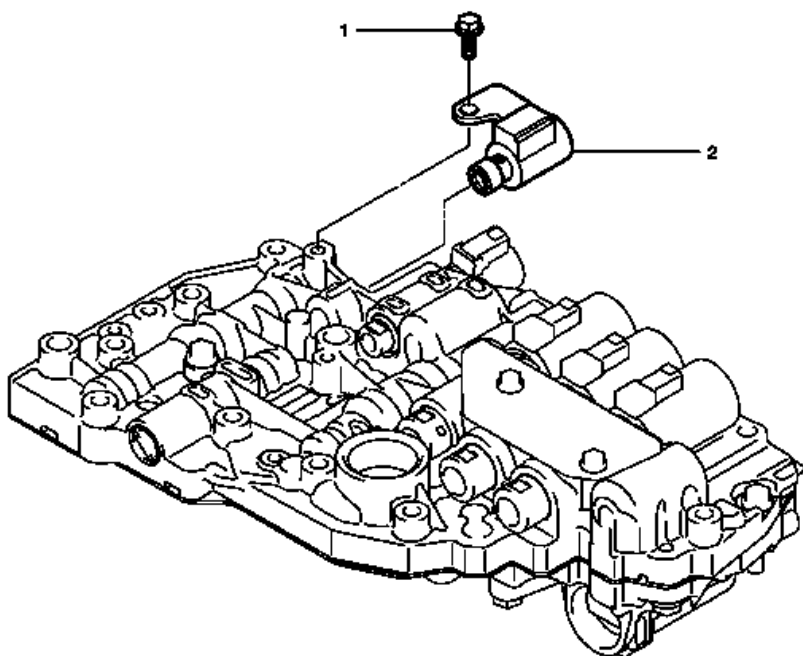


Fig. 70: 1-2 Shift Solenoid Valve
 Courtesy of GENERAL MOTORS COMPANY

1-2 Shift Solenoid Valve Replacement

Callout	Component Name
Preliminary Procedure Remove the oil Strainer. Refer to <u>Automatic Transmission Fluid and Filter Replacement</u> .	
1	Shift Solenoid Valve Bolt (Qty: 1) CAUTION: Refer to <u>Fastener Caution</u> . Procedure Disconnect the electrical connector. Tighten 7 (62 lb in)
2	Shift Solenoid Valve

TRANSMISSION CONTROL MODULE REPLACEMENT

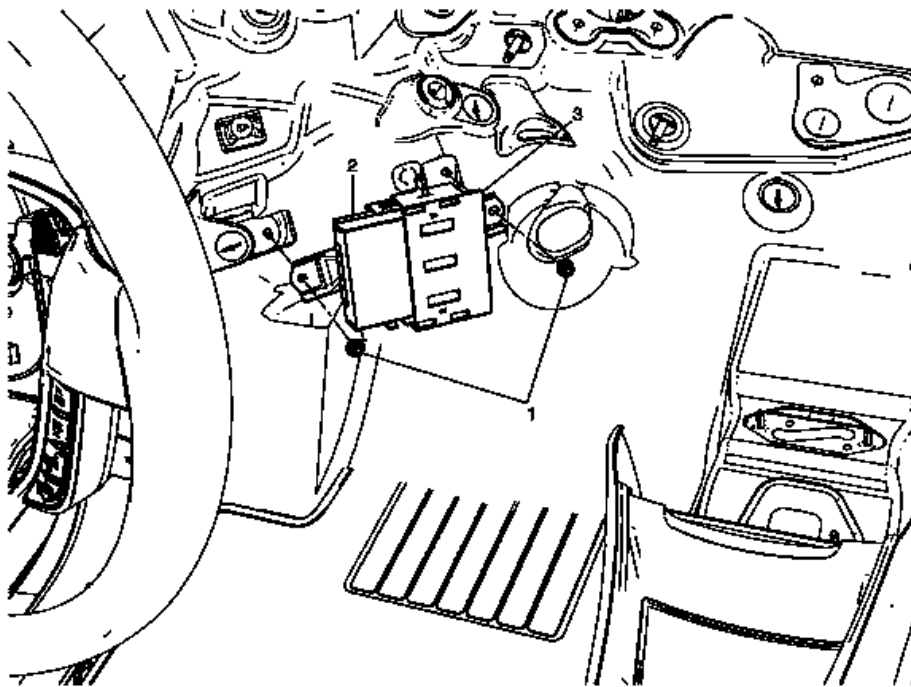


Fig. 71: Transmission Control Module
 Courtesy of GENERAL MOTORS COMPANY

Transmission Control Module Replacement

Callout	Component Name
1	TCM Fastener CAUTION: Refer to <u>Fastener Caution</u> . Tighten 7 (62 lb in)
2	Transmission Control Module (TCM) Procedure 1. Disconnect the TCM electrical connector. 2. The TCM must be programmed when replaced. Refer to <u>Control Module References</u> for programming and setup information. 3. Perform the transmission adaptive learn when replaced. Refer to <u>Transmission Adaptive Learn</u>.
3	TCM Cover

FRONT WHEEL DRIVE SHAFT SEAL REPLACEMENT - LEFT SIDE

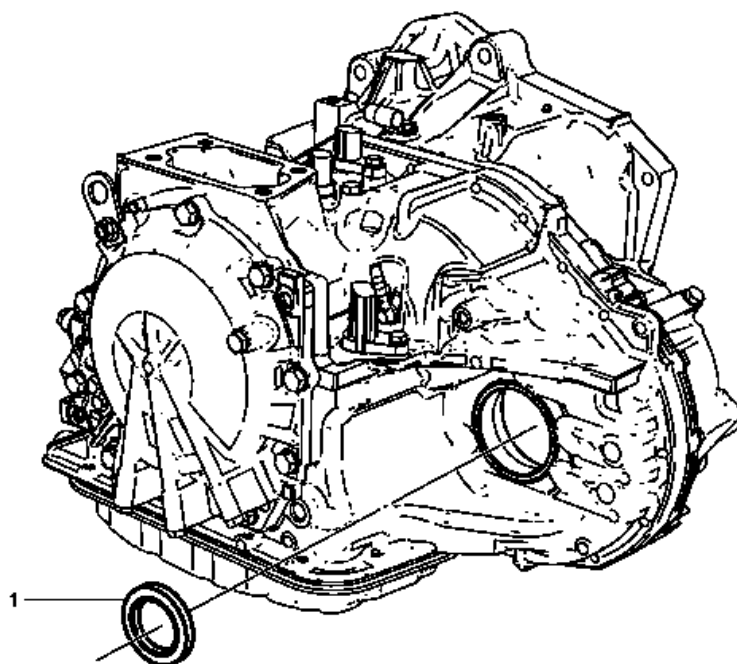


Fig. 72: Front Wheel Drive Shaft Seal - Left Side
 Courtesy of GENERAL MOTORS COMPANY

Front Wheel Drive Shaft Seal Replacement - Left Side

Callout	Component Name
Preliminary Procedures	
1. Raise the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Remove the left wheel drive shaft. Refer to <u>Front Wheel Drive Shaft Replacement</u> .	
	Left Front Wheel Drive Shaft Oil Seal
	Procedure - For seal removal, use DT-7004 slide hammer with DT-586 seal remover. - For seal installation, use DT-47521 seal installer.
1	Special Tools • DT-586 Seal Remover • DT-7004 Slide Hammer • DT-47521 Seal Installer
For equivalent regional tools, refer to <u>Special Tools</u> .	

FRONT WHEEL DRIVE SHAFT SEAL REPLACEMENT - RIGHT SIDE

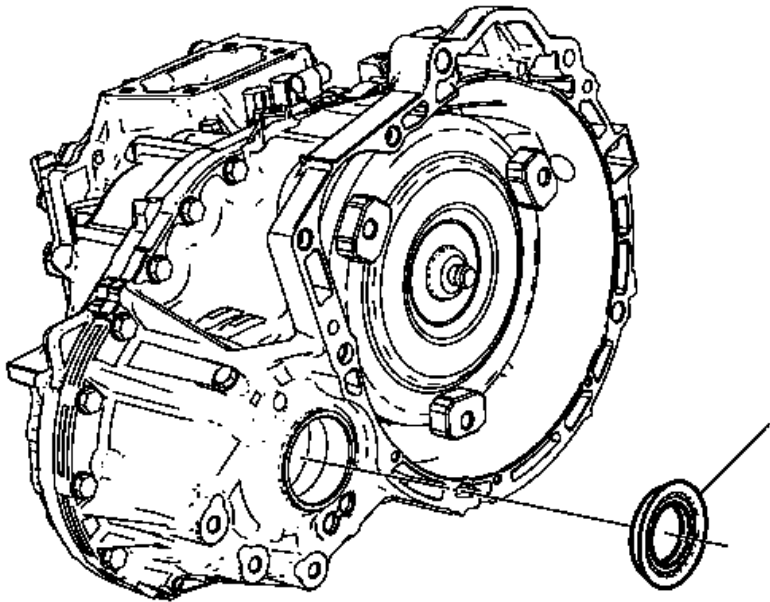


Fig. 73: Front Wheel Drive Shaft Seal - Right Side
 Courtesy of GENERAL MOTORS COMPANY

Front Wheel Drive Shaft Seal Replacement - Right Side

Callout	Component Name
Preliminary Procedures	
1. Raise the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Remove the right wheel drive shaft. Refer to <u>Front Wheel Drive Shaft Replacement</u> .	
	Right Front Wheel Drive Shaft Oil Seal
	Procedure 1. For seal removal, use DT-7004 slide hammer with DT-586 seal remover. 2. For seal installation, use DT-46471 seal installer.
1	Special Tools • DT-586 Seal Remover • DT-7004 Slide Hammer • DT-46471 Seal Installer
For equivalent regional tools, refer to <u>Special Tools</u> .	

CONTROL VALVE BODY COVER REPLACEMENT

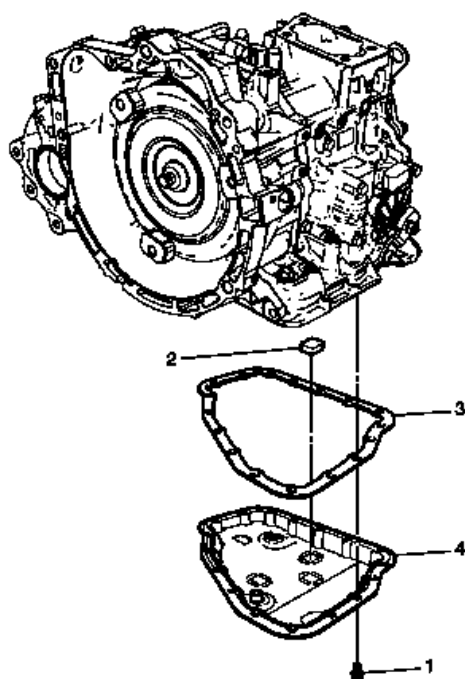


Fig. 74: Control Valve Body Cover
 Courtesy of GENERAL MOTORS COMPANY

Control Valve Body Cover Replacement

Callout	Component Name
Preliminary Procedure Drain the transmission. Refer to <u>Transmission Fluid Drain and Fill</u> .	
1	Control Valve Body Cover Bolt (Qty: 17) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 7 N.m (62 lb in)
2	Magnet (Qty: 4)
3	Gasket TIP: Do not reuse the gasket.
4	Control Valve Body Cover

CONTROL VALVE BODY REPLACEMENT

Removal Procedure

1. Disconnect the battery negative cable. Refer to Battery Negative Cable Disconnection and Connection .

2. Remove the control valve body cover. Refer to **Control Valve Body Cover Replacement**.
3. Remove the oil strainer. Refer to **Automatic Transmission Fluid and Filter Replacement**.

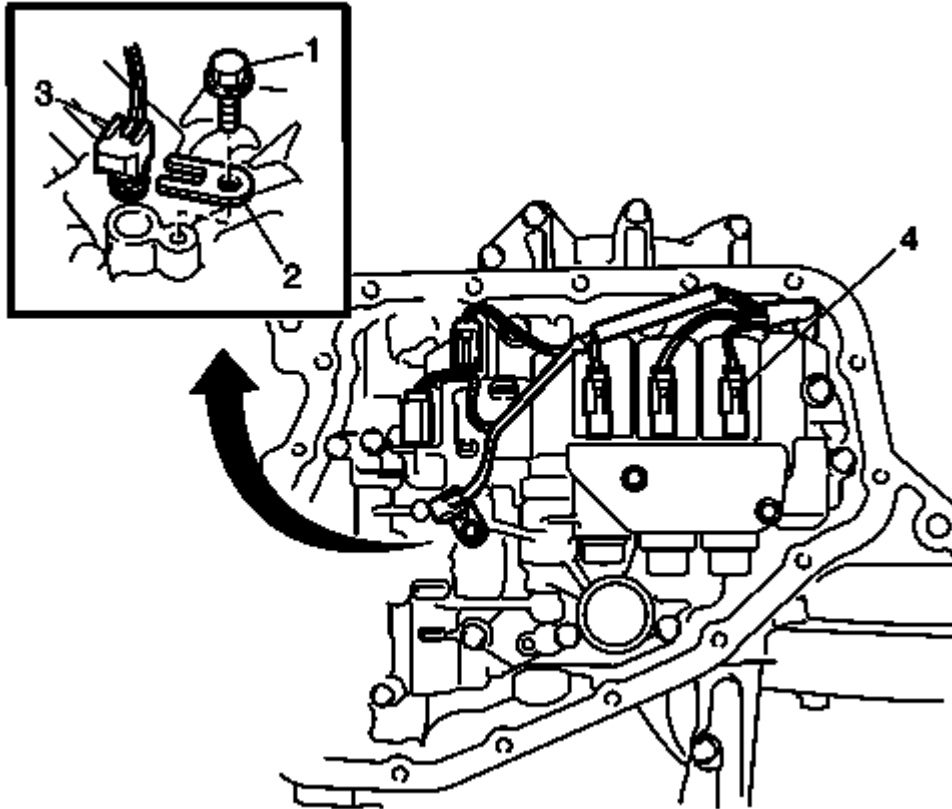


Fig. 75: Transmission Fluid Temperature Sensor Clamp
Courtesy of GENERAL MOTORS COMPANY

4. Remove the bolt (1) and transmission fluid temperature sensor clamp (2), and pull out the sensor (3) from the valve body assembly.
5. Disconnect the 5 solenoid connectors (4).

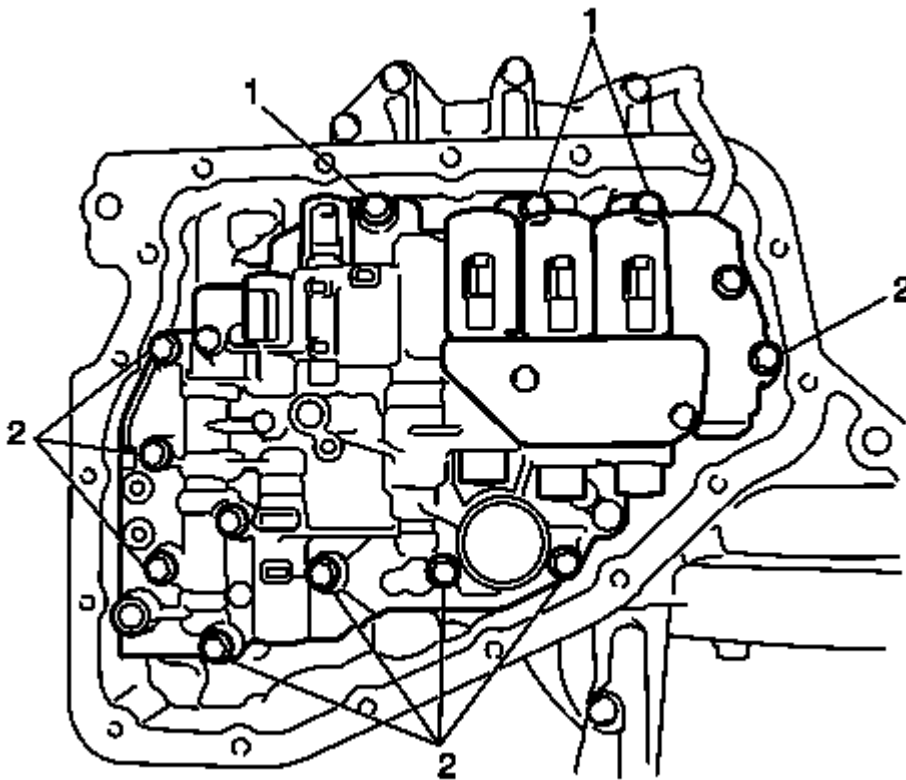


Fig. 76: Valve Body Assembly

Courtesy of GENERAL MOTORS COMPANY

6. Support the valve body assembly and remove the 11 bolts (1, 2).
7. Disconnect the manual valve control rod from the manual valve lever, then remove the valve body assembly.

Installation Procedure

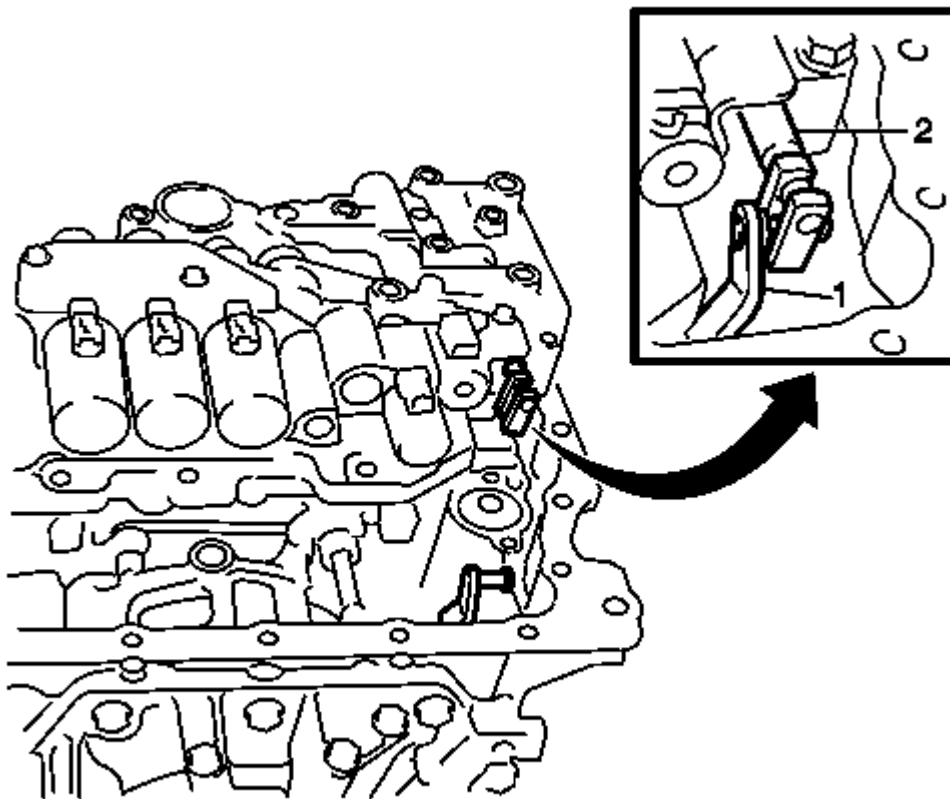


Fig. 77: Manual Valve Control Rod And Manual Lever
Courtesy of GENERAL MOTORS COMPANY

1. Connect the manual valve control rod (2) to the manual lever (1).

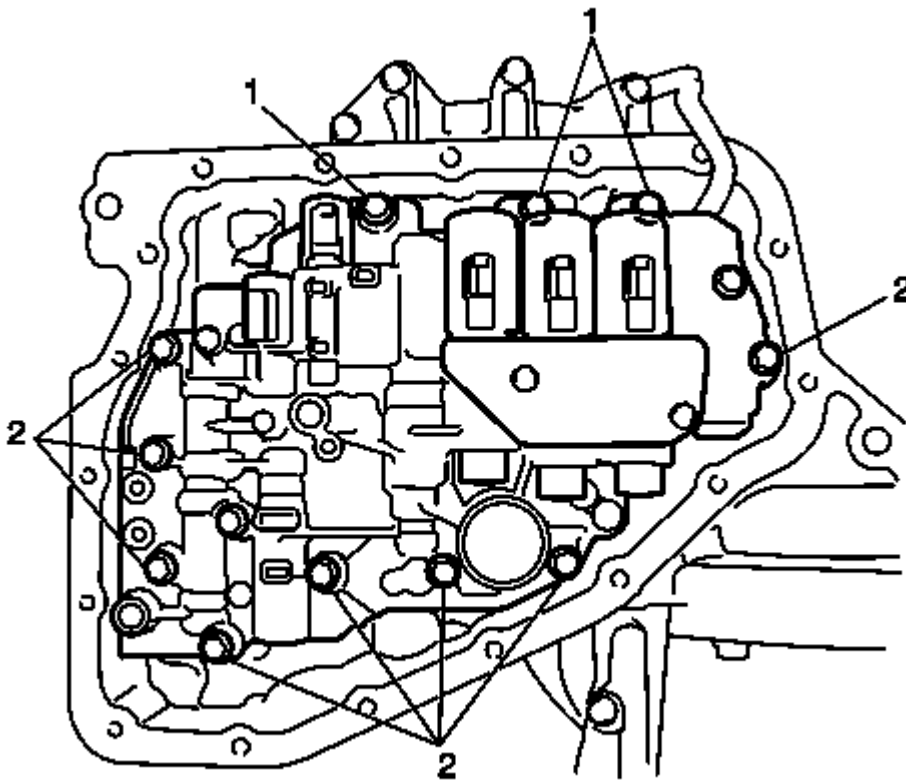


Fig. 78: Valve Body Assembly

Courtesy of GENERAL MOTORS COMPANY

NOTE: When installing the valve body to the transmission case, do not let the accumulator piston incline. When installing the valve body to the transmission case, do not hold the solenoid.

2. Install the valve body assembly to the transmission case.

CAUTION: Refer to Fastener Caution .

NOTE: The bolts (1) size is 20 mm and the bolts (2) size is 36 mm.

3. Install the 11 valve body bolts (1, 2) and tighten to 11 (97 lb in).

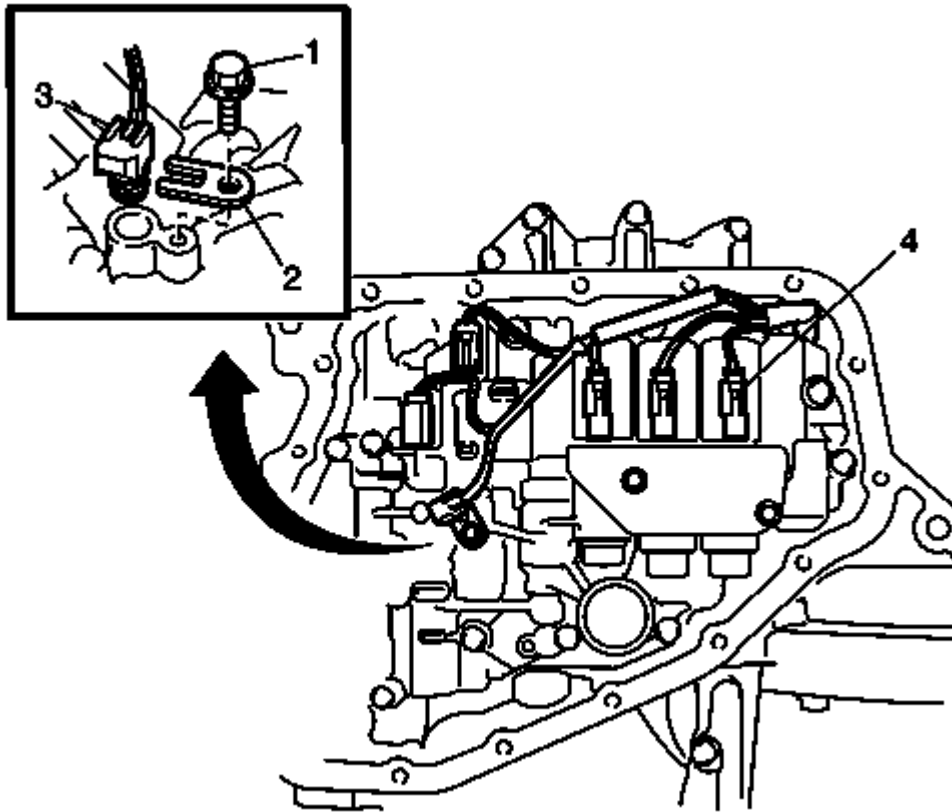


Fig. 79: Transmission Fluid Temperature Sensor Clamp
Courtesy of GENERAL MOTORS COMPANY

4. Connect the 5 connectors (4).
5. Install the transmission fluid temperature sensor (3) with the clamp (2).
6. Install the transmission fluid temperature sensor bolt (1) and tighten to 7 (62 lb in).
7. Install the oil strainer. Refer to **Automatic Transmission Fluid and Filter Replacement**.
8. Install the control valve body cover. Refer to **Control Valve Body Cover Replacement**.
9. Connect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection** .
10. Perform the transmission adaptive learn when replaced. Refer to **Transmission Adaptive Learn**.

AUTOMATIC TRANSMISSION WIRING HARNESS REPLACEMENT

Removal Procedure

1. Remove the control valve body. Refer to **Control Valve Body Replacement**.

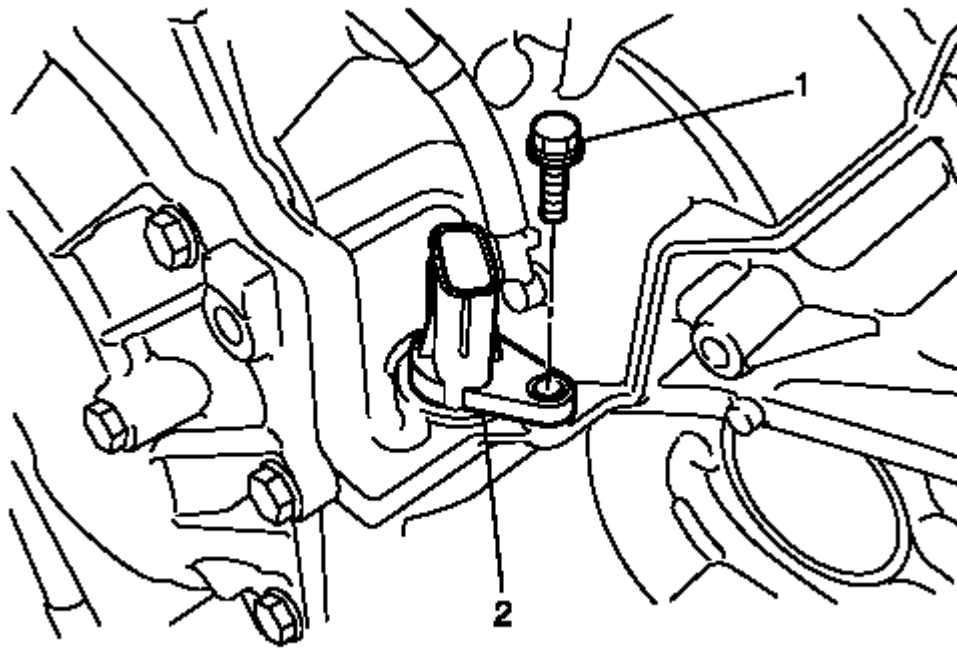


Fig. 80: Wiring Harness Assembly
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage the wiring harness and do not pull out the harness forcibly.

2. Remove the bolt (1) and transmission wiring harness from the transmission case.
3. Remove the wiring harness assembly (2) from the transmission case.

Installation Procedure

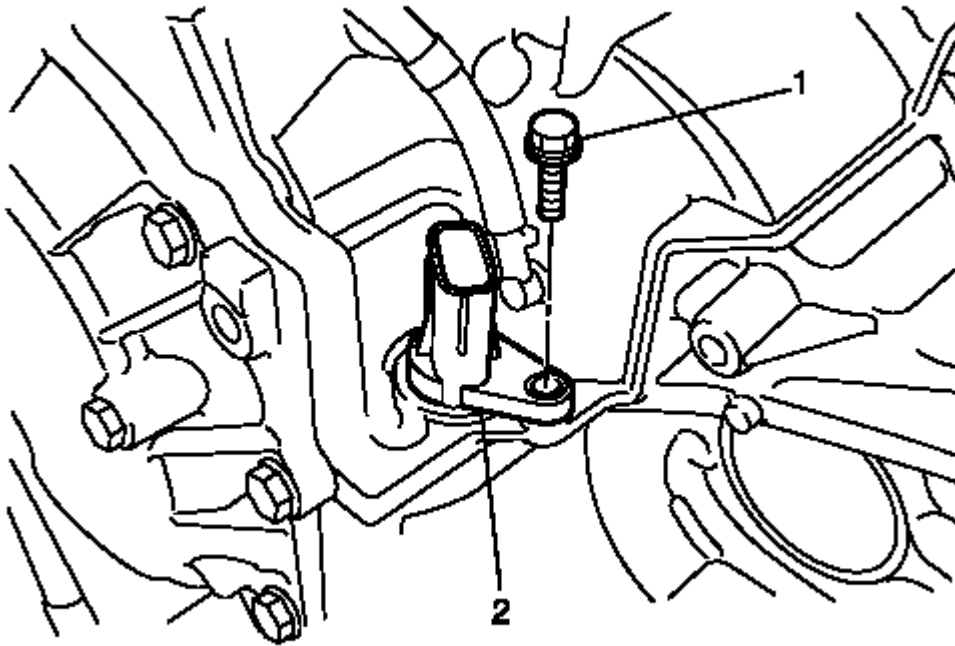


Fig. 81: Wiring Harness Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Install the wiring harness assembly (2) to the transmission.

CAUTION: Refer to Fastener Caution .

2. Install the transmission wiring harness bolt (1) and tighten to 5 (44 lb in).
3. Install the control valve body. Refer to **Control Valve Body Replacement**.

TRANSMISSION REAR MOUNT BRACKET REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Using a suitable jack stand, support the rear of the powertrain.

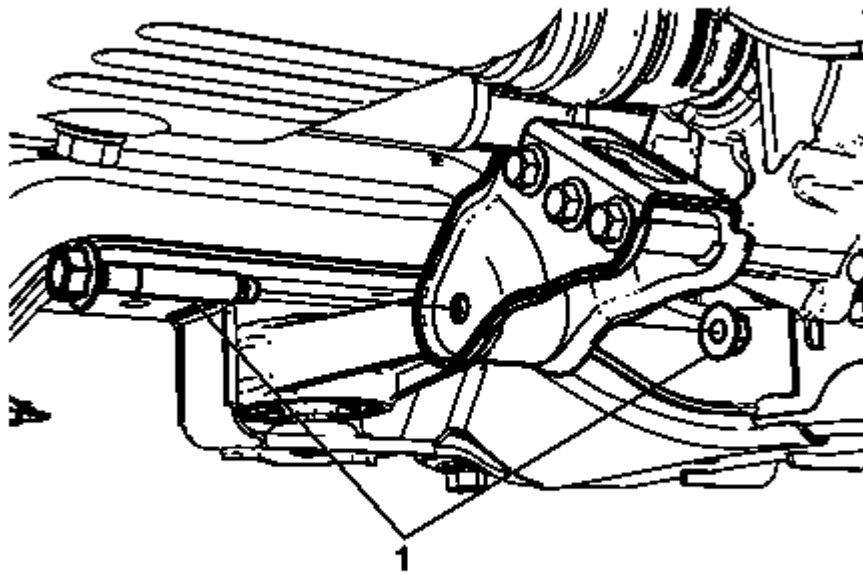


Fig. 82: Transmission Bracket Mount

Courtesy of GENERAL MOTORS COMPANY

3. Remove the transmission bracket mount to mount through bolt and nut (1).

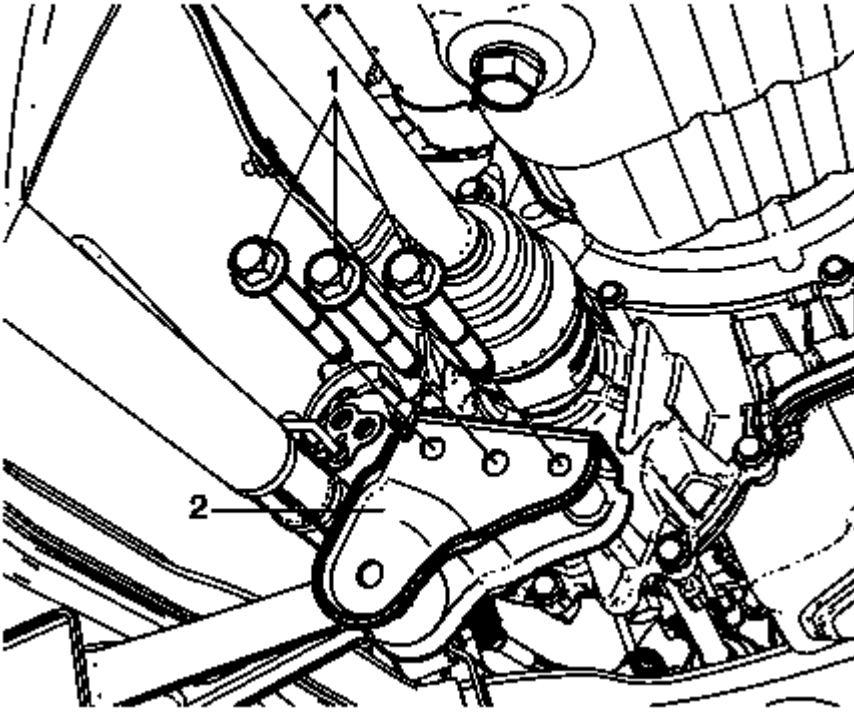


Fig. 83: Transmission Mount To Transmission Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove the transmission mount to transmission bolts (1).
5. Remove the transmission mount bracket (2).

Installation Procedure

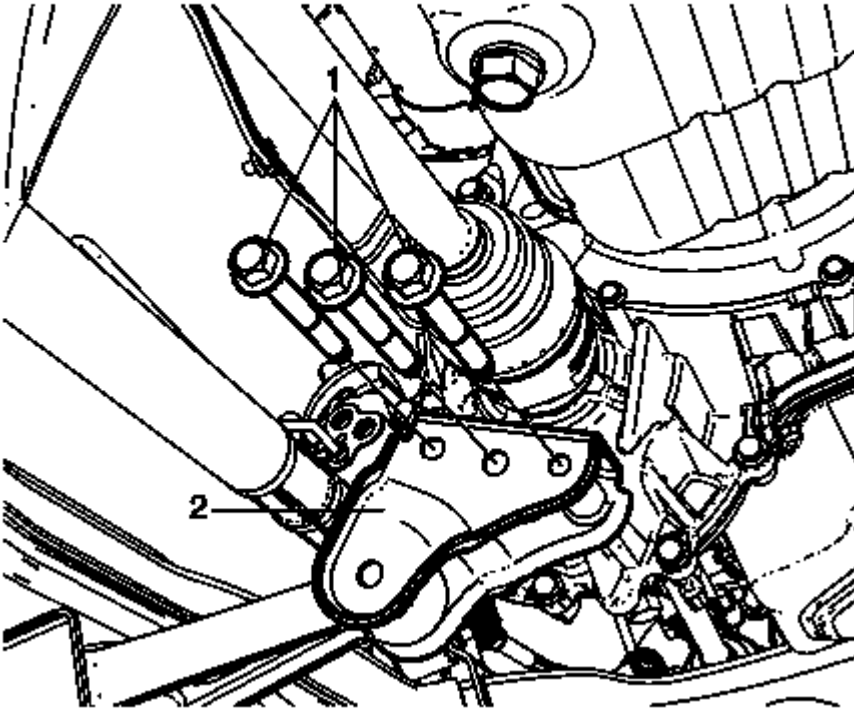


Fig. 84: Transmission Mount To Transmission Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the transmission mount bracket (2).

CAUTION: Refer to Fastener Caution .

2. Install the transmission mount to transmission bolts (1) and tighten to 60 (44 lb ft).

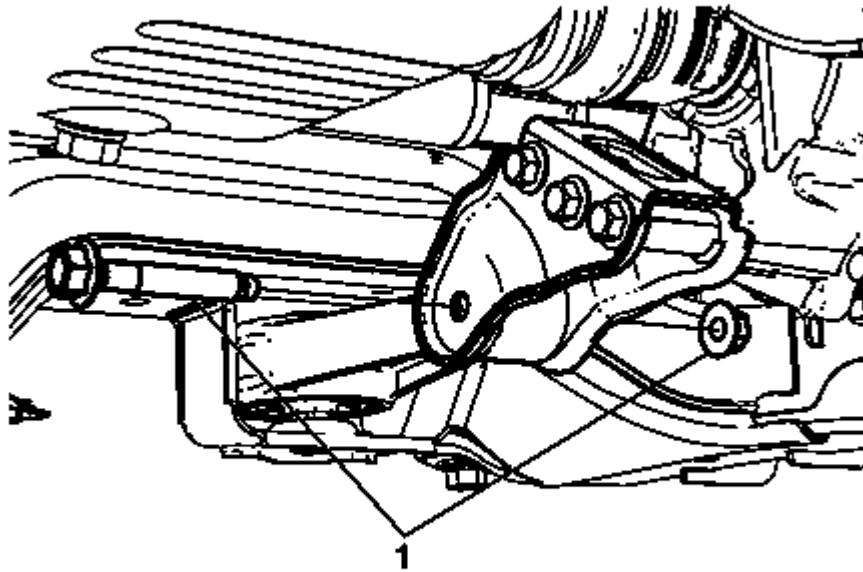


Fig. 85: Transmission Bracket Mount
Courtesy of GENERAL MOTORS COMPANY

3. Install the transmission bracket mount to mount through bolt and nut (1) and tighten to 80 (59 lb ft).
4. Remove the jack stand.
5. Lower the vehicle.

TRANSMISSION REAR MOUNT REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Using a suitable jack stand, support the rear of the powertrain.

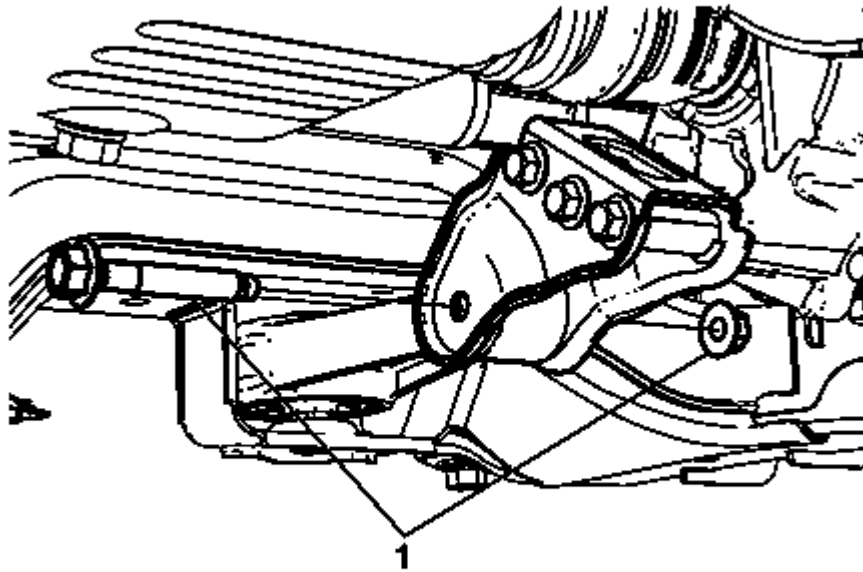


Fig. 86: Transmission Bracket Mount
Courtesy of GENERAL MOTORS COMPANY

3. Remove the transmission bracket mount to mount through bolt and nut (1).

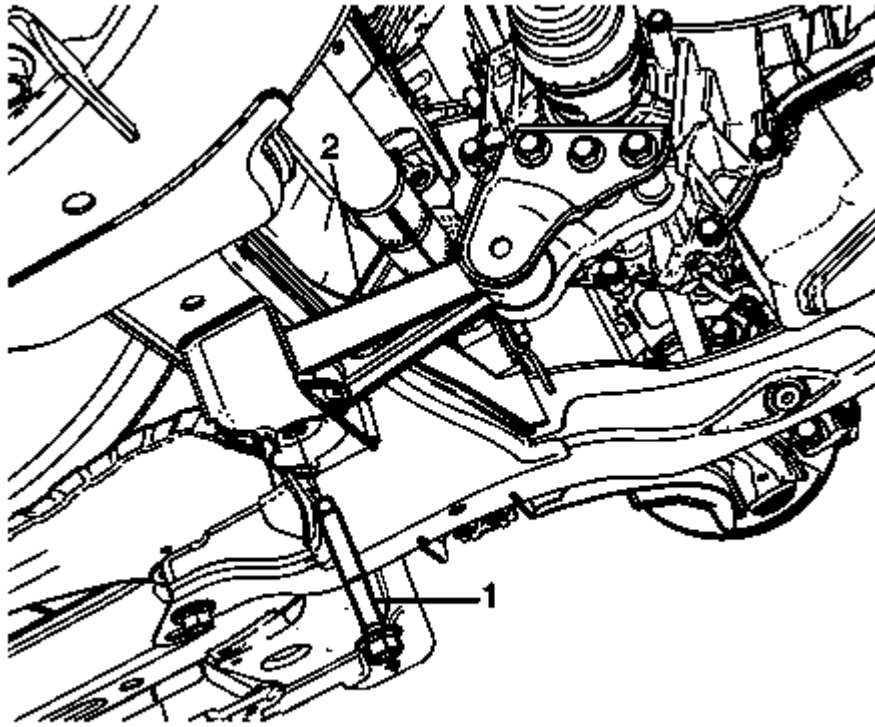


Fig. 87: Transmission Mount To Frame Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Remove the transmission mount to frame bolt (1).
5. Remove the transmission mount (2).

Installation Procedure

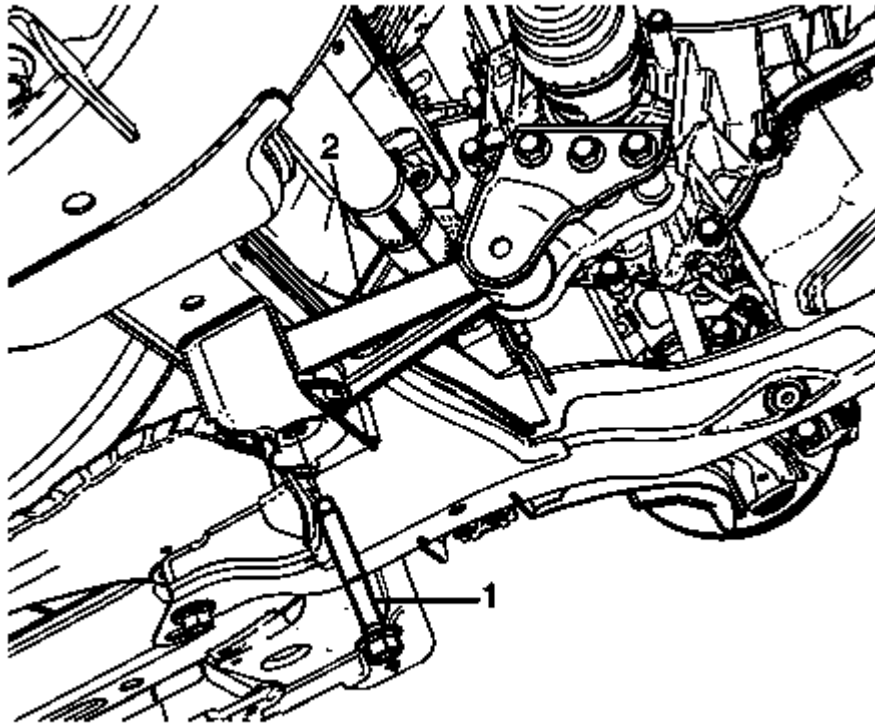


Fig. 88: Transmission Mount To Frame Bolt
Courtesy of GENERAL MOTORS COMPANY

1. Install the transmission mount (2).

CAUTION: Refer to Fastener Caution .

2. Install the transmission mount to frame bolt (1) and tighten to 100 (74 lb ft).

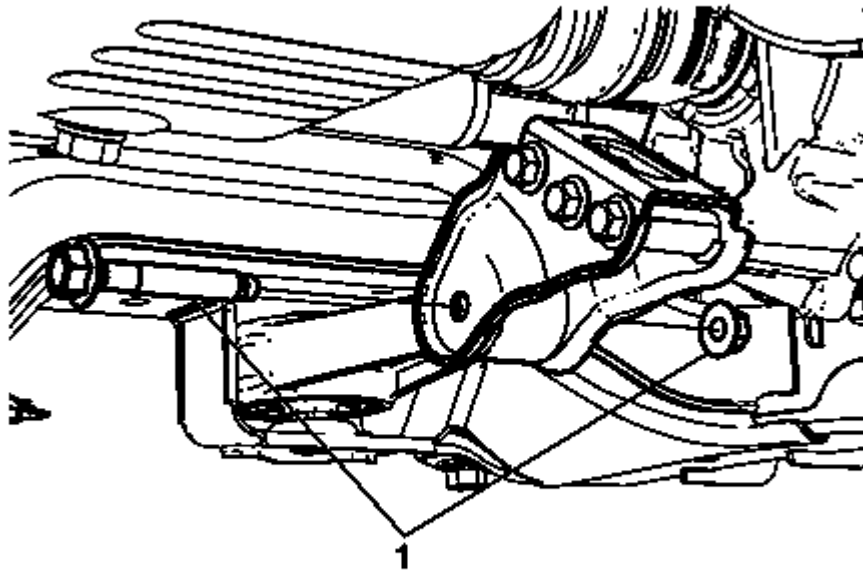


Fig. 89: Transmission Bracket Mount
Courtesy of GENERAL MOTORS COMPANY

3. Install the transmission bracket mount to mount through bolt and nut (1) and tighten to 80 (59 lb ft).
4. Remove the jack stand.
5. Lower the vehicle.

TRANSMISSION MOUNT BRACKET REPLACEMENT - LEFT SIDE

Special Tools

EN-28467 Engine Fixture

For equivalent regional tools, refer to **Special Tools**.

Removal Procedures

1. Remove the battery tray. Refer to **Battery Tray Replacement** .
2. Remove the power brake booster pump bracket. Refer to **Power Brake Booster Pump Replacement (Automatic Transmission)** , **Power Brake Booster Pump Replacement (CVT)** .
3. Install the **EN-28467** engine fixture. Refer to **Engine Support Fixture** .
4. Remove the left transmission mount. Refer to **Transmission Mount Replacement - Left Side (MX2,**

MEM) .

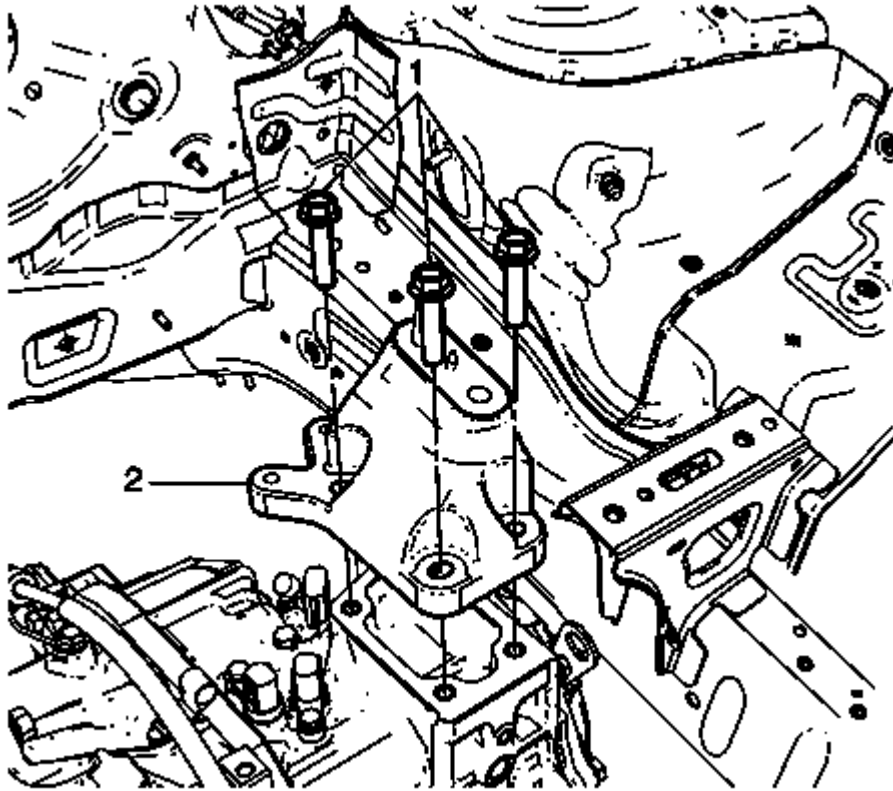


Fig. 90: Left Transmission Mount Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the left transmission mount bracket bolts (1).
6. Remove the left transmission mount bracket (2) from the vehicle.

Installation Procedure

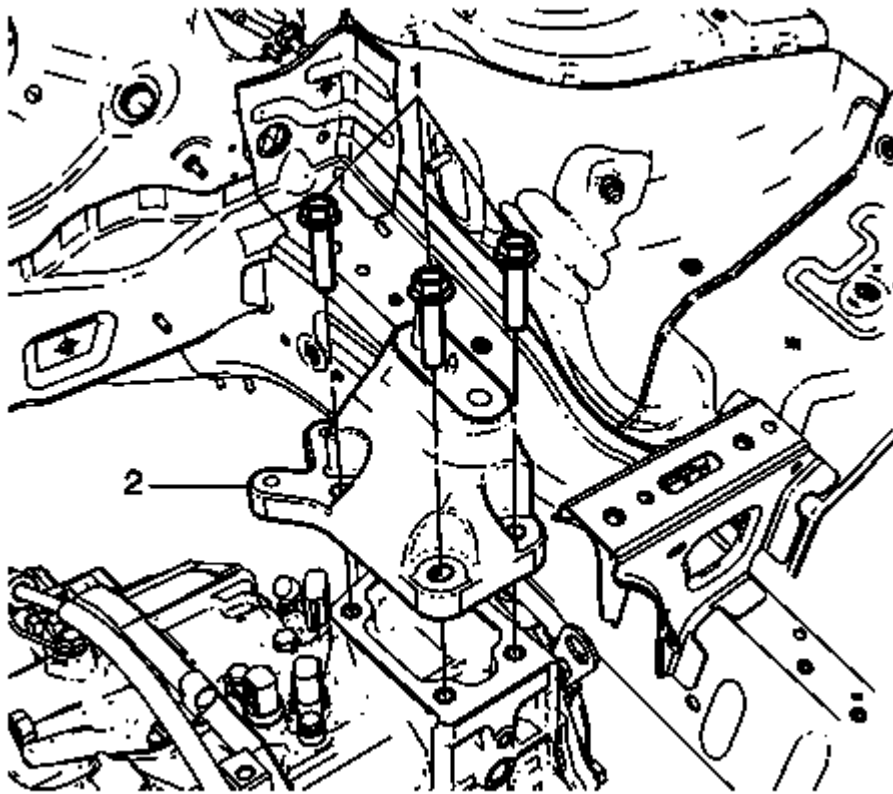


Fig. 91: Left Transmission Mount Bracket Bolts
 Courtesy of GENERAL MOTORS COMPANY

1. Install the left transmission mount bracket (2) to the vehicle.

CAUTION: Refer to Fastener Caution .

2. Install the left transmission mount bracket bolts (1) and tighten to 60 (44 lb ft).
3. Install the left transmission mount. Refer to Transmission Mount Replacement - Left Side (MX2, MFM) .
4. Remove the EN-28476 engine fixture. Refer to Engine Support Fixture .
5. Install the power brake booster pump bracket. Refer to Power Brake Booster Pump Replacement (Automatic Transmission) , Power Brake Booster Pump Replacement (CVT) .
6. Install the battery tray. Refer to Battery Tray Replacement .

TRANSMISSION MOUNT REPLACEMENT - LEFT SIDE

Special Tools

EN-28467 Engine Fixture

For equivalent regional tools, refer to **Special Tools**.

Removal Procedure

1. Remove the battery tray. Refer to **Battery Tray Replacement** .
2. Install the EN-28467 engine fixture. Refer to **Engine Support Fixture** .

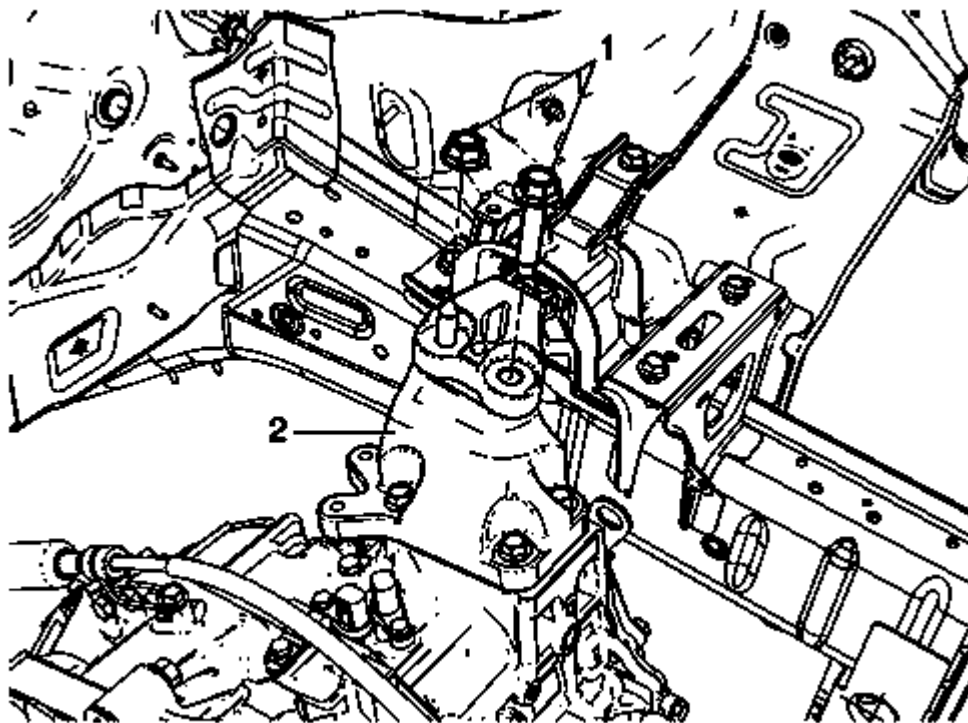


Fig. 92: Left Transmission Mount Bolt And Nut
Courtesy of GENERAL MOTORS COMPANY

3. Remove the left transmission mount bolt and nut (1) from the transmission mount bracket (2).

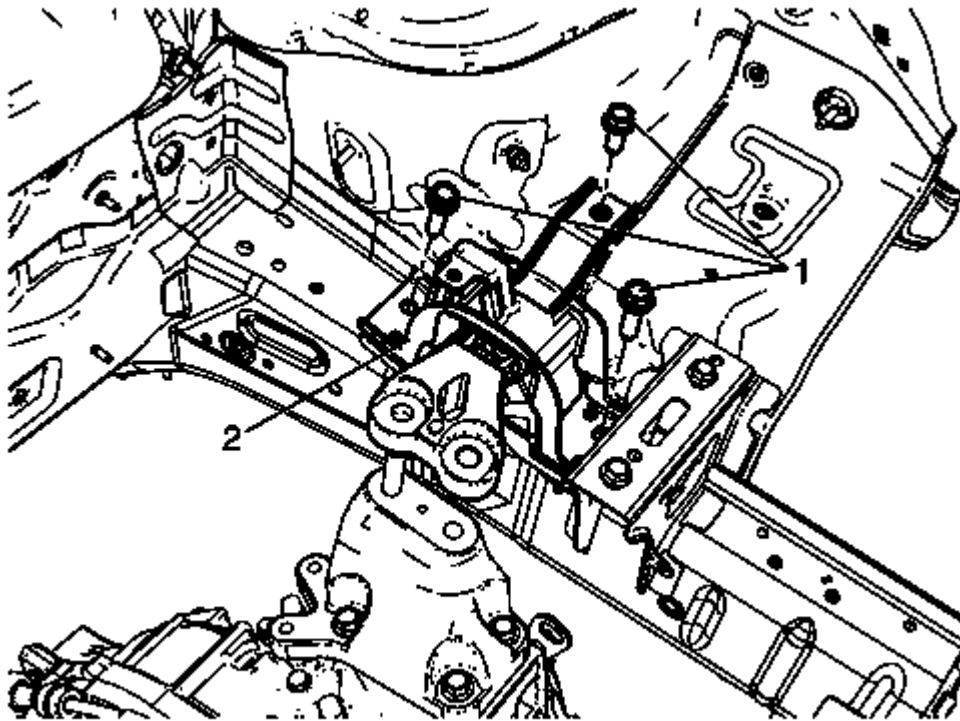


Fig. 93: Left Transmission Mount

Courtesy of GENERAL MOTORS COMPANY

4. Remove the left transmission mount to body bolts (1).
5. Remove the left transmission mount (2) from the vehicle.

Installation Procedure

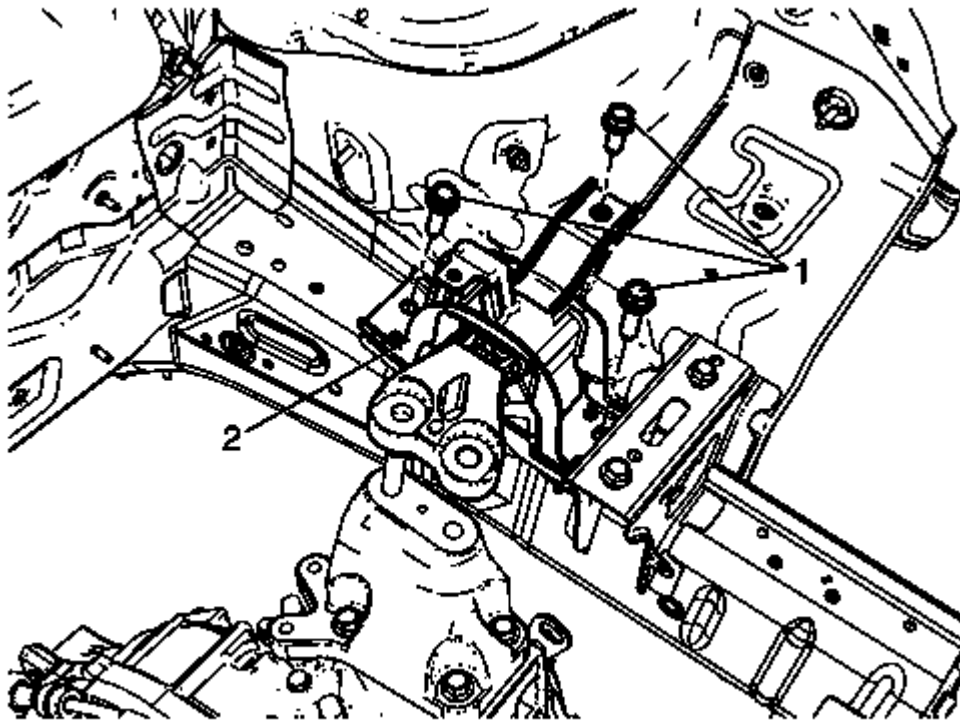


Fig. 94: Left Transmission Mount

Courtesy of GENERAL MOTORS COMPANY

1. Install the left transmission mount (2) to the vehicle.

CAUTION: Refer to Fastener Caution .

2. Install the left transmission mount to body bolts (1) and tighten to 50 (37 lb ft).

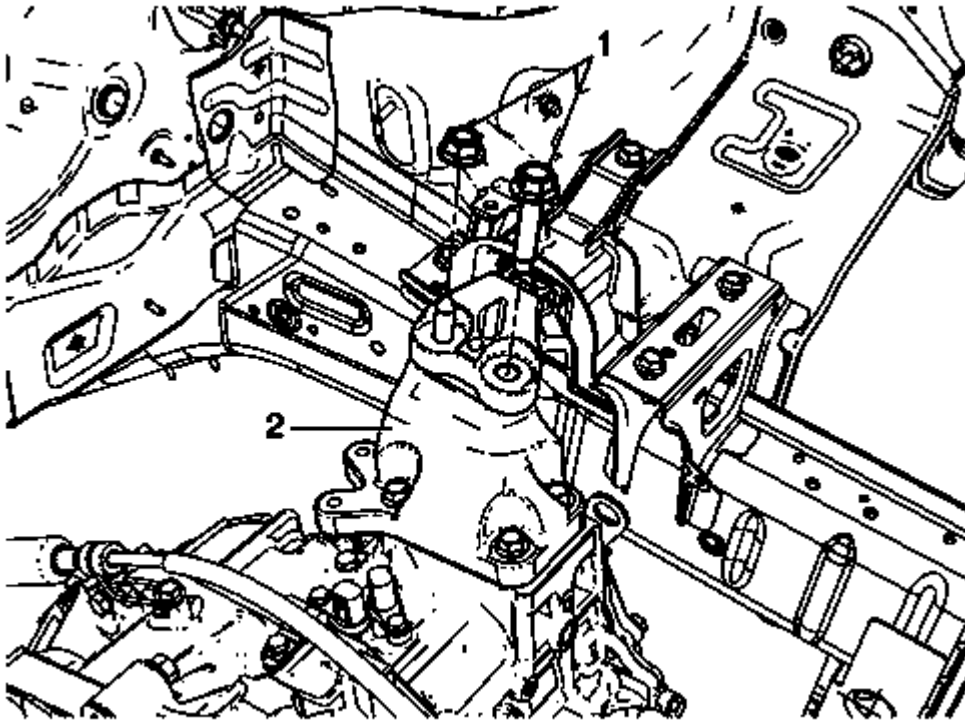


Fig. 95: Left Transmission Mount Bolt And Nut
Courtesy of GENERAL MOTORS COMPANY

3. Install the left transmission mount bolt and nut (1) to the transmission mount bracket (2) and tighten to 95 (70 lb ft).
4. Remove the **EN-28467** engine fixture. Refer to **Engine Support Fixture** .
5. Install the battery tray. Refer to **Battery Tray Replacement** .

TRANSMISSION REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Drain the transmission fluid. Refer to **Transmission Fluid Drain and Fill**.
3. After removing the related parts for the powertrain assembly removal, remove the powertrain assembly from the vehicle. Refer to **Engine Replacement (LFM)** , **Engine Replacement (LL0)** .
4. Remove the starter. Refer to **Starter Replacement** .

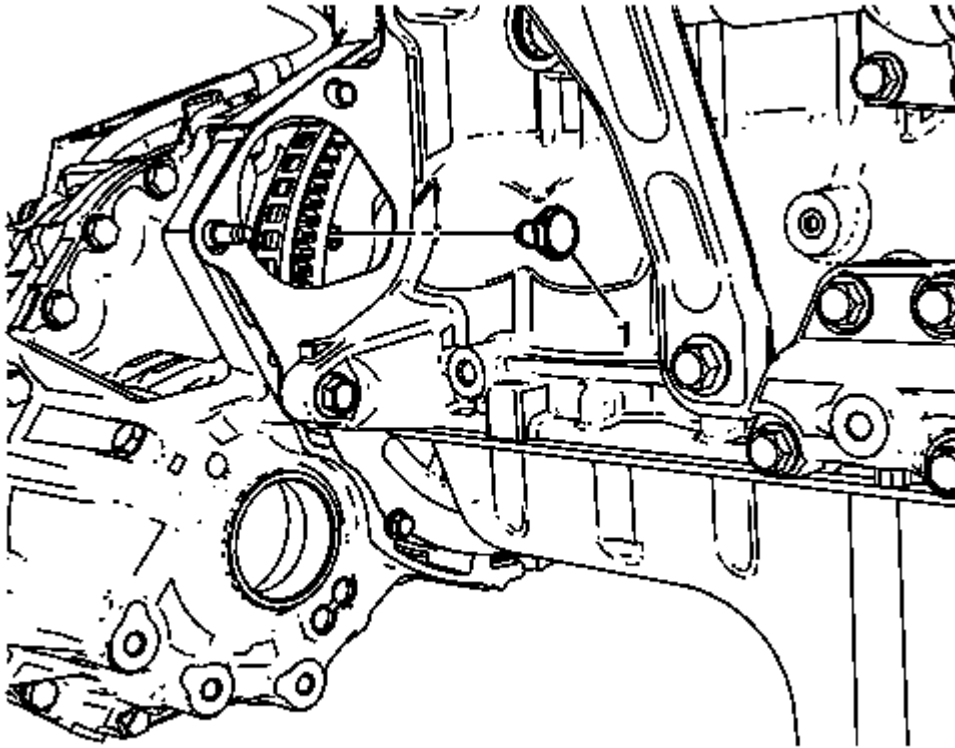


Fig. 96: Torque Converter Bolts

Courtesy of GENERAL MOTORS COMPANY

5. Remove and discard the torque converter bolts (1).
6. Disconnect the transmission wiring harness electrical connector.
7. Disconnect the input speed sensor electrical connector.
8. Disconnect the output speed sensor electrical connector.
9. Disconnect the park/neutral position (PNP) switch electrical connector.
10. Remove the oxygen sensor connector bracket bolt and bracket.
11. Remove the crankshaft position sensor. Refer to **Crankshaft Position Sensor Replacement** .

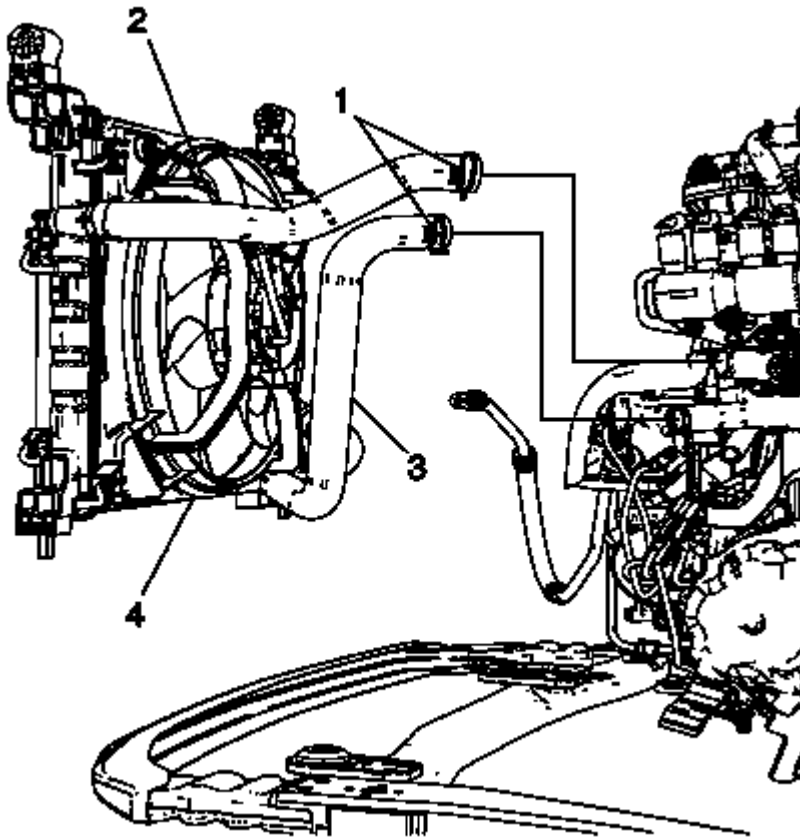


Fig. 97: Radiator Inlet And Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

12. Remove the radiator inlet and outlet hose clamp (1).
13. Disconnect the radiator inlet and outlet hoses (2, 3) and remove the radiator and condenser assembly (4).
14. Disconnect the oil cooler pipes from the transmission. Refer to **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (Aisin 80-40LE)** , **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (Jatco CVT)** .

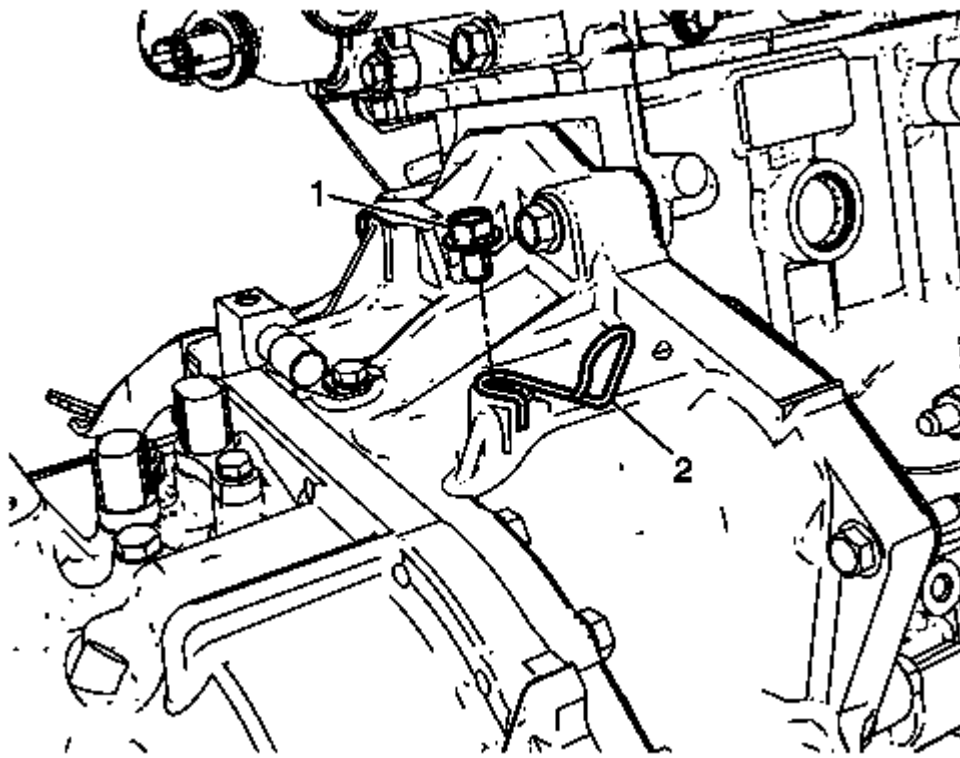


Fig. 98: Selector Control Cable Clamp Bolt And Clamp
Courtesy of GENERAL MOTORS COMPANY

15. Remove the selector control cable clamp bolt (1) and clamp (2).
16. Separate the related wiring harness from the transmission.
17. Remove the front wheel drive shaft from the transmission. Refer to **Front Wheel Drive Shaft Replacement** .
18. Remove the transmission rear mount bracket. Refer to **Transmission Rear Mount Bracket Replacement**.
19. Remove the left transmission mount bracket. Refer to **Transmission Mount Replacement - Left Side**.

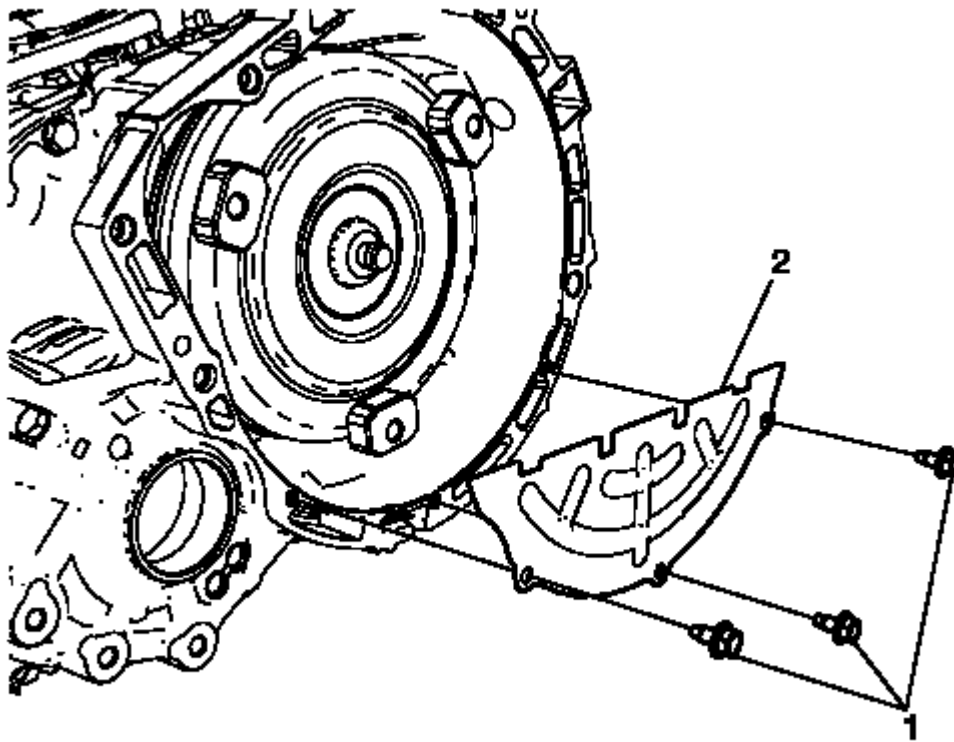


Fig. 99: Torque Converter Cover Plate Bolts
Courtesy of GENERAL MOTORS COMPANY

20. Remove the torque converter cover plate bolts (1).
21. Remove the torque converter cover plate (2).

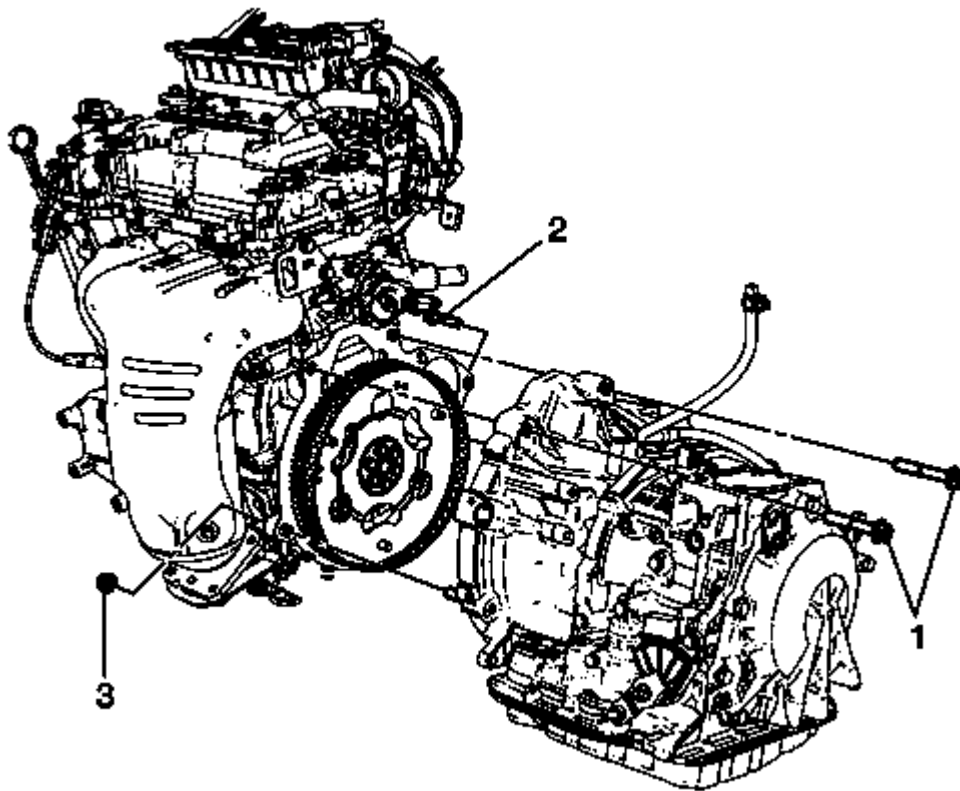


Fig. 100: Transmission Upper Bolts
Courtesy of GENERAL MOTORS COMPANY

22. Remove the transmission upper bolts (1).
23. Remove the transmission lower bolt (2).
24. Remove the transmission lower nut (3).
25. Separate the transmission from the engine.

Installation Procedure

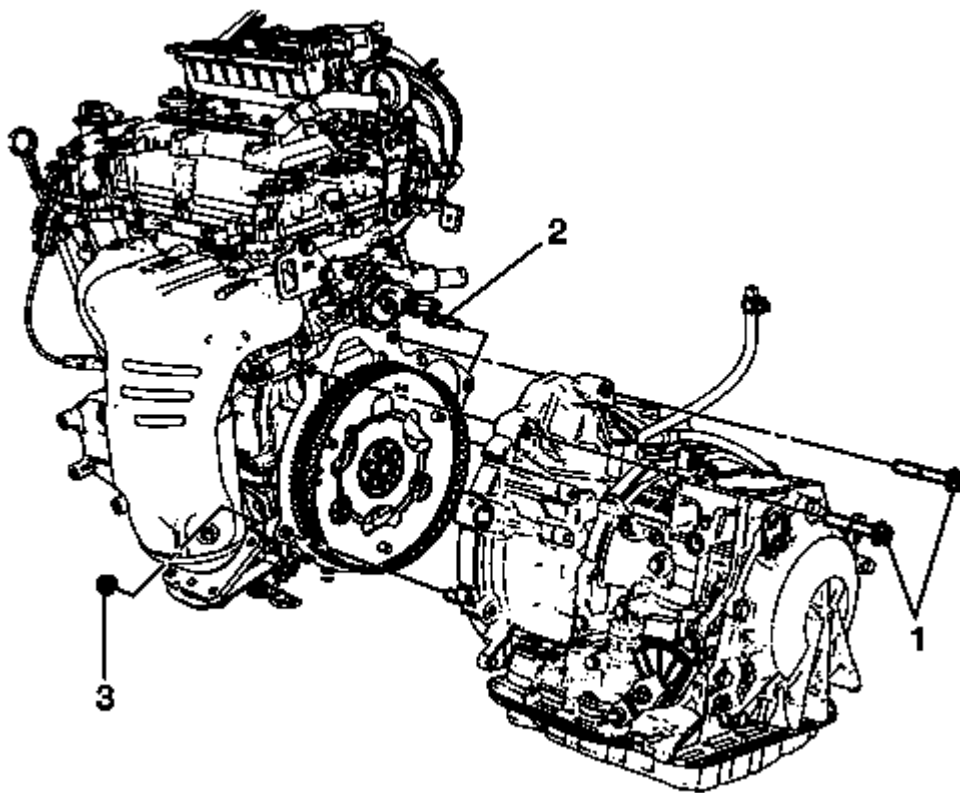


Fig. 101: Transmission Upper Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the transmission to the engine.

CAUTION: Refer to Fastener Caution .

2. Install the transmission lower nut (3) and tighten to 61 (44 lb ft).
3. Install the transmission lower bolt (2) and tighten to 61 (44 lb ft).
4. Install the transmission upper bolts (1) and tighten to 61 (44 lb ft).

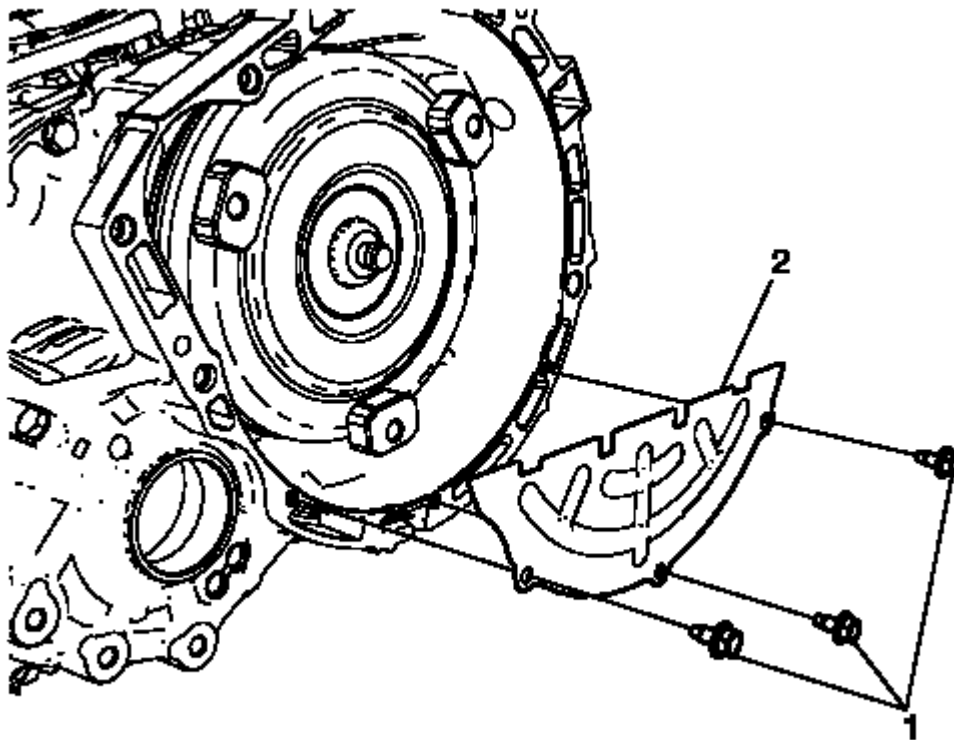


Fig. 102: Torque Converter Cover Plate Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Install the torque converter cover plate (2).
6. Install the torque converter cover plate bolts (1) and tighten to 10 (89 lb in).
7. Install the left transmission mount bracket. Refer to **Transmission Mount Replacement - Left Side**.
8. Install the transmission rear mount bracket. Refer to **Transmission Rear Mount Bracket Replacement (MX2, MFM)**.
9. Install the front wheel drive shaft to the transmission. Refer to **Front Wheel Drive Shaft Replacement**.
10. Position the wiring harness into the transmission.

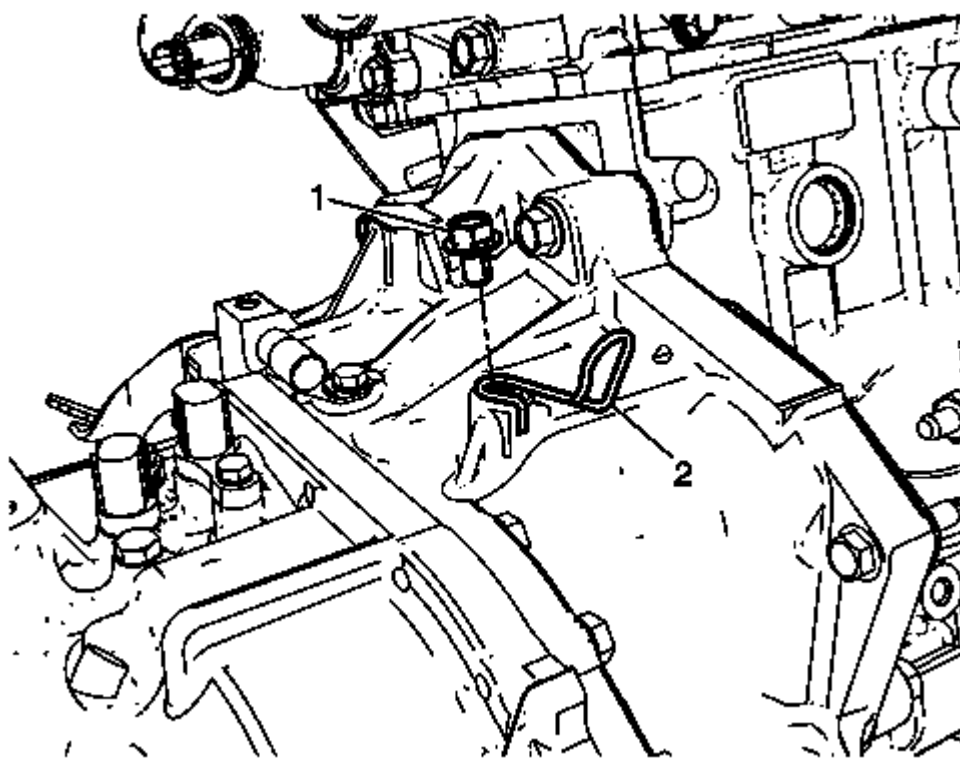


Fig. 103: Selector Control Cable Clamp Bolt And Clamp
Courtesy of GENERAL MOTORS COMPANY

11. Install clamp (2) and the selector control cable clamp bolt (1) tighten to 22 (16 lb ft).

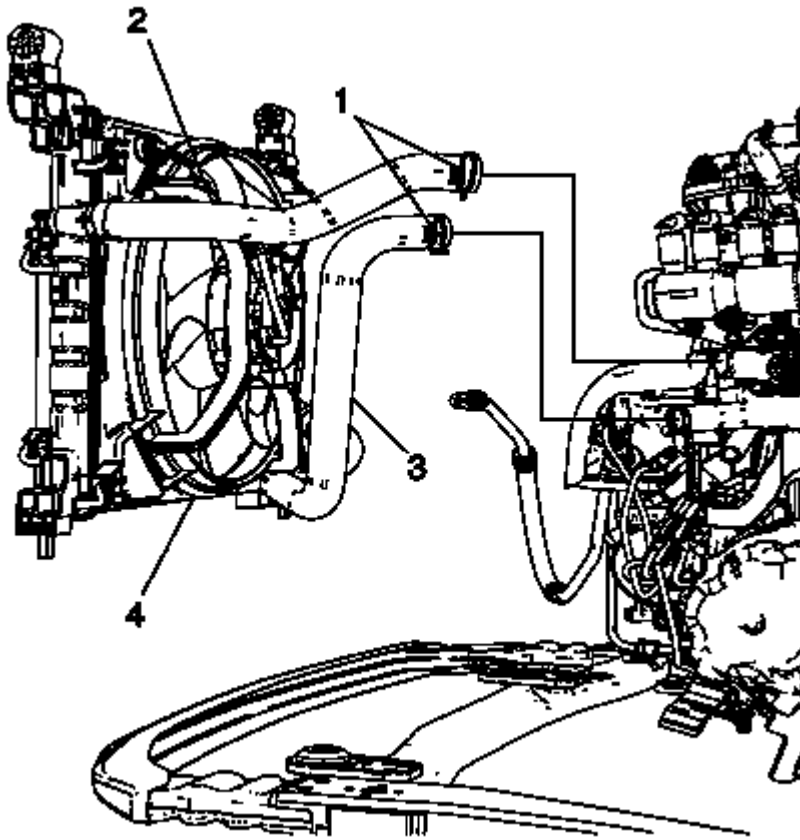


Fig. 104: Radiator Inlet And Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

12. Connect the oil cooler pipes to the transmission. Refer to **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (Aisin 80-40LE)** , **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (Jatco CVT)** .
13. Install the radiator and condenser assembly (4) and connect the radiator inlet and outlet hoses (2, 3).
14. Install the radiator inlet and outlet hose clamp (1).
15. Install the crankshaft position sensor. Refer to **Crankshaft Position Sensor Replacement** .
16. Install the oxygen sensor connector bracket with a bolt and tighten to 10 (89 lb in).
17. Connect the park/neutral position (PNP) switch electrical connector.
18. Connect the output speed sensor electrical connector.
19. Connect the input speed sensor electrical connector.
20. Connect the transmission wiring harness electrical connector.

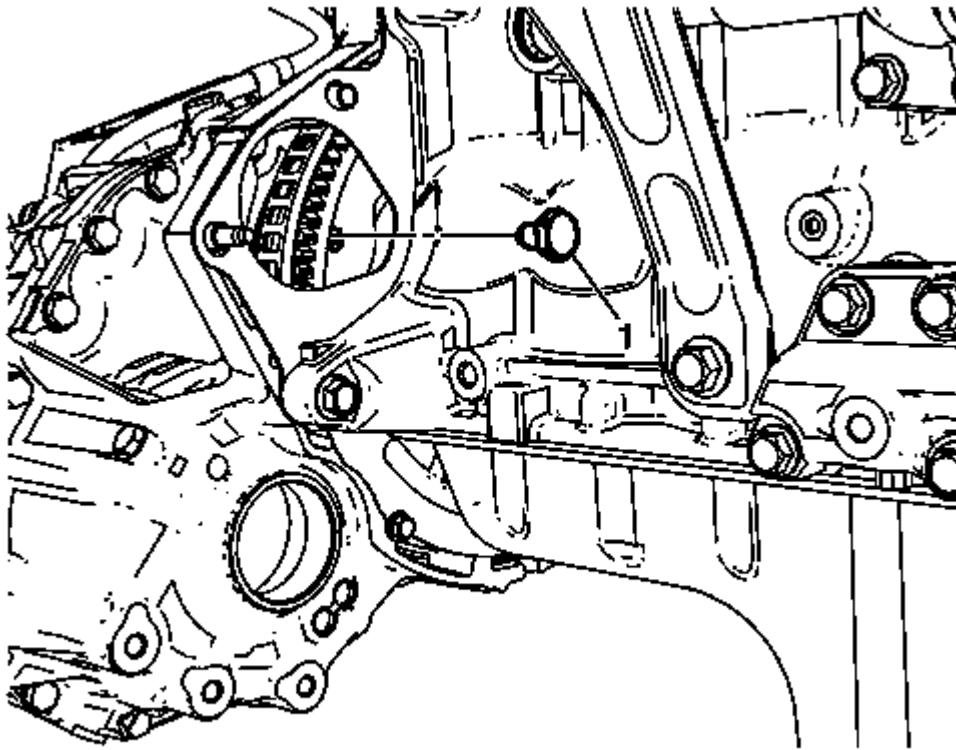


Fig. 105: Torque Converter Bolts
Courtesy of GENERAL MOTORS COMPANY

21. Install NEW torque converter bolts (1) and tighten to 60 (44 lb ft).
22. Install the starter. Refer to **Starter Replacement** .
23. Install the powertrain assembly to the vehicle and then install the related parts. Refer to **Engine Replacement (LFM)** , **Engine Replacement (LL0)** .
24. Perform the transmission fluid cooler flushing and flow test. Refer to **Transmission Fluid Cooler Flushing and Flow Test (JATCO CVT)** , **Transmission Fluid Cooler Flushing and Flow Test (Aisin 80-40LE)** .
25. Fill the transmission with fluid. Refer to **Transmission Fluid Drain and Fill**.
26. Check the transmission fluid for proper level. Refer to **Transmission Fluid Level and Condition Check**.
27. Perform the transmission adaptive learn when replaced. Refer to **Transmission Adaptive Learn**.

REPAIR INSTRUCTIONS - OFF VEHICLE

TRANSMISSION DISASSEMBLE

Special Tools

- DT-46455 (DW240-060-01) Brake Spring Compressor Bolt/Nut

- **DT-46457 (DW240-070)** 1st and Reverse Brake Adapter
- **DT-46459 (DW240-090)** Planetary Ring Gear Remover
- **DT-46463 (DW240-150)** Transmission Case Side Bearing Outer Race Adapter
- **DT-46465 (DW240-170)** Adapter Handle
- **DT-46472 (DW240-041)** Planetary Ring Gear Nut Removal/Installation Socket

For equivalent regional tools, refer to **Special Tools**.

Disassembly Procedure

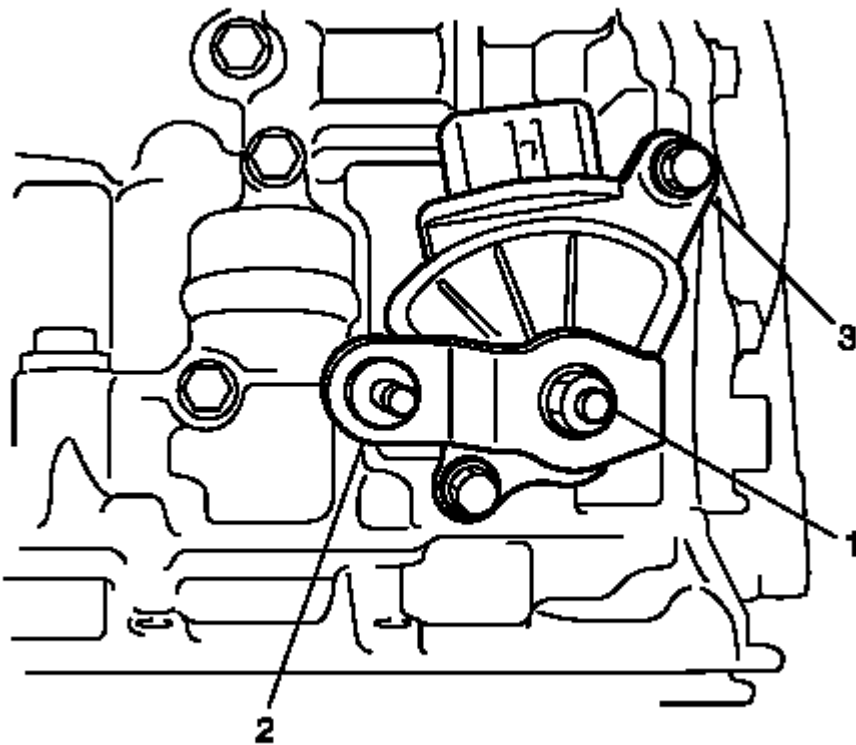


Fig. 106: Spring Washer And Control Shaft Lever
Courtesy of GENERAL MOTORS COMPANY

1. Remove the torque converter from the transmission.
2. Remove the nut (1), spring washer and control shaft lever (2).
3. Remove the 2 bolts (3) and pull out and DISCARD the park/neutral position (PNP) switch.

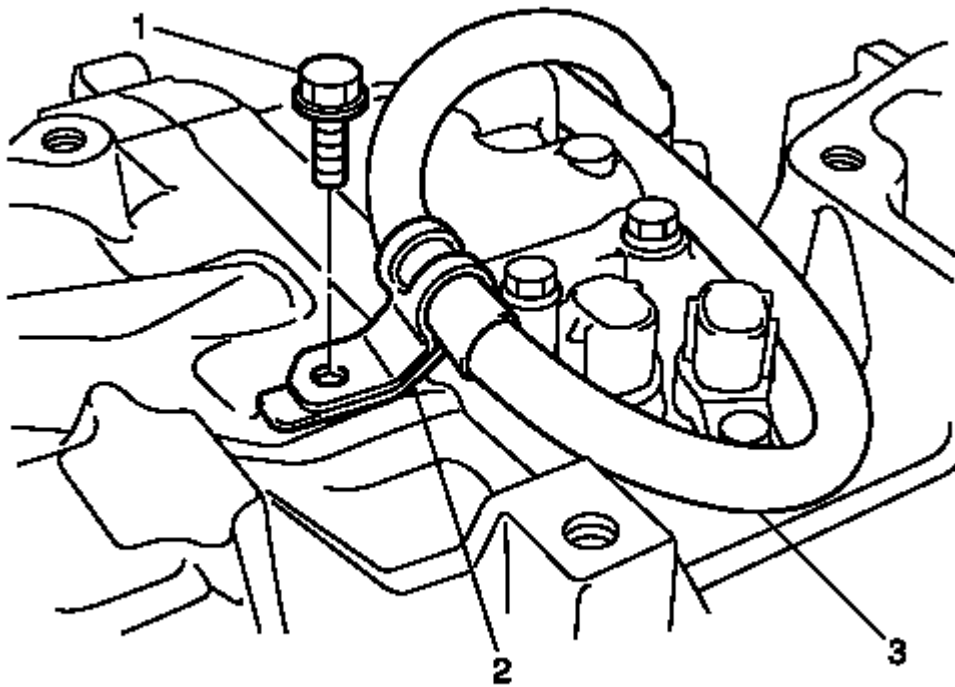


Fig. 107: Breather Plug Bracket

Courtesy of GENERAL MOTORS COMPANY

4. Remove the bolt (1) and breather plug bracket (2) from the transmission case.
5. Disengage the hose clamp and remove the breather hose (3).
6. Remove the breather plug from the transmission case.
7. Remove the O-ring from the breather plug.

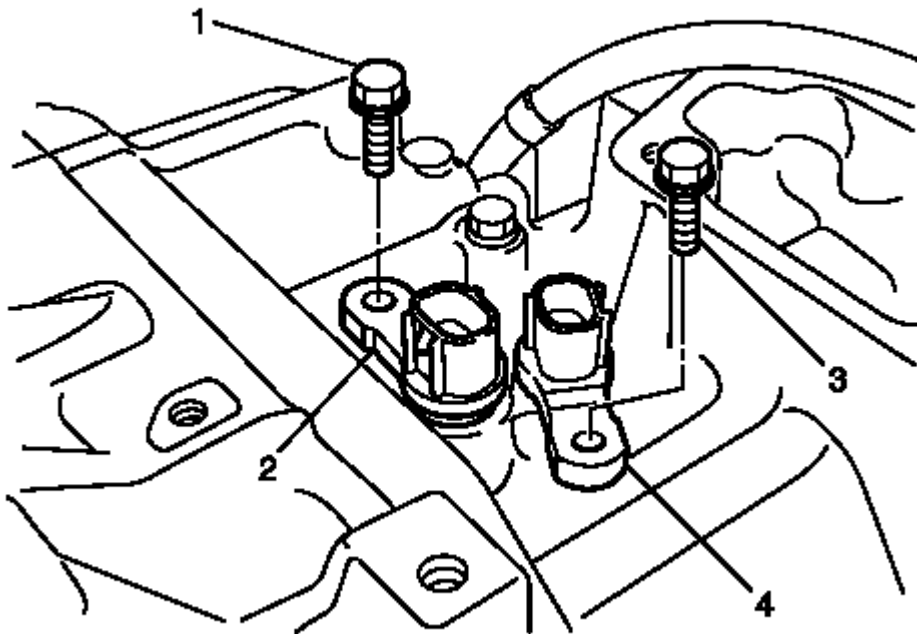


Fig. 108: Input Speed Sensor

Courtesy of GENERAL MOTORS COMPANY

8. Remove the bolt (1) and input speed sensor (2).
9. Remove the bolt (3) and output speed sensor (4).

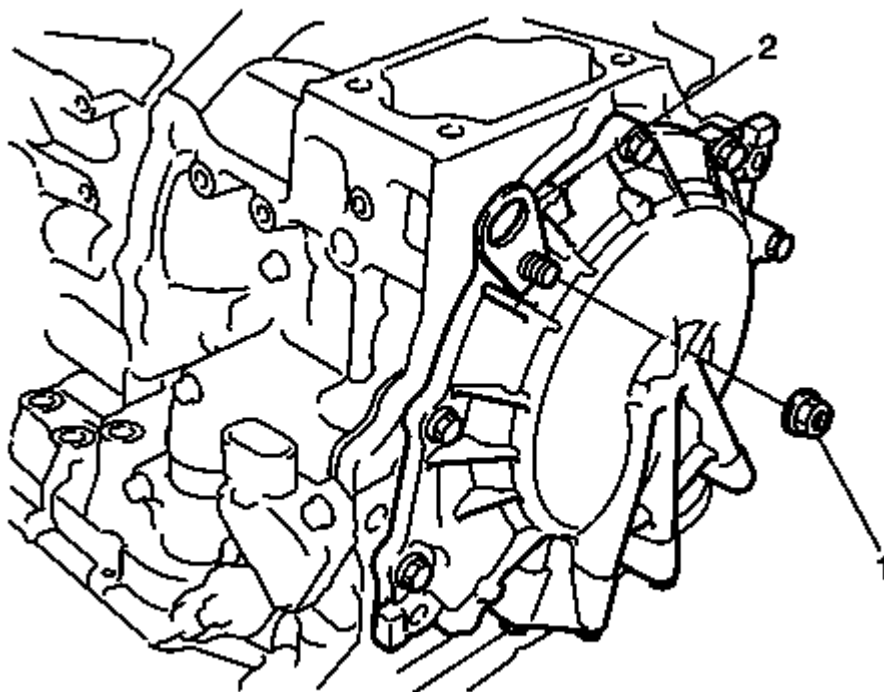


Fig. 109: Transmission Hook Nut
Courtesy of GENERAL MOTORS COMPANY

10. Remove the transmission hook nut (1) and hook (2).

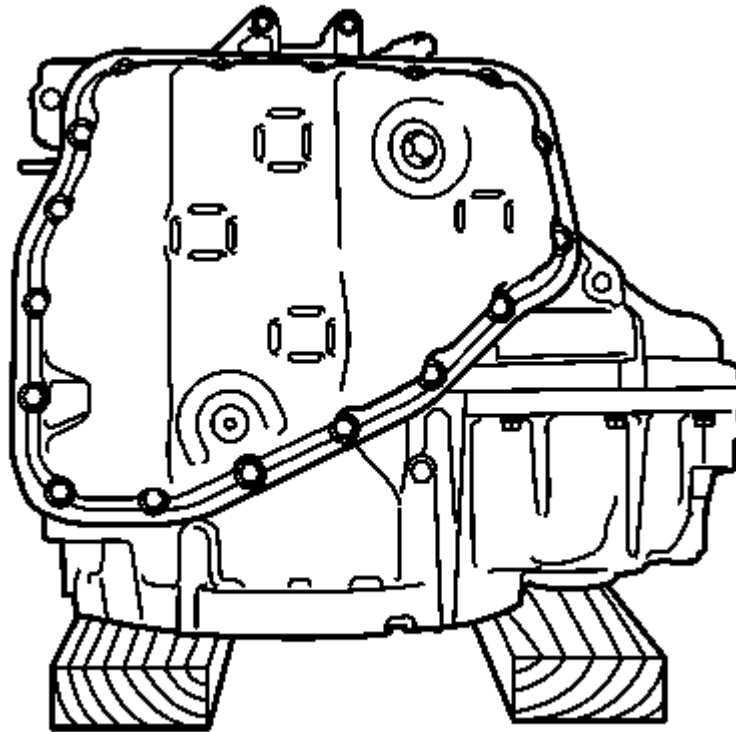


Fig. 110: Transmission Oil Pan Side Facing Up
Courtesy of GENERAL MOTORS COMPANY

11. Place the wooden blocks to fix the transmission oil pan side facing up.

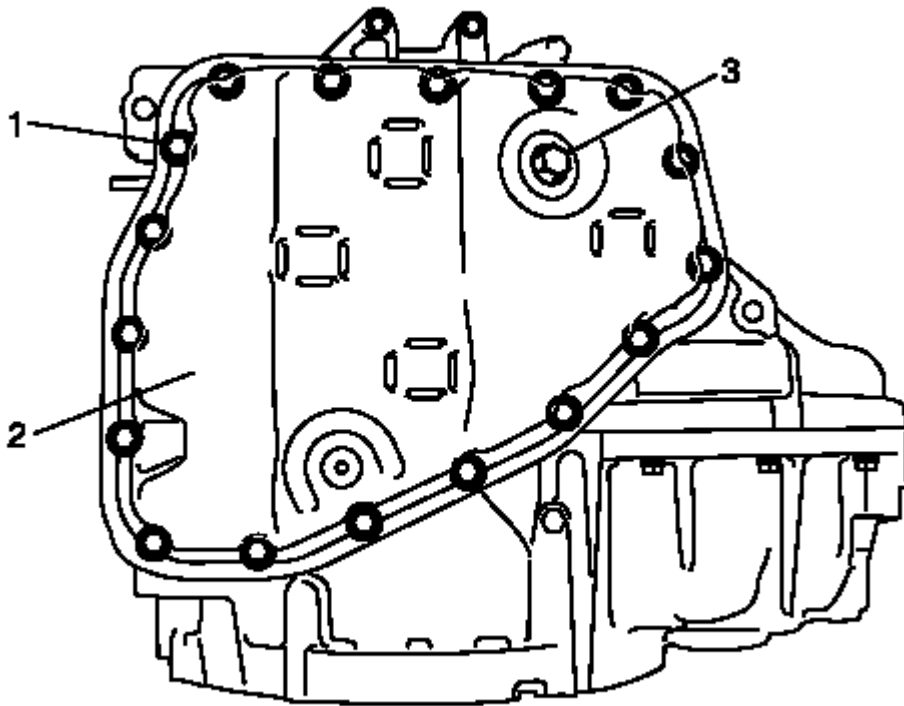


Fig. 111: Oil Pan And Oil Pan Gasket
Courtesy of GENERAL MOTORS COMPANY

12. Remove the 17 oil pan bolts (1).
13. Remove the oil pan (2) and oil pan gasket.
14. Remove the drain plug gasket and drain plug (3) from the oil pan.

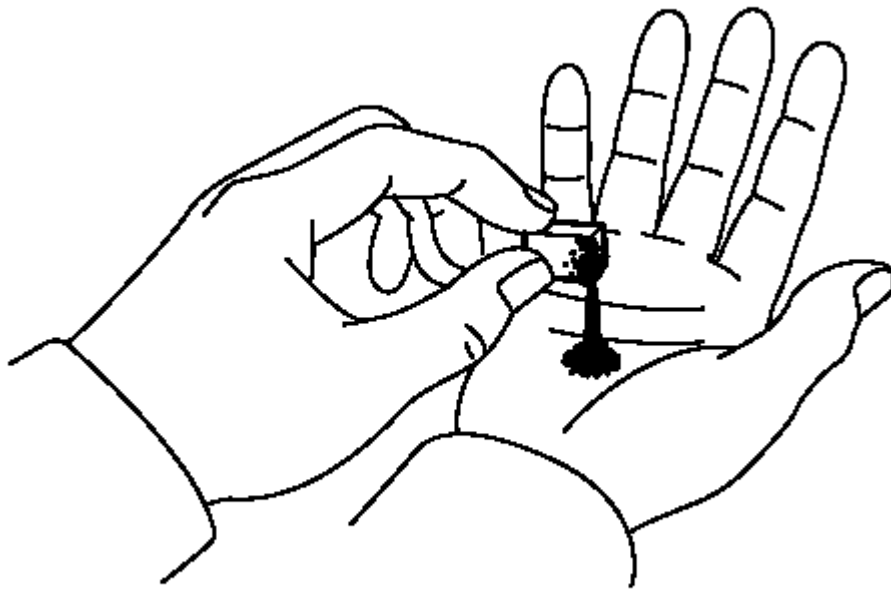


Fig. 112: Oil Pan

Courtesy of GENERAL MOTORS COMPANY

15. 15.Remove the magnets and use them to collect any steel chips.
16. Examine the chips and particles in the pan and on the magnet to determine what type of wear has occurred in the transmission.

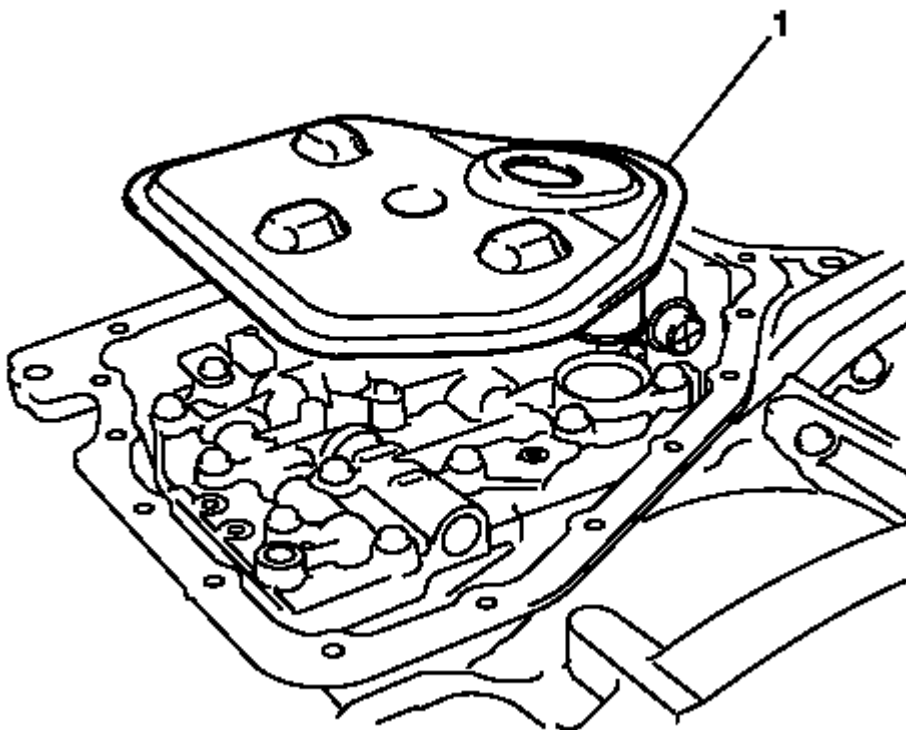


Fig. 113: Oil Strainer

Courtesy of GENERAL MOTORS COMPANY

17. Pull the oil strainer (1) and remove it.

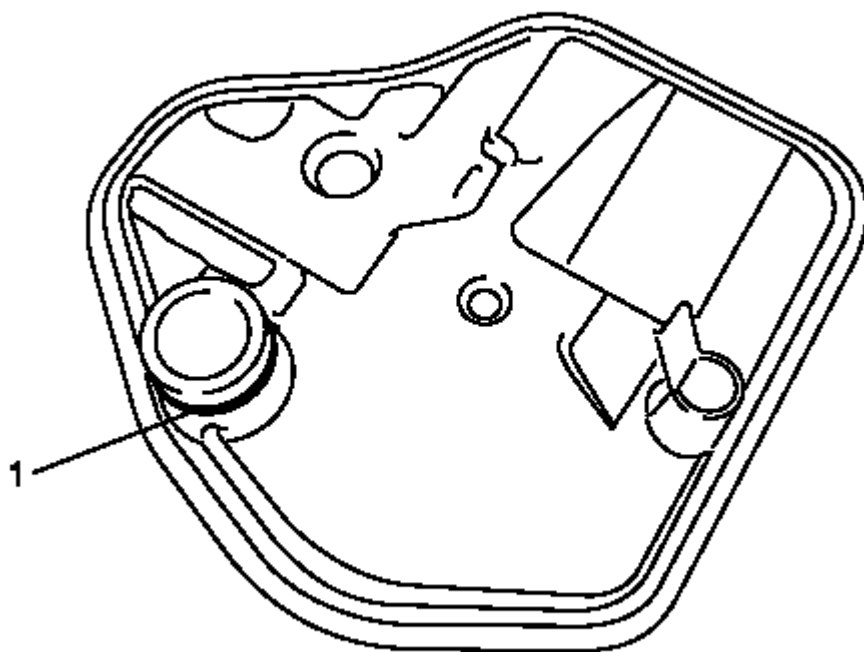


Fig. 114: Oil Strainer

Courtesy of GENERAL MOTORS COMPANY

18. Remove O-ring (1) from the oil strainer.

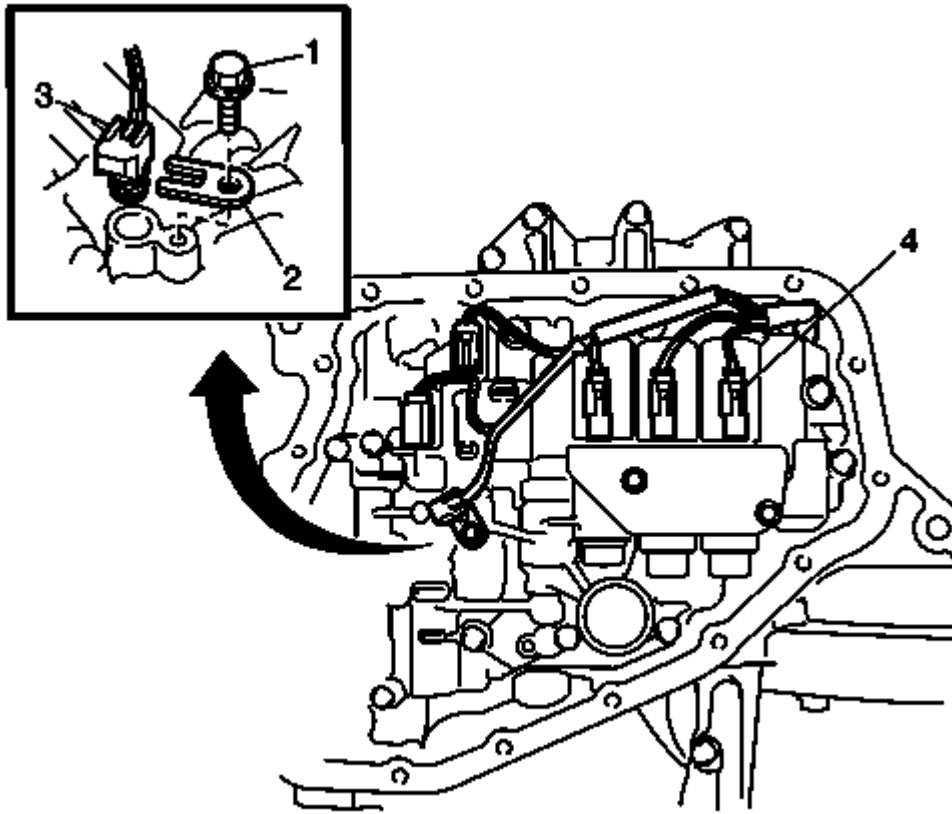


Fig. 115: Transmission Fluid Temperature Sensor Clamp
Courtesy of GENERAL MOTORS COMPANY

19. Remove the bolt (1) and transmission fluid temperature sensor clamp (2), and pull out the sensor (3) from the valve body assembly.
20. Disconnect the 5 solenoid connectors (4).

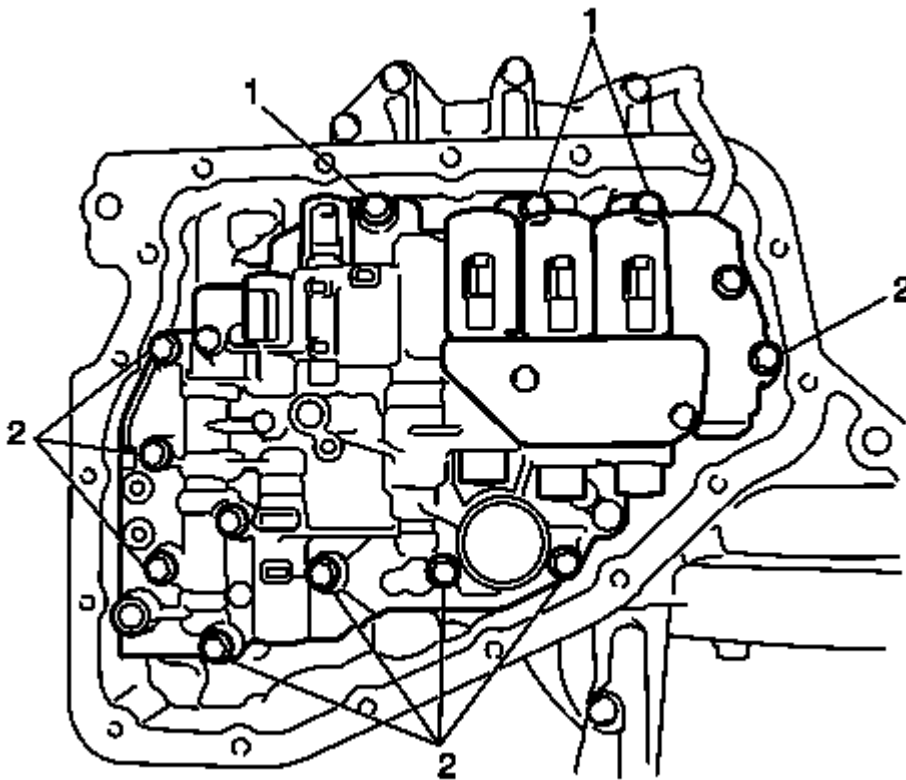


Fig. 116: Valve Body Assembly

Courtesy of GENERAL MOTORS COMPANY

21. Support the valve body assembly and remove the 11 bolts (1, 2).

Specifications

- The bolts (1) size is M6 x 1.0 x 20 mm.
 - The bolts (2) size is M6 x 1.0 x 36 mm.
22. Disconnect the manual valve control rod from the manual valve lever, then remove the valve body assembly.

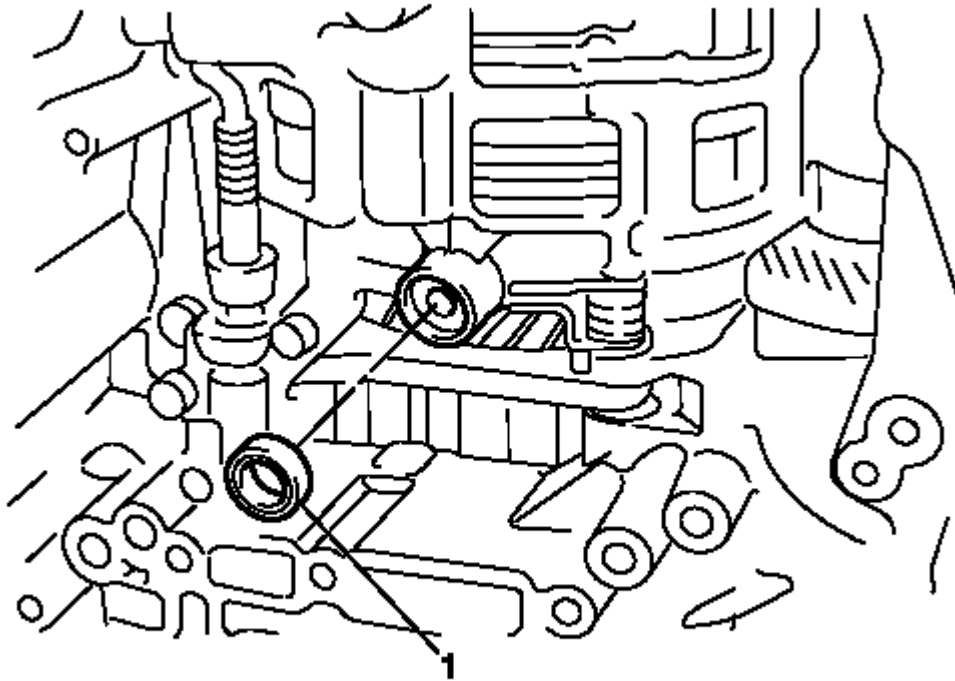


Fig. 117: Apply Gasket

Courtesy of GENERAL MOTORS COMPANY

23. Remove the apply gasket (1).

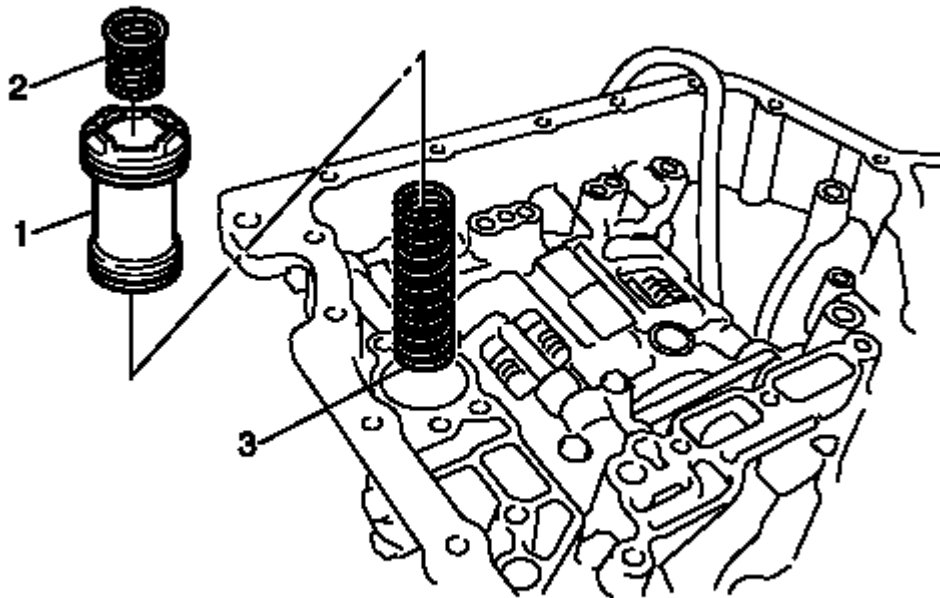


Fig. 118: Reverse Clutch

Courtesy of GENERAL MOTORS COMPANY

24. Using a screwdriver, remove the reverse clutch (C3) accumulator piston (1) and spring (2).
25. Remove the spring (3).

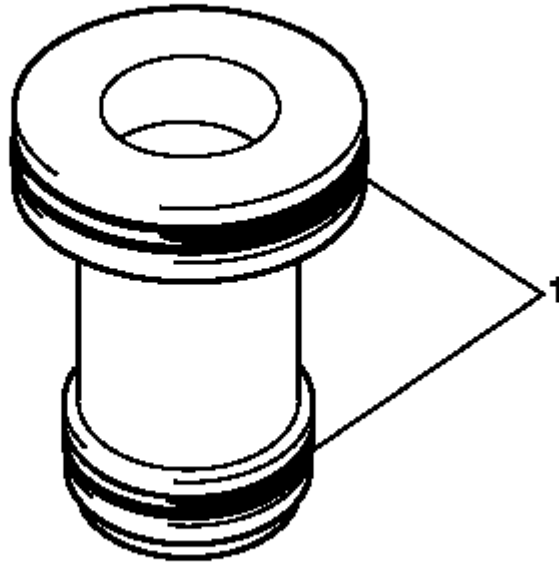


Fig. 119: 2 O-Rings

Courtesy of GENERAL MOTORS COMPANY

26. Using a screwdriver, remove the 2 O-rings (1) from the reverse clutch (C3) accumulator piston.

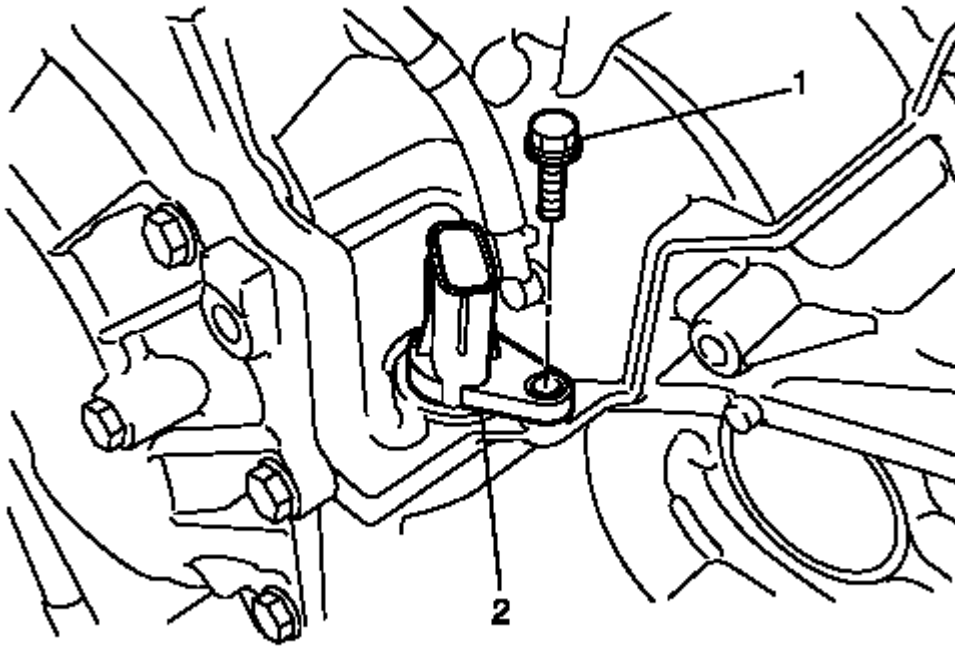


Fig. 120: Wiring Harness Assembly
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Do not damage the wiring harness and do not pull out the harness forcibly.**

27. Remove the bolt (1) and transmission wiring harness (2) from the transmission case.

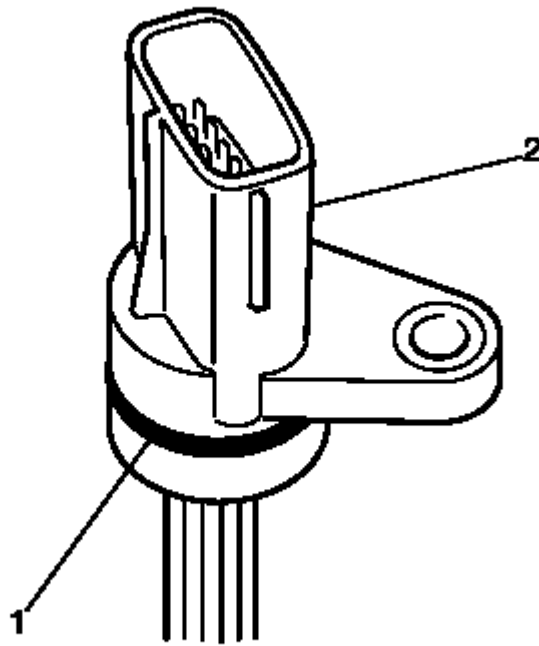


Fig. 121: Transmission Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

28. Remove the O-ring (1) from the transmission wiring harness (2).
29. Remove the O-ring from the transmission fluid temperature sensor.

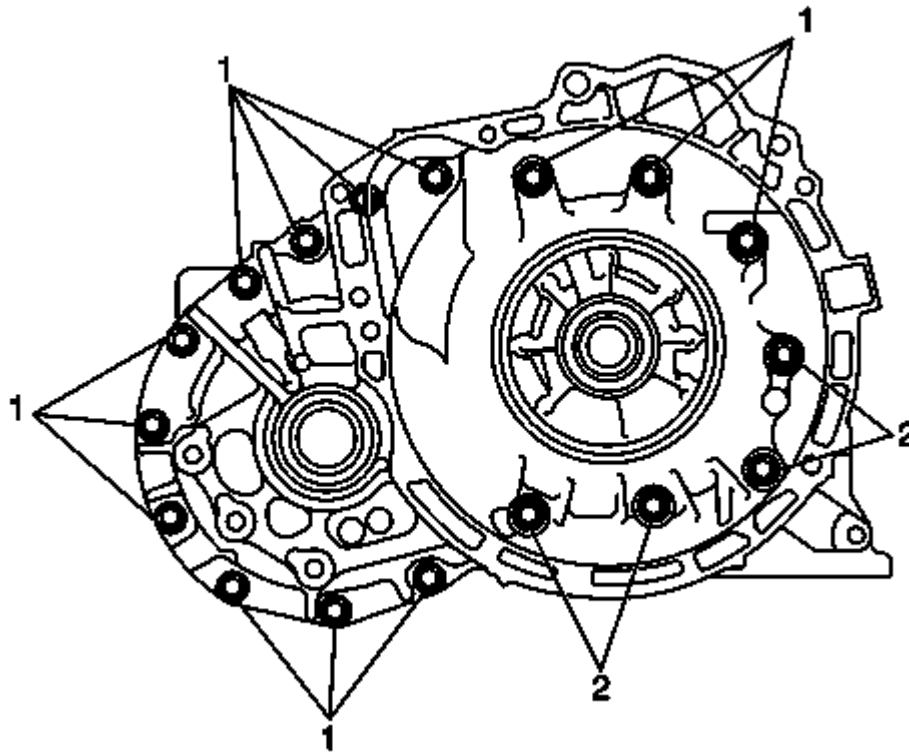


Fig. 122: Transmission Housing Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not drop the differential gear assembly when the transmission housing is removed.

30. Remove the 17 transmission housing bolts (1, 2).

Specifications

- The bolts (1) size is M8 x 1.25 x 30 mm.
- The bolts (2) size is M8 x 1.25 x 30 mm (Seal).

31. Using a plastic hammer, tap the transmission housing to remove it.

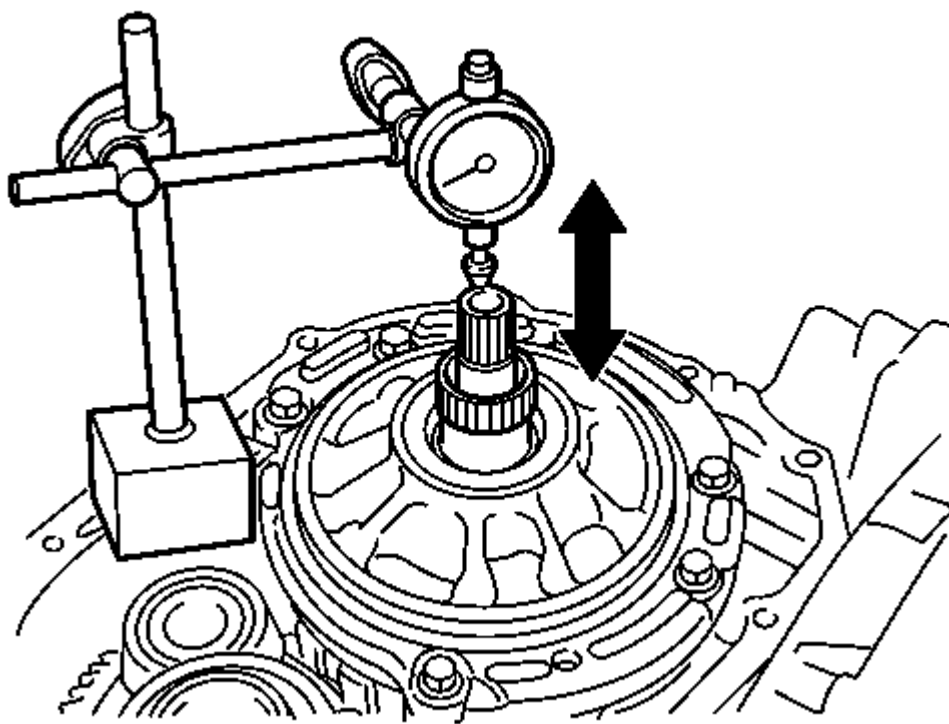


Fig. 123: Measuring Input Shaft End Play
Courtesy of GENERAL MOTORS COMPANY

32. Using a dial indicator, measure the input shaft end play.

Specification

The end play is 0.3-0. mm (0.012-0.035 in).

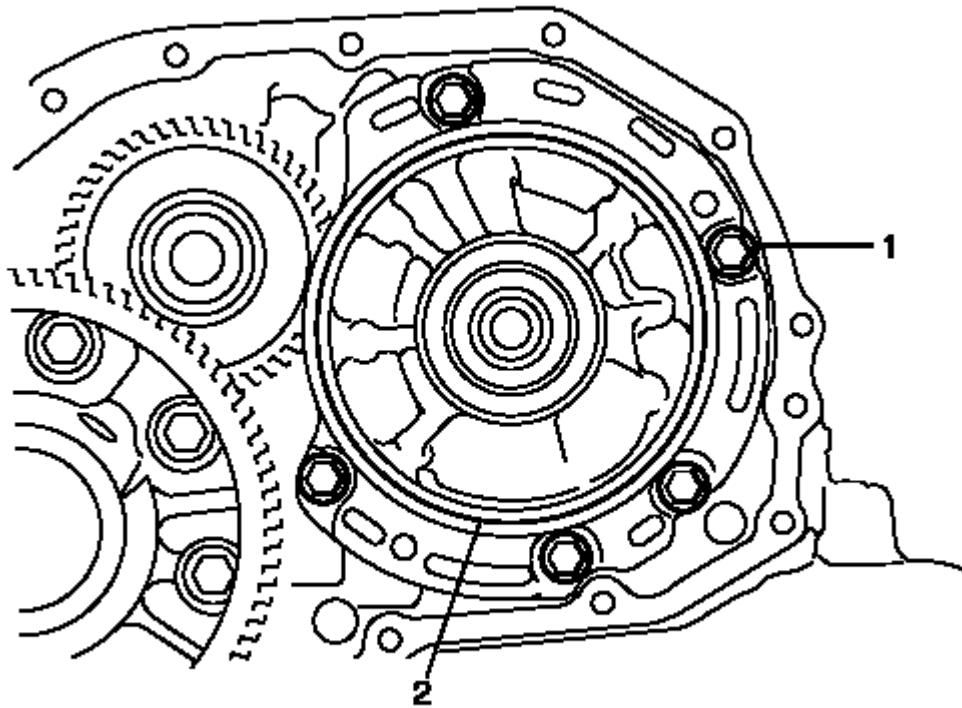


Fig. 124: Oil Pump Assembly

Courtesy of GENERAL MOTORS COMPANY

NOTE: In some cases, the oil pump assembly may be removed with the thrust needle roller bearing attached.

33. Remove the 5 oil pump bolts (1) and oil pump (2).

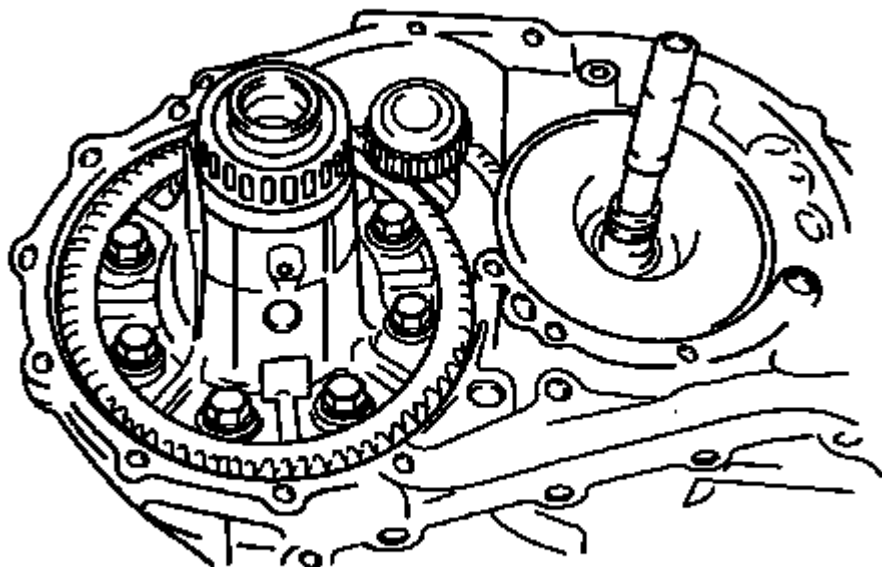


Fig. 125: Differential Gear Assembly & Transaxle Case
Courtesy of GENERAL MOTORS COMPANY

34. Remove the differential gear assembly from the transmission case.

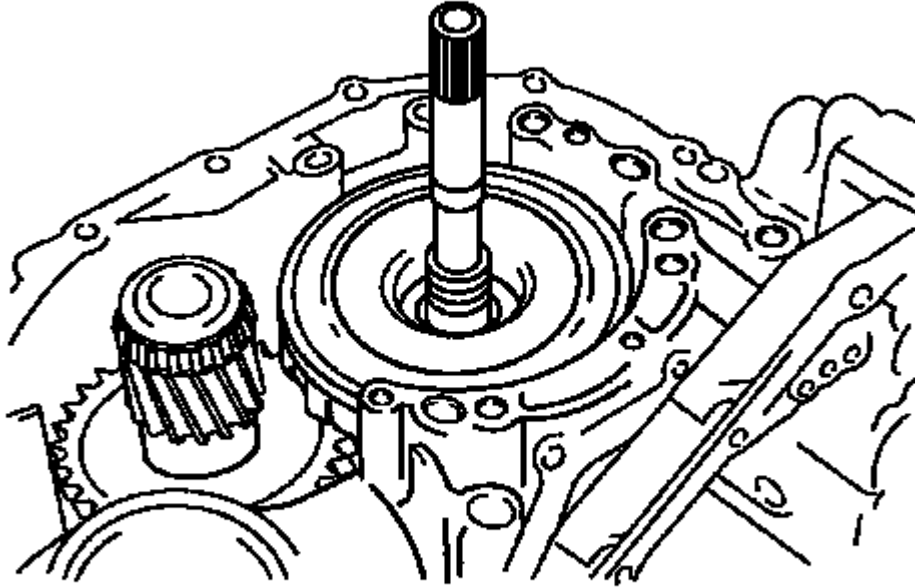


Fig. 126: Direct Clutch Assembly & Transaxle Case
Courtesy of GENERAL MOTORS COMPANY

NOTE: In some cases, the direct clutch assembly may be removed with the thrust needle roller bearing attached.

35. Remove the direct clutch assembly from the transmission case.

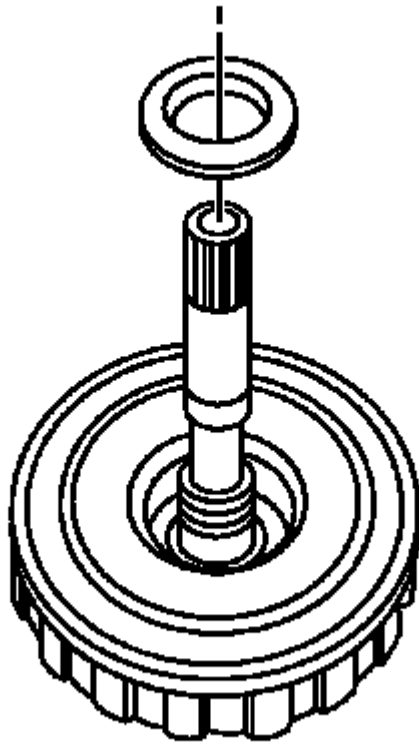


Fig. 127: Thrust Needle Roller Bearing & Direct Clutch Assembly
Courtesy of GENERAL MOTORS COMPANY

36. Remove the thrust needle roller bearing from the direct clutch assembly.

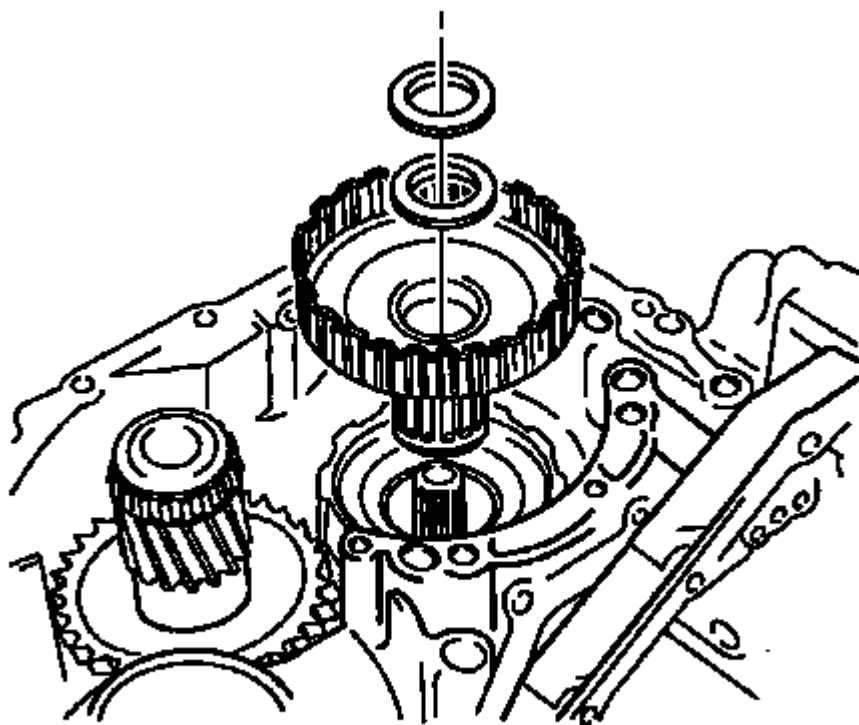


Fig. 128: Direct Clutch Hub, Thrust Needle Roller Bearing, Race & Transaxle Case
Courtesy of GENERAL MOTORS COMPANY

37. Remove the direct clutch hub, thrust needle roller bearing and thrust bearing race from the transmission case.

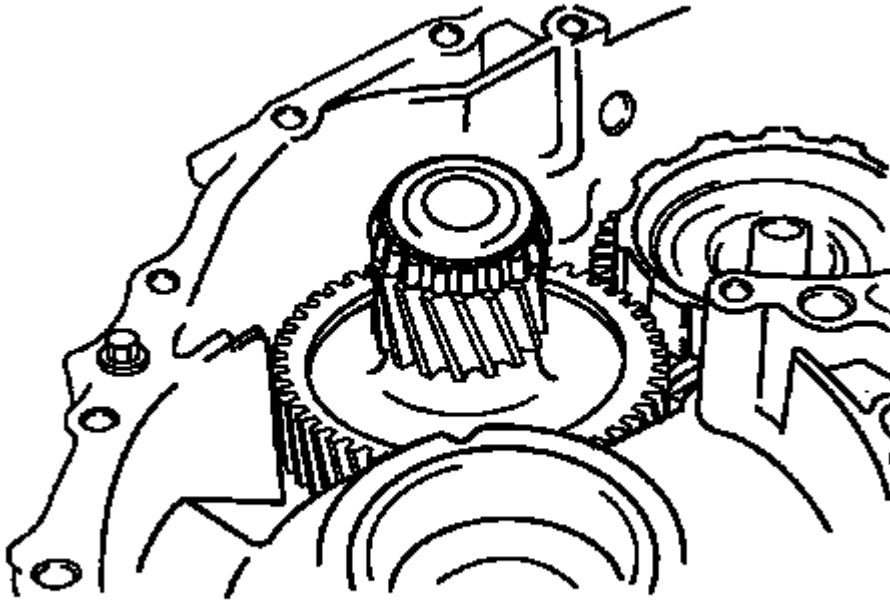


Fig. 129: Counter Driven Gear Assembly & Transaxle Case
Courtesy of GENERAL MOTORS COMPANY

38. Remove the counter driven gear assembly from the transmission case.

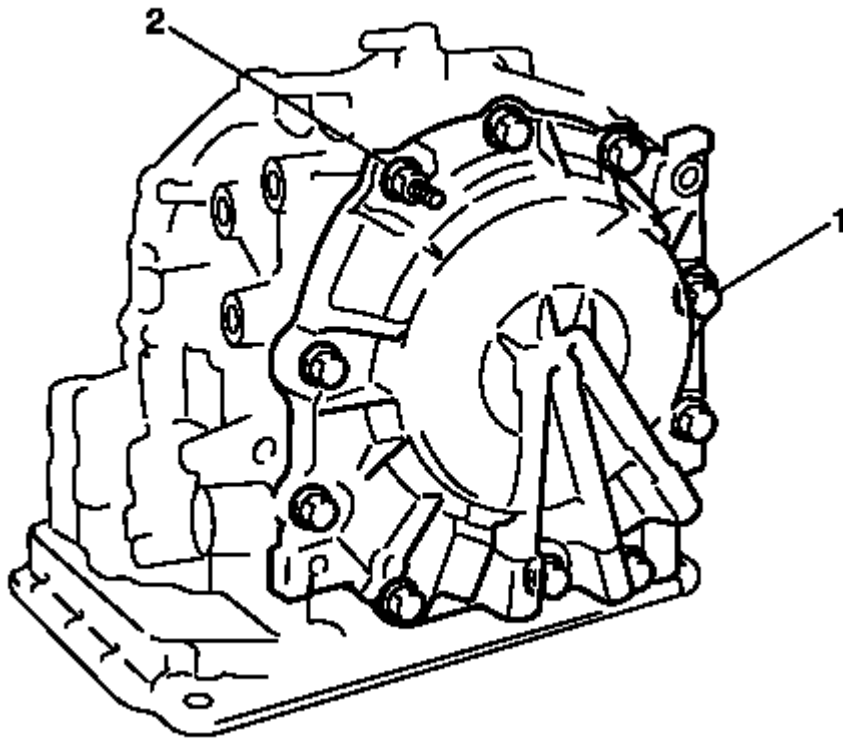


Fig. 130: Transmission Rear Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

39. Remove the 9 transmission rear cover bolts (1) and 1 stud bolt (2).

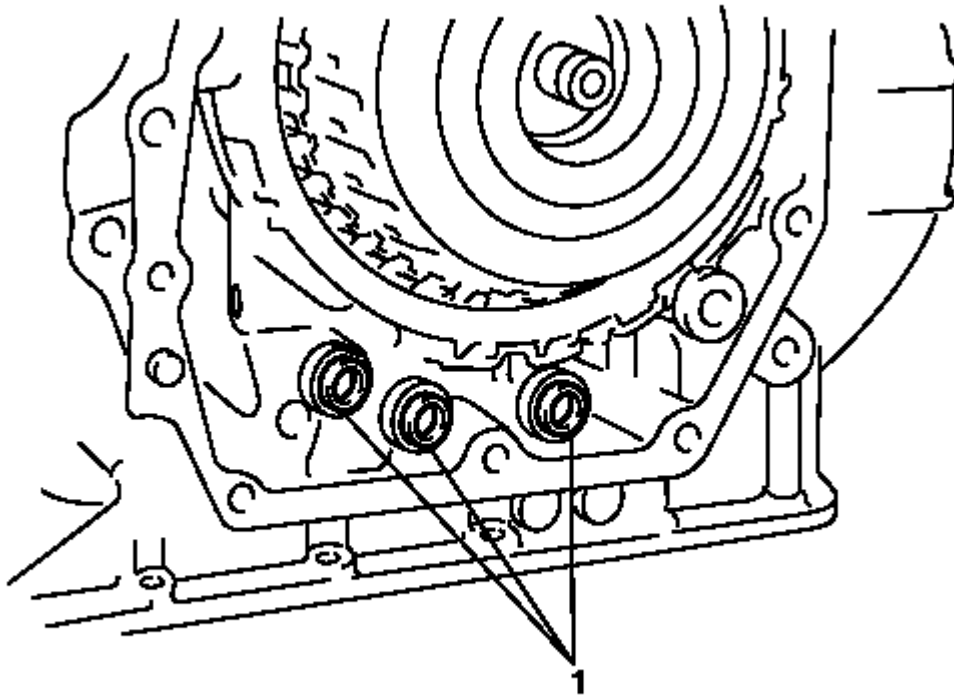


Fig. 131: O-Rings

Courtesy of GENERAL MOTORS COMPANY

40. Remove the 3 O-rings (1).

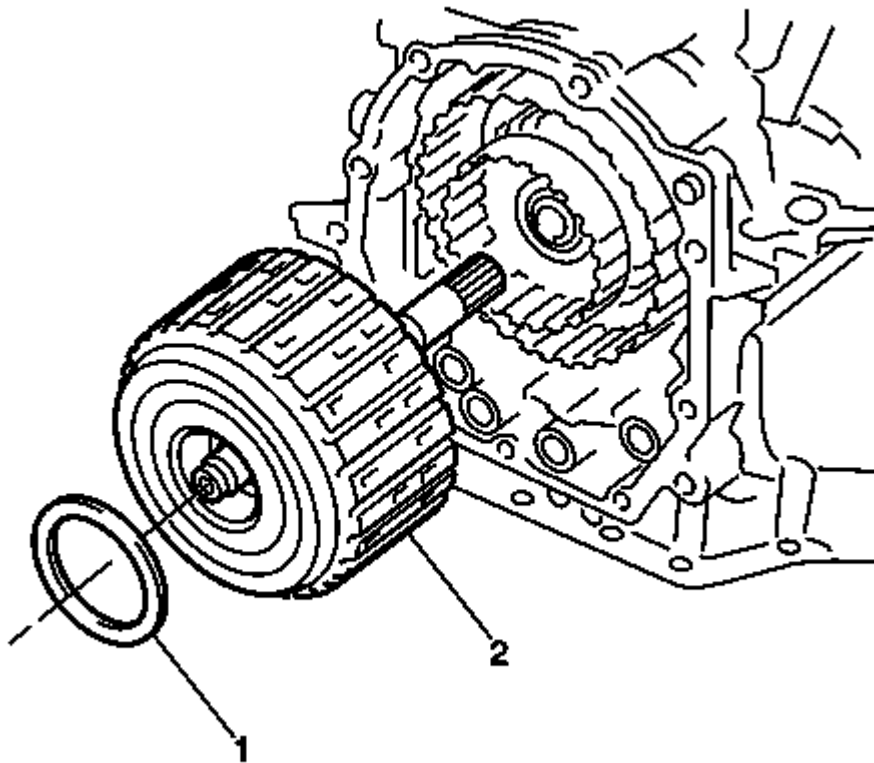


Fig. 132: Thrust Needle Roller Bearing
Courtesy of GENERAL MOTORS COMPANY

41. Remove the thrust needle roller bearing (1) and the forward and reverse clutch assembly (2).

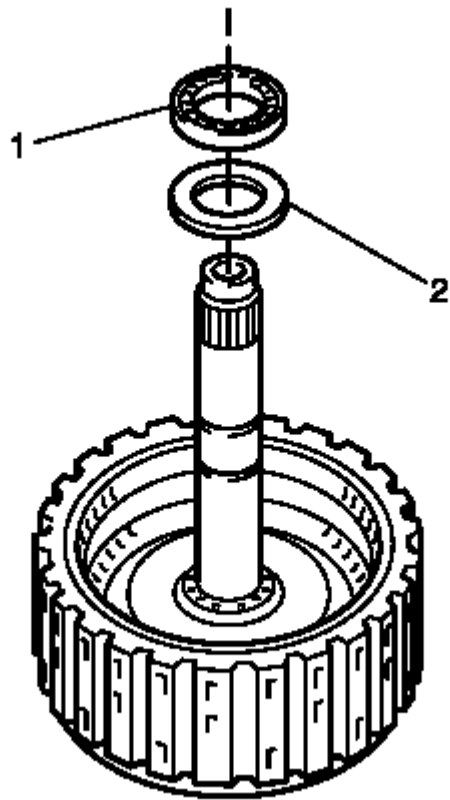


Fig. 133: Thrust Needle Roller Bearing
Courtesy of GENERAL MOTORS COMPANY

42. Remove the thrust needle roller bearing (1) and thrust bearing race (2) from the forward and reverse clutch assembly.

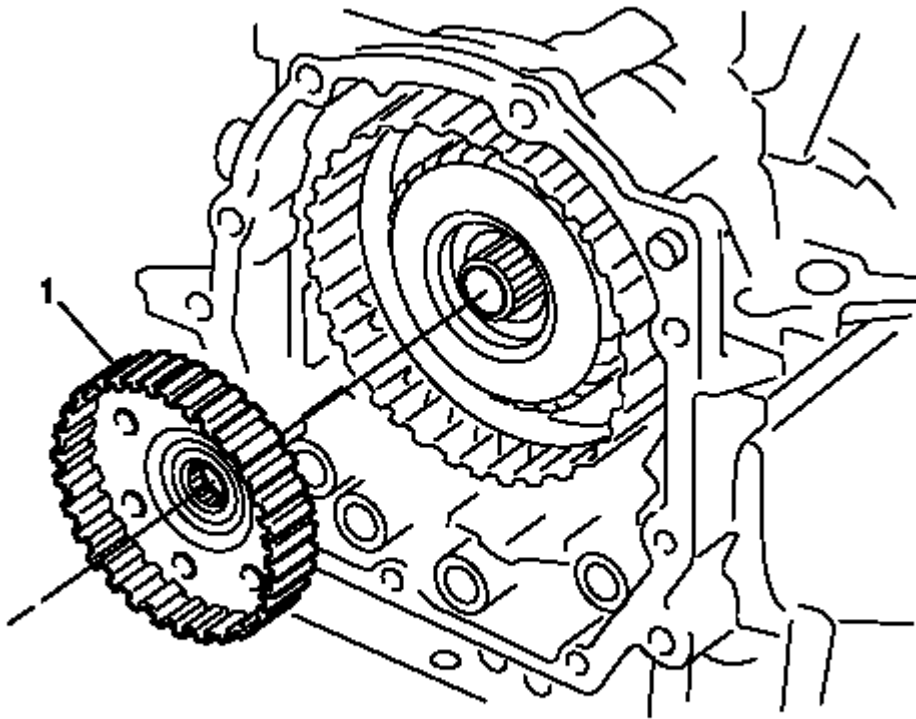


Fig. 134: Forward Clutch Hub

Courtesy of GENERAL MOTORS COMPANY

43. Remove the forward clutch hub (1) from the transmission case.

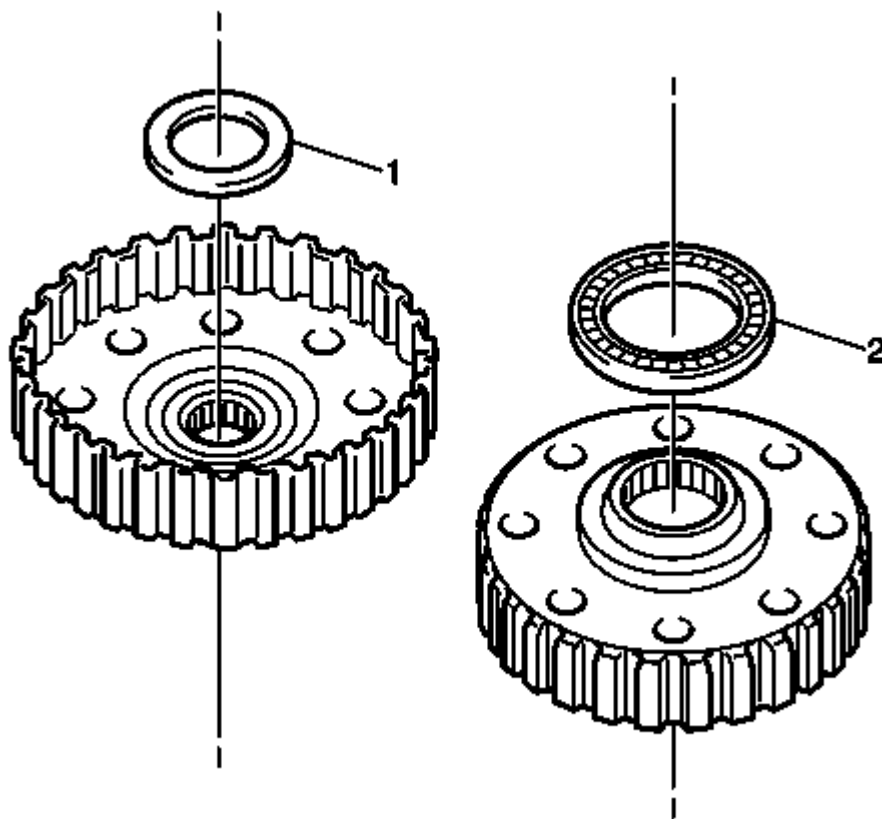


Fig. 135: Thrust Bearing Race

Courtesy of GENERAL MOTORS COMPANY

44. Remove the thrust bearing race (1) and thrust needle roller bearing (2) from the forward clutch hub.

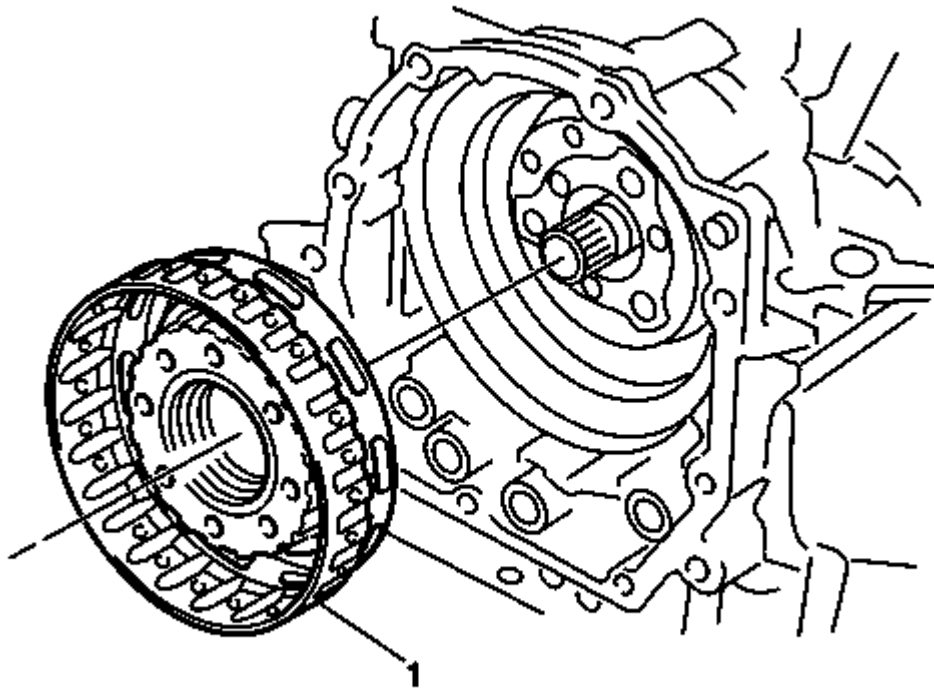


Fig. 136: Rear Planetary Sun Gear
Courtesy of GENERAL MOTORS COMPANY

45. Remove the rear planetary sun gear (1) from the transmission case.

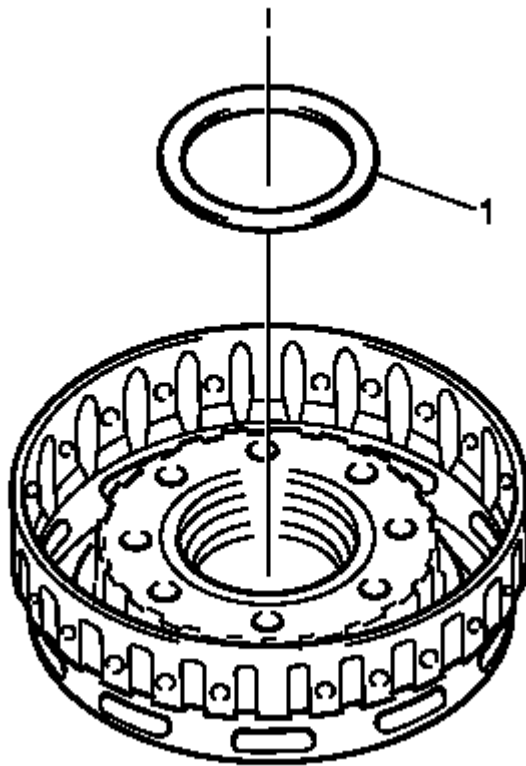


Fig. 137: Thrust Bearing Race

Courtesy of GENERAL MOTORS COMPANY

46. Remove the thrust bearing race (1) from the rear planetary sun gear.

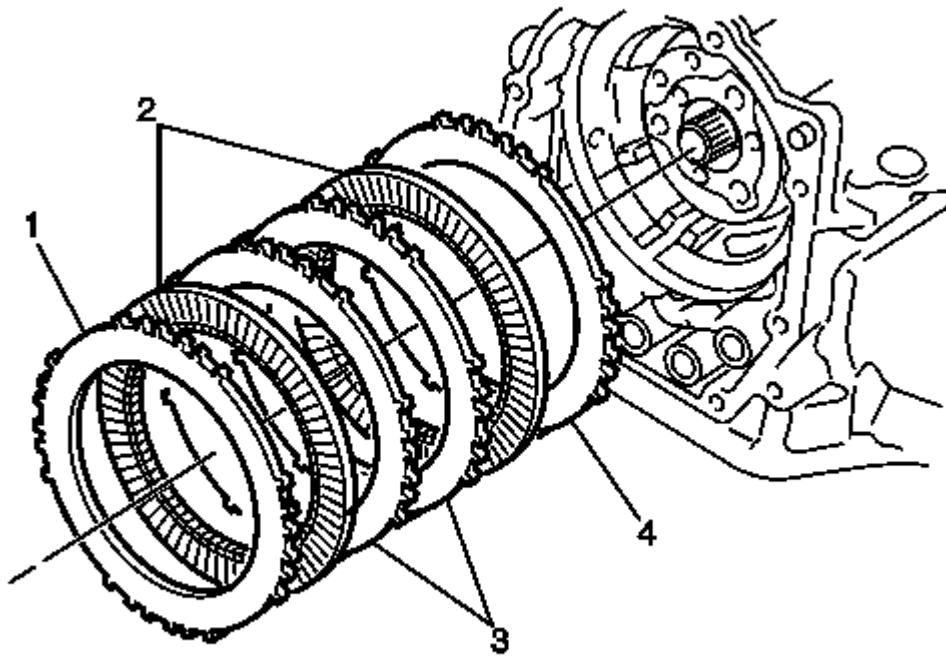


Fig. 138: Flanges, Discs And Plates
Courtesy of GENERAL MOTORS COMPANY

47. Remove 2 flanges (1, 4), 2 discs (2), and 2 plates (3) of 2nd coast and overdrive (O/D) brake from the transmission case.

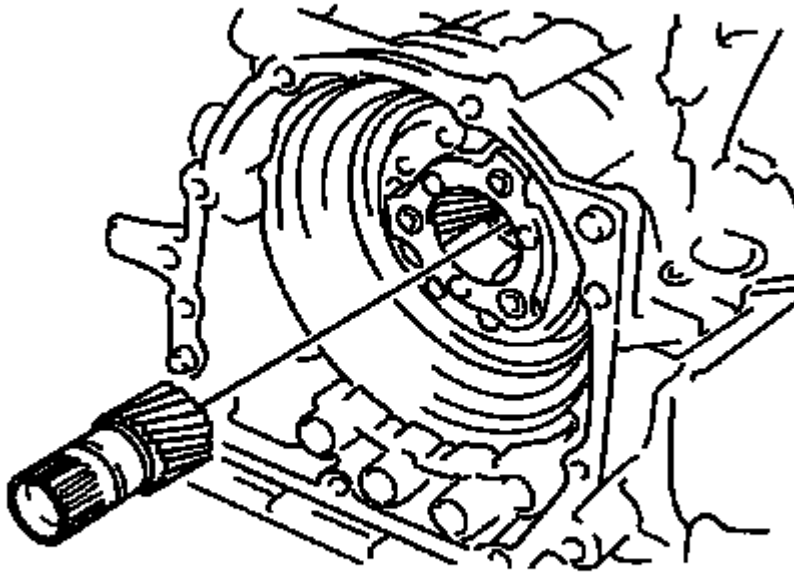


Fig. 139: Front Planetary Sun Gear & Thrust Bearing Race
Courtesy of GENERAL MOTORS COMPANY

48. Remove the front planetary sun gear from the transmission case.
49. Remove the thrust bearing race from the front planetary sun gear.

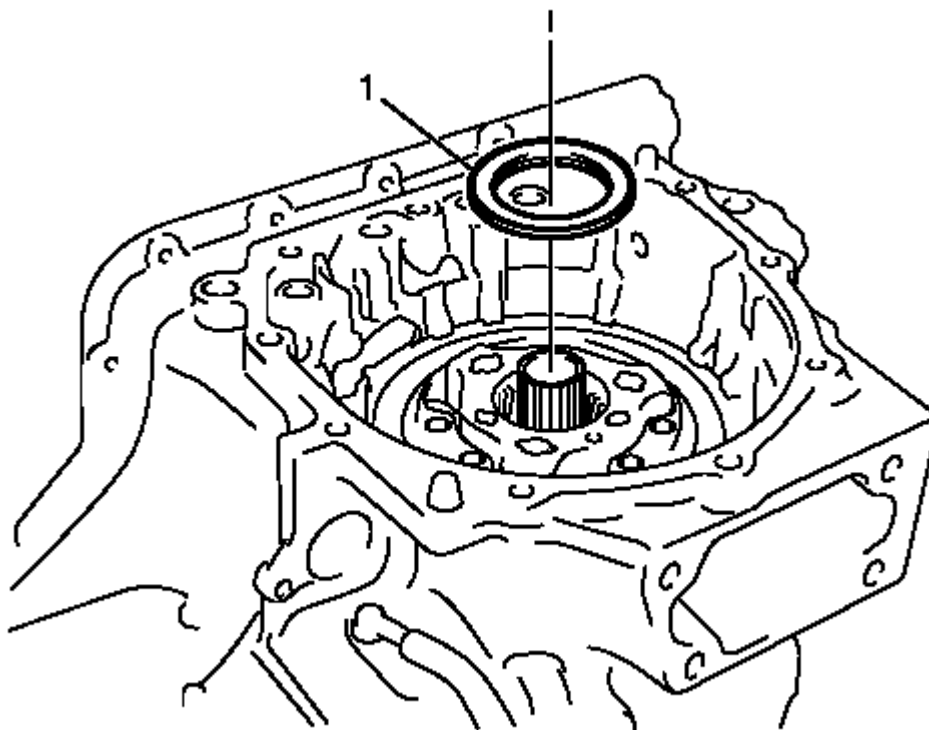


Fig. 140: Thrust Needle Roller Bearing
Courtesy of GENERAL MOTORS COMPANY

50. Remove the thrust needle roller bearing (1).

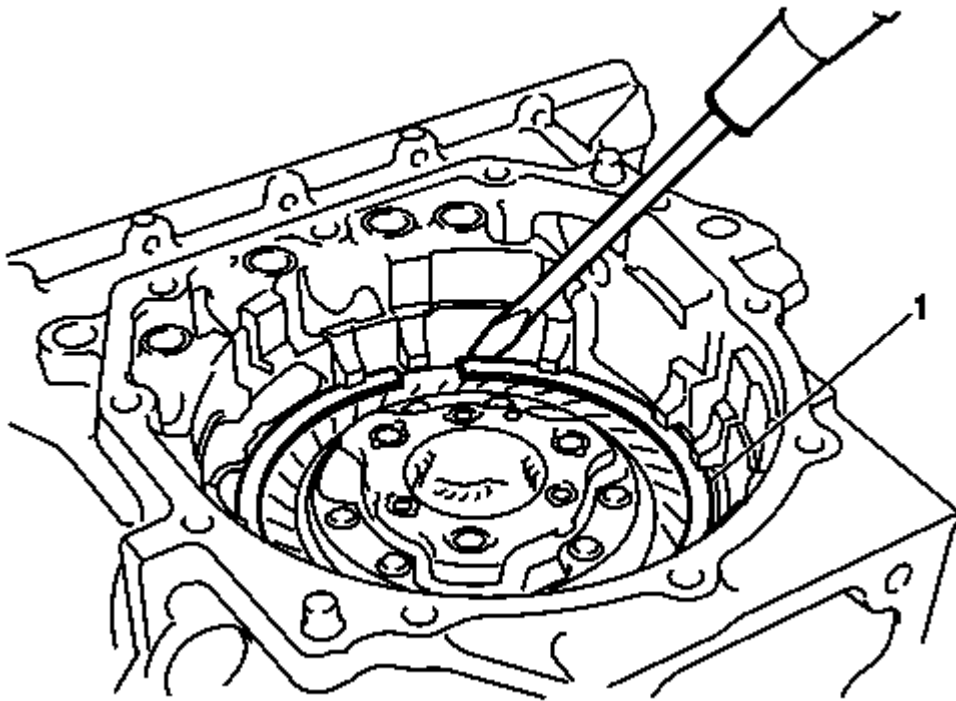


Fig. 141: View Of Snap Ring

Courtesy of GENERAL MOTORS COMPANY

51. Using a screwdriver, remove the snap ring (1).

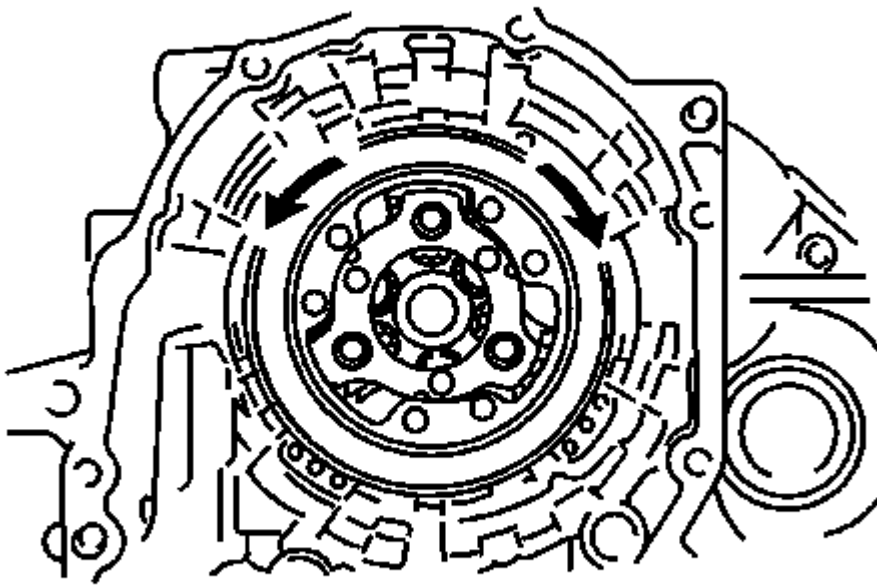


Fig. 142: Verifying Planetary Gear Turns Freely
Courtesy of GENERAL MOTORS COMPANY

52. Check that the planetary gear turns freely counterclockwise and locks clockwise.

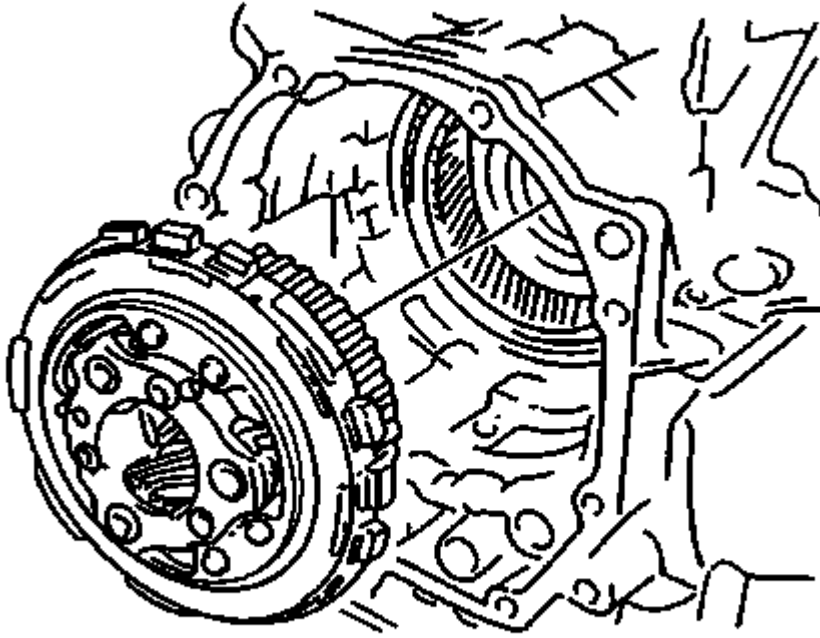


Fig. 143: No. 2 One Way Clutch & Planetary Gear
Courtesy of GENERAL MOTORS COMPANY

NOTE: Remove the sun gear in the center while holding it.

53. Remove the No. 2 one-way clutch and planetary gear from the transmission case.

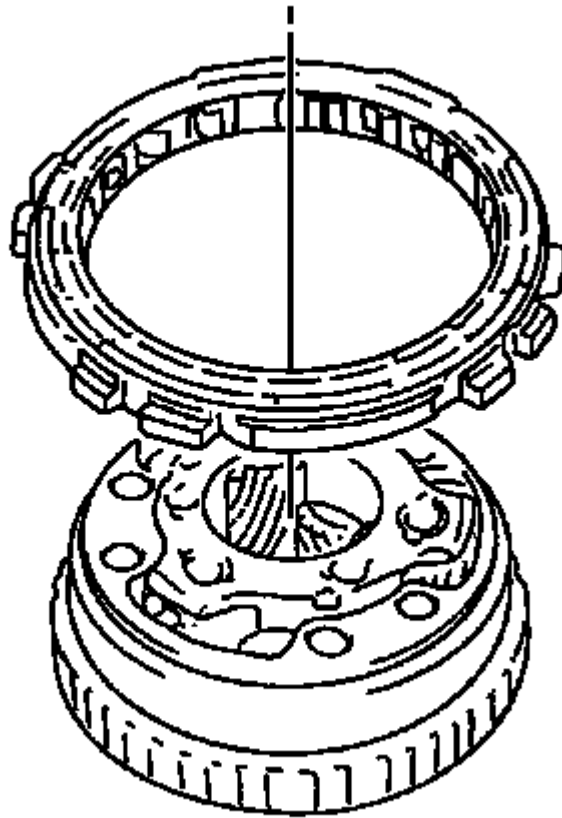


Fig. 144: No. 2 One Way Clutch, Planetary Gear & Remove Anti-Rattle Clip
Courtesy of GENERAL MOTORS COMPANY

54. Remove the No. 2 one-way clutch from the planetary gear.

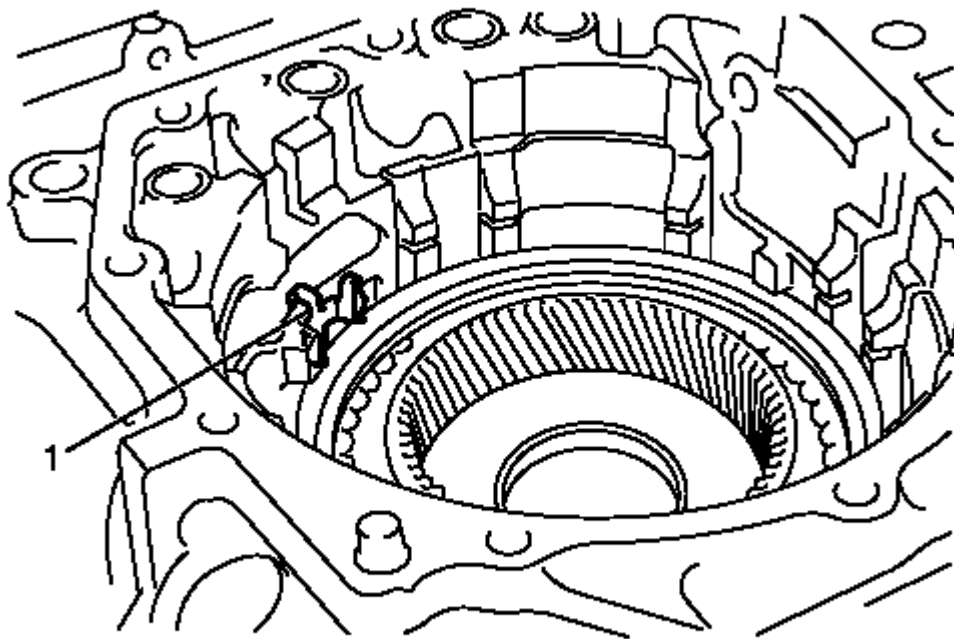


Fig. 145: Outer Race Retainer

Courtesy of GENERAL MOTORS COMPANY

55. Remove the outer race retainer (1) from the transmission case.

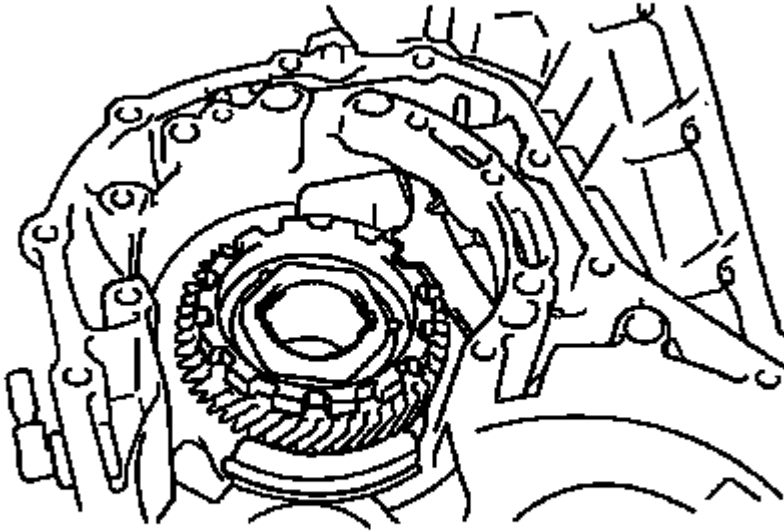


Fig. 146: Counter Drive Gear & Parking Lock Pawl
Courtesy of GENERAL MOTORS COMPANY

56. Place the parking lock pawl in the park position to lock the counter drive gear.

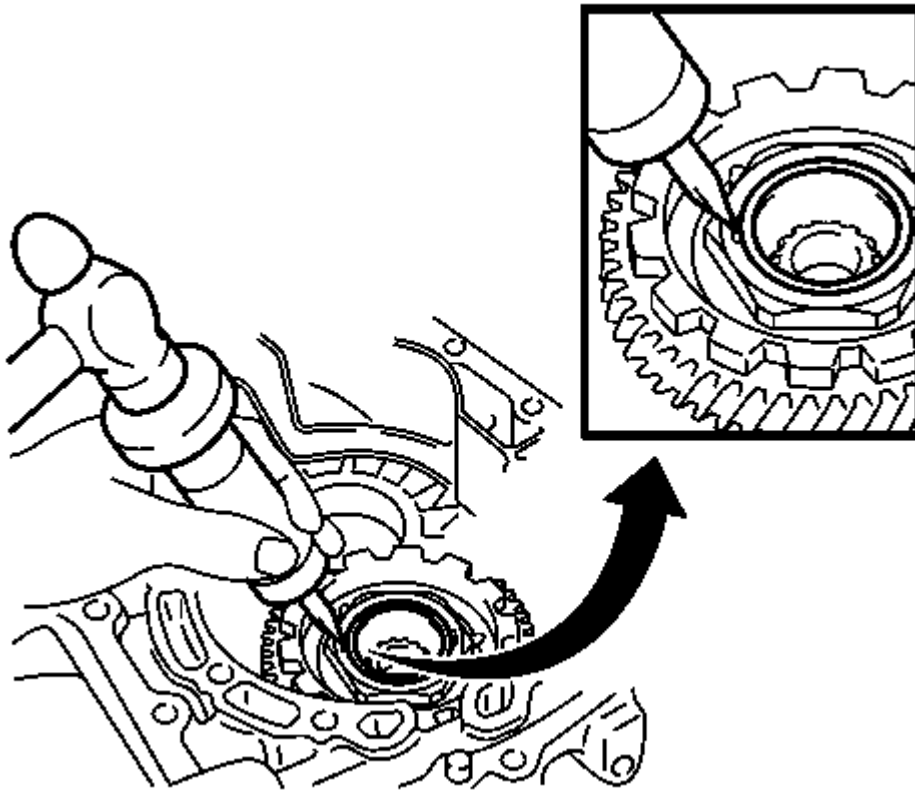


Fig. 147: Counter Drive Gear Nut
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage the bearing when removing the nut.

57. Unstake the counter drive gear nut.

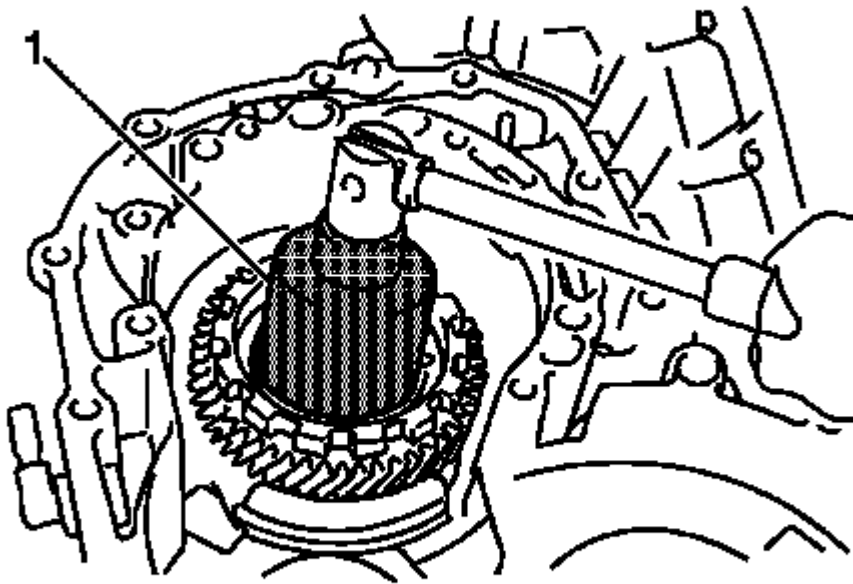


Fig. 148: Removing Planetary Ring Gear Nut Using DT 46472
Courtesy of GENERAL MOTORS COMPANY

58. Remove the planetary ring gear nut using **DT-46472** planetary ring gear nut removal/installation socket (1).

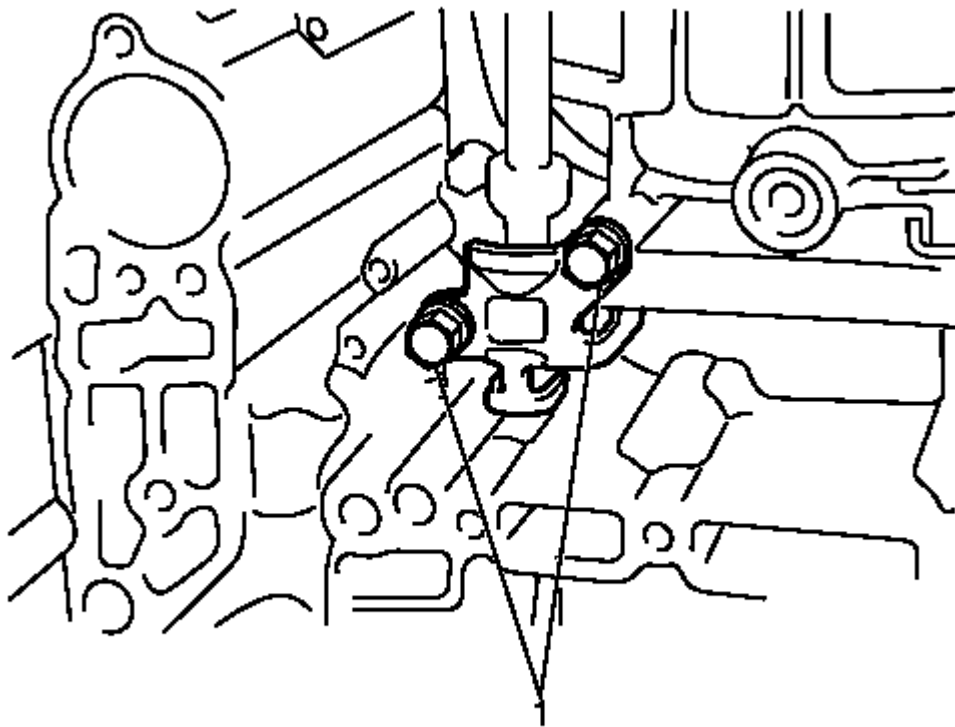


Fig. 149: Parking Lock Pawl Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

59. Remove the 2 parking lock pawl bracket bolts (1) and parking lock pawl bracket.

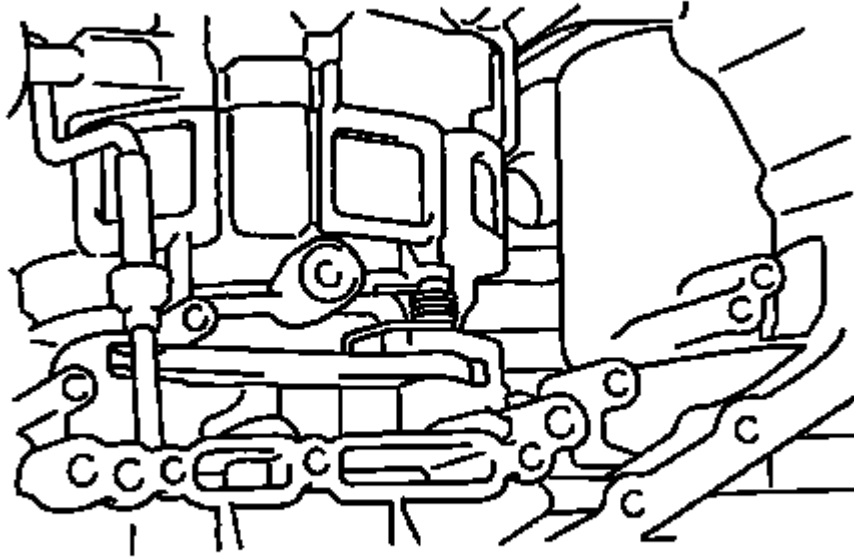


Fig. 150: Parking Lock Pawl, Shaft & Torsion Spring
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not apply too much force to the spring.

60. Remove the parking lock pawl shaft, torsion spring and parking lock pawl.

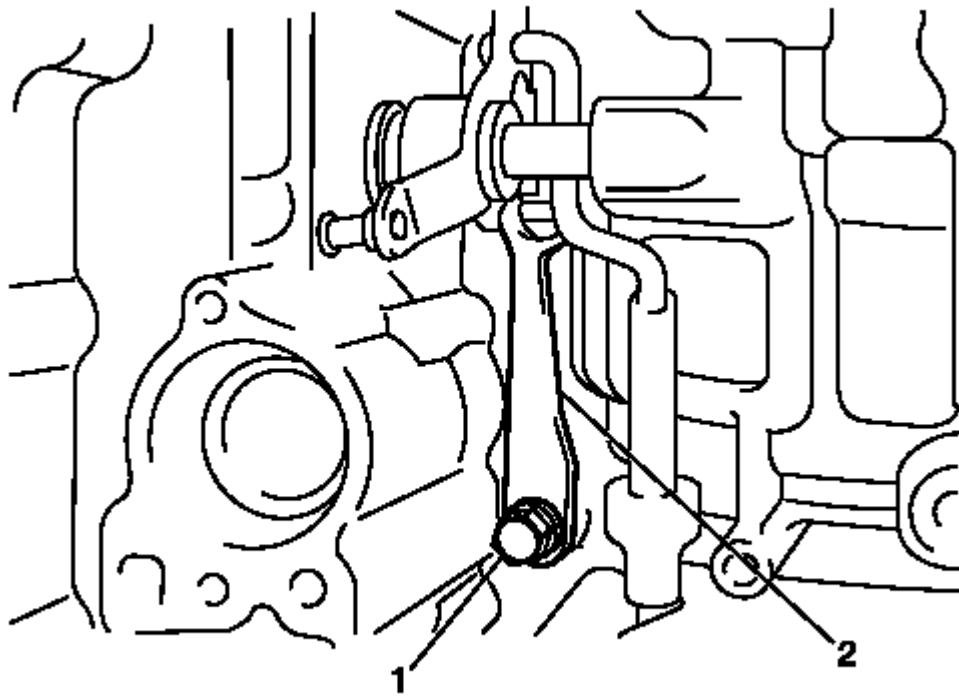


Fig. 151: Manual Detent Spring

Courtesy of GENERAL MOTORS COMPANY

61. Remove the bolt (1) and manual detent spring (2).

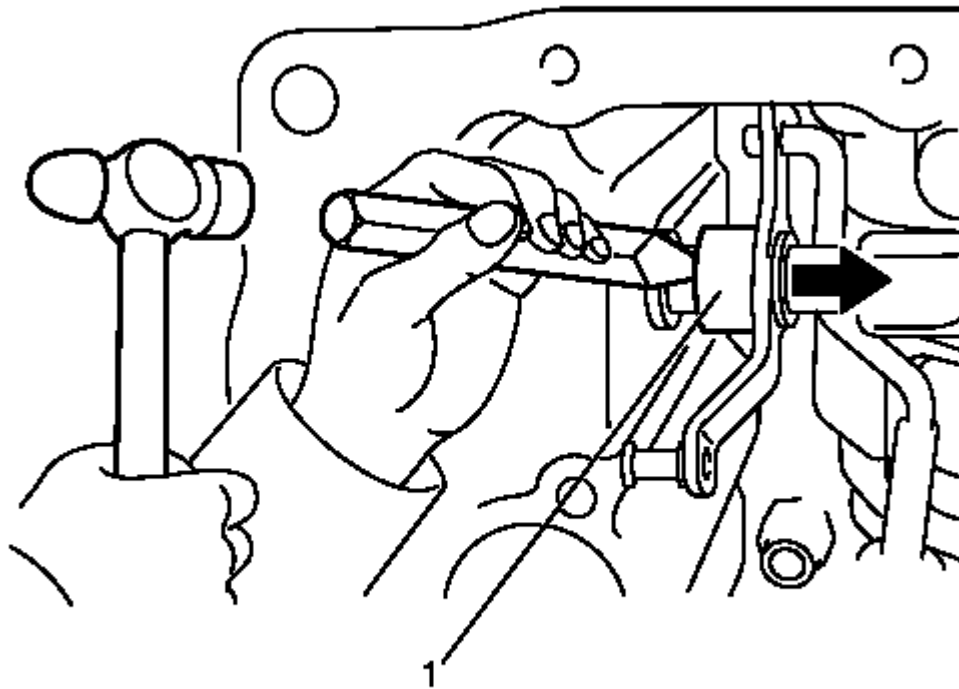


Fig. 152: spacer

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage the manual valve lever and lever shaft.

62. Using a chisel and hammer, unstake and remove the spacer (1).

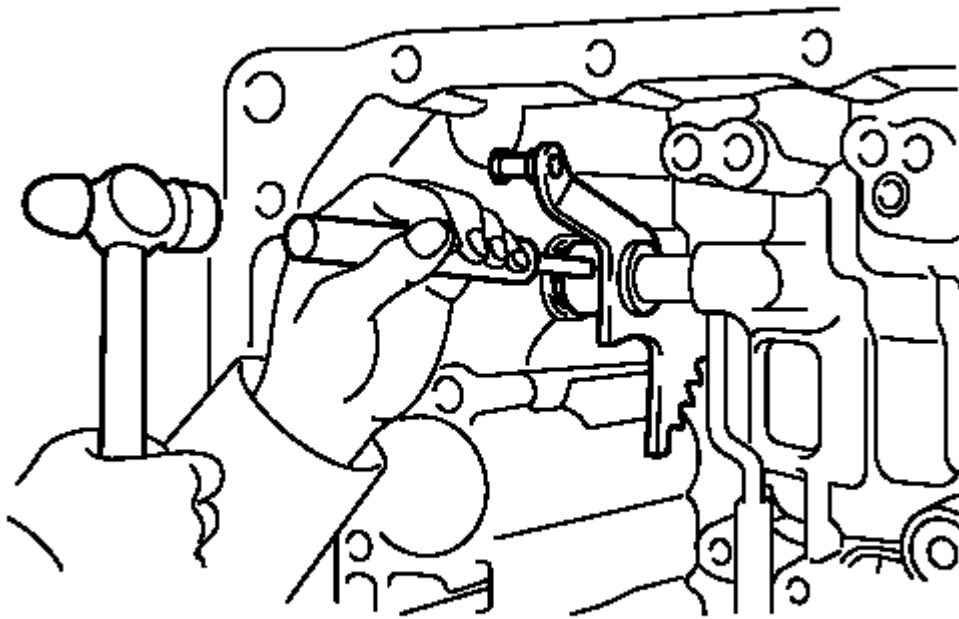


Fig. 153: Using A Pin Punch And Hammer, Driving Out Pin
Courtesy of GENERAL MOTORS COMPANY

63. Using a pin punch and hammer, drive out the pin.

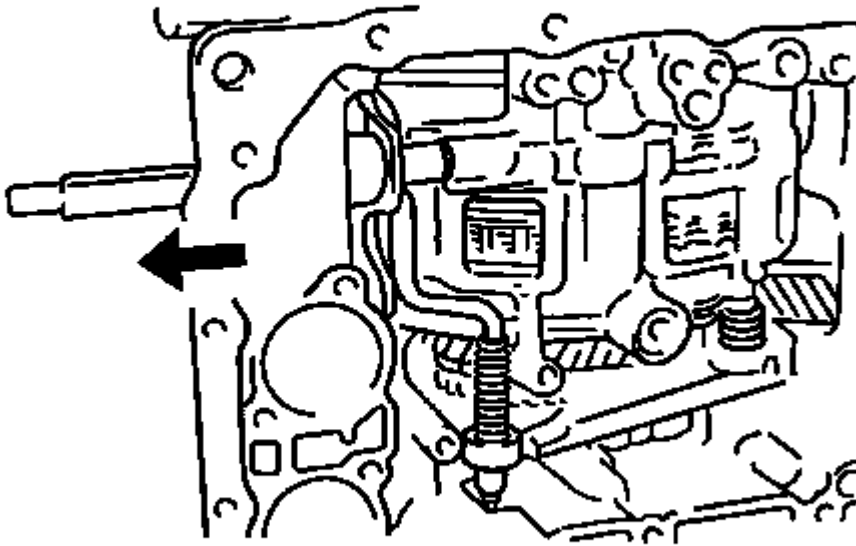


Fig. 154: Manual Valve Lever & Shaft
Courtesy of GENERAL MOTORS COMPANY

64. Remove the manual valve lever shaft and manual valve lever with the parking lock rod.

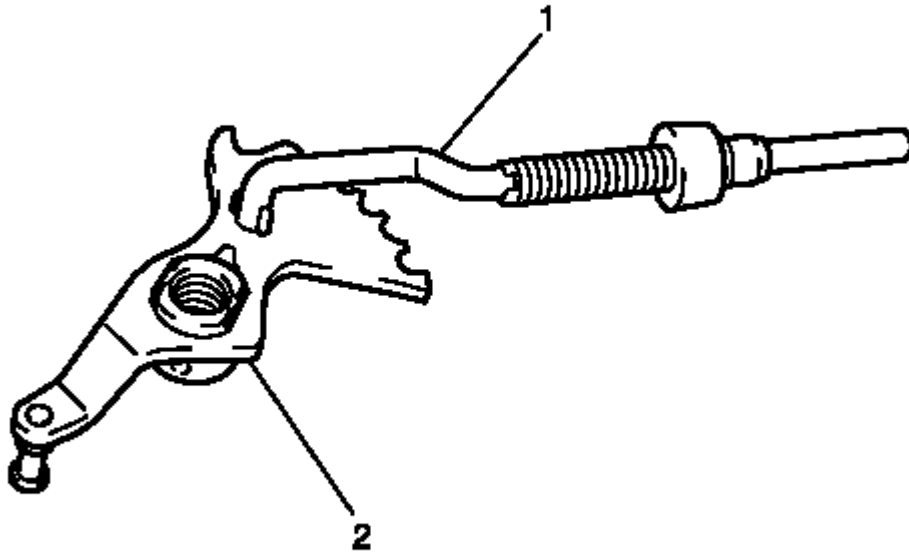


Fig. 155: Parking Lock Rod

Courtesy of GENERAL MOTORS COMPANY

65. Remove the parking lock rod (1) from the manual valve lever (2).

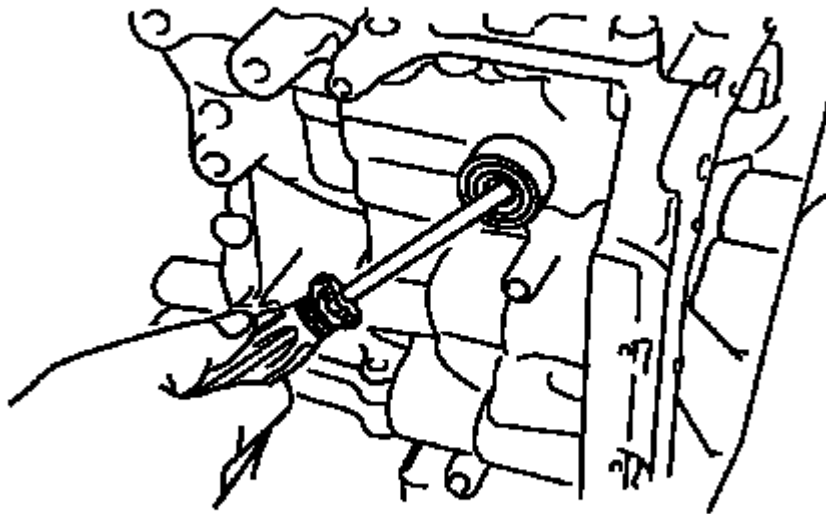


Fig. 156: Removing Oil Seal Using A Screwdriver
Courtesy of GENERAL MOTORS COMPANY

NOTE: If using a screwdriver, use a wooden block or equivalent to avoid damaging the fitting surface of the transmission case.

66. Using a screwdriver, remove the manual valve lever oil seal.

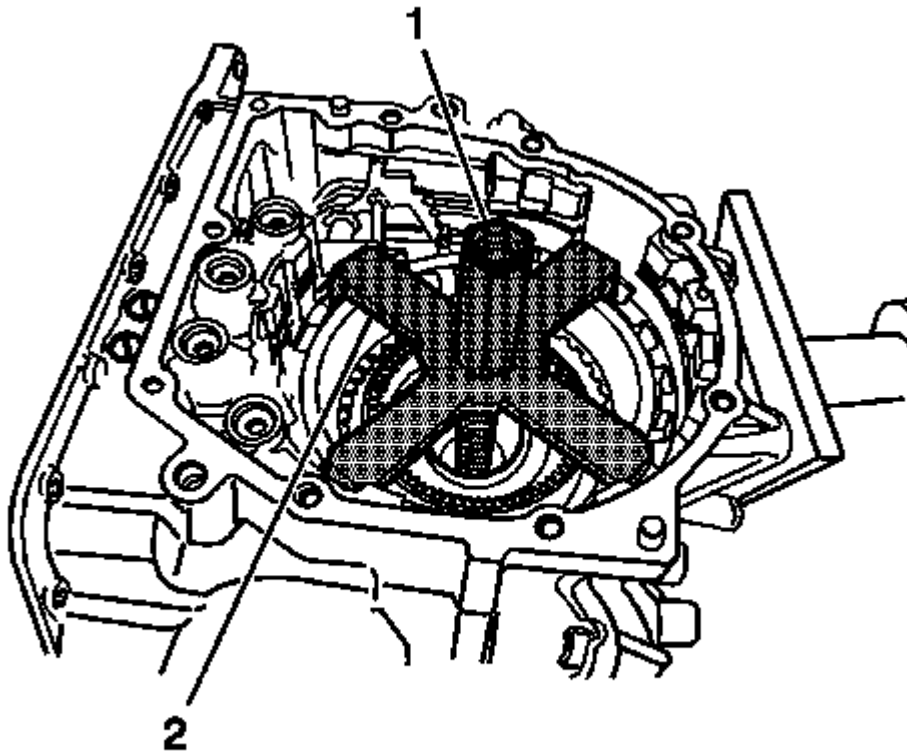


Fig. 157: DT 46455, DT 46457, Snap Ring Of 1st & Reverse Brake
Courtesy of GENERAL MOTORS COMPANY

WARNING: Use extreme care when removing snap rings. Always wear adequate eye protection in order to avoid personal injury.

67. Using **DT-46455** brake spring compressor bolt/nut (1) and **DT-46457** 1st and reverse brake adapter (2), remove the snap ring of 1st and reverse brake.

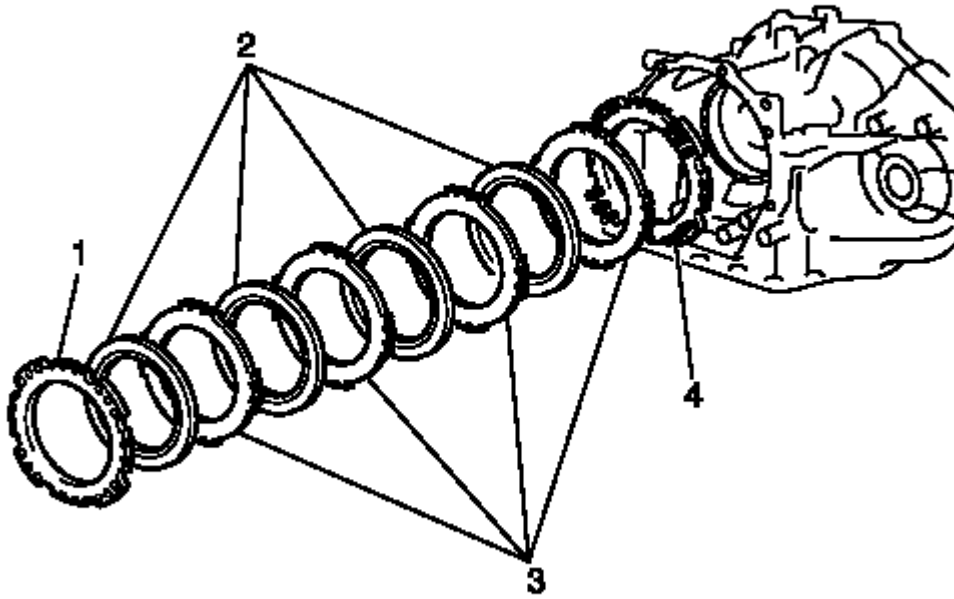


Fig. 158: Brake No. Flange, Discs, Plates
Courtesy of GENERAL MOTORS COMPANY

68. Remove the brake no. 3 flange (1), 4 discs (2), 4 plates (3), and 1st and reverse return spring (4).

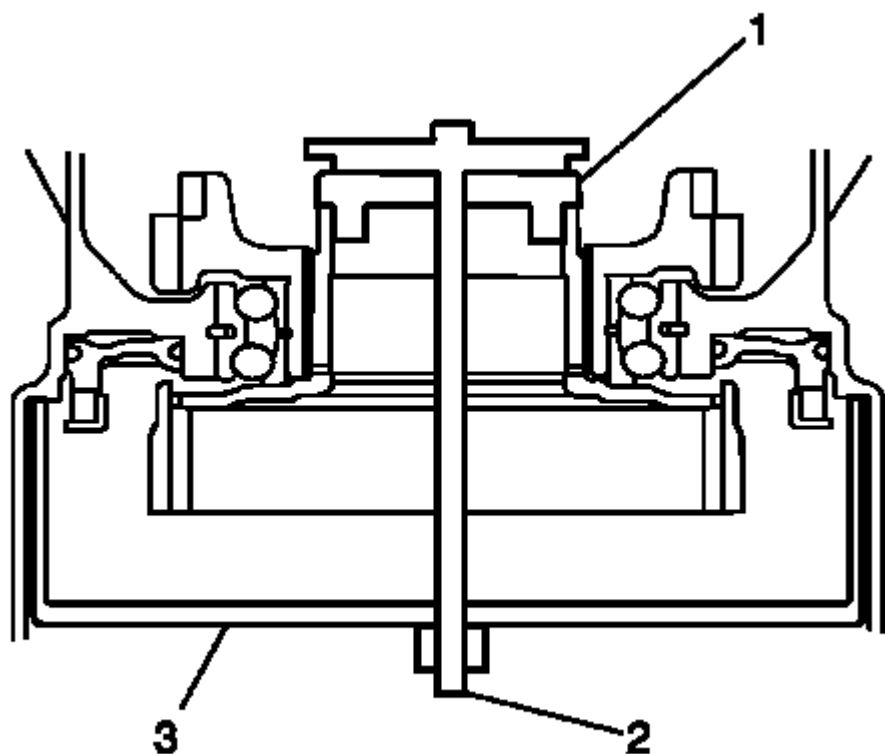


Fig. 159: Planetary Ring Gear, DT 46455, DT 46457 & DT 46459
Courtesy of GENERAL MOTORS COMPANY

69. Using **DT-46455** brake spring compressor bolt/nut (2), **DT-46457** 1st and reverse brake adapter (3), and **DT-46459** planetary ring gear remover (1), remove the planetary ring gear.

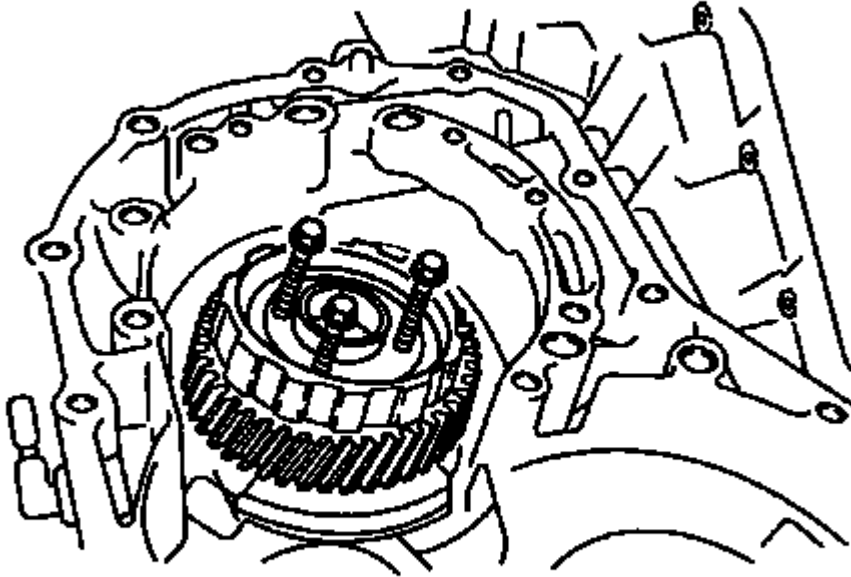


Fig. 160: Counter Drive Gear & Bolts
Courtesy of GENERAL MOTORS COMPANY

70. Install the bolts to the counter drive gear.

Specifications

- The bolt (M6) length is equal to 40-80 mm (1.57-3.15 in).
- The bolt (M6) pitch is equal to 1.0 mm (0.04 in).

71. Rotate the bolts in order and remove the counter drive gear and planetary ring gear.

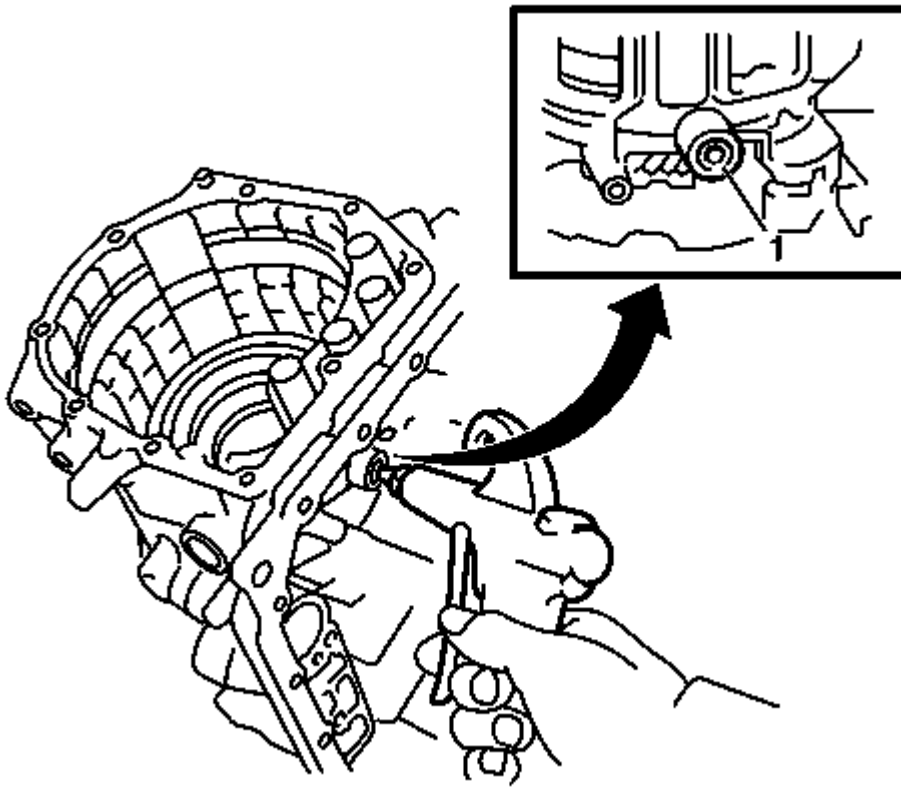


Fig. 161: Applying Compressed Air To Transmission Case
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- Air pressure may cause the pistons to jump out. When removing the piston, hold it in place with your hand using a waste cloth.
- Take care not to splash ATF when air-blowing.

72. Apply compressed air 392 kPa (56 psi) to the transmission case to remove the 1st and reverse brake piston.

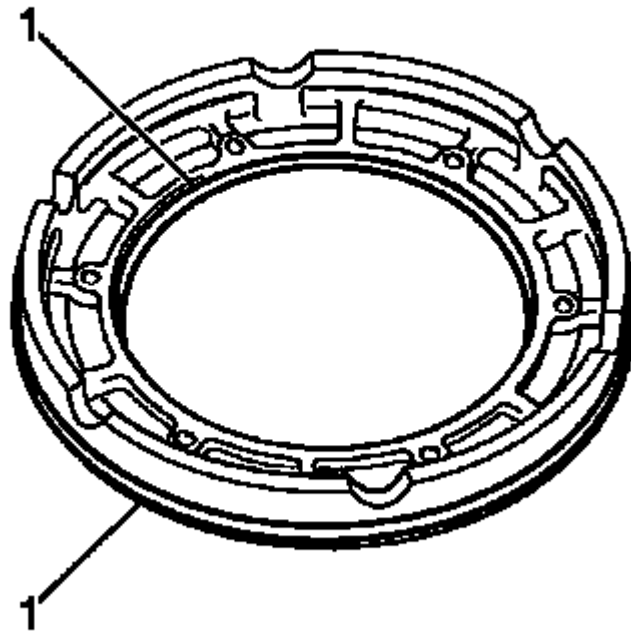


Fig. 162: O-Rings & 1st & Reverse Brake Piston
Courtesy of GENERAL MOTORS COMPANY

73. Remove the 2 O-rings (1) from the 1st and reverse brake piston.

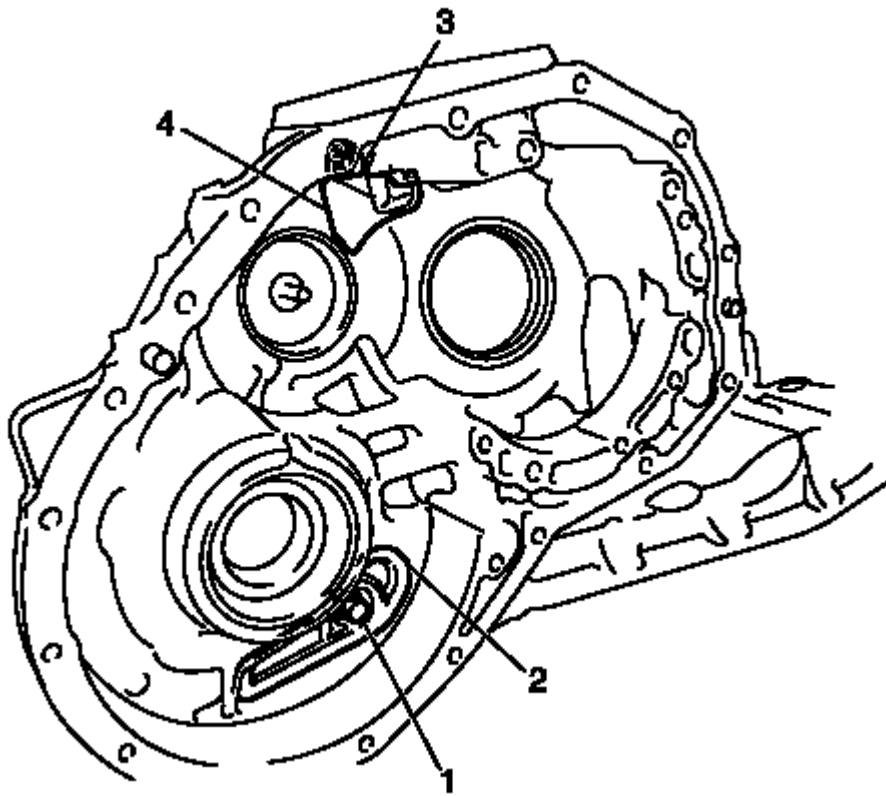


Fig. 163: Bolt And Transmission Case No. 1 Plate
Courtesy of GENERAL MOTORS COMPANY

74. Remove the bolt (1) and transmission case no. 1 plate (2).
75. Remove the bolt (3) and transmission case no. 2 plate (4).

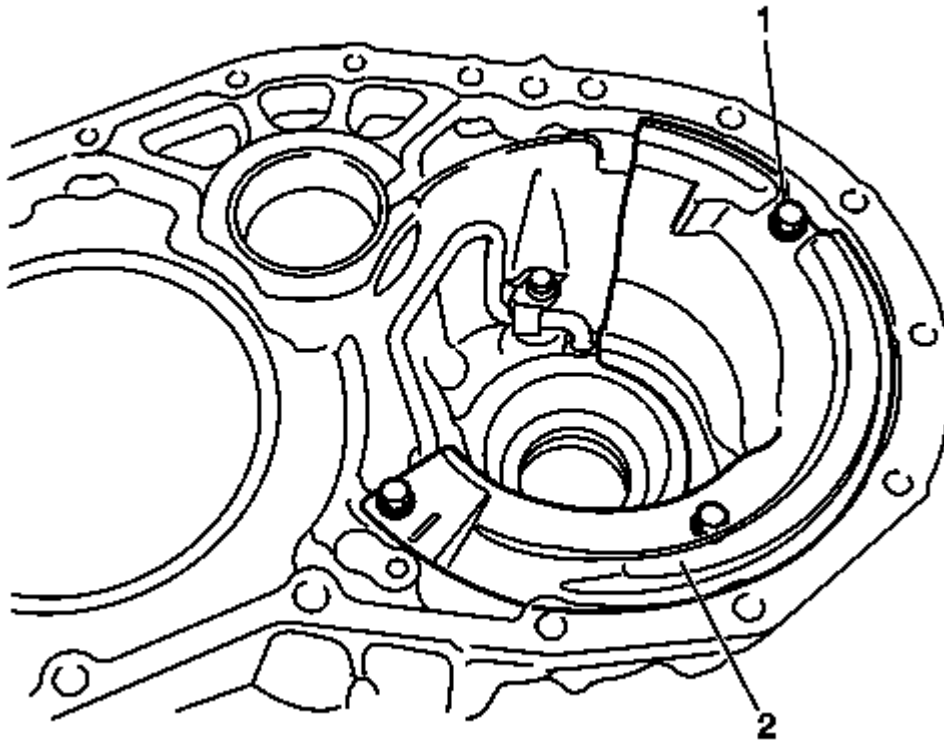


Fig. 164: Transmission Case No. 2 Plate
Courtesy of GENERAL MOTORS COMPANY

76. Remove the 3 bolts (1) and oil reservoir lock plate (2) from the transmission housing.

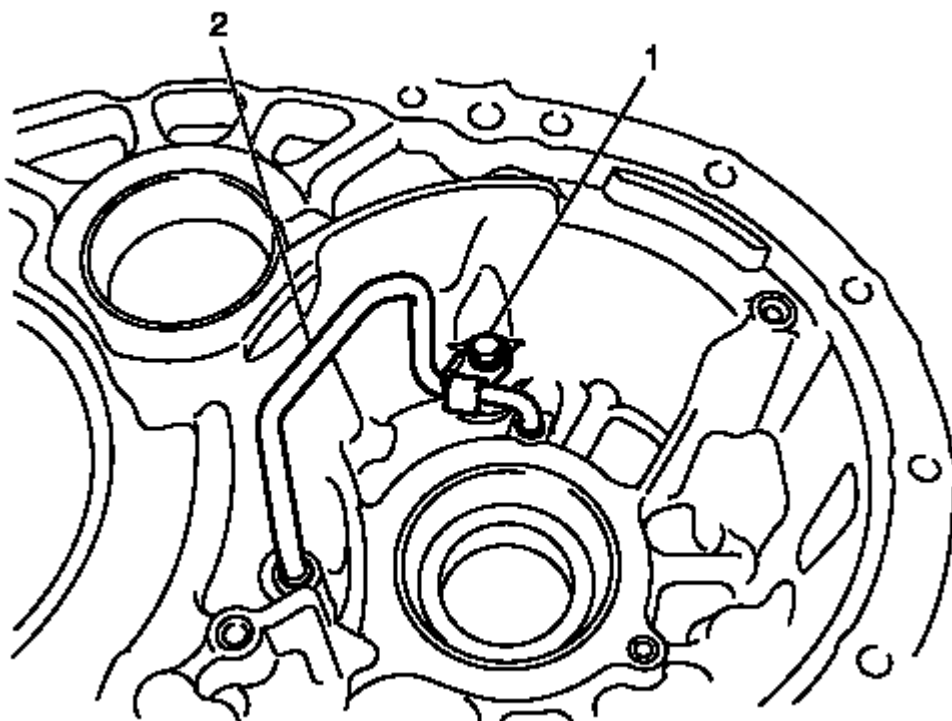


Fig. 165: Bolt And Tube Clamp

Courtesy of GENERAL MOTORS COMPANY

77. Remove the bolt (1) and tube clamp from the transmission housing.
78. Remove the differential gear lube apply tube (2) from the transmission housing.

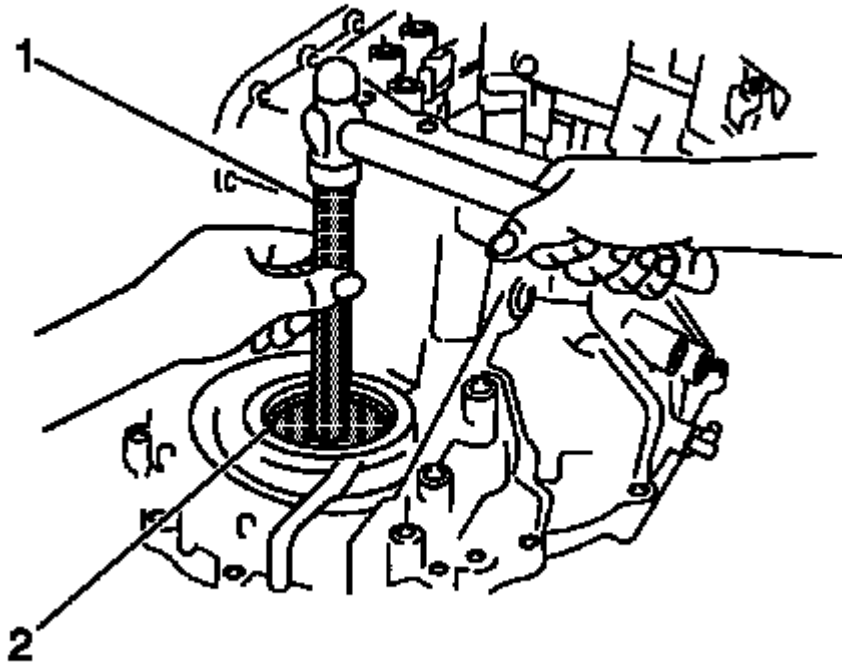


Fig. 166: Removing Transaxle Case Side Bearing Outer Race & Shim Using DT 46463 & DT 46465
Courtesy of GENERAL MOTORS COMPANY

79. Remove the wheel drive shaft seal from the transmission case.
80. Using **DT-46463** transmission case side bearing outer race adapter (2) and **DT-46465** adapter handle (1), remove the differential gear side outer tapered roller bearing race and shim from the transmission case.

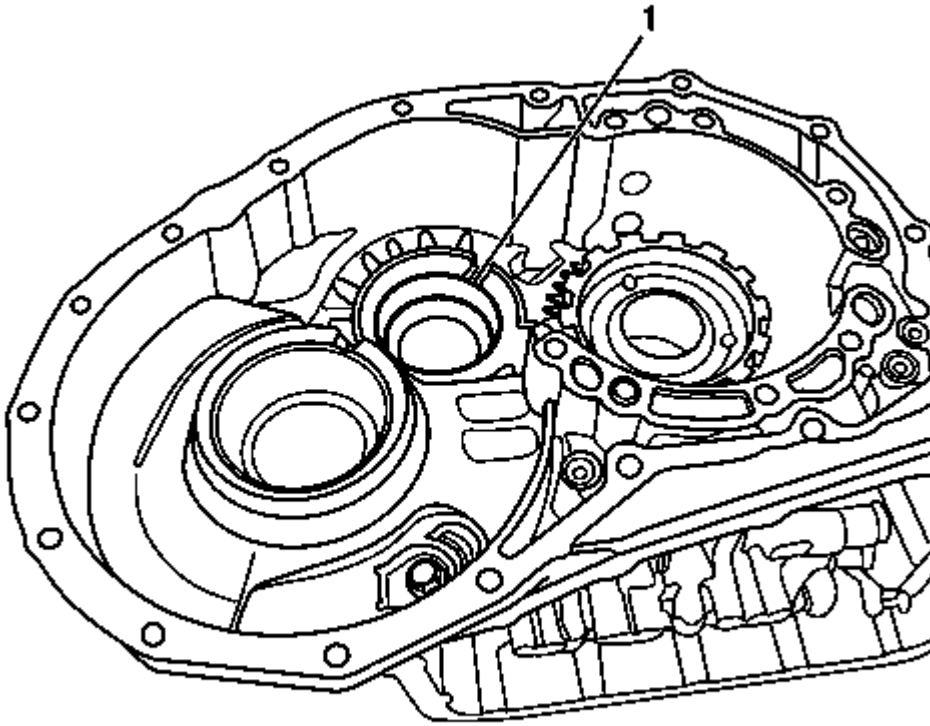


Fig. 167: Counter Driven Gear Side Outer Tapered Roller Bearing Race
Courtesy of GENERAL MOTORS COMPANY

81. Using a suitable puller, remove the counter driven gear side outer tapered roller bearing race (1) and shim from the transmission case.

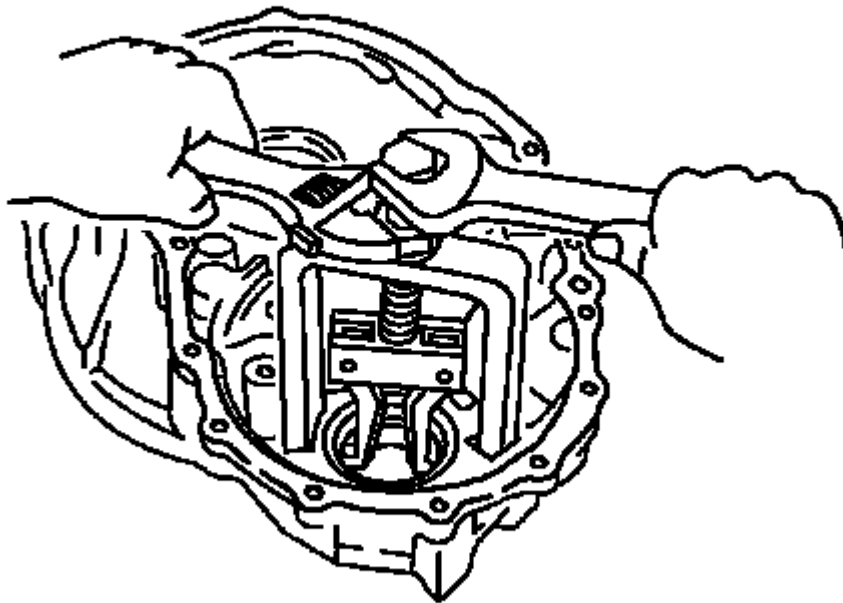


Fig. 168: Removing Side Bearing Outer Race & Transaxle Housing Using A Puller
Courtesy of GENERAL MOTORS COMPANY

82. Remove the wheel drive shaft seal from the transmission housing.
83. Using a suitable puller, remove the differential gear side outer tapered roller bearing race and shim from the transmission housing.

TRANSMISSION ASSEMBLE

Special Tools

- **J-44908** Bearing Race Installer
- **DT-45404** Transmission Indicator Alignment Tool
- **DT-46455** Brake Spring Compressor Bolt/Nut
- **DT-46456** Brake Spring Compressor Plate
- **DT-46457** 1st/Reverse Brake Adapter
- **DT-46460** Counter Drive Gear Installation Adapter
- **DT-46461** Differential Preload Adapter
- **DT-46464** Transmission Case Outer Tapered Roller Bearing Race Adapter

- **DT-46465** Adapter Handle
- **DT-46471** Transmission Housing Oil Seal Installer
- **DT-46472** Planetary Ring Gear Nut Removal/Installation Socket
- **DT-47520** Measuring Terminal
- **DT-47521** Transmission Case Oil Seal Installer
- **DT-50955** Oil Pump Oil Seal Installer

For equivalent regional tools, refer to **Special Tools**.

Assembly Procedure

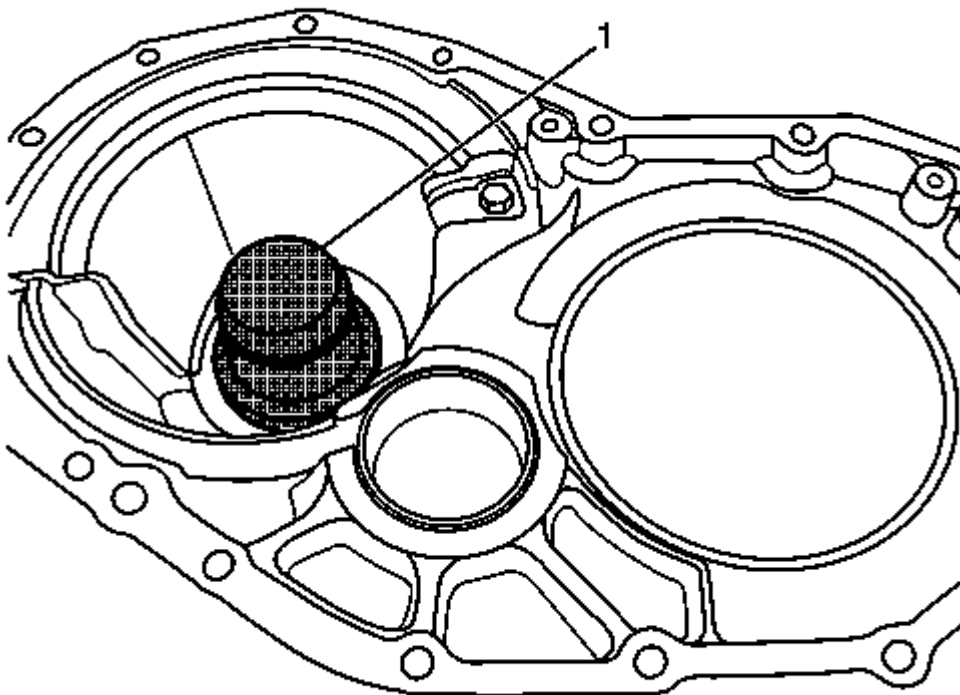


Fig. 169: Transmission Housing
Courtesy of GENERAL MOTORS COMPANY

1. Install the shim to the transmission housing.
2. Using **J-44908** bearing race installer (1), install the differential gear side outer tapered roller bearing race to the transmission housing.

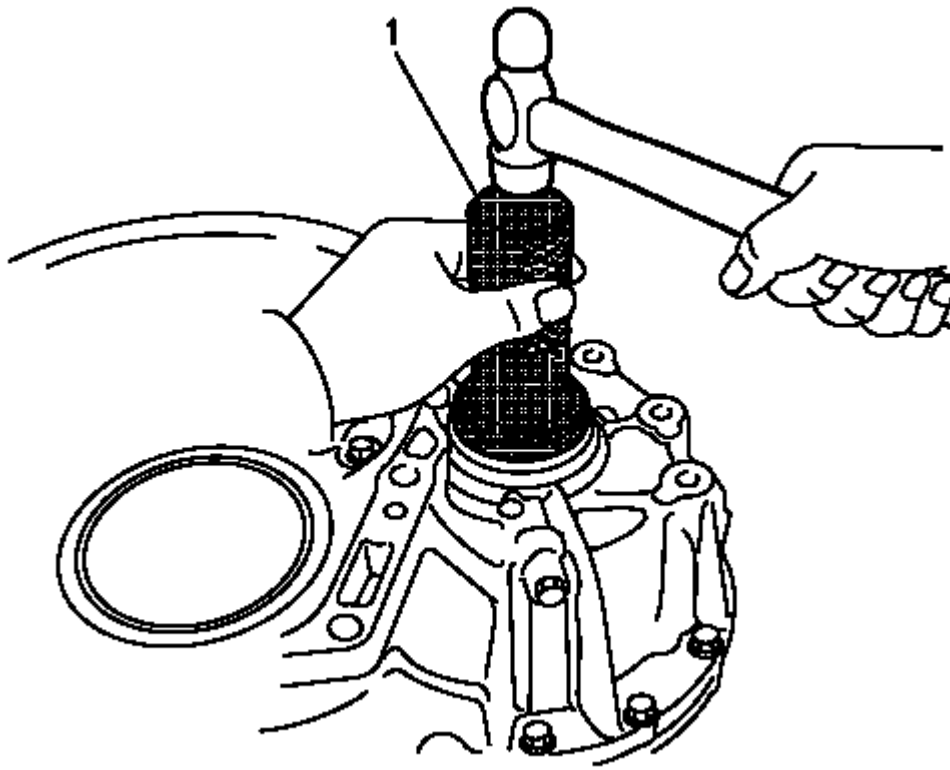


Fig. 170: Transmission Housing Oil Seal Installer
Courtesy of GENERAL MOTORS COMPANY

3. Using **DT-46471** transmission housing oil seal installer (1) and a hammer, install a new transmission housing oil seal.

Specification

The oil seal depth is 2.6-3.6 mm (0.102-0.142 in).

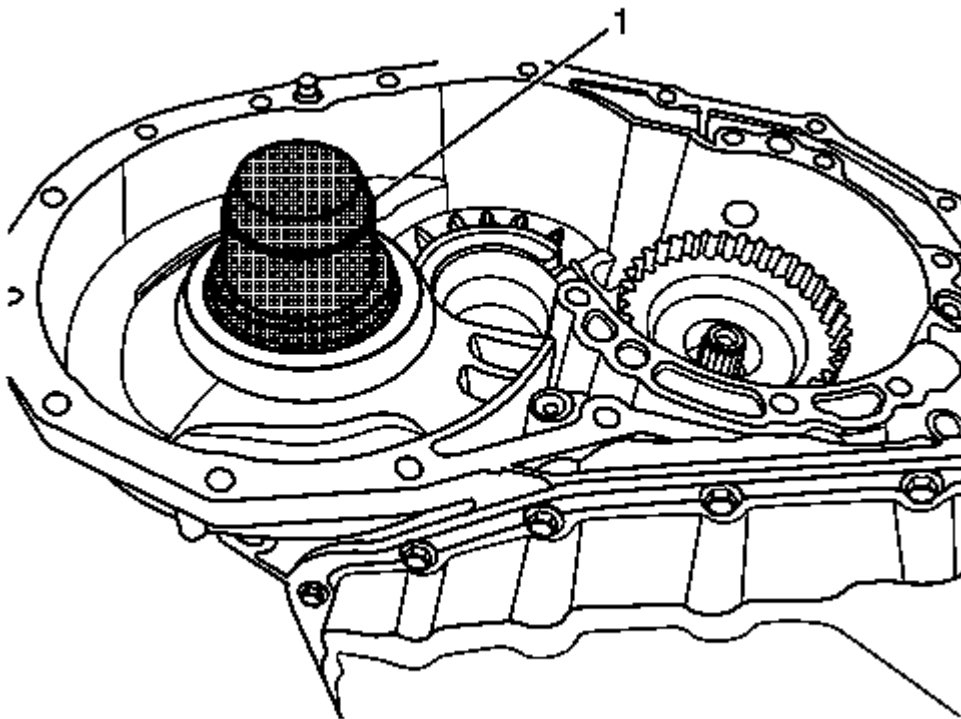


Fig. 171: J - 44908 Bearing Race Installer
Courtesy of GENERAL MOTORS COMPANY

4. Install the shim to the transmission case.
5. Using **J-44908** bearing race installer (1), install the differential gear side outer tapered roller bearing race to the transmission case.

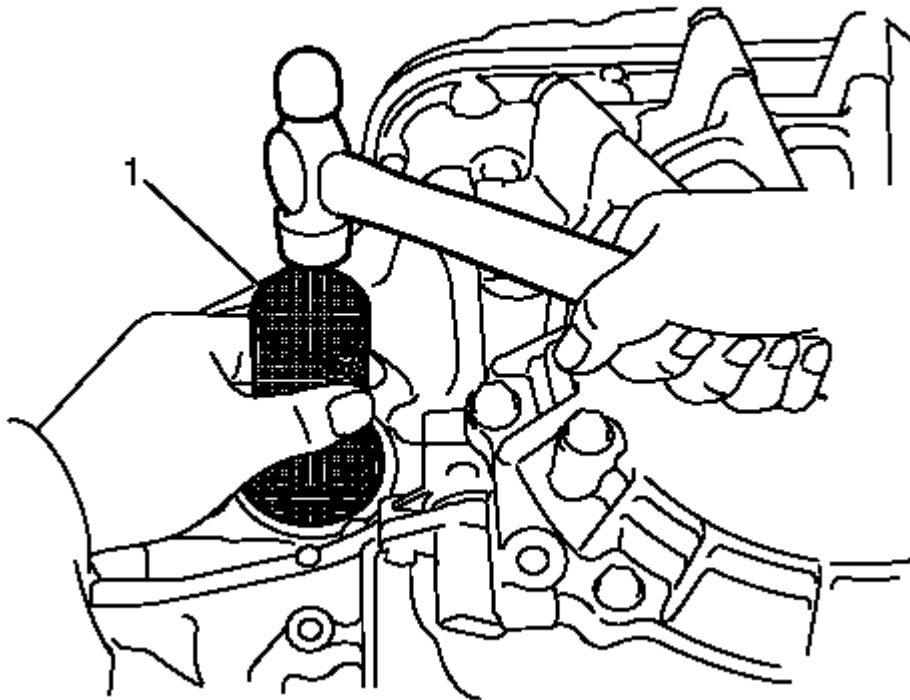


Fig. 172: Transmission Case Oil Seal Installer
Courtesy of GENERAL MOTORS COMPANY

6. Using **DT-47521** transmission case oil seal installer (1) and a hammer, install a new transmission case oil seal.

Specification

The oil seal depth is 2.6-3.6 mm (0.102-0.142 in).

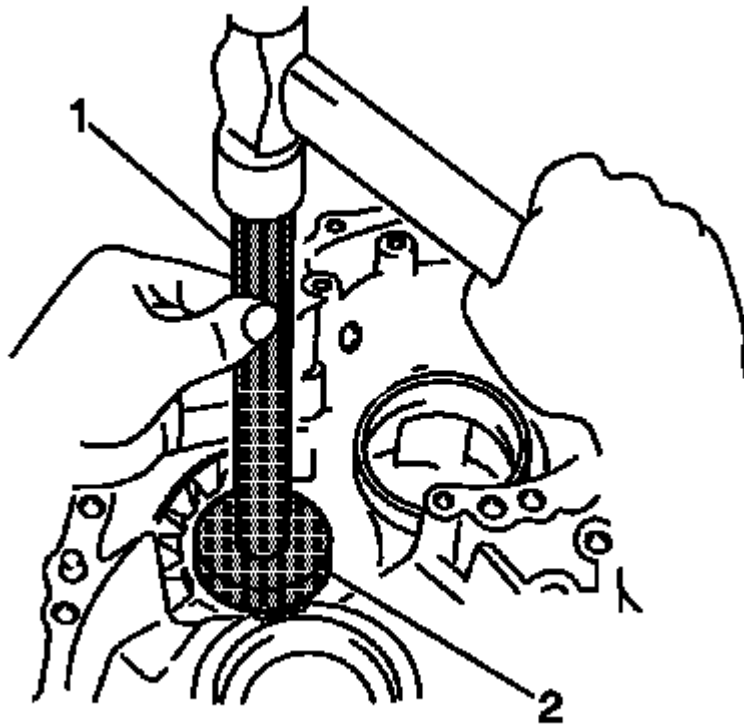


Fig. 173: Pressing In A New Outer Tapered Roller Bearing Race Using DT 46464 & DT 46465
Courtesy of GENERAL MOTORS COMPANY

7. Install the shim to the transmission case.
8. Using **DT-46464** transmission case outer tapered roller bearing race adapter (2) and **DT-46465** adapter handle (1), install the counter driven gear side outer tapered roller bearing race to the transmission case.

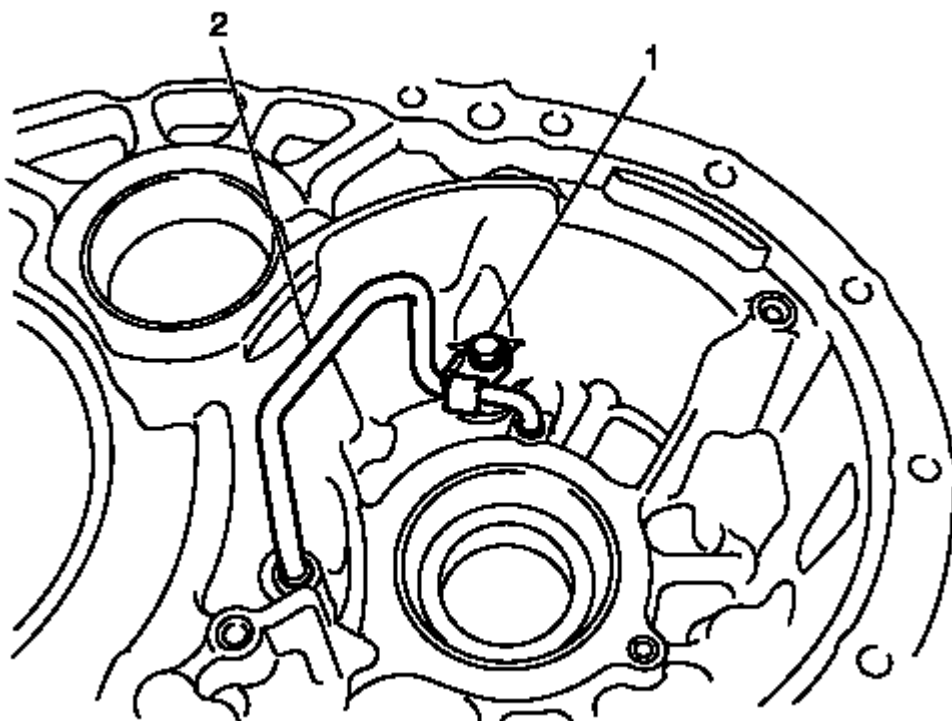


Fig. 174: Bolt And Tube Clamp

Courtesy of GENERAL MOTORS COMPANY

9. Install the apply tube (2) to the transmission housing.

CAUTION: Refer to Fastener Caution .

10. Install the tube clamp with the bolt (1) and tighten to 5 (44 lb in).

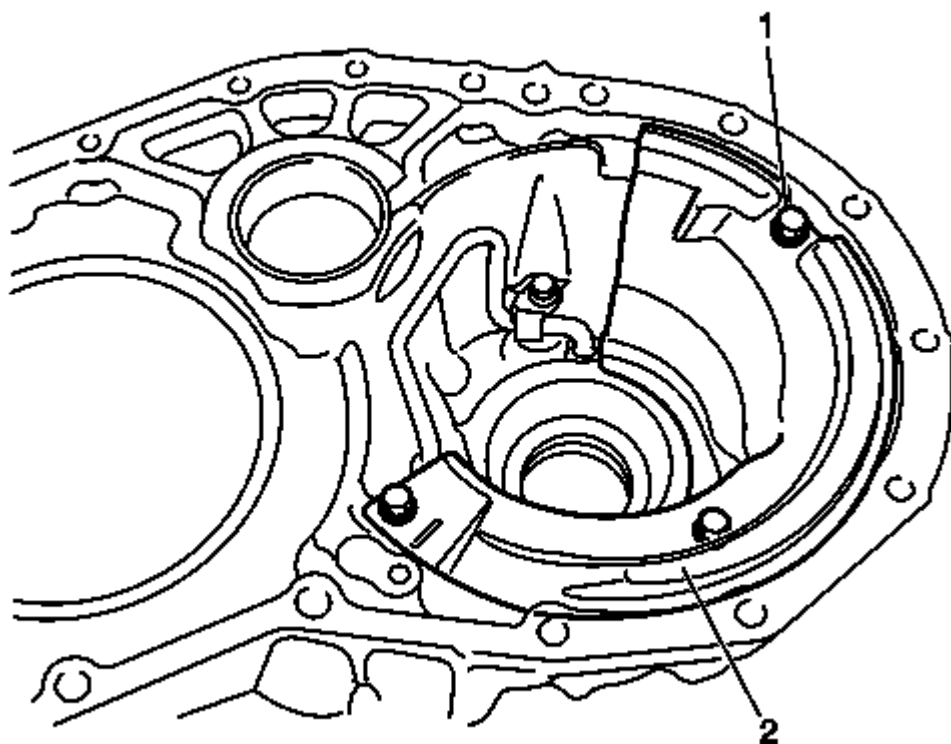


Fig. 175: Transmission Case No. 2 Plate
Courtesy of GENERAL MOTORS COMPANY

11. Install the oil reservoir lock plate (2) with the 3 bolts (1) and tighten to 5 (44 lb in).

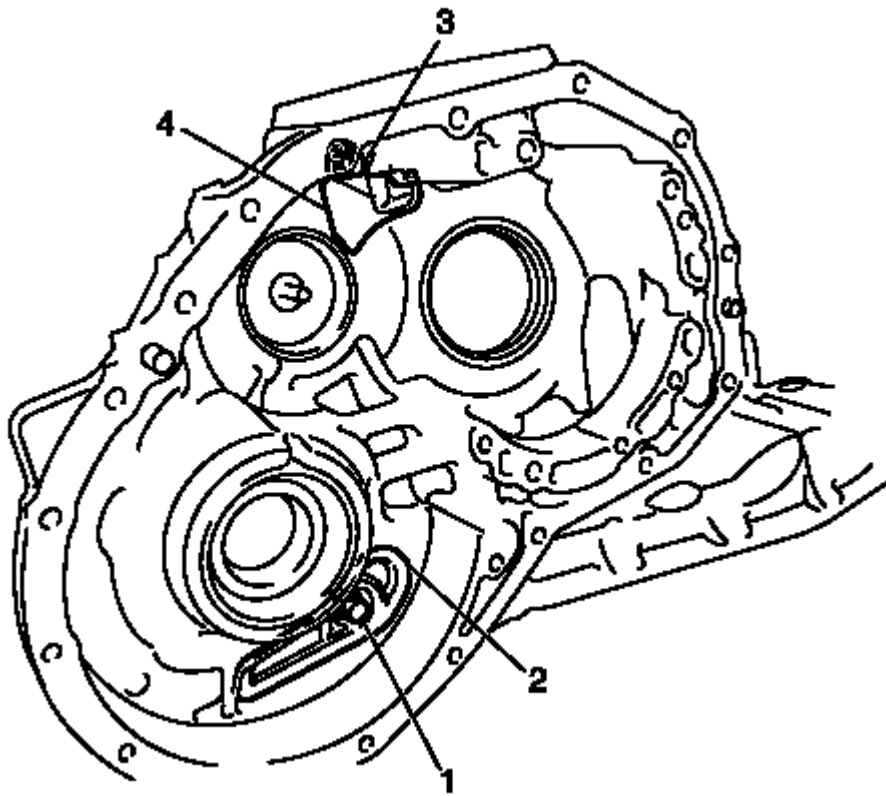


Fig. 176: Bolt And Transmission Case No. 1 Plate
Courtesy of GENERAL MOTORS COMPANY

12. Install the transmission case no. 2 plate (4) and the bolt (3) and tighten to 10 (89 lb in).
13. Install the transmission case no. 1 plate (2) and the bolt (1) and tighten to 10 (89 lb in).

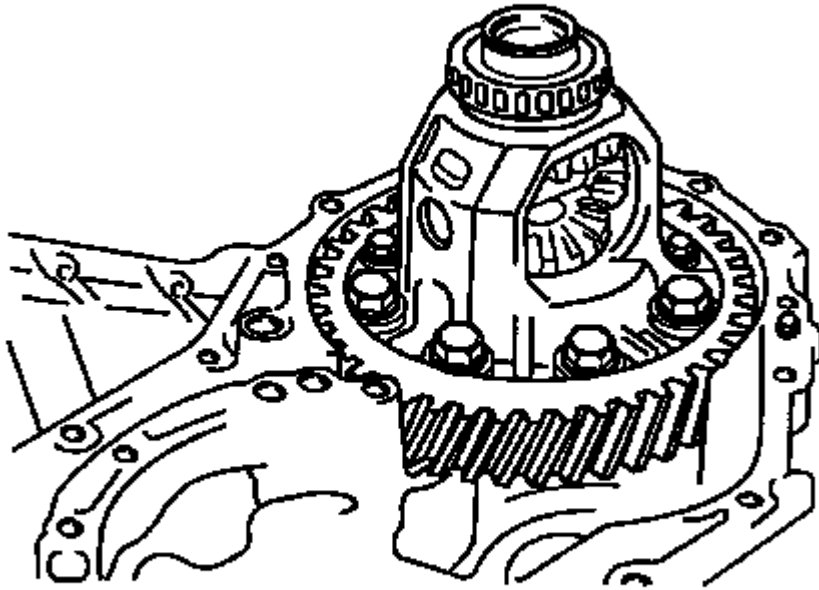


Fig. 177: Differential Gear & Transaxle Case
Courtesy of GENERAL MOTORS COMPANY

14. Coat the bearing on the differential case with ATF.
15. Install the differential gear to the transmission case.

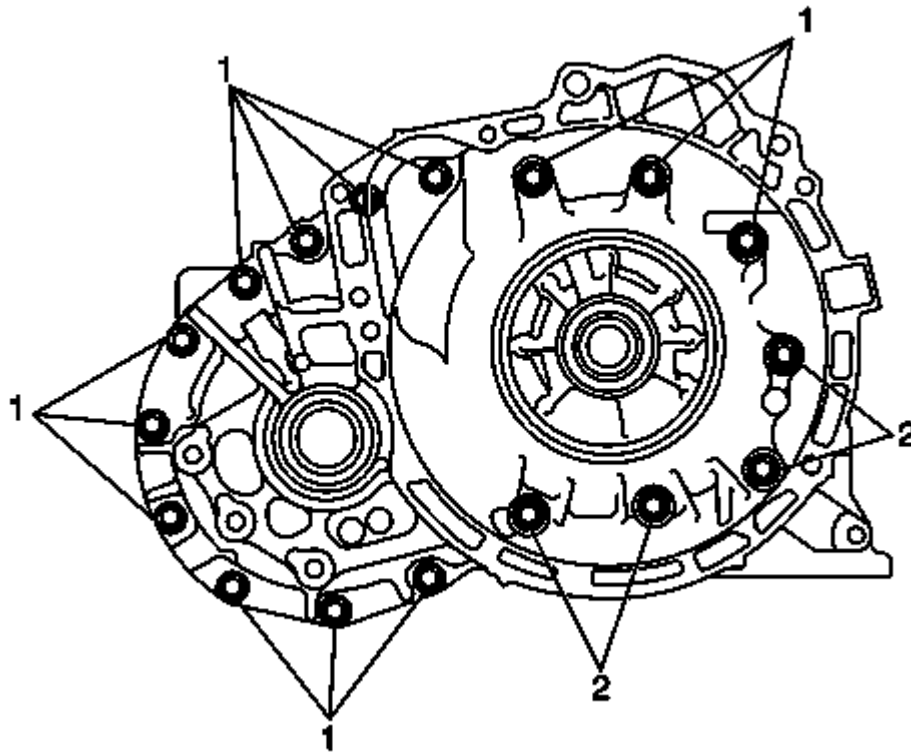


Fig. 178: Transmission Housing Bolts
Courtesy of GENERAL MOTORS COMPANY

16. Install the transmission housing and tighten the 17 bolts (1, 2) of the transmission housing temporarily.
17. Tighten 8 or 9 bolts out of 17 bolts of the transmission housing completely to tighten to 30 (22 lb ft).

Specifications

- The bolts (1) size is M8 x 1.25 x 30 mm.
- The bolts (2) size is M8 x 1.25 x 30 mm (Seal).

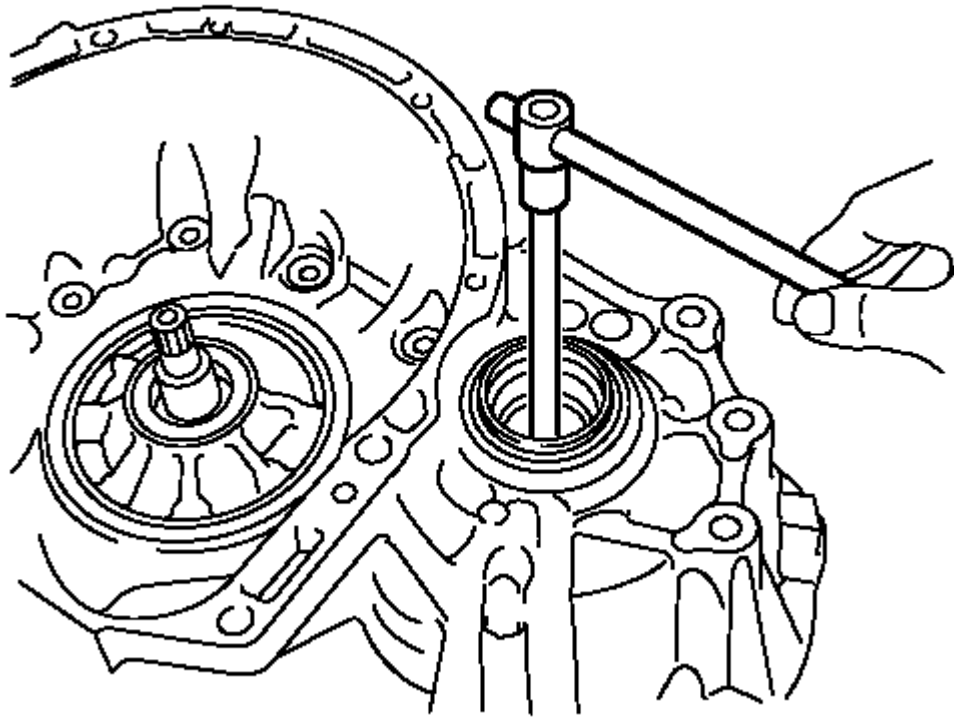


Fig. 179: Turning Differential Gear Assembly Right And Left Using DT-46461 Tool
Courtesy of GENERAL MOTORS COMPANY

18. Using **DT-46461** differential preload adapter, turn the differential gear assembly right and left 2 or 3 times to allow the bearing to settle.

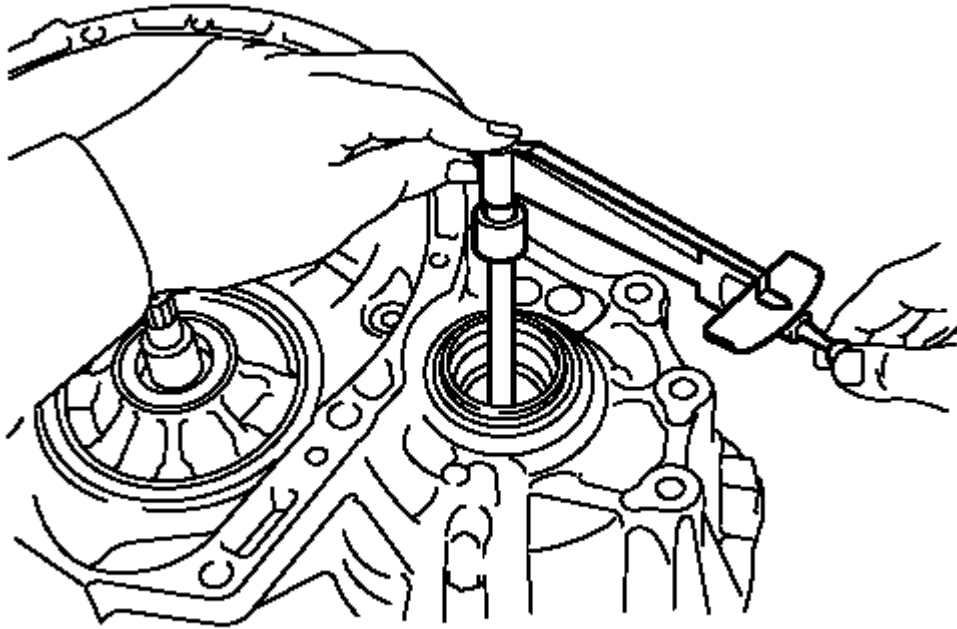


Fig. 180: Measuring Preload Of Differential Gear
Courtesy of GENERAL MOTORS COMPANY

19. Using **DT-46461** differential preload adapter and a small torque wrench, measure the preload of the differential gear.

Specifications

- The preload for a new bearing is 0.78-1.37 (6.90-12.13 lb in).
- The preload for a reused bearing is 0.39-0.69 (3.45-6.11 lb in).

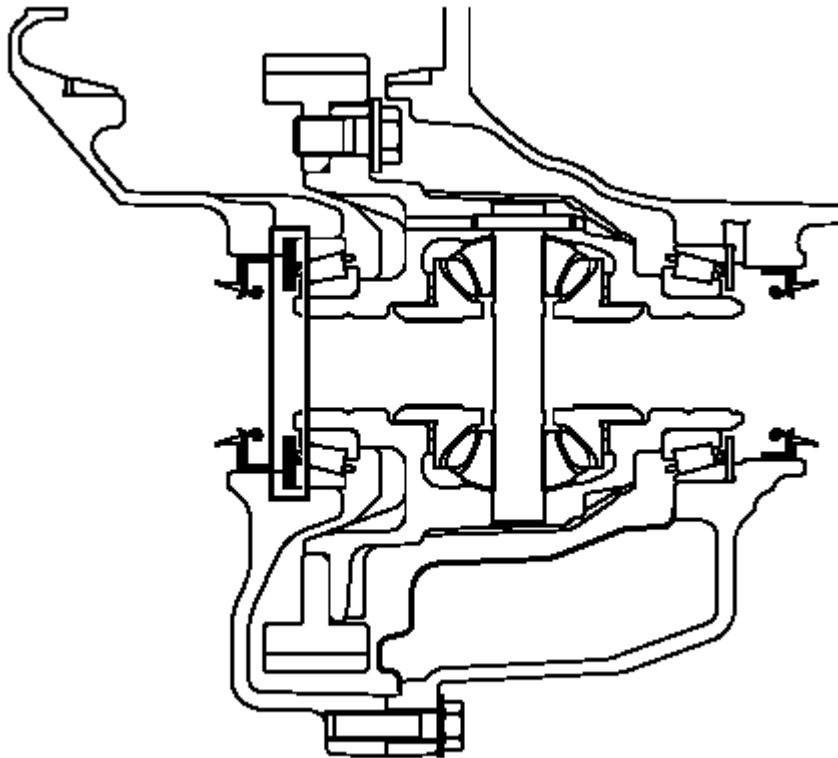


Fig. 181: Differential Gear Bearing Race Adjuster Shim
Courtesy of GENERAL MOTORS COMPANY

NOTE: When the preload is larger than the specification, select a thinner adjuster shim. When the preload is smaller than specification, select a thicker adjuster shim.

20. If the preload of the differential gear does not satisfy the specification, select the differential gear bearing race adjuster shim from the table and re-measure the value. Refer to **Transmission General Specifications**. Until the value is within the specification, repeat the procedure.

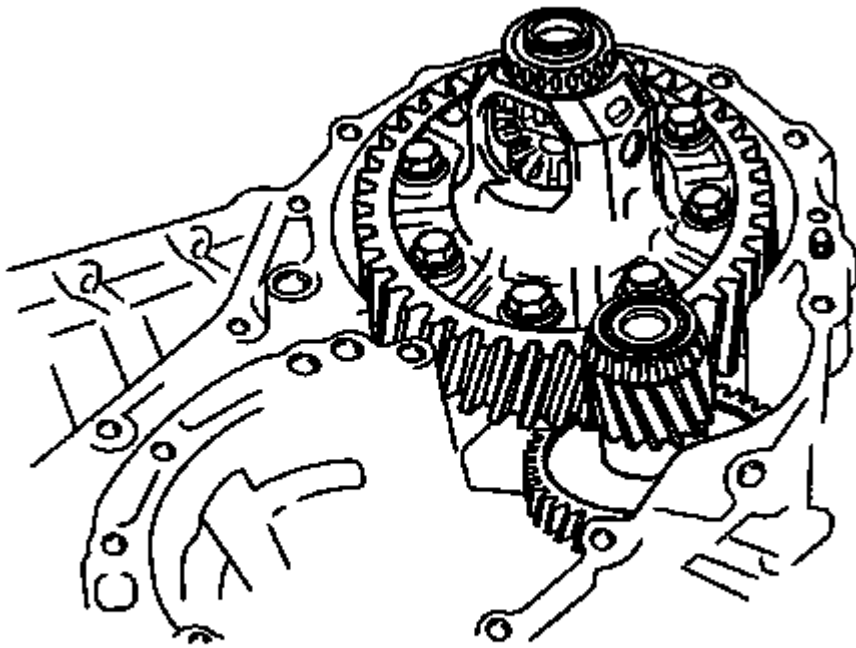


Fig. 182: View Of Counter Driven Gear
Courtesy of GENERAL MOTORS COMPANY

21. Remove the transmission housing and install the counter driven gear.

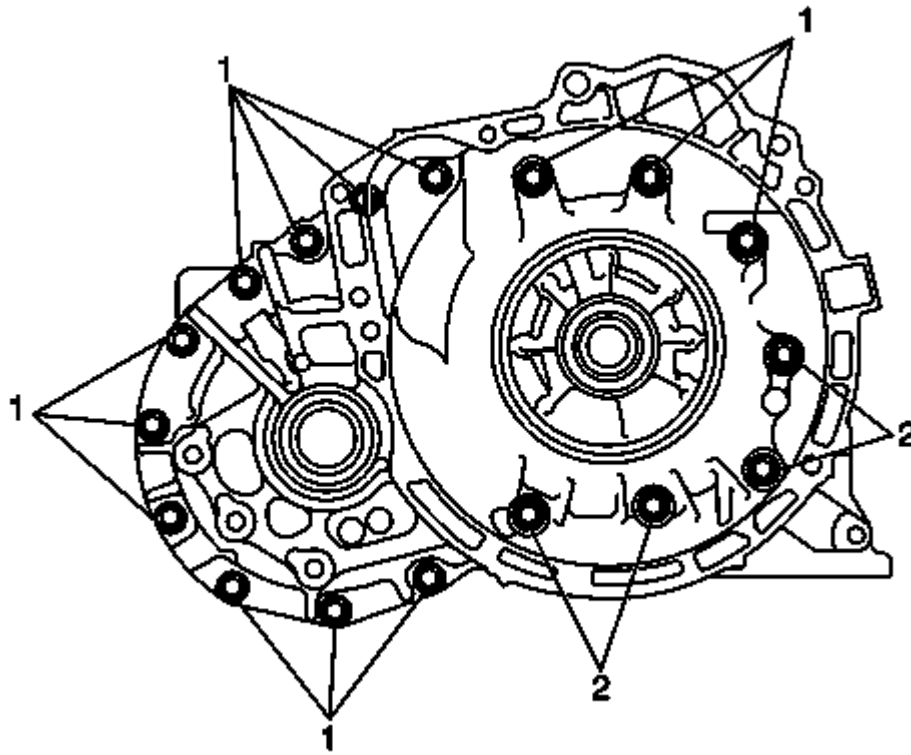


Fig. 183: Transmission Housing Bolts
Courtesy of GENERAL MOTORS COMPANY

22. Install the transmission housing and tighten the 17 bolts of the transmission housing temporarily.
23. Tighten 8 or 9 bolts out of 17 bolts of the transmission housing completely to tighten to 30 (22 lb ft).

Specifications

- The bolts (1) size is M8 x 1.25 x 30 mm.
- The bolts (2) size is M8 x 1.25 x 30 mm (Seal).

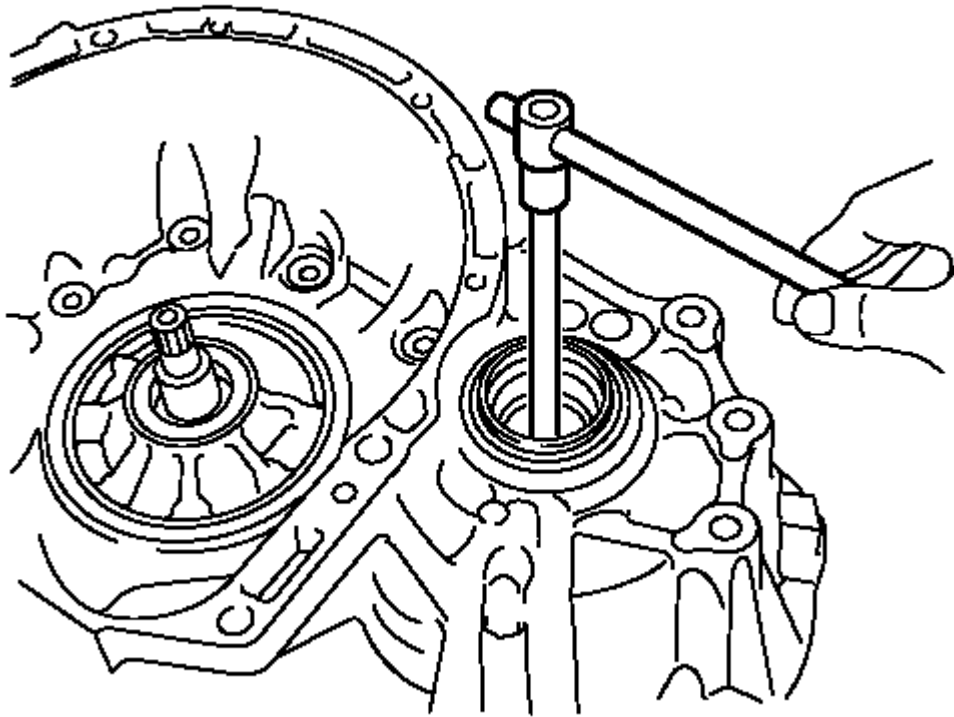


Fig. 184: Turning Differential Gear Assembly Right And Left Using DT-46461 Tool
Courtesy of GENERAL MOTORS COMPANY

24. Using **DT-46461** differential preload adapter, turn the differential gear assembly right and left 2 or 3 times to allow the bearing to settle.

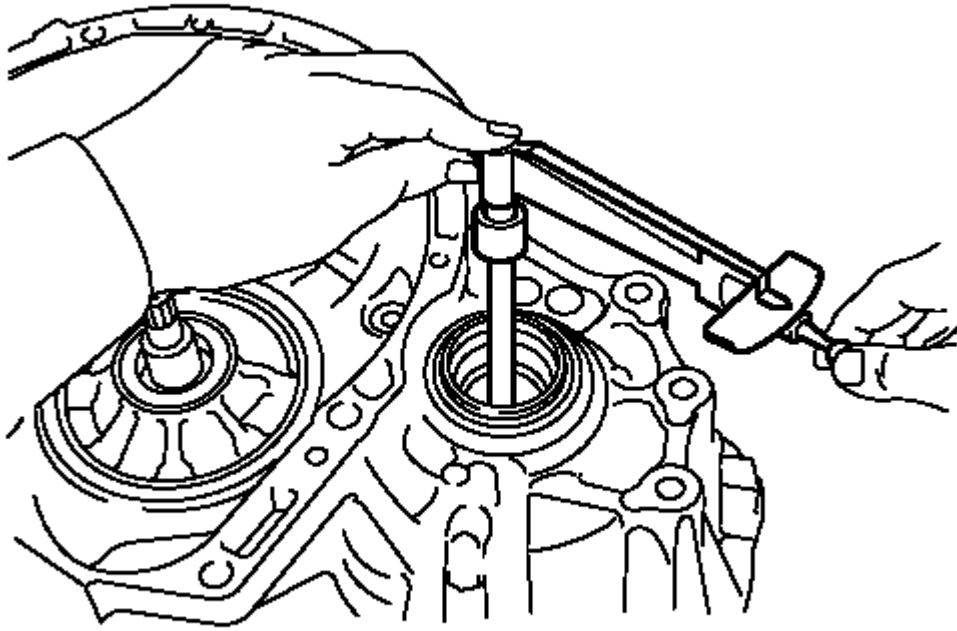


Fig. 185: Measuring Preload Of Differential Gear
Courtesy of GENERAL MOTORS COMPANY

25. Using **DT-46461** differential preload adapter and a small torque wrench, measure the preload of the differential gear.

Specifications

- The preload for a new bearing is 0.33-0.76 (2.92-6.73 lb in).
- The preload for a reused bearing is 0.17-0.38 (1.50-3.36 lb in).

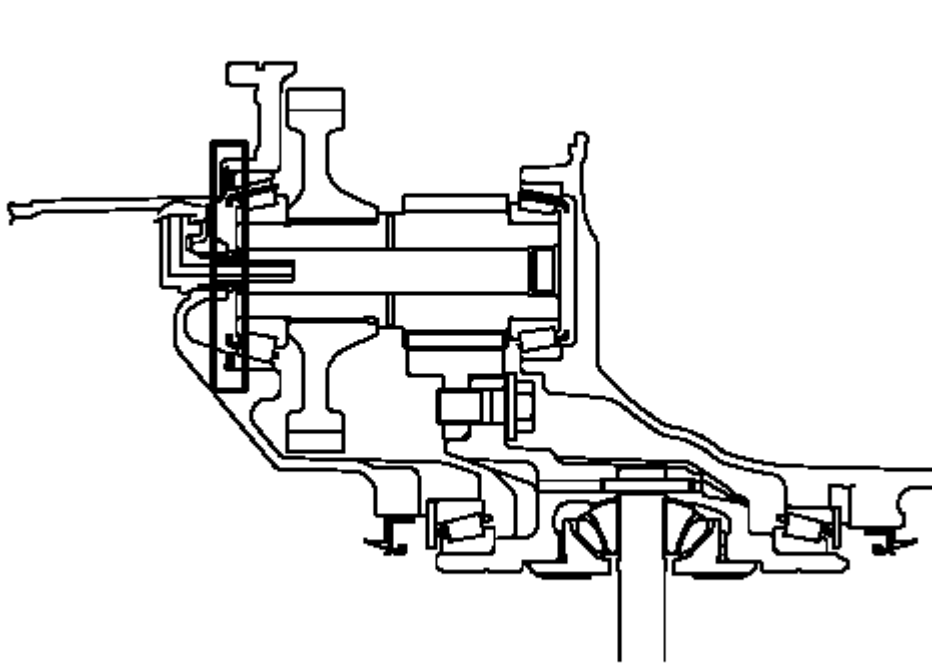


Fig. 186: Counter Driven Gear Bearing Race Adjuster Shim
Courtesy of GENERAL MOTORS COMPANY

NOTE: When the preload is larger than the specification, select a thinner adjuster shim. When the preload is smaller than specification, select a thicker adjuster shim.

26. If the above measured preload does not satisfy the specification, select the counter driven gear bearing race adjuster shim from the table and re-measure the value. Refer to **Transmission General Specifications**. Until the value is within the specification, repeat the procedure.

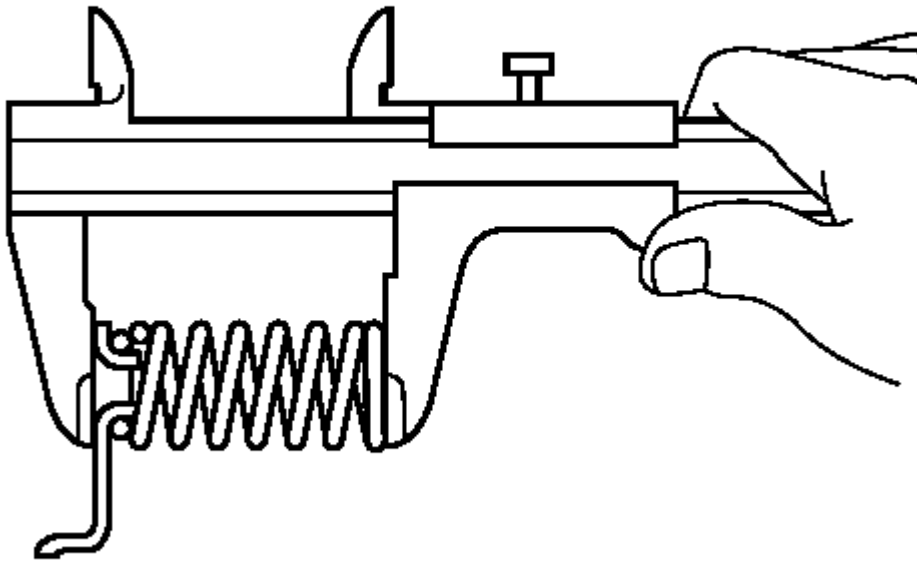


Fig. 187: Measuring Free Length Of 1st And Reverse Brake Piston Return Spring
Courtesy of GENERAL MOTORS COMPANY

27. Using the vernier calipers, measure the free length of the 1st and reverse brake piston return spring.

Specification

The standard free length is 18.93 mm (0.7452 in).

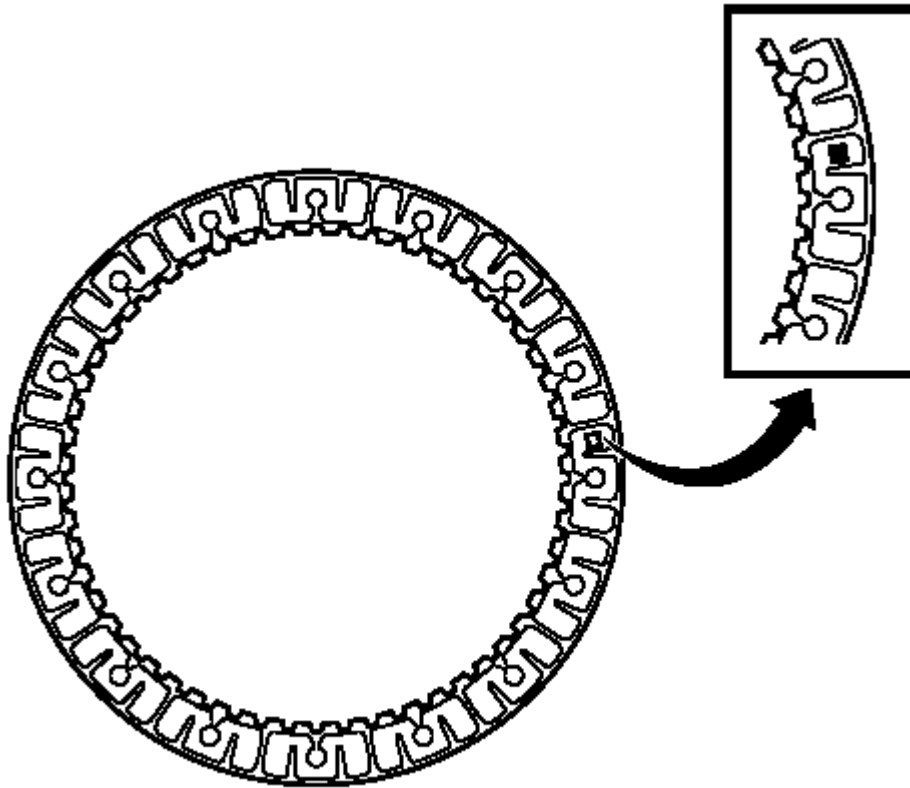


Fig. 188: Inspecting Sliding Surface Of Disc
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- If the lining of the disc is peeling off or discolored, or even if a part of the groove is defaced, replace all discs.
- Before assembling the new discs, soak them in ATF for at least 15 minutes.

28. Inspect the sliding surface of the disc, the plate and the flange of the 1st and reverse brake for wear or burn. Replace if necessary.

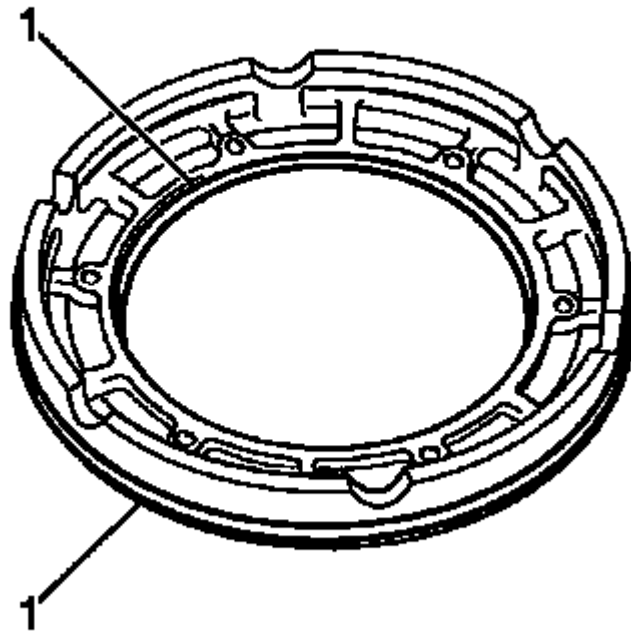


Fig. 189: O-Rings & 1st & Reverse Brake Piston
Courtesy of GENERAL MOTORS COMPANY

29. Coat the new O-rings (1) with ATF and install the O-rings to the 1st and reverse piston.

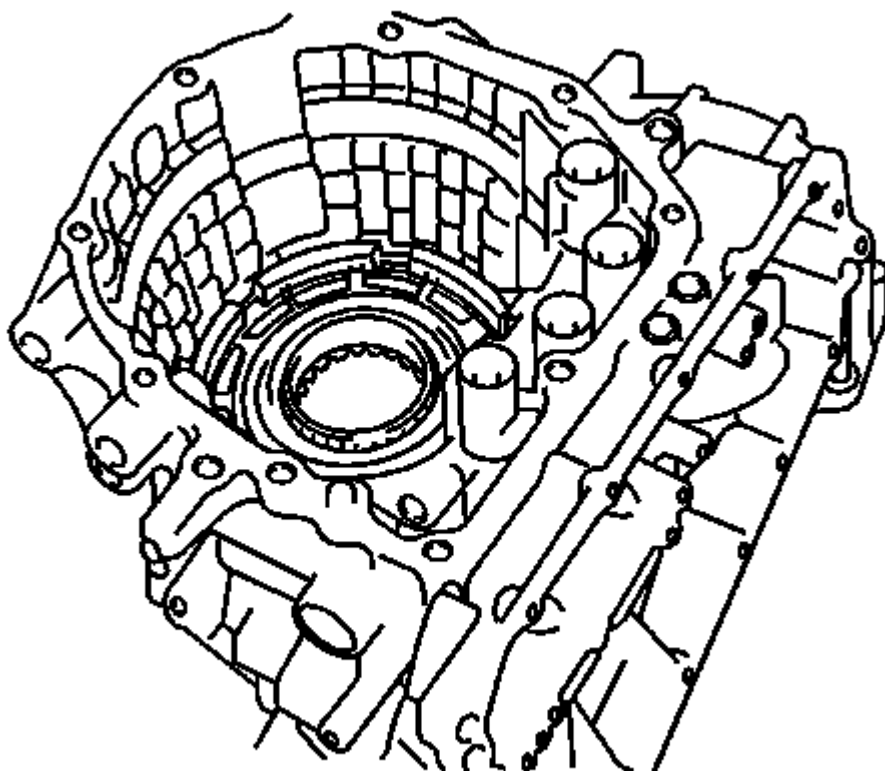


Fig. 190: 1st & Reverse Brake Piston
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage the O-rings of the 1st and reverse brake piston.

30. Install the 1st and reverse brake piston to the transmission case.

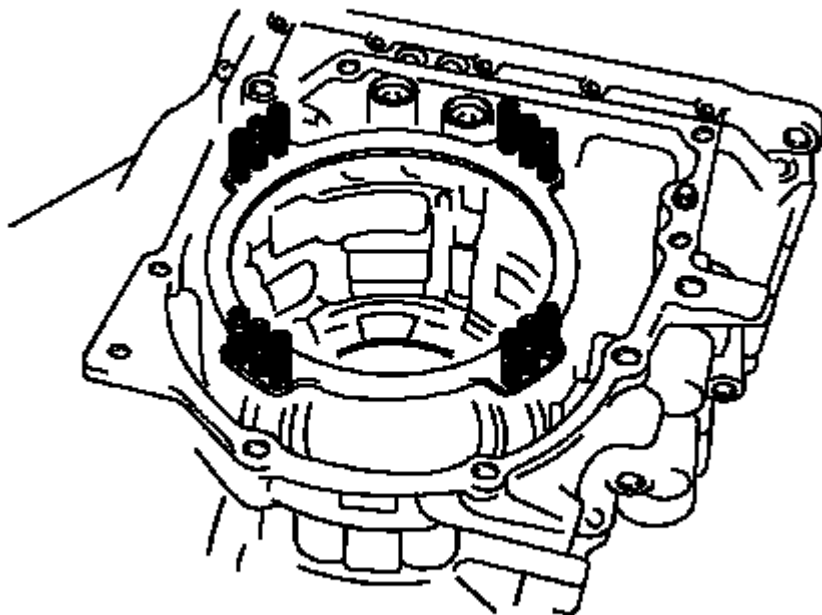


Fig. 191: Return Spring & Transaxle Case
Courtesy of GENERAL MOTORS COMPANY

31. Install the return spring to the transmission case.

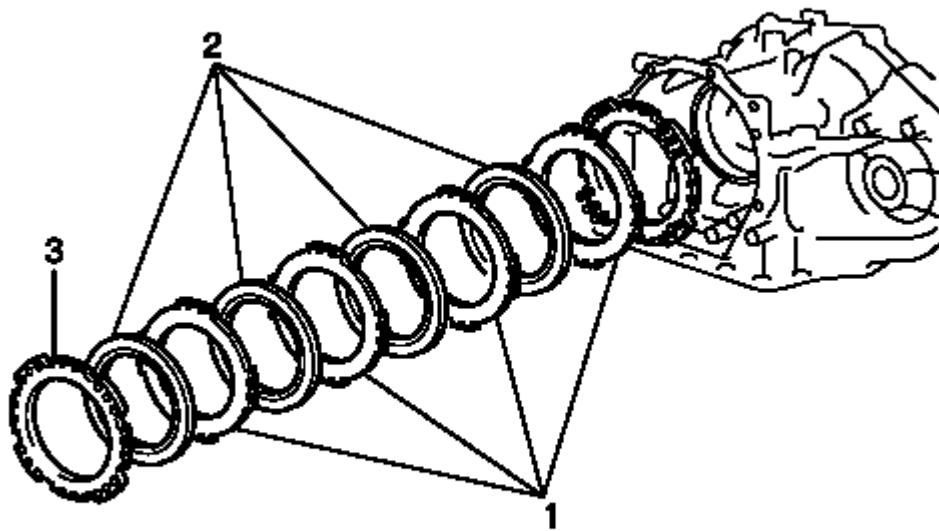


Fig. 192: Plates, 4 Discs And Flange
Courtesy of GENERAL MOTORS COMPANY

32. Install the 4 plates (1), the 4 discs (2) and the flange (3).

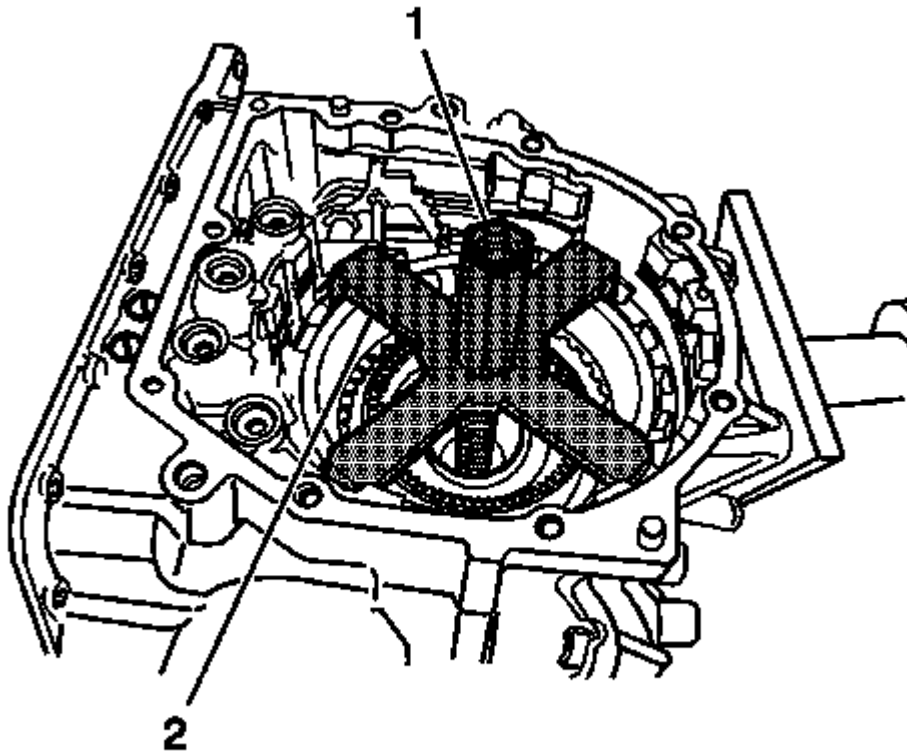


Fig. 193: DT 46455, DT 46457, Snap Ring Of 1st & Reverse Brake
Courtesy of GENERAL MOTORS COMPANY

NOTE: Verify that the snap ring is installed correctly in the groove of the transmission case.

33. Using **DT-46457** 1st/reverse brake adapter (2) and **DT-46455** Brake Spring Compressor Bolt/Nut (1), install the snap ring.

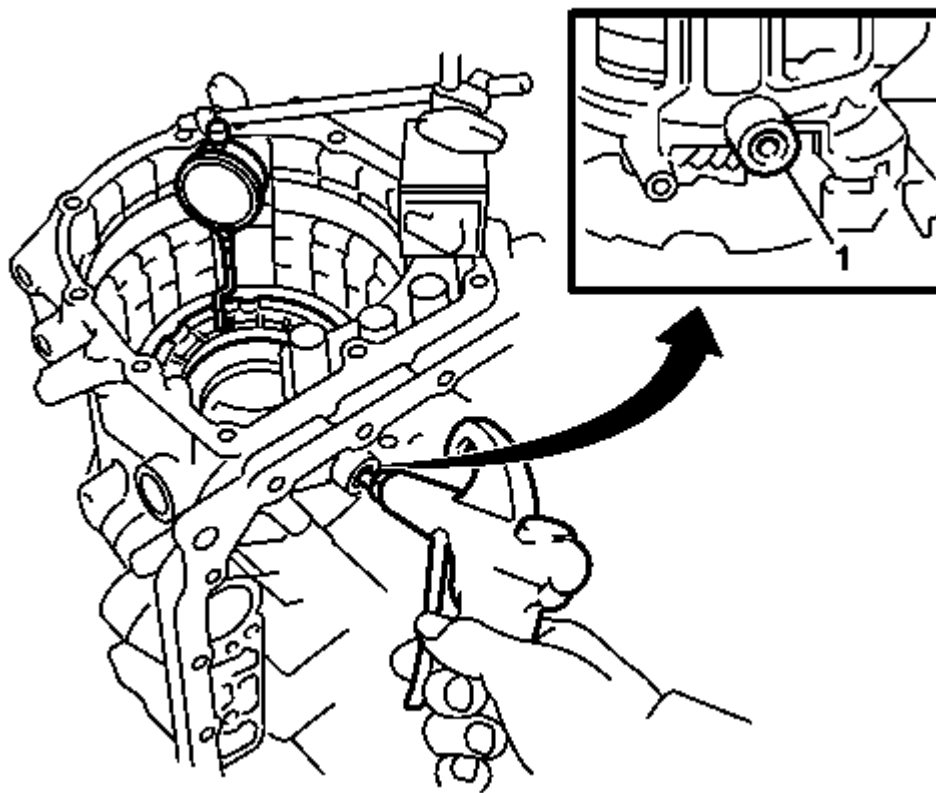


Fig. 194: DT -- 47520 Measuring Terminal
Courtesy of GENERAL MOTORS COMPANY

NOTE: If the piston stroke is non-standard, inspect the discs, the plates and the flange. The piston stroke is 0.65-1.05 mm (0.025-0.041 in).

34. Using a dial indicator and **DT-47520** measuring terminal, measure the 1st and reverse brake piston stroke while applying and releasing compressed air 392 kPa (56 psi) (1).

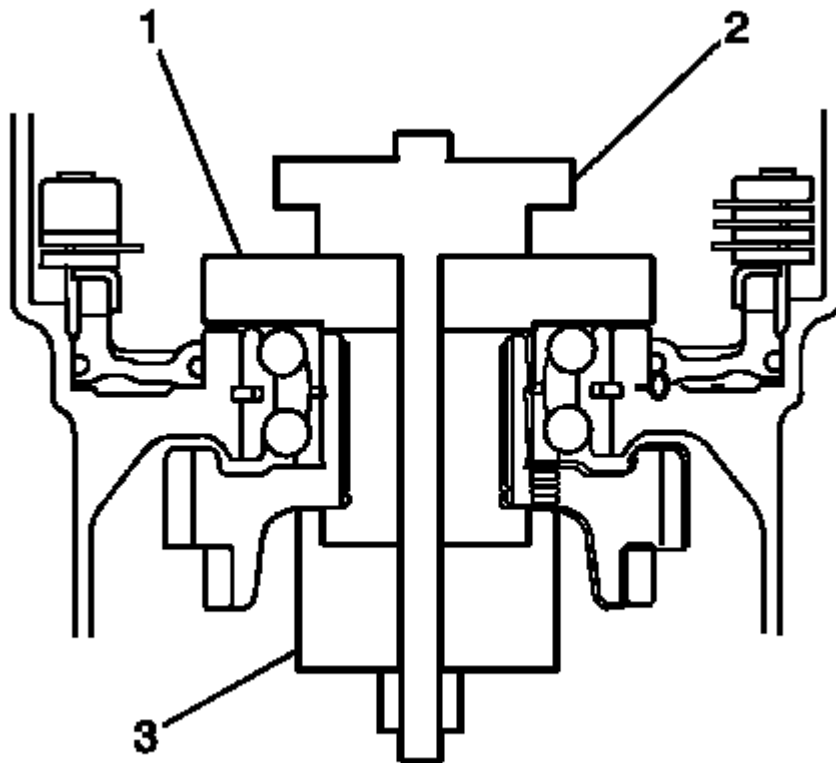


Fig. 195: DT 46460, DT 46455 & DT 46456
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Do not apply excessive force to the transmission case.**

35. Using **DT-46460** counter drive gear installation adapter (3), **DT-46455** brake spring compressor bolt/nut tool (2) and **DT-46456** brake spring compressor plate (1), install the counter drive gear.

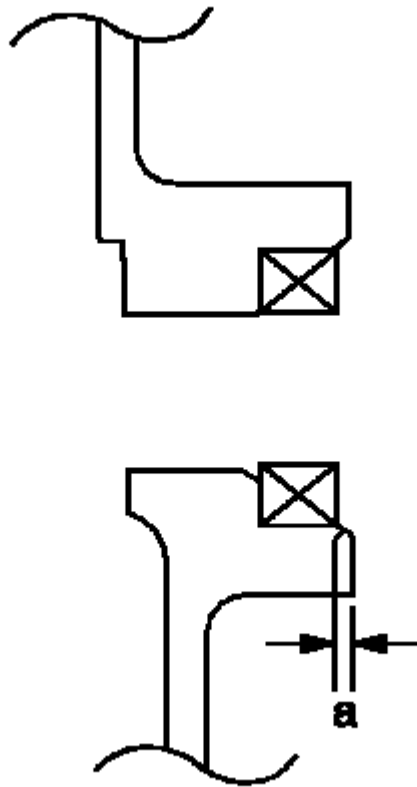


Fig. 196: Transaxle Housing & Counter Driven Gear
Courtesy of GENERAL MOTORS COMPANY

36. Coat a new manual valve lever oil seal with ATF.
37. Install the manual valve lever oil seal to the transmission case.

Specification

The oil seal depth is 0.75-1.25 mm (0.030-0.049 in).

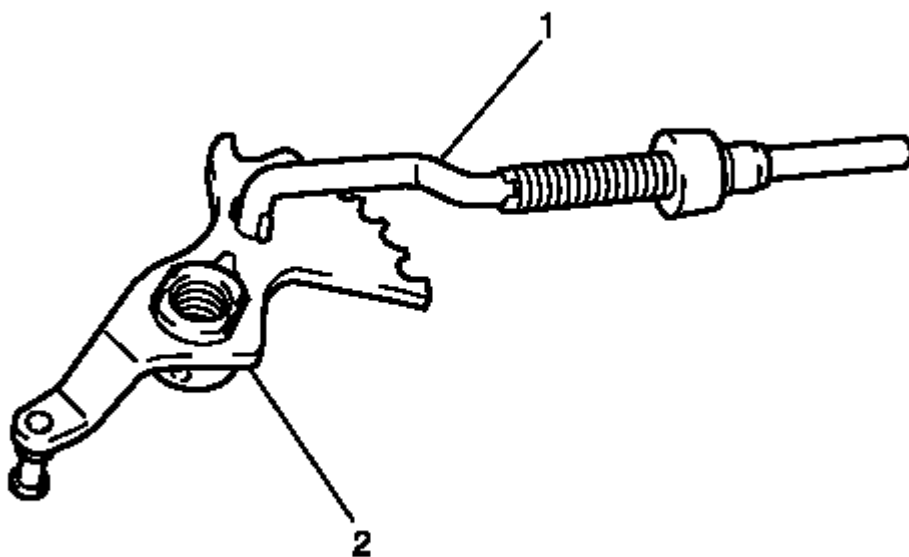


Fig. 197: Parking Lock Rod

Courtesy of GENERAL MOTORS COMPANY

38. Install the parking lock rod (1) to the manual valve lever (2).

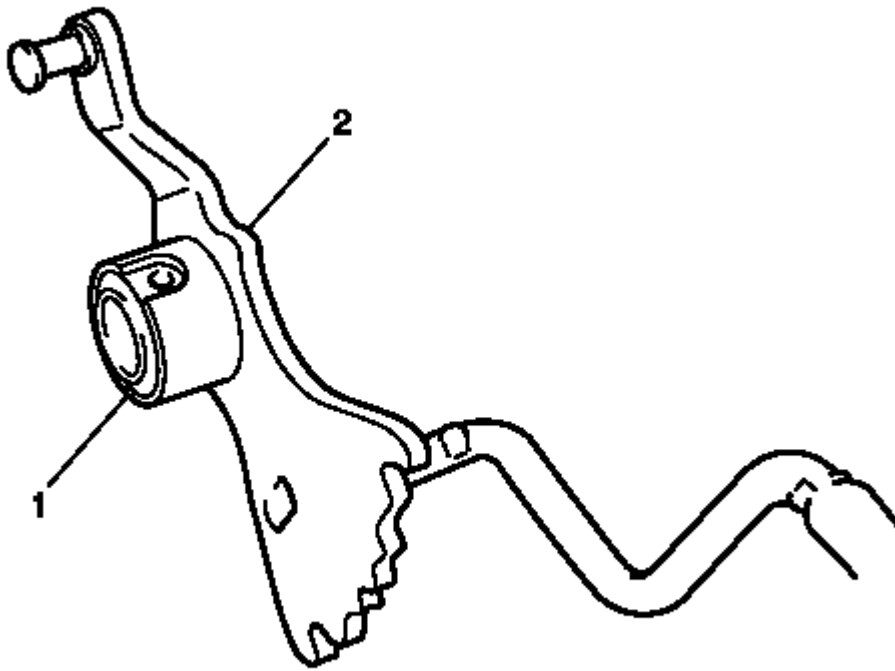


Fig. 198: Manual Valve Lever

Courtesy of GENERAL MOTORS COMPANY

39. Install a new spacer (1) to the manual valve lever (2).

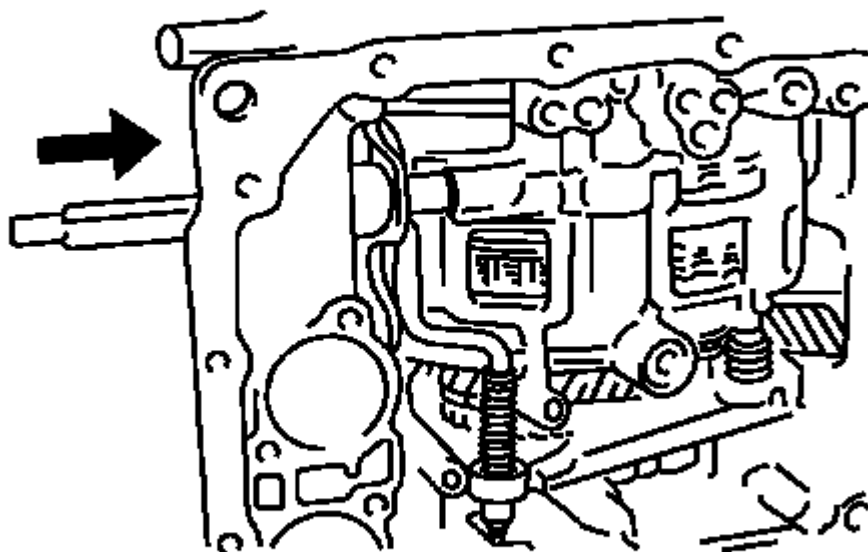


Fig. 199: Manual Valve Lever & Shaft
Courtesy of GENERAL MOTORS COMPANY

40. Install the manual valve lever shaft and the manual valve lever.

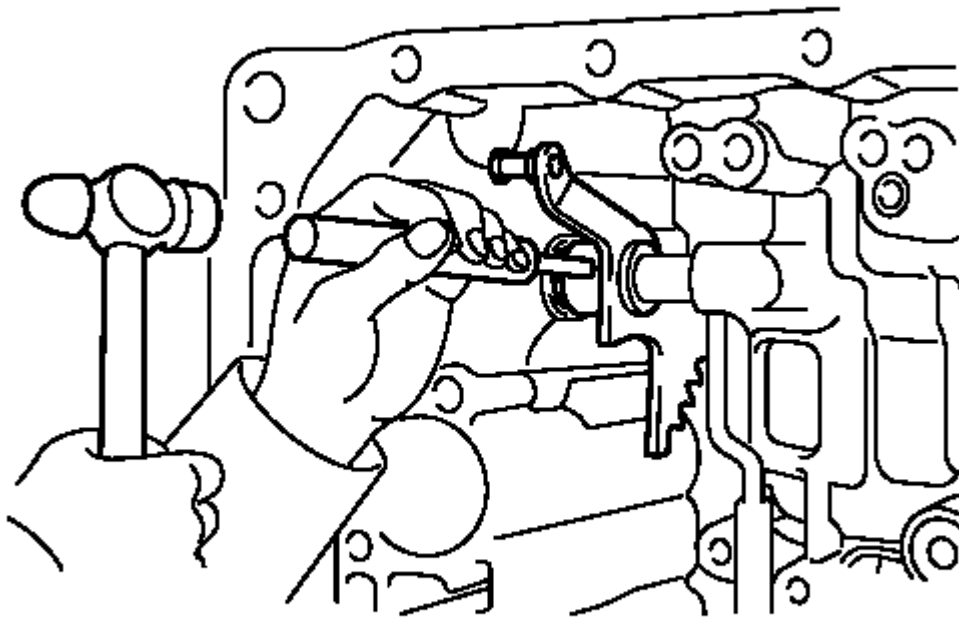


Fig. 200: Using A Pin Punch And Hammer, Driving Out Pin
Courtesy of GENERAL MOTORS COMPANY

41. Using a pin punch and hammer, drive in a new pin.

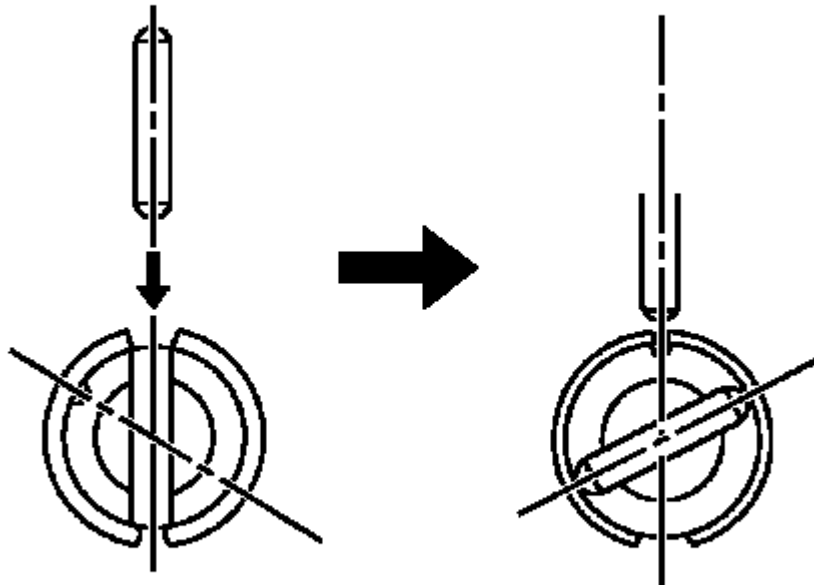


Fig. 201: Staking Spacer Through Small Hole
Courtesy of GENERAL MOTORS COMPANY

42. Turn the spacer and the lever shaft to align the small hole for locating the staking position in the spacer with the staking position mark on the lever shaft.
43. Using a pin punch, stake the spacer through the small hole.
44. Verify that the spacer does not turn.

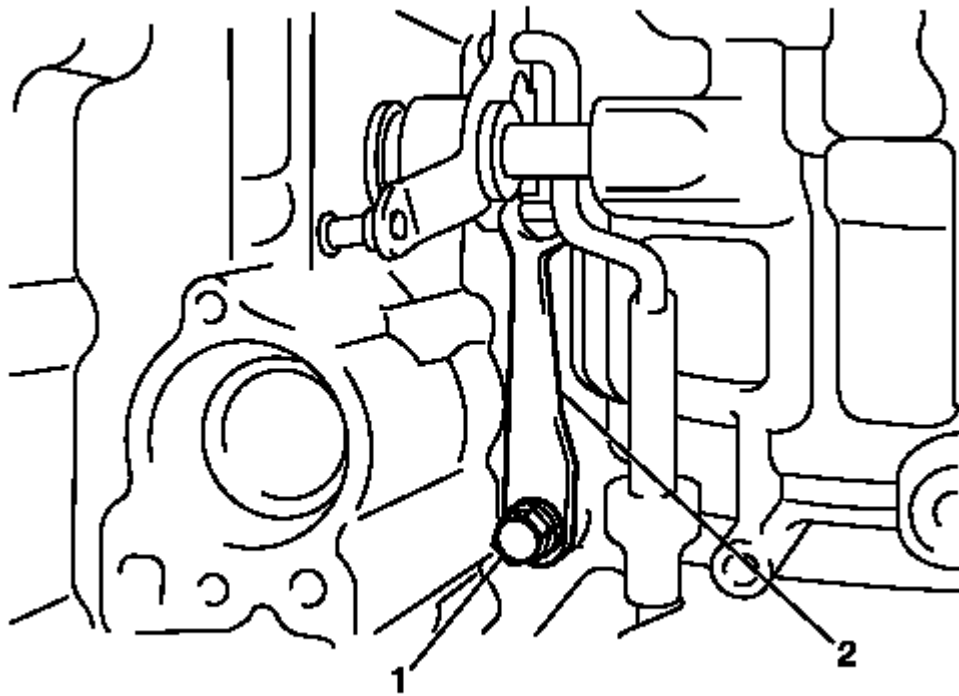


Fig. 202: Manual Detent Spring

Courtesy of GENERAL MOTORS COMPANY

45. Install the manual detent spring (2).
46. Install the manual detent spring bolt (1) and tighten to 10 (89 lb in).

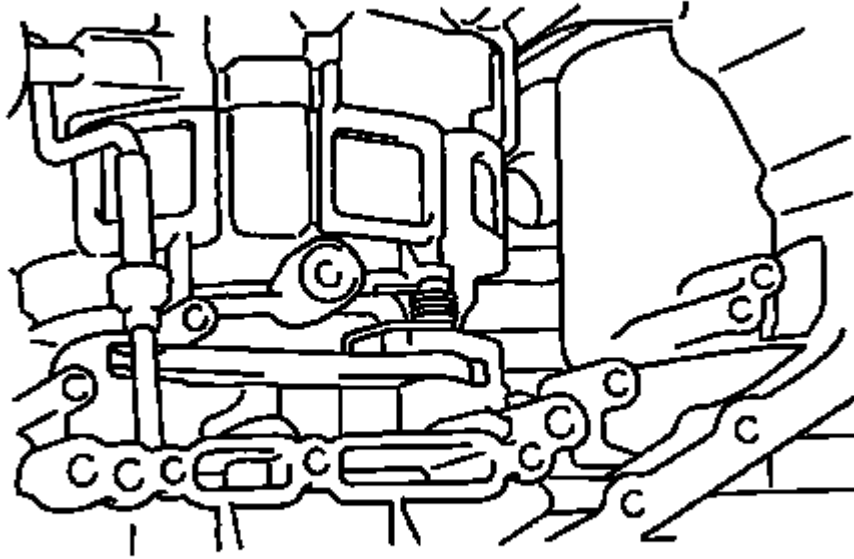


Fig. 203: Parking Lock Pawl, Shaft & Torsion Spring
Courtesy of GENERAL MOTORS COMPANY

47. Install the parking lock pawl shaft, torsion spring, and the parking lock pawl.

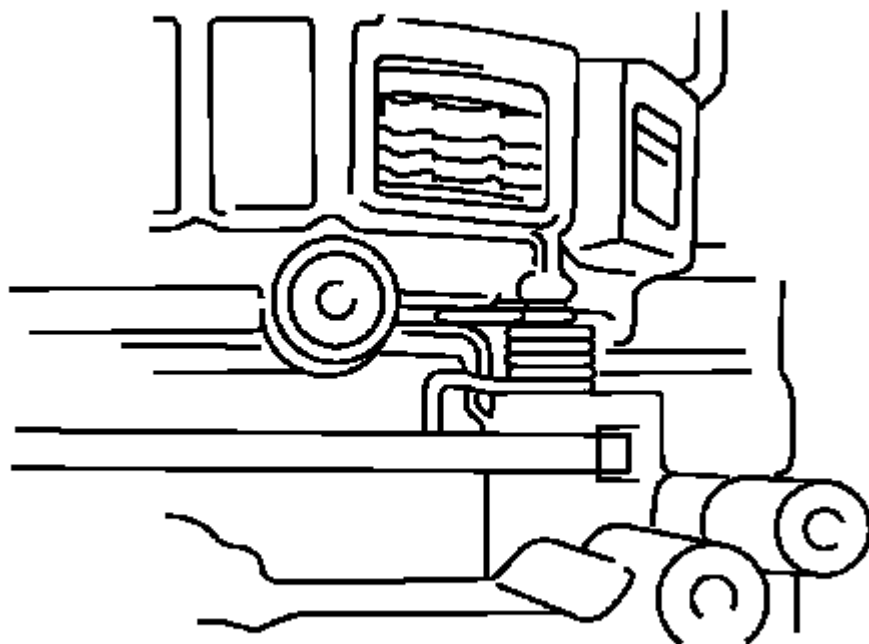


Fig. 204: Edge Of Torsion Spring
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not apply too much force to the spring.

48. Verify that the edge of the torsion spring fits into the groove securely.

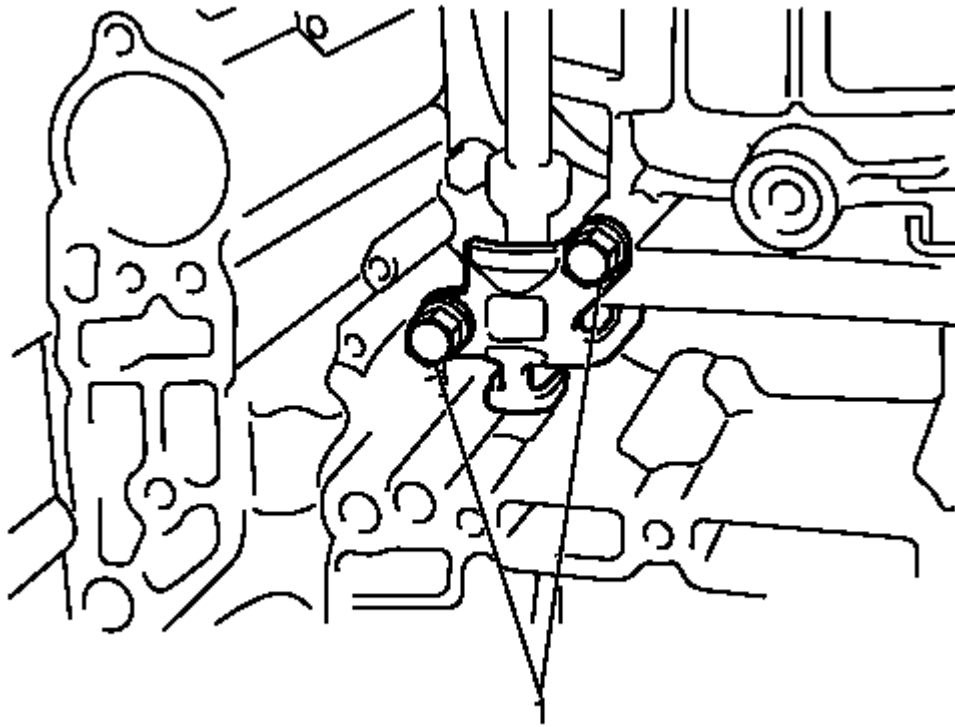


Fig. 205: Parking Lock Pawl Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

49. Install the parking lock pawl bracket.
50. Install the parking lock pawl bolts (1) and tighten to 7 (62 lb in).

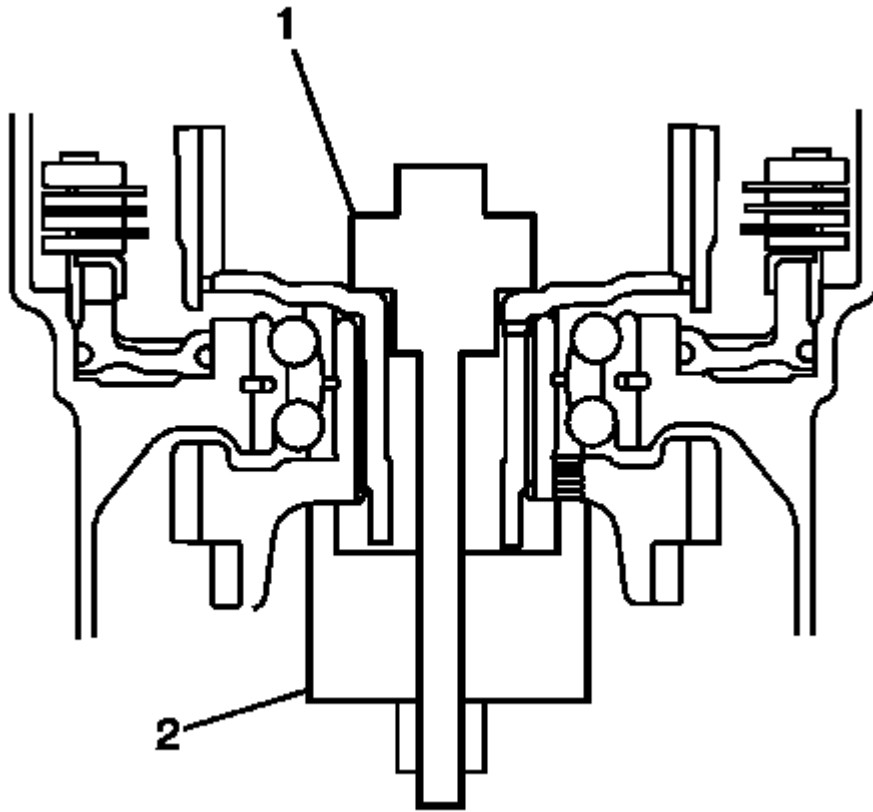


Fig. 206: DT 46460, DT 46455 & Planetary Ring Gear
Courtesy of GENERAL MOTORS COMPANY

51. Replace the planetary ring gear flange of the planetary ring gear with a new one.
52. Using **DT-46460** counter drive gear installation adapter (2) and **DT-46455** brake spring compressor bolt/nut tool (1), install the planetary ring gear.

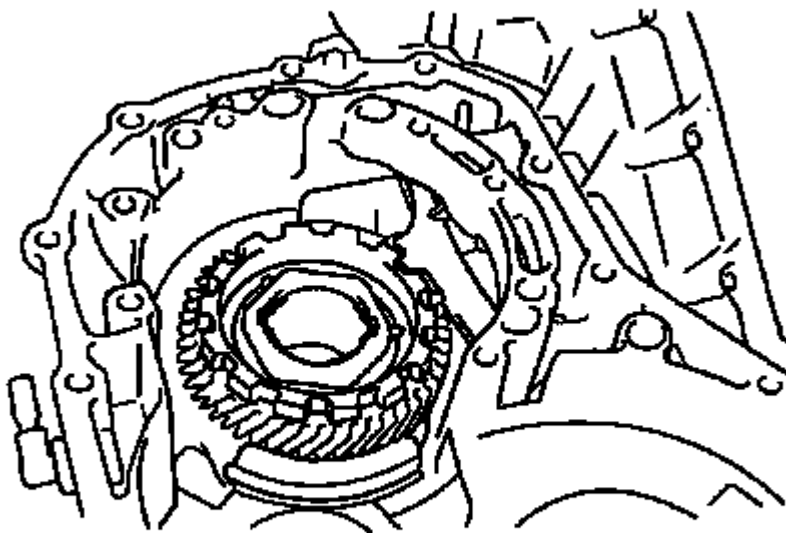


Fig. 207: Counter Drive Gear & Parking Lock Pawl
Courtesy of GENERAL MOTORS COMPANY

53. Fix the counter drive gear with the parking lock pawl.

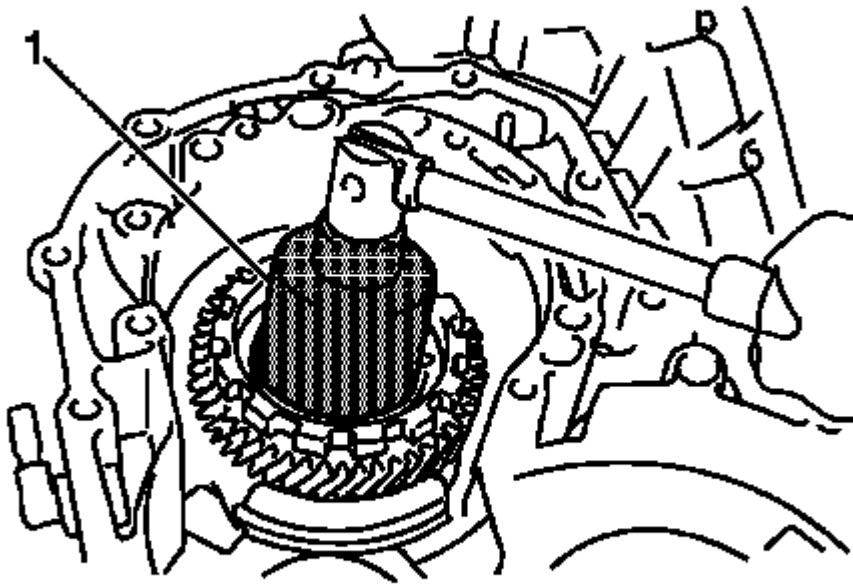


Fig. 208: Removing Planetary Ring Gear Nut Using DT 46472
Courtesy of GENERAL MOTORS COMPANY

NOTE: Tightening torque value is a reference value and must ensure that the tightening torque in the next step.

54. Using **DT-46472** planetary ring gear nut removal/installation socket (1), install a new nut and tighten to 115 (85 lb ft).

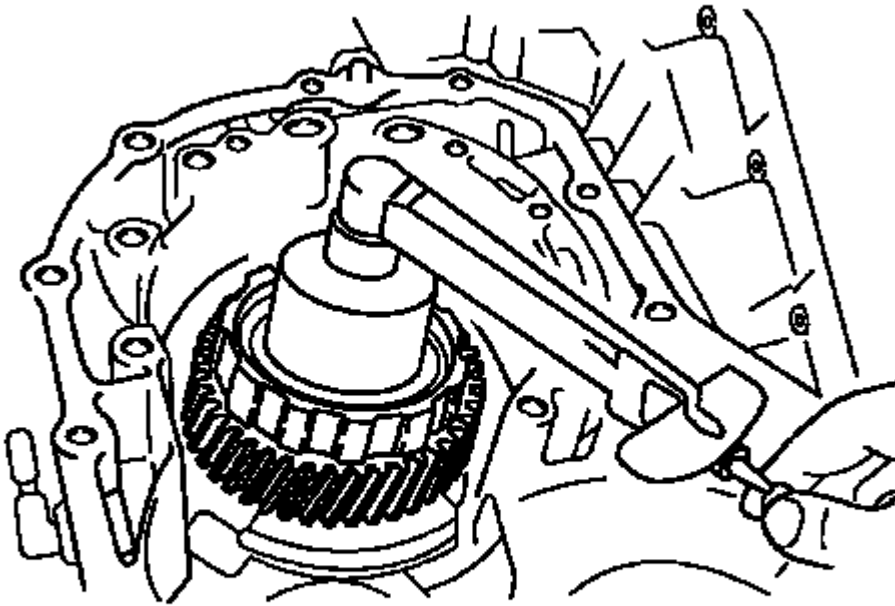


Fig. 209: Turning The Counter Drive Gear Using A Wrench
Courtesy of GENERAL MOTORS COMPANY

55. Using a small torque wrench, turn the counter drive gear 100 turn per minute and measure the preload.

Specification

When the preload is smaller than the specification, tighten the nut more and adjust the preload to 0.05-0.35 (0.43-3.12 lb in).

56. Inspect the rotation of the counter drive gear is smooth.

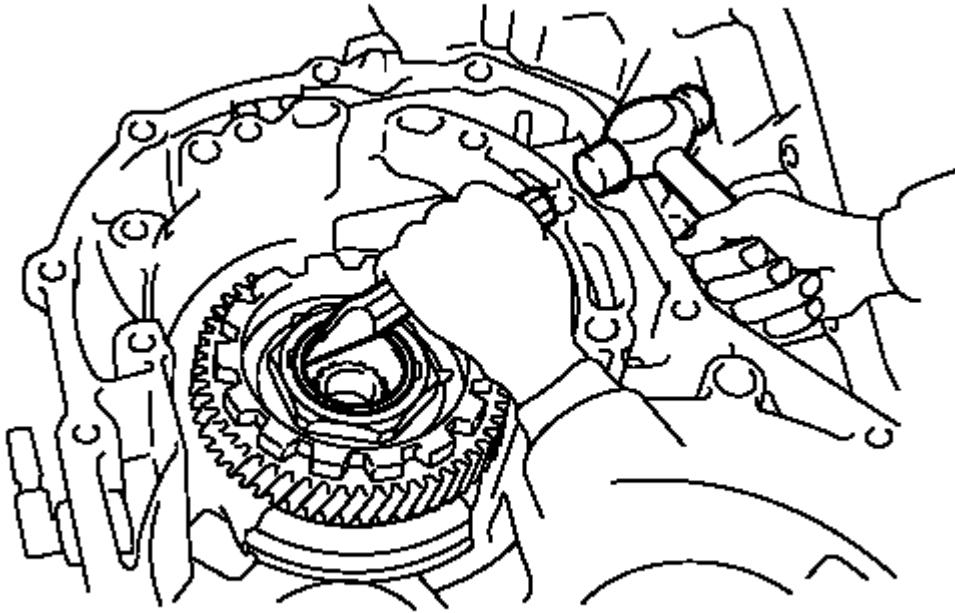


Fig. 210: Counter Drive Gear Nut
Courtesy of GENERAL MOTORS COMPANY

57. Using a chisel and a hammer, stake the counter drive gear nut.

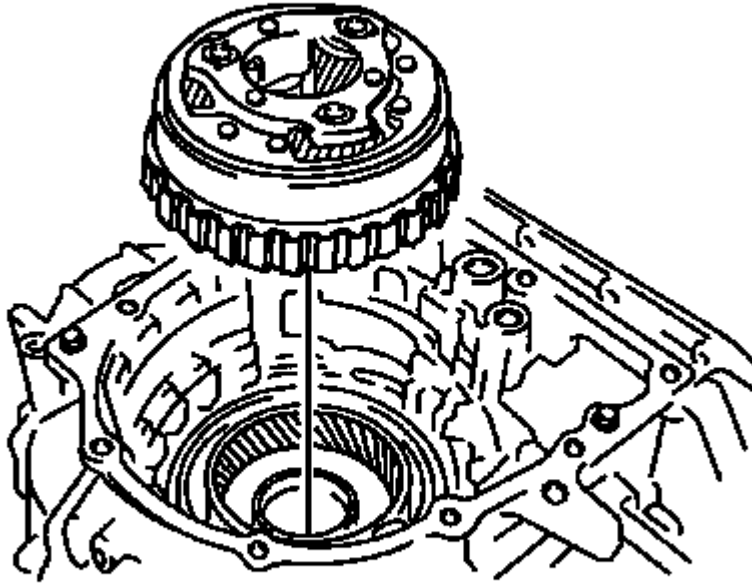


Fig. 211: Planetary Gear & Transaxle Case
Courtesy of GENERAL MOTORS COMPANY

58. Install the planetary gear to the transmission case.

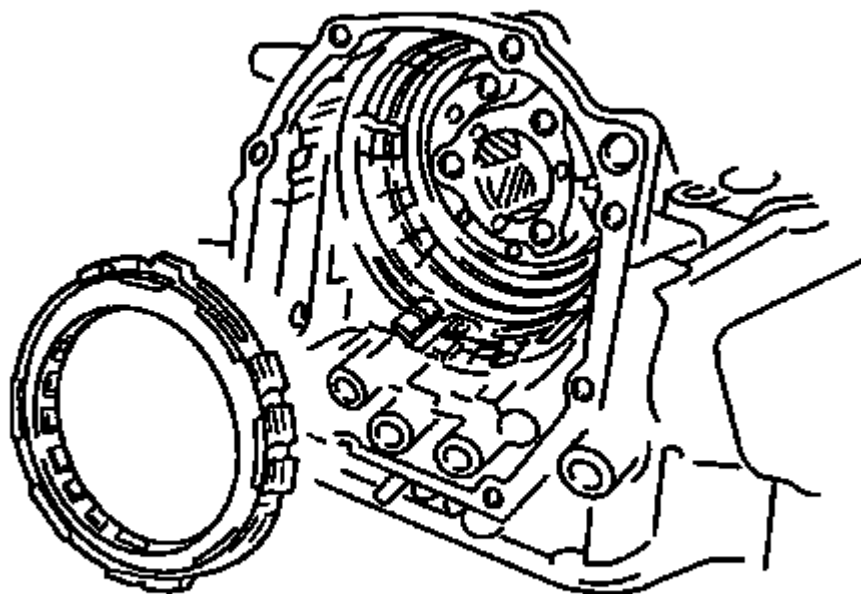


Fig. 212: No. 2 One-Way Clutch & Transaxle Case
Courtesy of GENERAL MOTORS COMPANY

59. Install the No. 2 one-way clutch to the transmission case.

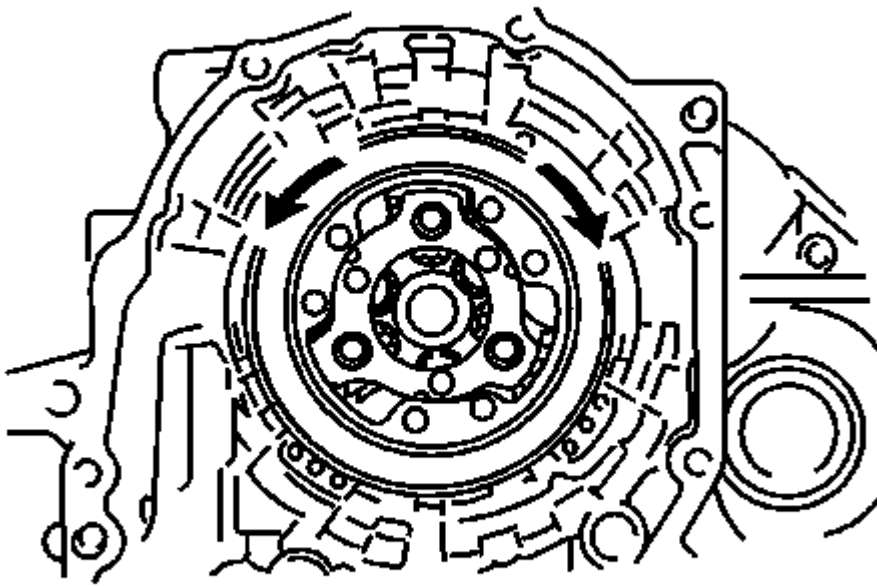


Fig. 213: Verifying Planetary Gear Turns Freely
Courtesy of GENERAL MOTORS COMPANY

60. Verify that the planetary gear turns freely counterclockwise and locks clockwise.

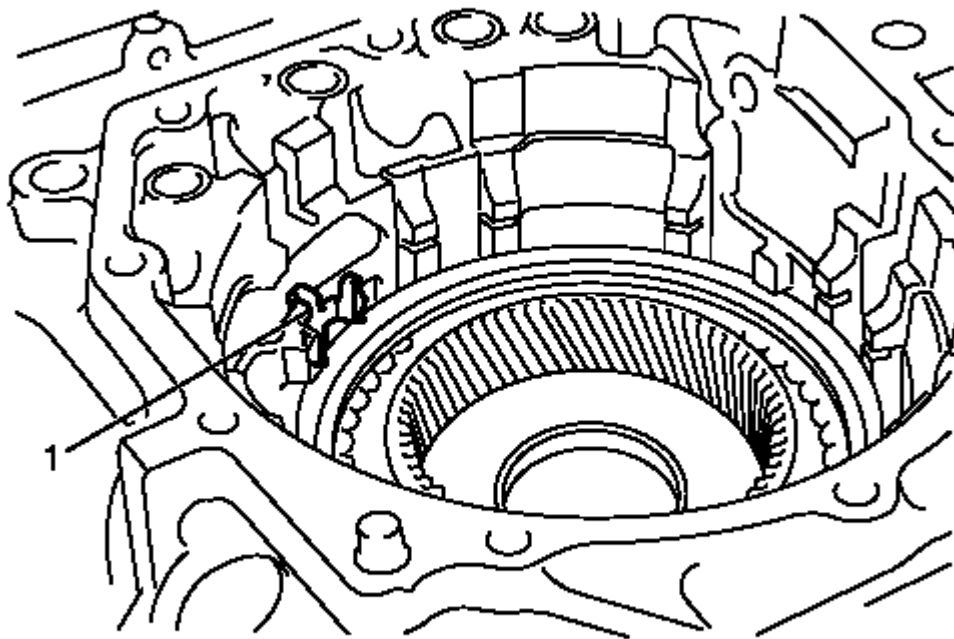


Fig. 214: Outer Race Retainer

Courtesy of GENERAL MOTORS COMPANY

61. Install the outer race retainer (1) in the space between No. 2 one-way clutch outer race and transmission case, push the outer race retainer in until you hear the click.

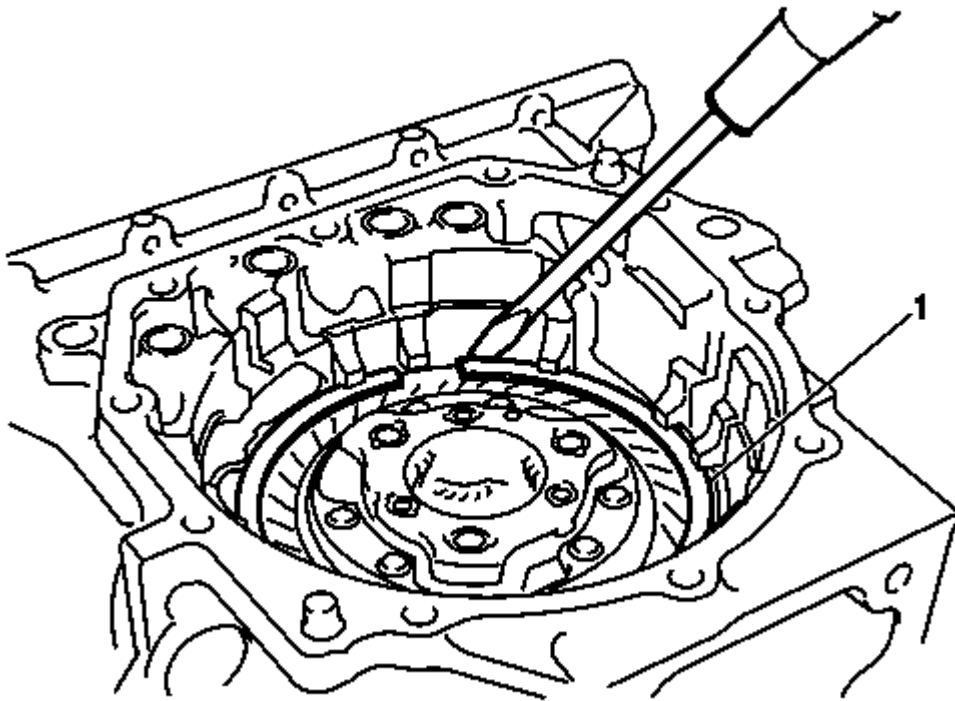


Fig. 215: View Of Snap Ring

Courtesy of GENERAL MOTORS COMPANY

NOTE: Make sure that the snap ring is installed in the groove of the transmission case correctly.

62. Using a screwdriver, install the snap ring (1).

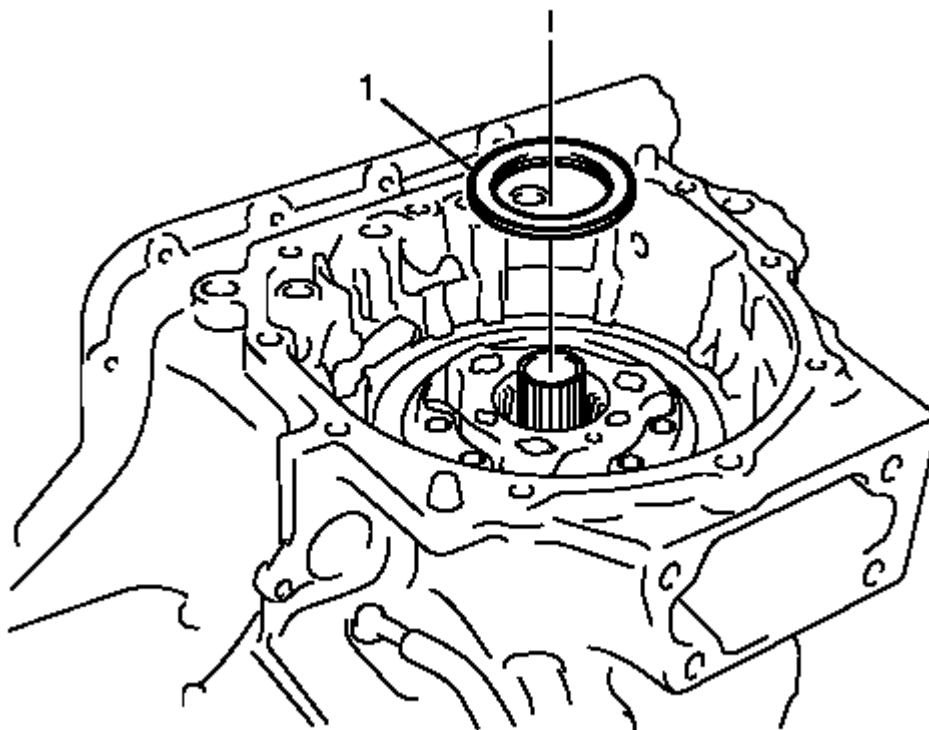


Fig. 216: Thrust Needle Roller Bearing
Courtesy of GENERAL MOTORS COMPANY

NOTE: Verify the direction of the bearing.

63. Install the thrust needle roller bearing (1).

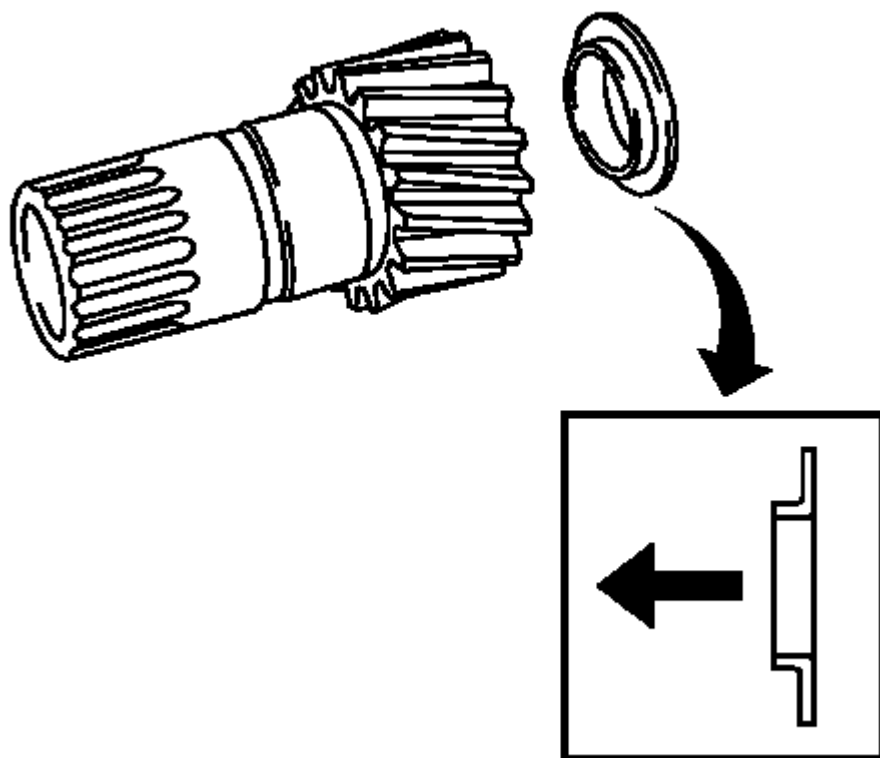


Fig. 217: Thrust Bearing Race & Front Planetary Sun Gear
Courtesy of GENERAL MOTORS COMPANY

64. Coat the thrust bearing race with petroleum jelly and install the race onto the front planetary sun gear.

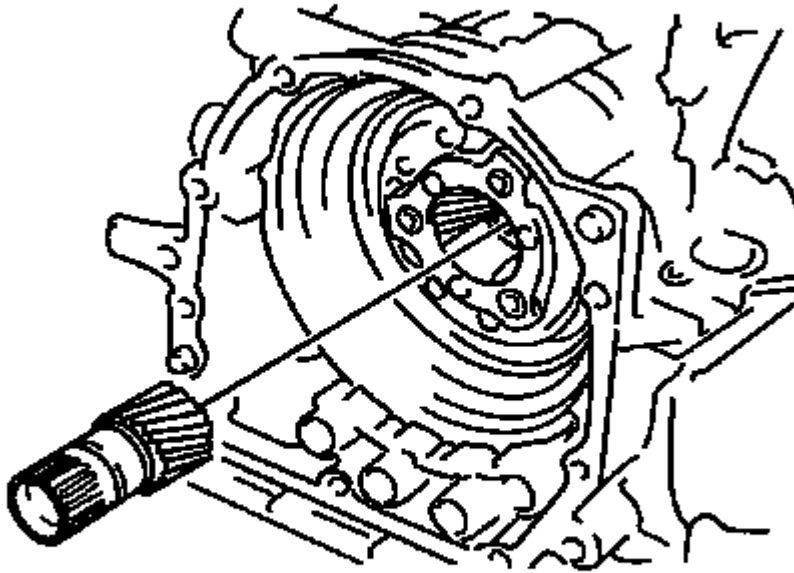


Fig. 218: Front Planetary Sun Gear & Thrust Bearing Race
Courtesy of GENERAL MOTORS COMPANY

65. Install the front planetary sun gear to the transmission case.

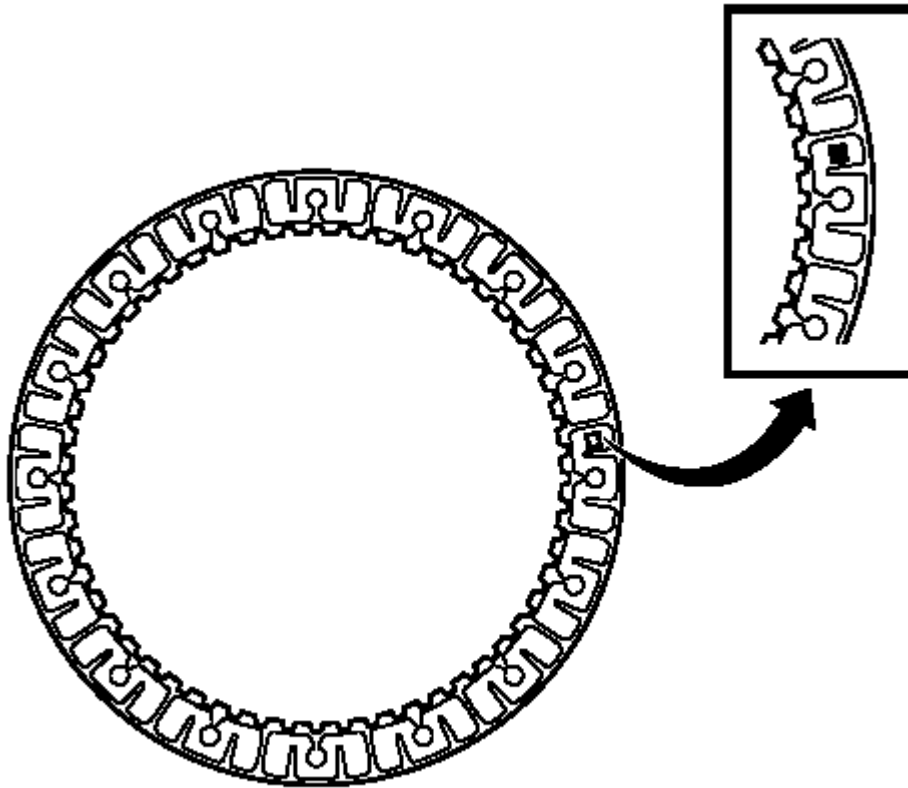


Fig. 219: Inspecting Sliding Surface Of Disc
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- If the lining of the disc is peeling off or discolored, or even if a part of the printed mark is defaced, replace all discs.
- Before assembling the new discs, soak the discs in ATF for at least 15 minutes.

66. If the sliding surface of the disc, the plate and the flange of O/D and 2nd coast brake are worn or burnt, replace the parts.

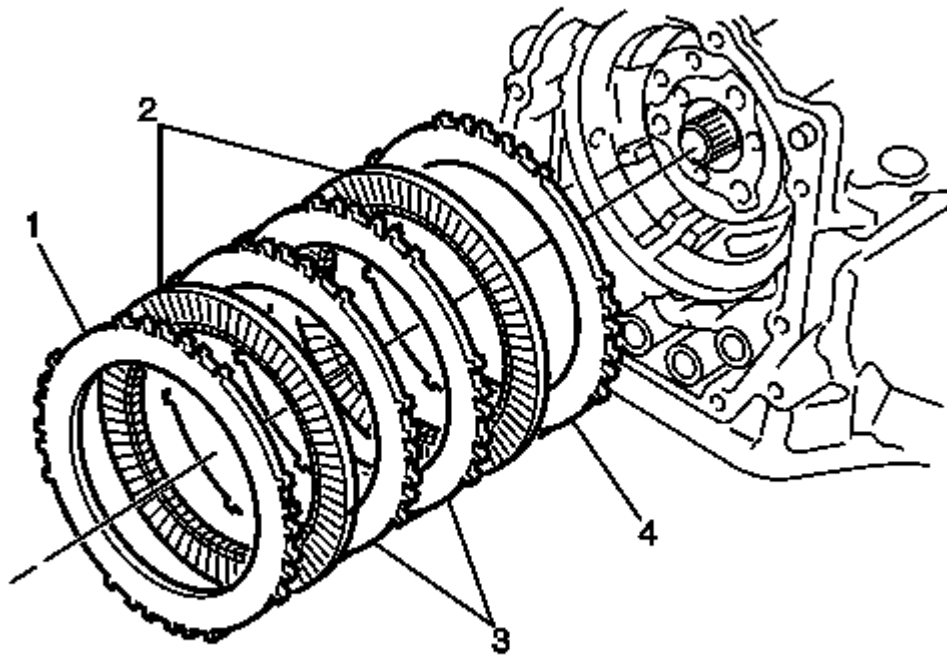


Fig. 220: Flanges, Discs And Plates
Courtesy of GENERAL MOTORS COMPANY

67. Install 2 flanges (1, 4), 2 discs (2), and 2 plates (3) of O/D and 2nd coast brake to the transmission case.

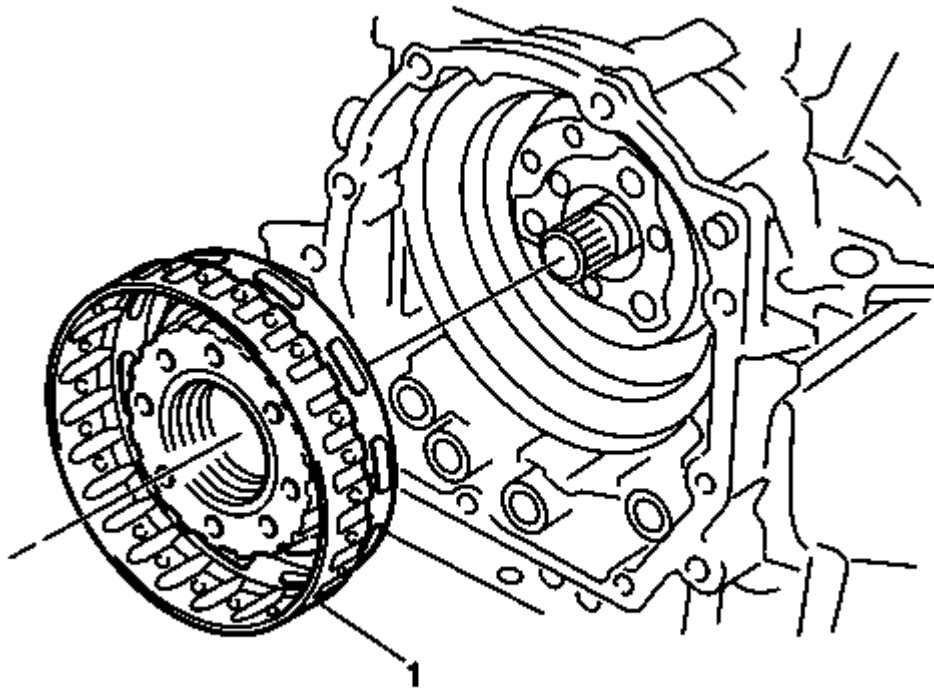


Fig. 221: Rear Planetary Sun Gear
Courtesy of GENERAL MOTORS COMPANY

68. Install the rear planetary sun gear (1) to the transmission case.

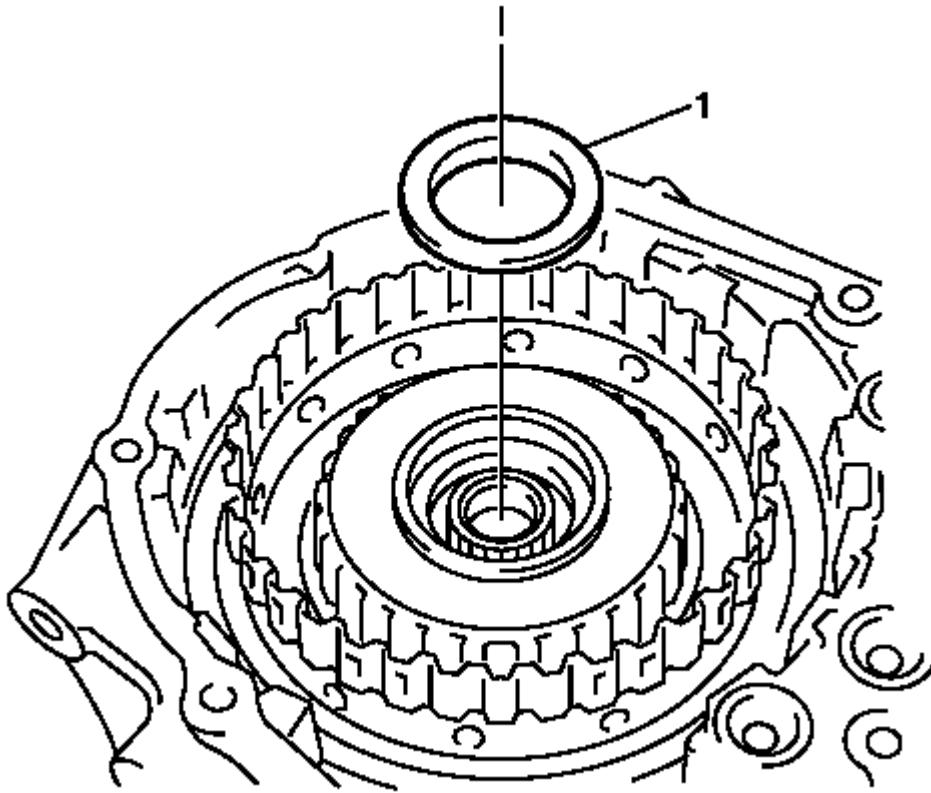


Fig. 222: Thrust Bearing Race

Courtesy of GENERAL MOTORS COMPANY

NOTE: **Verify the direction of the race.**

69. Coat the thrust bearing race (1) with petroleum jelly and install it onto the transmission case.

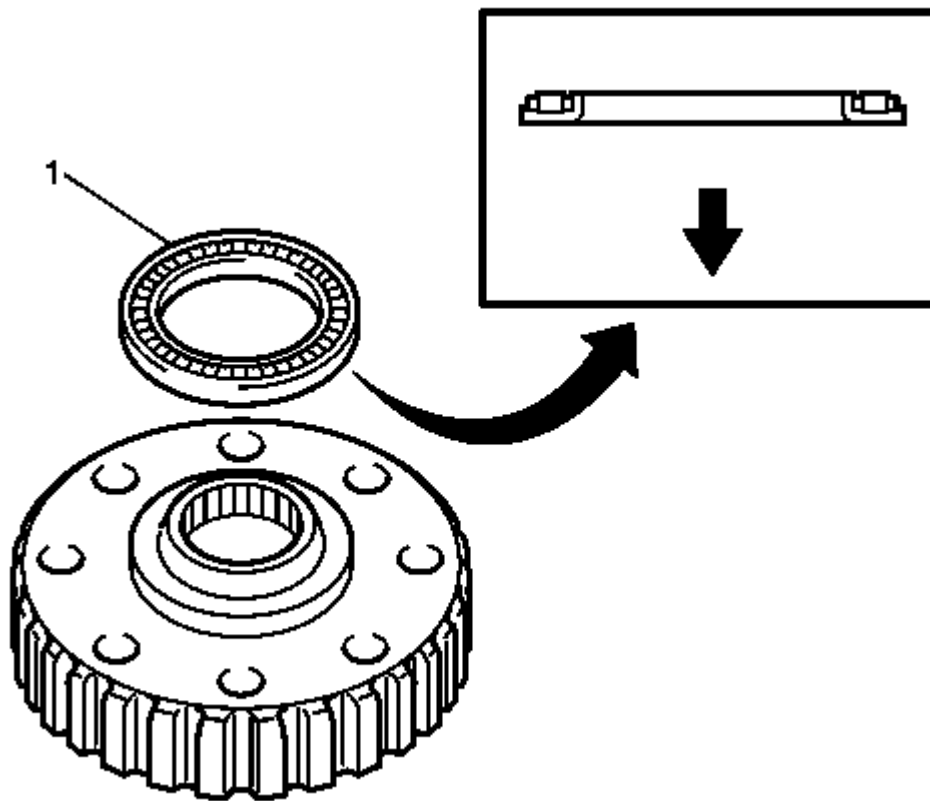


Fig. 223: Thrust Needle Roller Bearing
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Verify the direction of the bearing.**

70. Coat the thrust needle roller bearing (1) with petroleum jelly and install it onto the forward clutch hub.

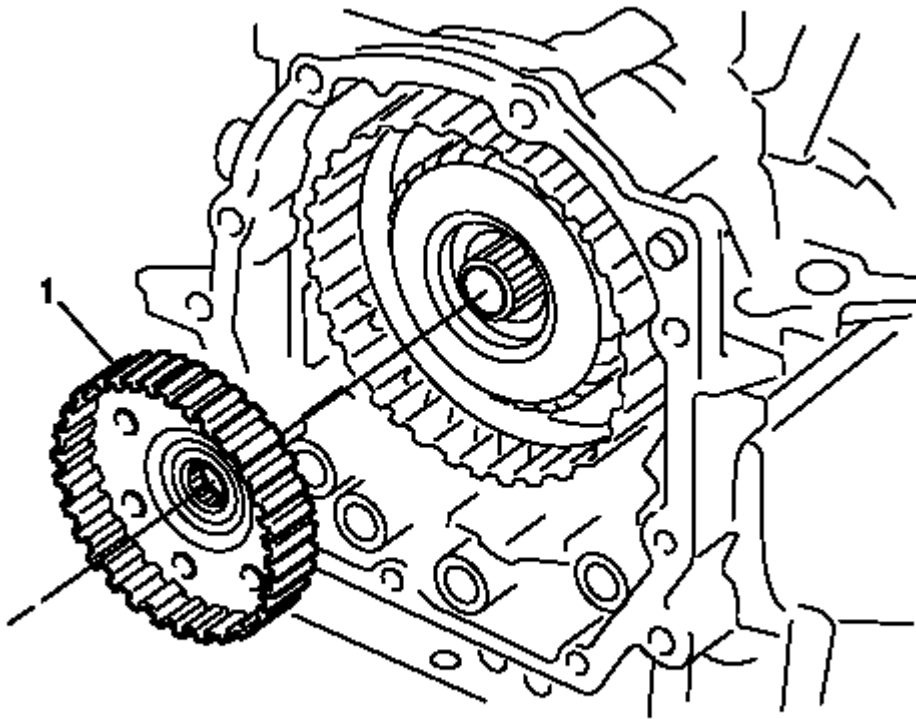


Fig. 224: Forward Clutch Hub

Courtesy of GENERAL MOTORS COMPANY

71. Install the forward clutch hub (1) to the transmission case.

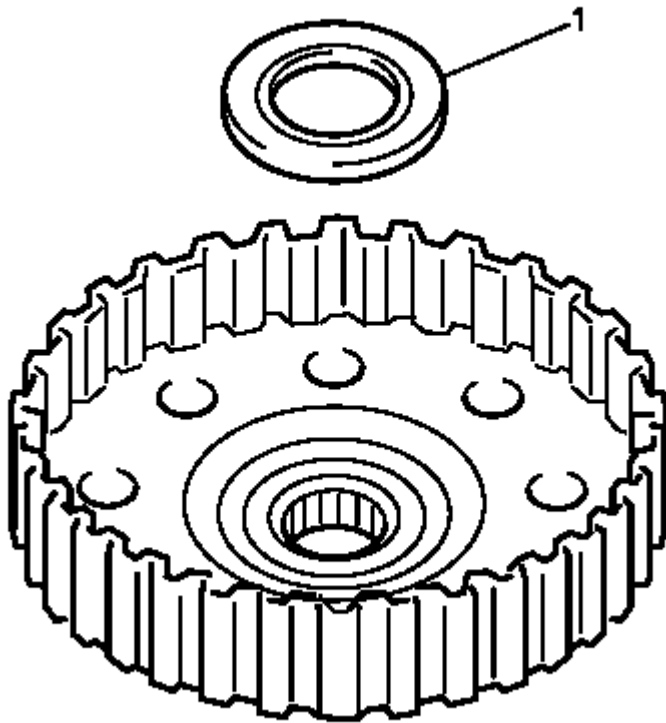


Fig. 225: Thrust Bearing Race

Courtesy of GENERAL MOTORS COMPANY

72. Coat the thrust bearing race (1) with petroleum jelly and install it onto the forward clutch hub.

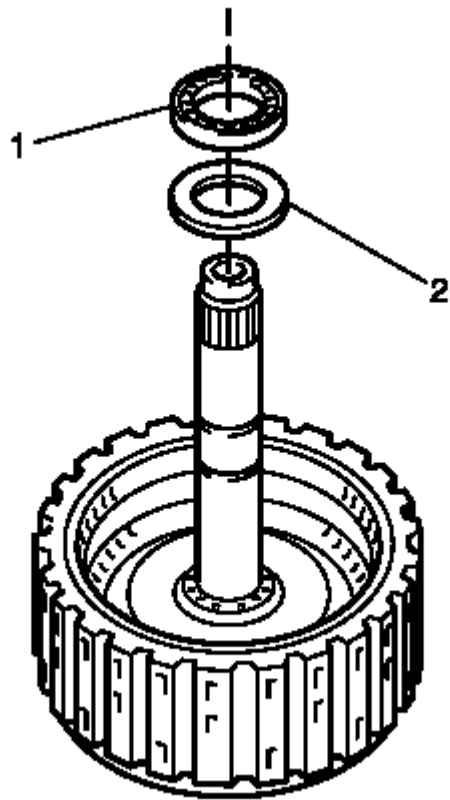


Fig. 226: Thrust Needle Roller Bearing
Courtesy of GENERAL MOTORS COMPANY

73. Install the thrust bearing race (2) and thrust needle roller bearing (1) to the forward and reverse clutch assembly.

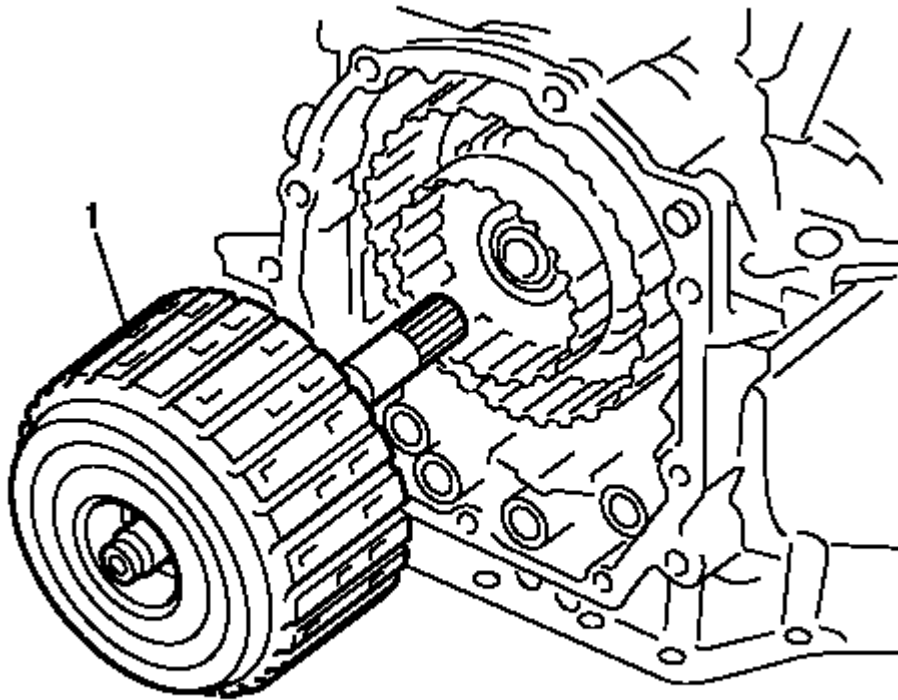


Fig. 227: Reverse Clutch Assembly
Courtesy of GENERAL MOTORS COMPANY

74. Install the forward and reverse clutch assembly (1) to the transmission case.

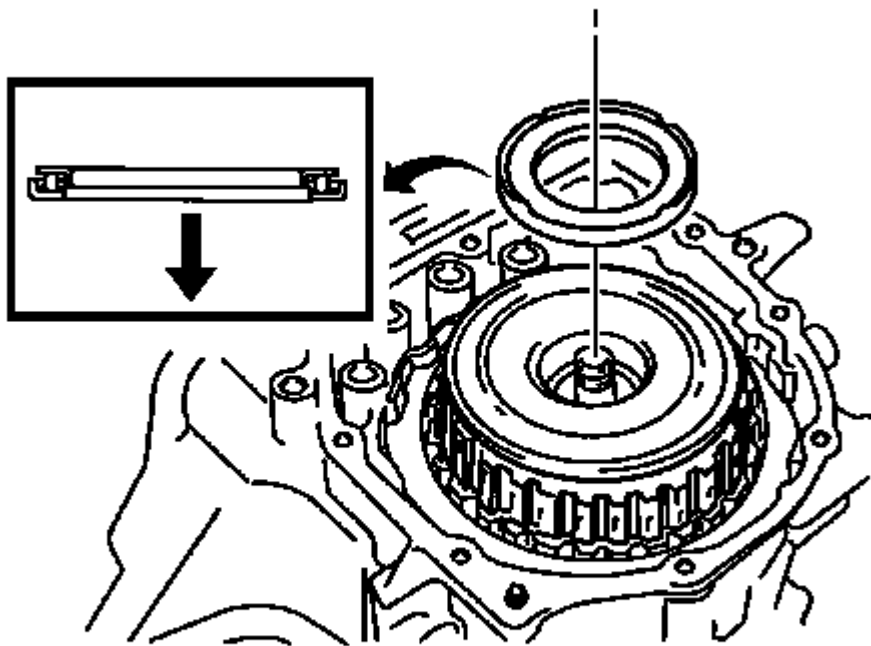


Fig. 228: Thrust Needle Roller Bearing & Forward/Reverse Clutch Assembly
Courtesy of GENERAL MOTORS COMPANY

NOTE: Verify the direction of the bearing.

75. Coat the thrust needle roller bearing with petroleum jelly and install it onto the forward and reverse clutch assembly.
76. Clean the connected part of the transmission case and rear cover.

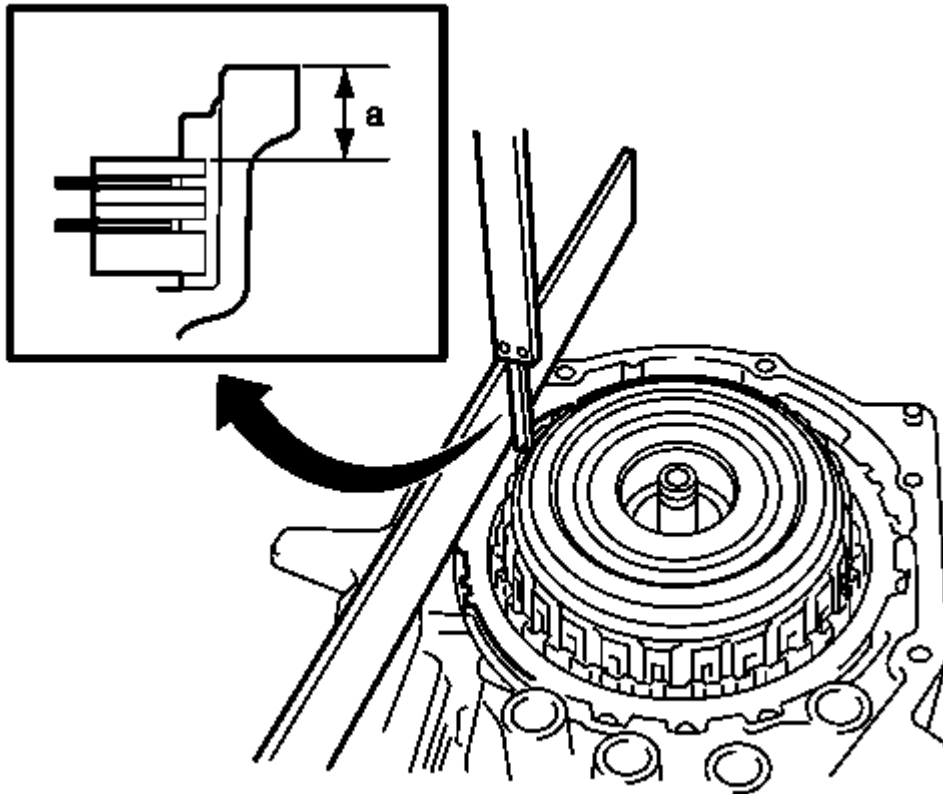


Fig. 229: Measuring Distance (a) Between 2Nd Coast And O/D Brake Flange
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Note down the measured value.**

77. Place a straight edge on the transmission case and measure the distance (a) between the 2nd coast and the O/D brake flange and the straight edge using vernier calipers.

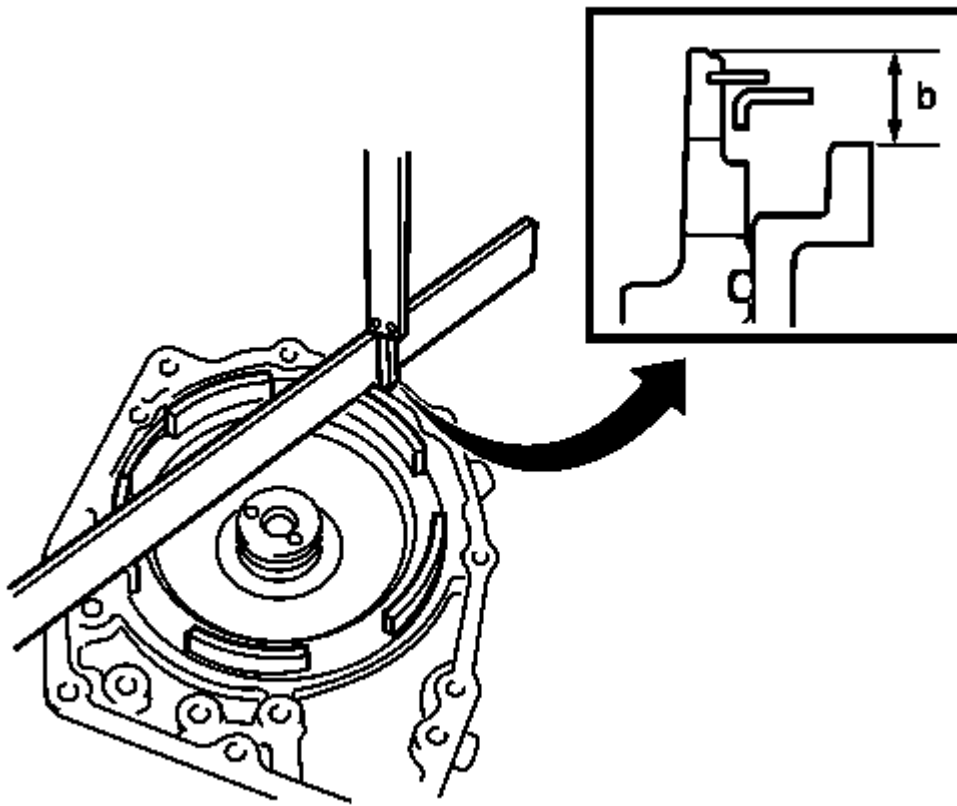


Fig. 230: Measuring Distance (B) Between Transmission Rear Cover And Straight Edge
Courtesy of GENERAL MOTORS COMPANY

78. Place a straight edge on the O/D brake piston and measure the distance (b) between the transmission rear cover and the straight edge using vernier calipers.
79. Calculate the piston stroke value using the following formula:

Piston stroke = Dimension a - Dimension b.

Select and install a flange which satisfies the piston stroke value.

Specification

The piston stroke is 0.65-1.05 mm (0.025-0.041 in).

80. If the piston stroke is out of standard, select another flange. Refer to **Transmission General Specifications**.

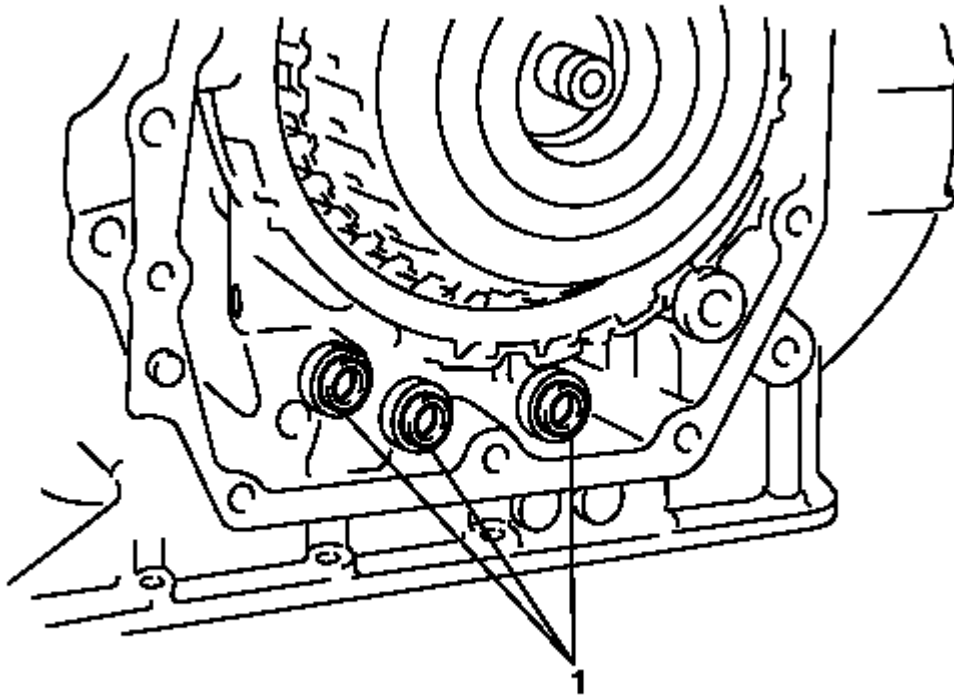


Fig. 231: O-Rings

Courtesy of GENERAL MOTORS COMPANY

81. Install new 3 O-rings (1) to the transmission rear cover.

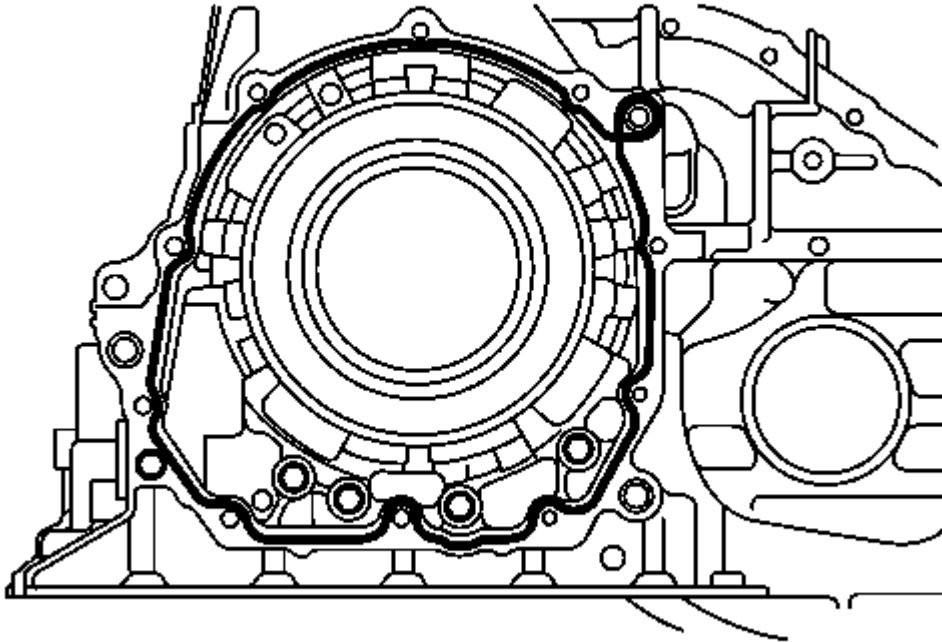


Fig. 232: Transmission Rear Cover
Courtesy of GENERAL MOTORS COMPANY

82. Remove any packing material. Do not get oil on the contacting surfaces of the transmission rear cover or transmission case.
83. Apply three bond 1281 or equivalent to the transmission case.

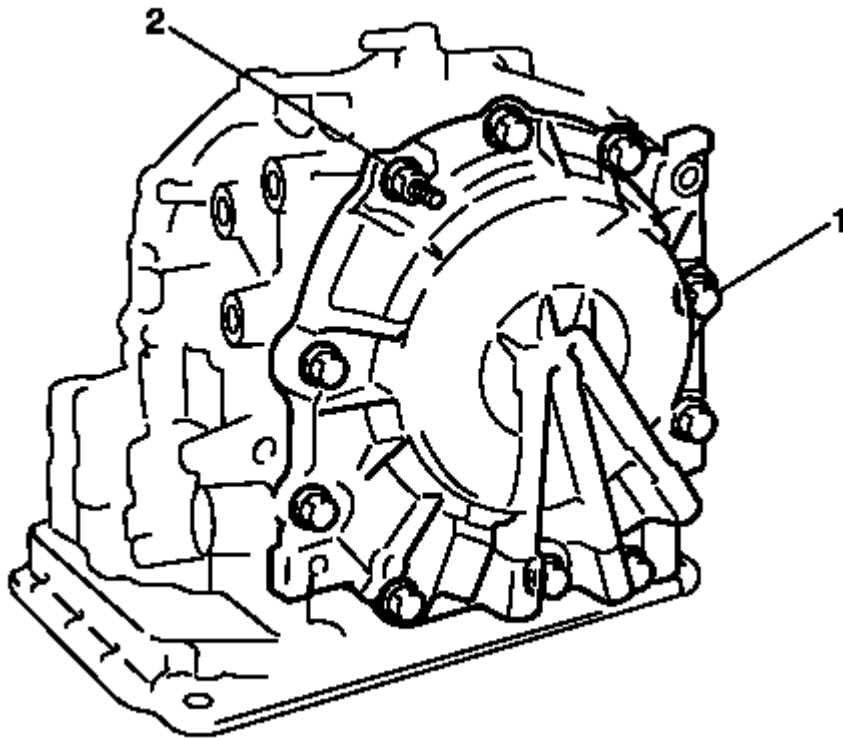


Fig. 233: Transmission Rear Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

84. Install the transmission rear cover to the transmission case.
85. Install the 9 transmission rear cover bolts (1) and 1 stud bolt (2) and tighten to 25 (18 lb ft).

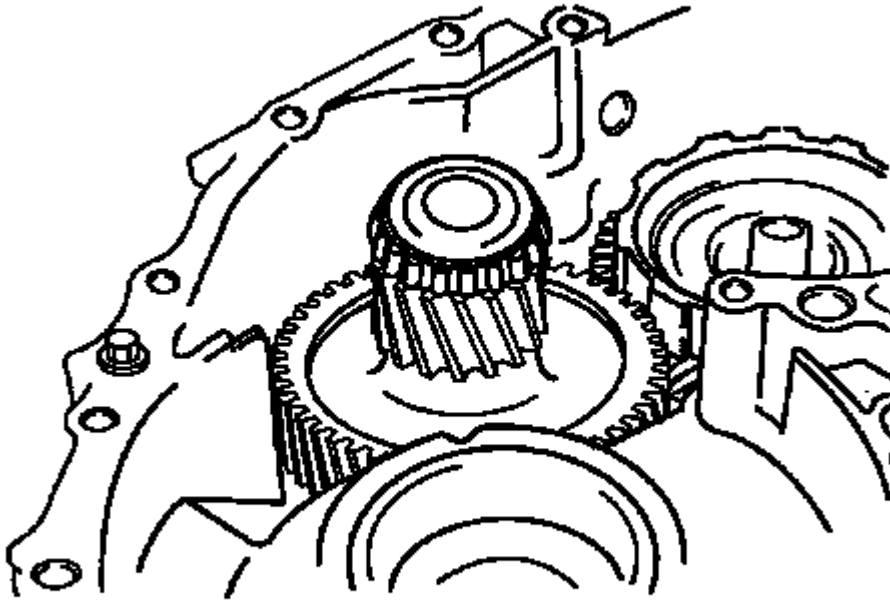


Fig. 234: Counter Driven Gear Assembly & Transaxle Case
Courtesy of GENERAL MOTORS COMPANY

86. Install the counter driven gear assembly to the transmission case.

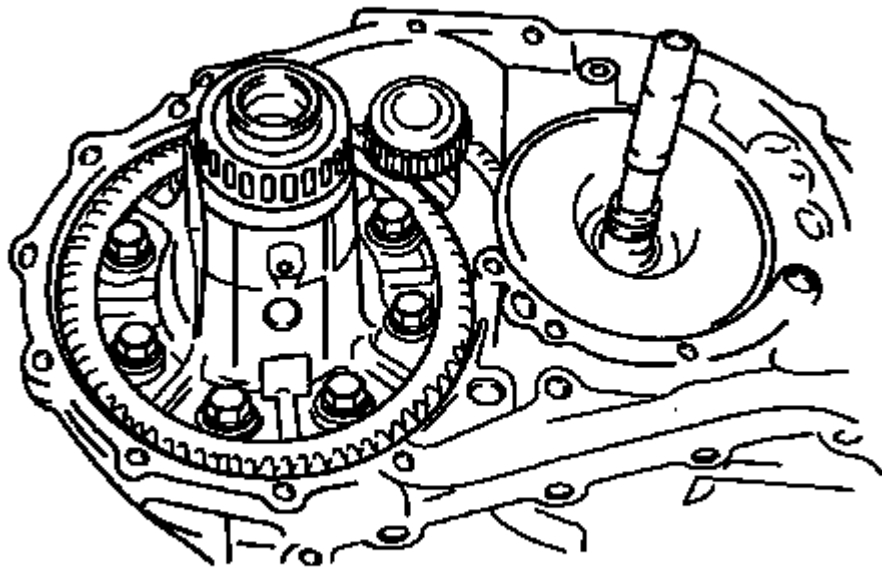


Fig. 235: Differential Gear Assembly & Transaxle Case
Courtesy of GENERAL MOTORS COMPANY

87. Install the differential gear assembly to the transmission case.

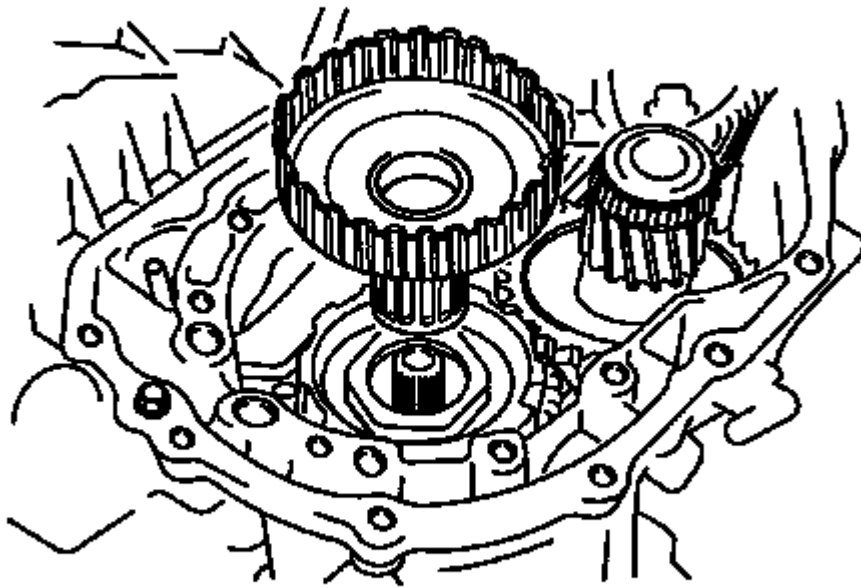


Fig. 236: Direct Clutch Hub & Transaxle Case
Courtesy of GENERAL MOTORS COMPANY

88. Install the direct clutch hub to the transmission case.

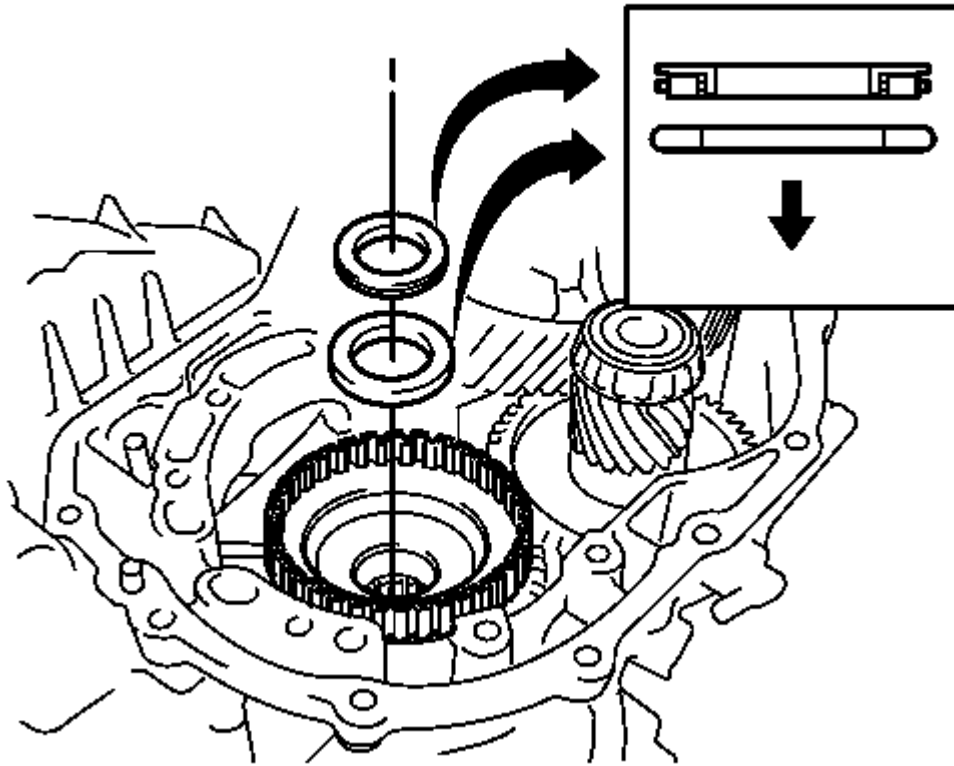


Fig. 237: Thrust Bearing Race
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Verify the direction of the bearing.**

89. Install the thrust bearing race and the thrust needle roller bearing to the transmission case.

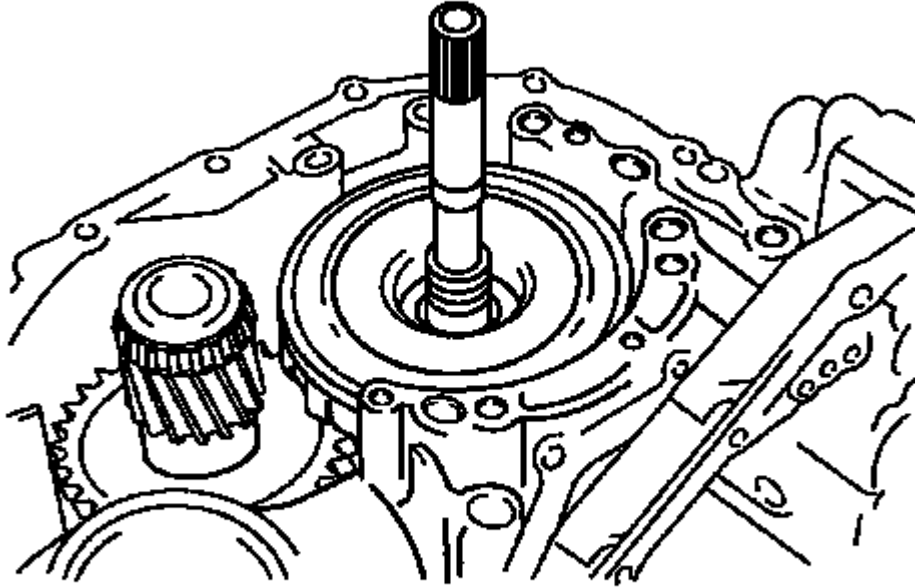


Fig. 238: Direct Clutch Assembly & Transaxle Case
Courtesy of GENERAL MOTORS COMPANY

90. Install the direct clutch assembly to the transmission case.

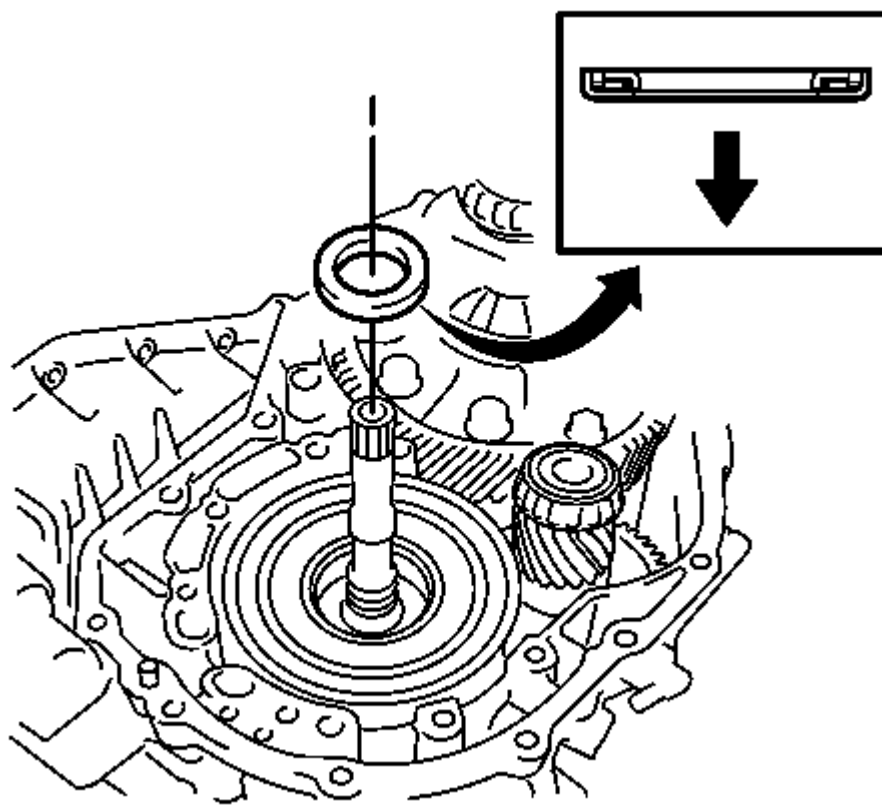


Fig. 239: Thrust Needle Roller Bearing
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Verify the direction of the bearing.**

91. Install the thrust needle roller bearing to the transmission case.
92. Place the oil pump through the input shaft, and align the bolt holes of the oil pump with the transmission case.

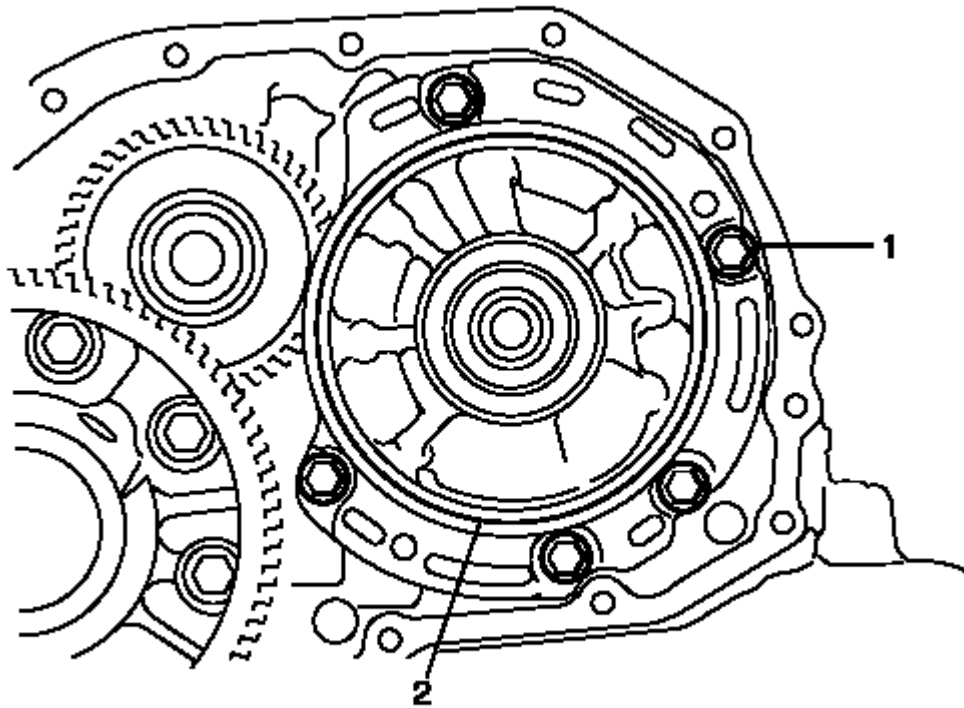


Fig. 240: Oil Pump Assembly

Courtesy of GENERAL MOTORS COMPANY

93. Install the 5 oil pump bolts (1) and tighten to 25 (18 lb ft).

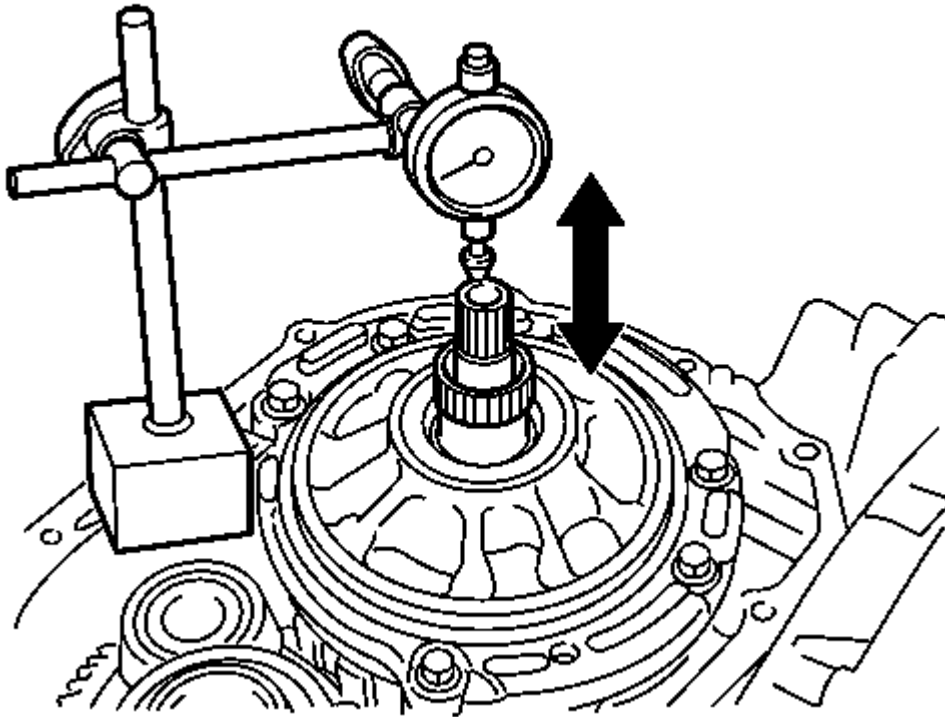


Fig. 241: Measuring Input Shaft End Play
Courtesy of GENERAL MOTORS COMPANY

94. Measure the end play in axial direction.

Specification

The end play is 0.3-0.9 mm (0.012-0.035 in).

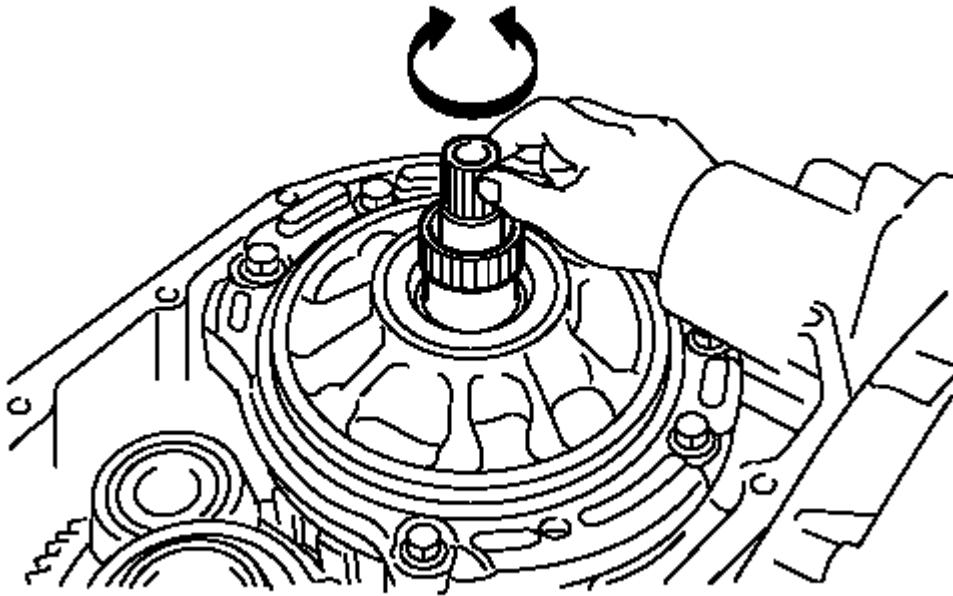


Fig. 242: Input Shaft Rotates Smoothly
Courtesy of GENERAL MOTORS COMPANY

95. Confirm that the input shaft rotates smoothly.

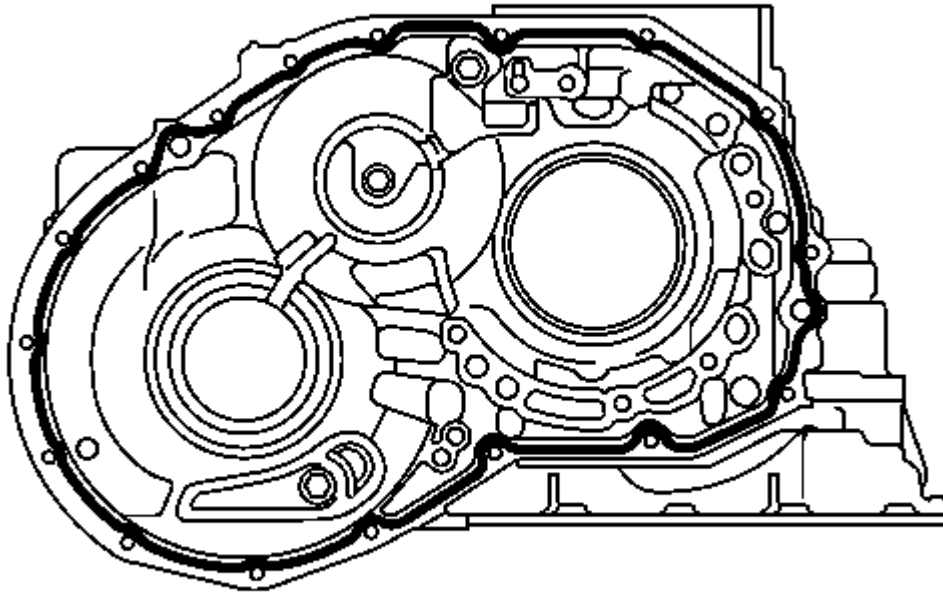


Fig. 243: Removing Any Packing Material
Courtesy of GENERAL MOTORS COMPANY

96. Remove any packing material. Do not get oil on the contacting surfaces of the transmission housing or the transmission case.
97. Apply three bond 1281 or equivalent to the transmission case.

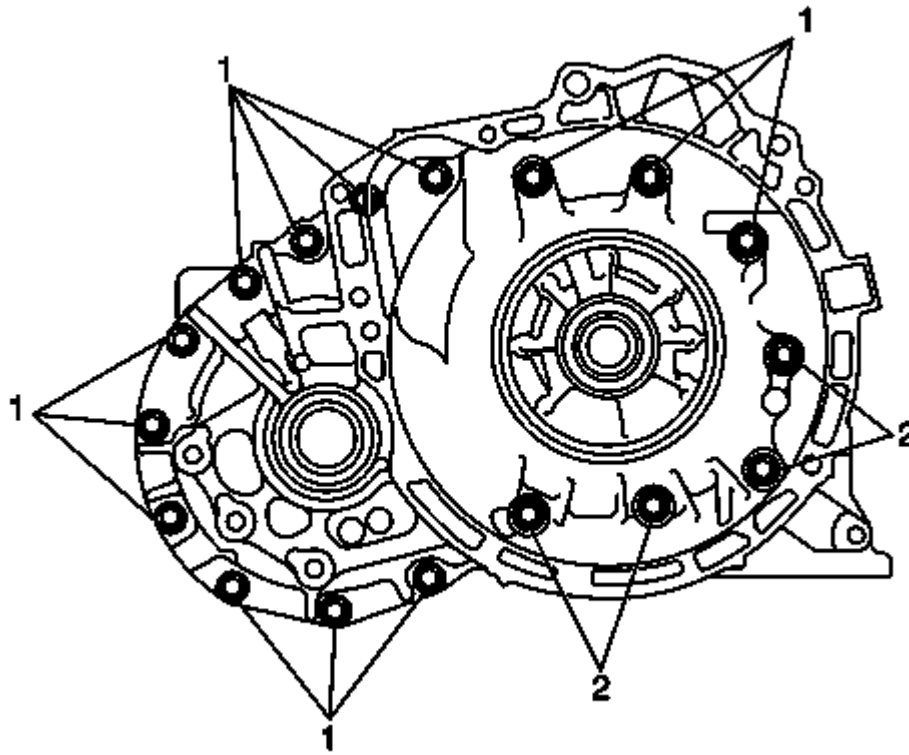


Fig. 244: Transmission Housing Bolts
Courtesy of GENERAL MOTORS COMPANY

98. Install the transmission housing to the transmission case.
99. Apply seal packing or equivalent to the 4 bolts (2).
100. Install the transmission housing bolts (1, 2) and tighten to 30 (22 lb ft).

Specifications

- The bolts (1) size is M8 x 1.25 x 30 mm.
- The bolts (2) size is M8 x 1.25 x 30 mm (Seal).

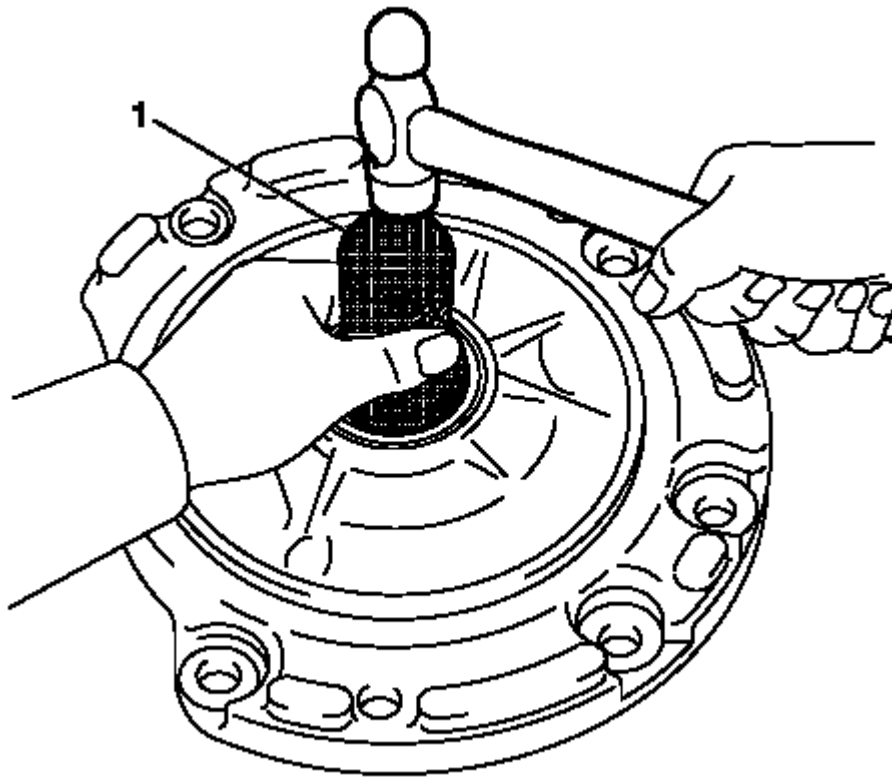


Fig. 245: Identifying DT - 50955 Oil Pump Seal Installer And A Hammer
Courtesy of GENERAL MOTORS COMPANY

101. Using **DT-50955** oil pump oil seal installer (1) and a hammer, drive in a new oil seal.
102. Coat the lip of oil seal with the grease.

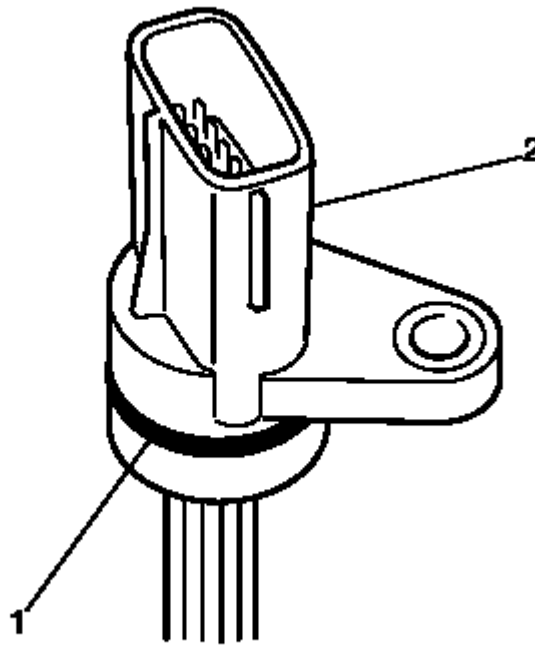


Fig. 246: Transmission Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

103. Coat a new O-ring (1) with ATF and install it to the transmission wiring harness (2).
104. Coat a new O-ring with ATF and install it to the transmission fluid temperature sensor.

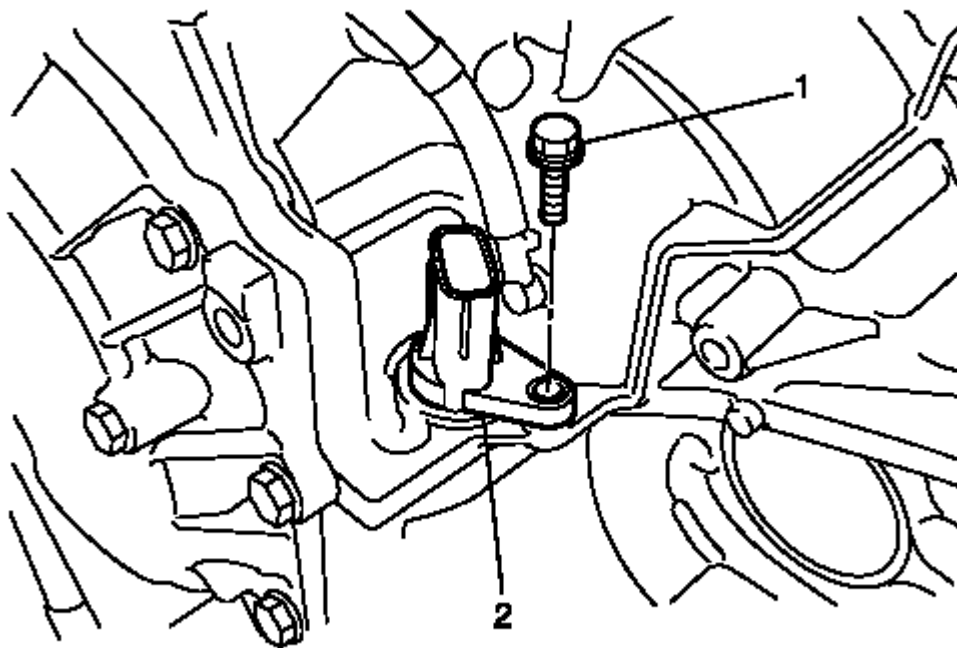


Fig. 247: Wiring Harness Assembly
Courtesy of GENERAL MOTORS COMPANY

105. Install the transmission wiring harness (2) to the transmission case.
106. Install the transmission wiring harness bolt (1) and tighten to 5 (44 lb in).

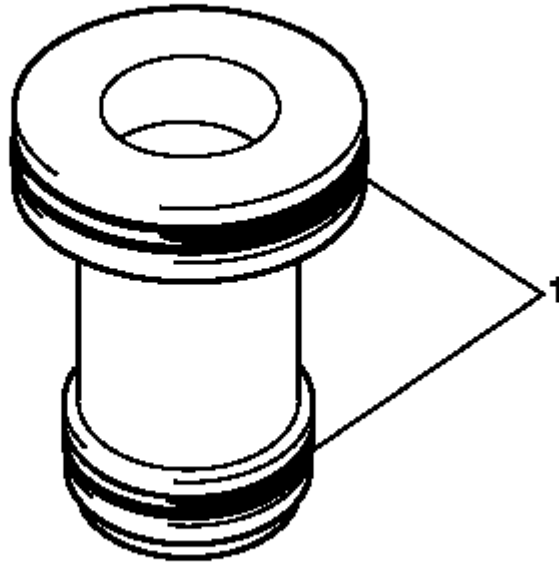


Fig. 248: 2 O-Rings

Courtesy of GENERAL MOTORS COMPANY

107. Coat new 2 O-rings (1) with ATF and install them to the piston.

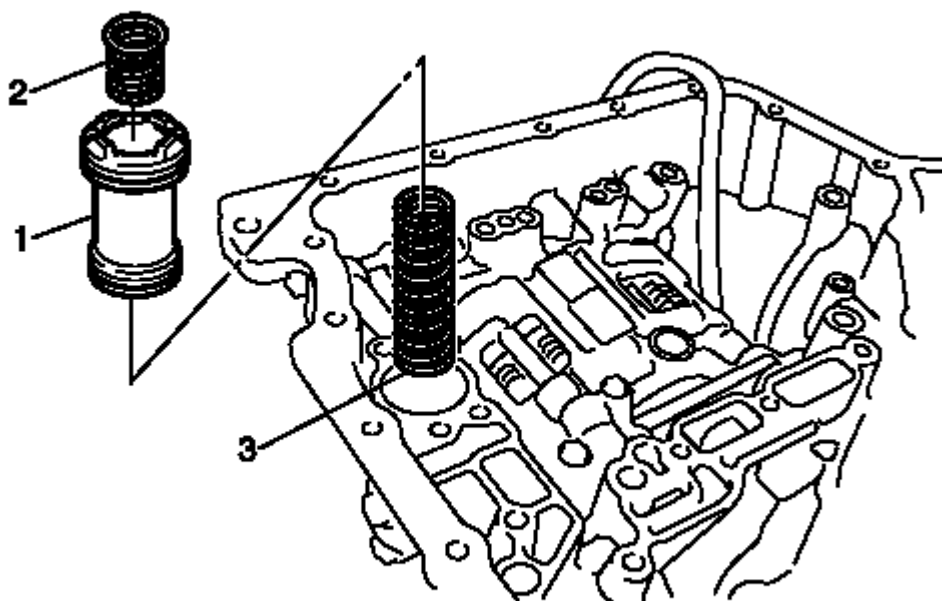


Fig. 249: Reverse Clutch

Courtesy of GENERAL MOTORS COMPANY

108. Coat the spring (2, 3) and reverse clutch (C3) accumulator piston (1) with ATF, install them to the hole.

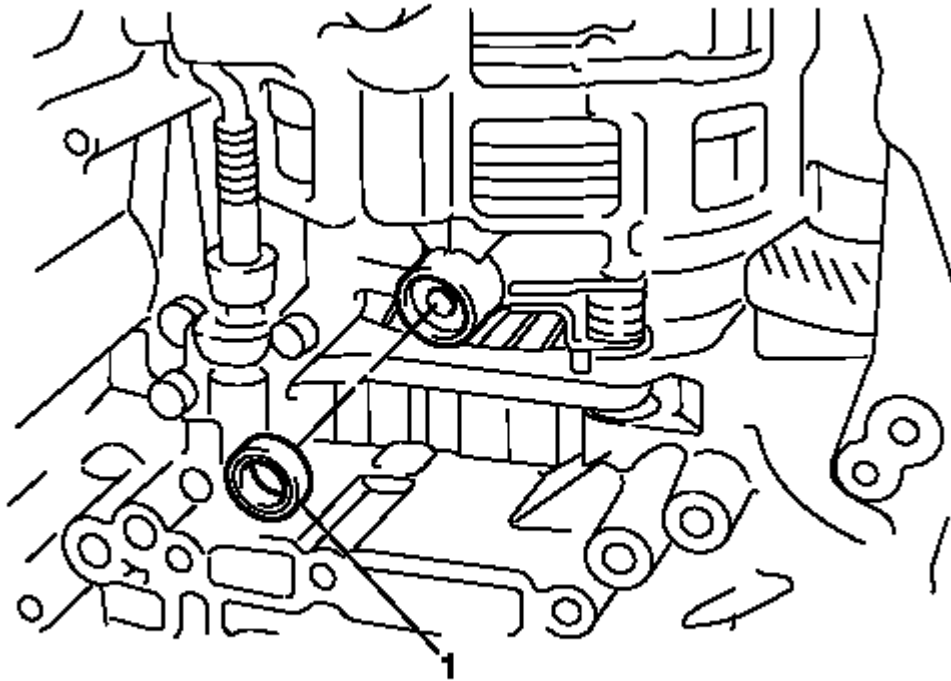


Fig. 250: Apply Gasket

Courtesy of GENERAL MOTORS COMPANY

109. Coat a new apply gasket (1) with ATF, install it to the transmission case.

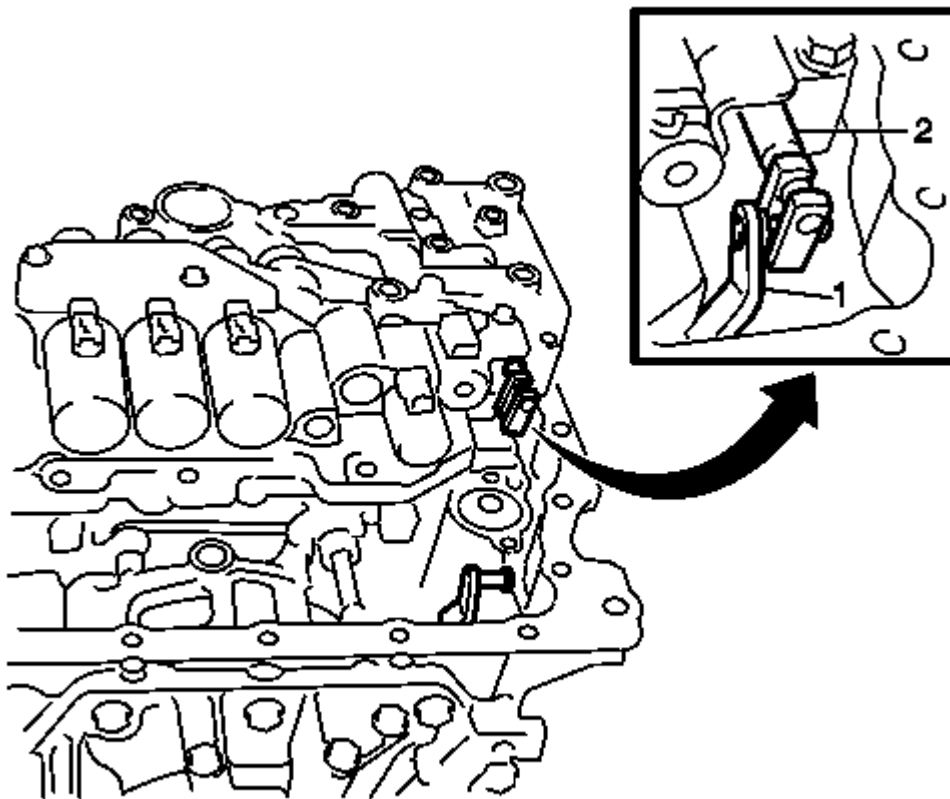


Fig. 251: Manual Valve Control Rod And Manual Lever
Courtesy of GENERAL MOTORS COMPANY

110. Connect the manual valve control rod (2) to the manual valve lever (1).

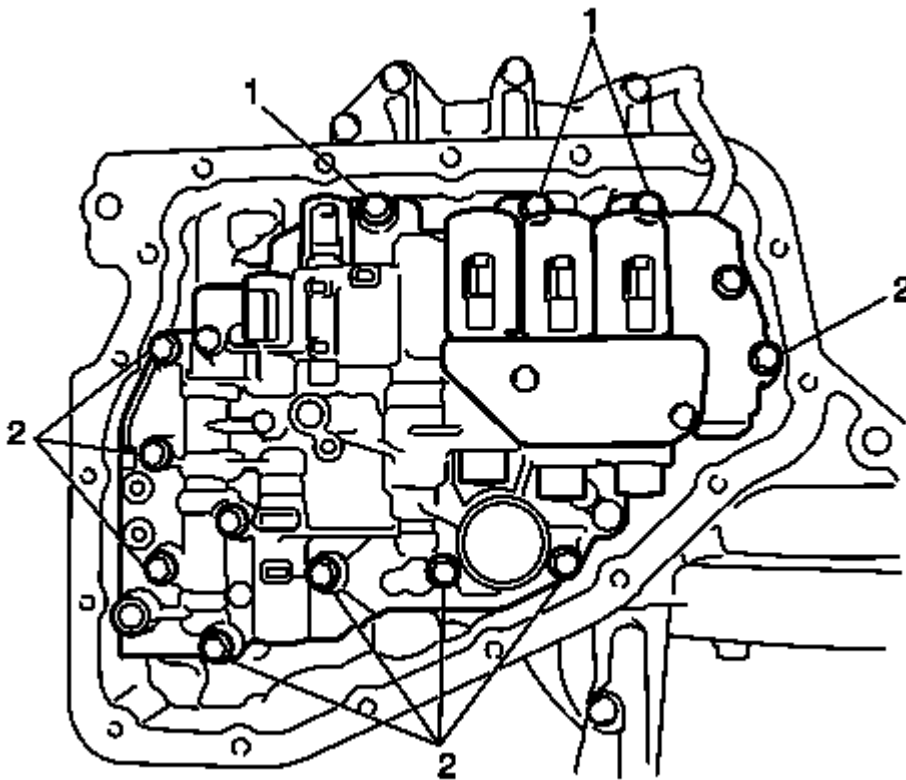


Fig. 252: Valve Body Assembly

Courtesy of GENERAL MOTORS COMPANY

NOTE: When installing the valve body to the transmission case, do not let the accumulator piston incline. When installing the valve body to the transmission case, do not hold the solenoid.

111. Install the valve body assembly to the transmission case.
112. Install the 11 valve body bolts (1, 2) and tighten to 11 (97 lb in).

Specifications

- The bolts (1) size is M6 x 1.0 x 20 mm.
- The bolts (2) size is M6 x 1.0 x 36 mm.

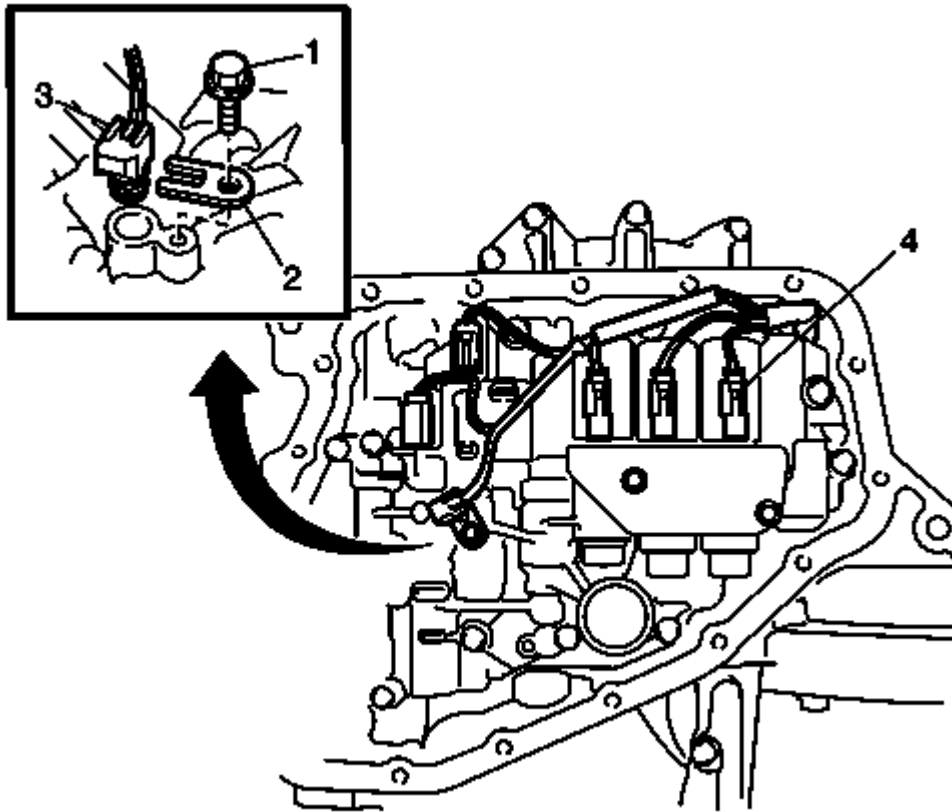


Fig. 253: Transmission Fluid Temperature Sensor Clamp
Courtesy of GENERAL MOTORS COMPANY

NOTE: Verify that the transmission wiring harness does not come out from the oil pan installations surface.

113. Connect the 5 connectors (4).
114. Install the transmission fluid temperature sensor (3) with the clamp (2).
115. Install the transmission fluid temperature sensor bolt (1) and tighten to 7 (62 lb in)

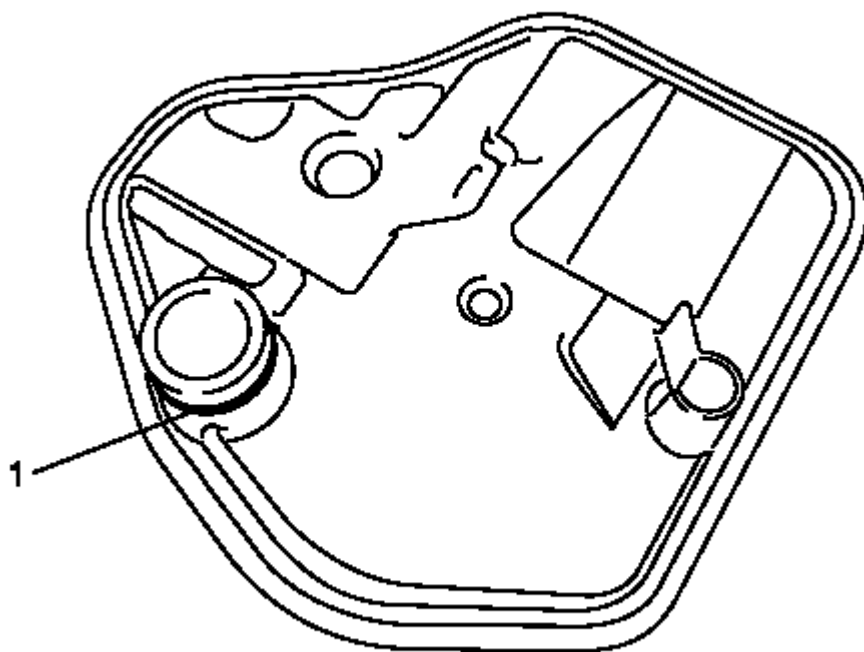


Fig. 254: Oil Strainer

Courtesy of GENERAL MOTORS COMPANY

116. Install a new O-ring (1) to the oil strainer.

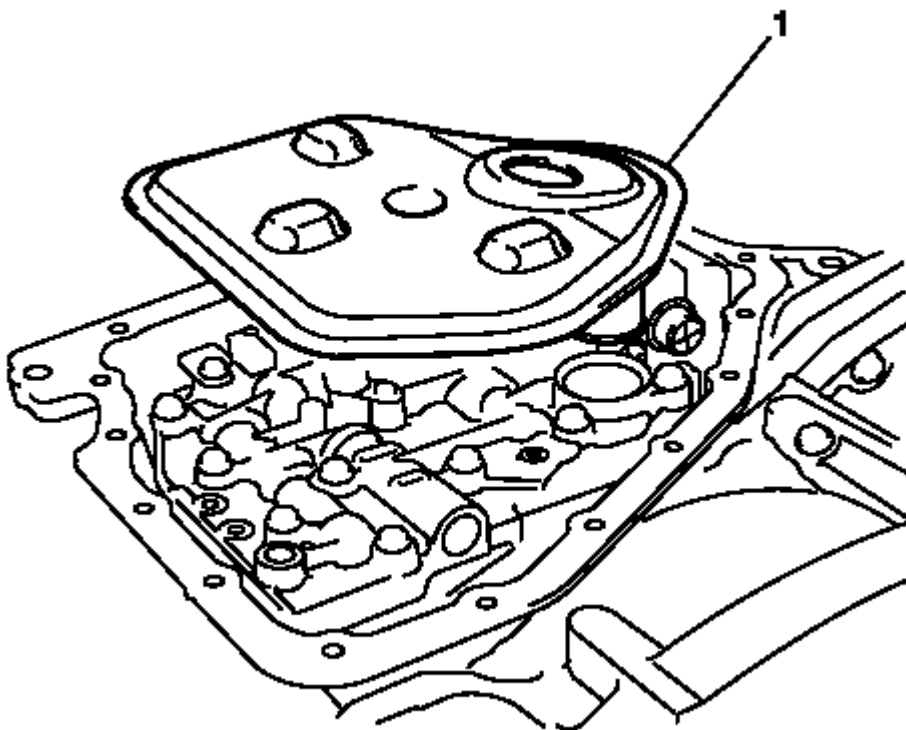


Fig. 255: Oil Strainer

Courtesy of GENERAL MOTORS COMPANY

117. Install the oil strainer (1) to the valve body.

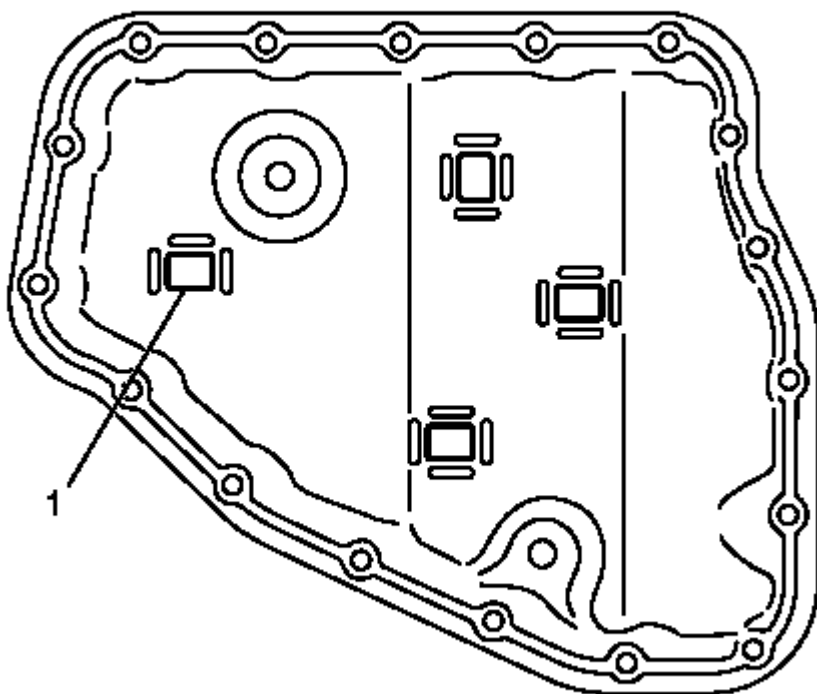


Fig. 256: View Of Magnets

Courtesy of GENERAL MOTORS COMPANY

118. Install the 4 magnets (1) in the oil pan.

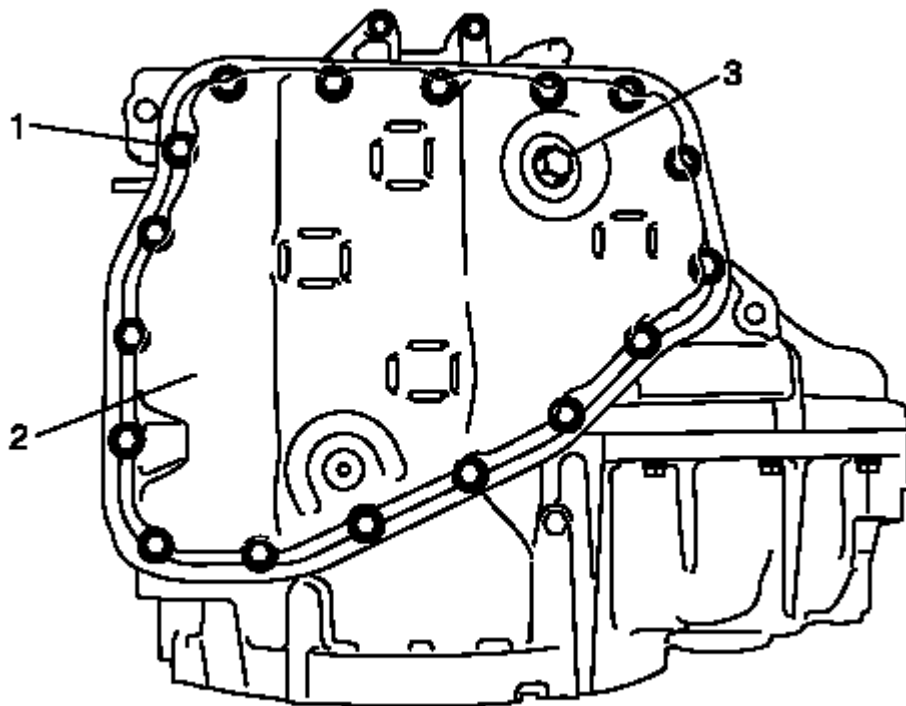


Fig. 257: Oil Pan And Oil Pan Gasket
Courtesy of GENERAL MOTORS COMPANY

119. Install a new gasket to the oil pan (2) and install the oil pan to the transmission case.
120. Install the 17 oil pan bolts (1) and tighten to 7 (62 lb in).

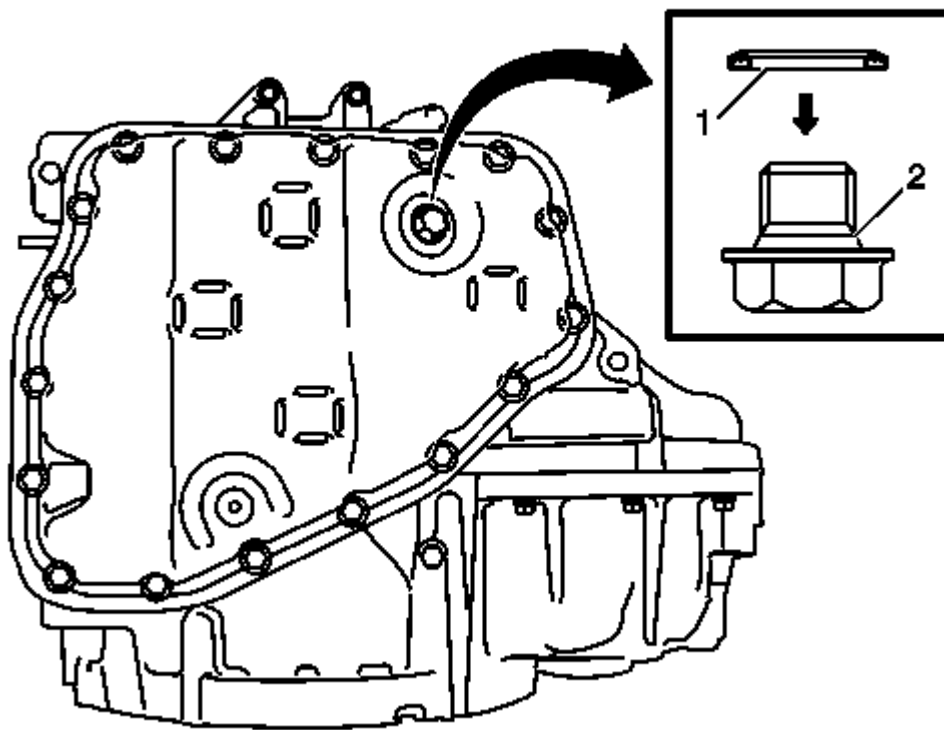


Fig. 258: Drain Plug Gasket

Courtesy of GENERAL MOTORS COMPANY

NOTE: Be sure to install the gasket in the correct direction.

121. Install a new drain plug gasket (1) with ATF and install it to the drain plug bolt (2).
122. Install the drain plug and tighten to 17 (13 lb ft).

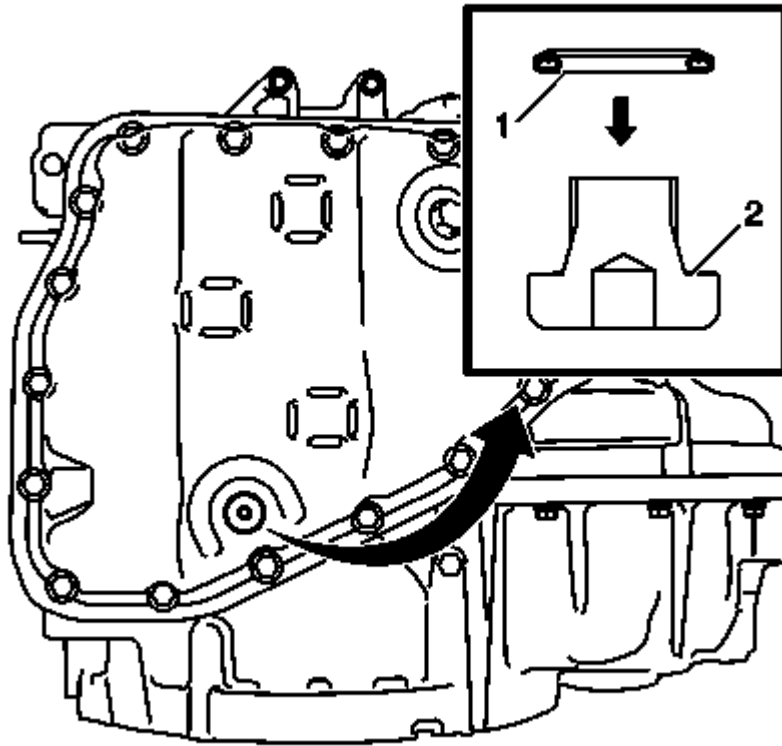


Fig. 259: View Of Plug Gasket

Courtesy of GENERAL MOTORS COMPANY

NOTE: Be sure to install the gasket in the correct direction.

123. Install the overflow plug (2) and a new gasket (1) and tighten to 24 (18 lb ft).

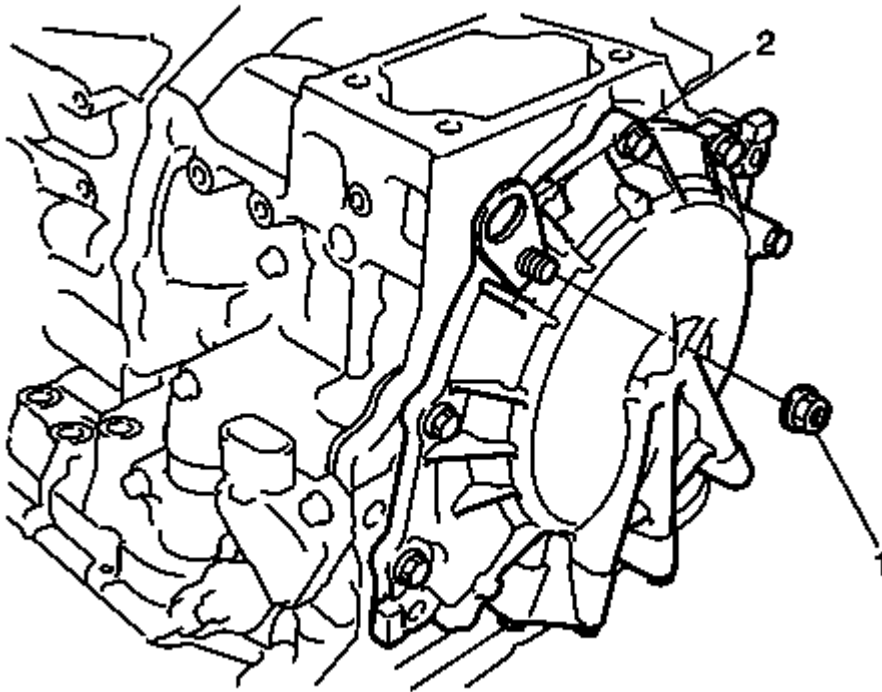


Fig. 260: Transmission Hook Nut
Courtesy of GENERAL MOTORS COMPANY

124. Install the hook (2) and transmission hook nut (1) and tighten to 17 (13 lb ft).

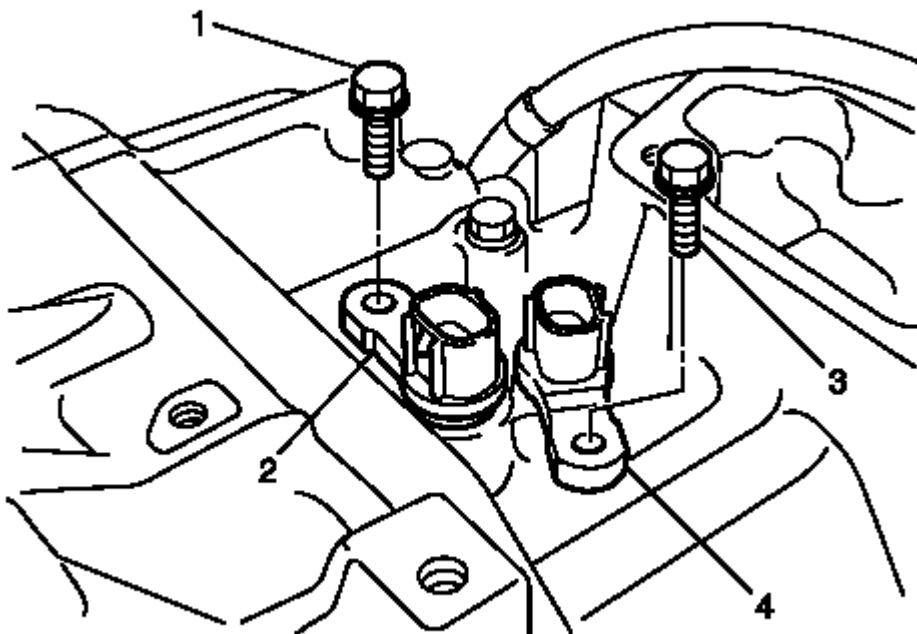


Fig. 261: Input Speed Sensor

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not install the speed sensor on the opposite side of the input and output.

125. Install the output speed sensor (4).
126. Install the output speed sensor bolt (3) and tighten to 5 (44 lb in).
127. Install the input speed sensor (2) and tighten to 5 (44 lb in).

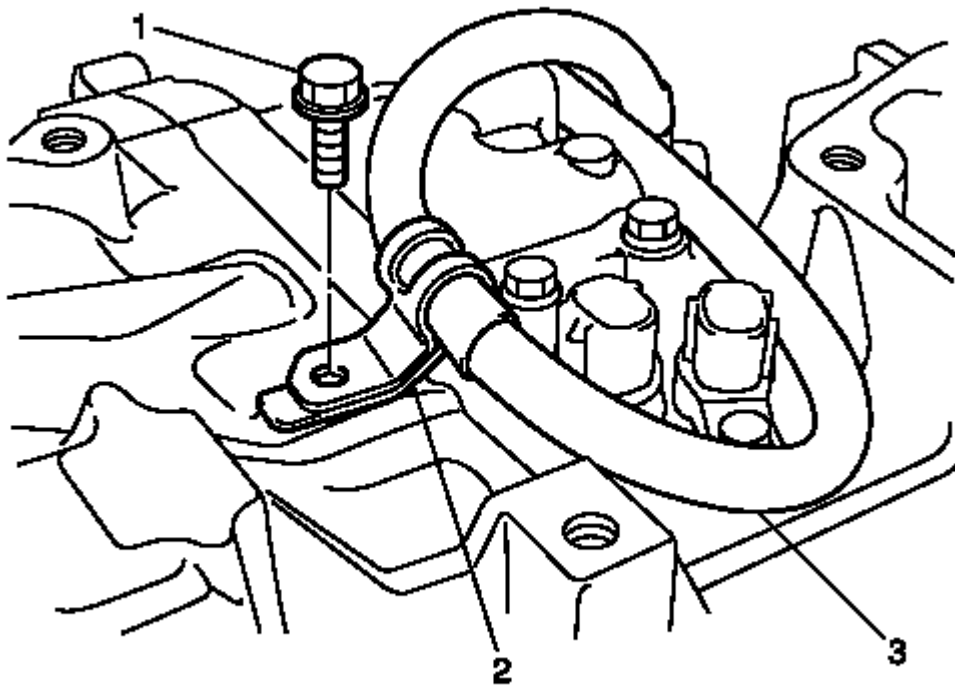


Fig. 262: Breather Plug Bracket

Courtesy of GENERAL MOTORS COMPANY

128. Coat a new O-ring with ATF, install it to the breather plug.
129. Install the breather plug to the transmission.
130. Install the breather hose (3) with the clamp to the breather plug.
131. Install the breather bracket (2) with a bolt and tighten to 5 (44 lb in).

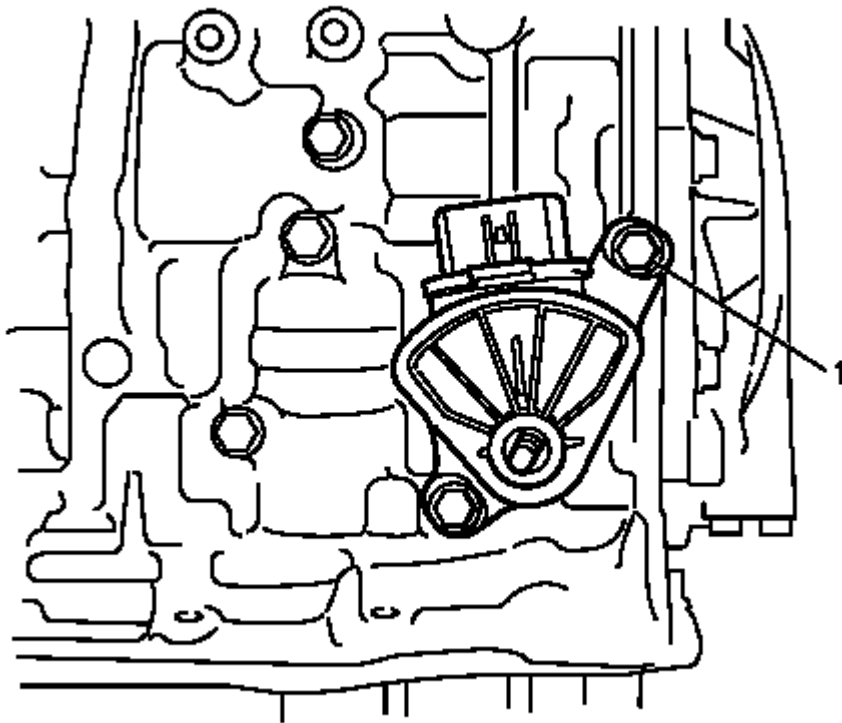


Fig. 263: Park/Neutral Position (PNP) Switch
Courtesy of GENERAL MOTORS COMPANY

NOTE: The park/neutral position (PNP) switch is inserted into the manual valve lever shaft by press fitting. Do NOT reuse the PNP switch once the switch is removed from the shaft. The used PNP switch may cause detection failure of position since the holding part of the used switch is deformed.

132. Install a NEW park/neutral position (PNP) switch onto the manual valve lever shaft and temporarily install the 2 adjusting bolts (1).

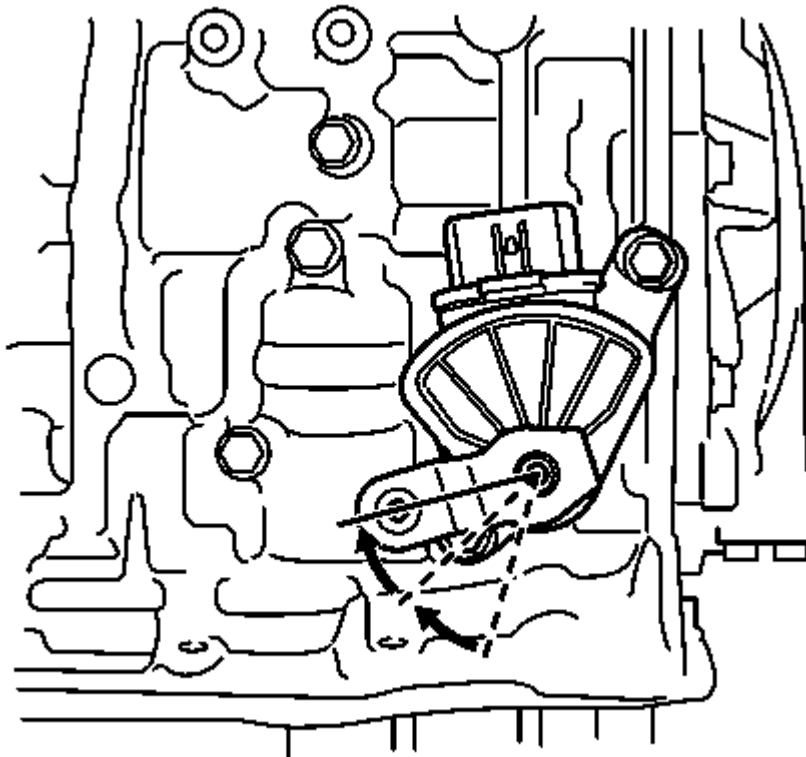


Fig. 264: View Of Range Selector Lever
Courtesy of GENERAL MOTORS COMPANY

133. Install the control lever temporarily and move to N (neutral) position.
134. Remove the control lever.

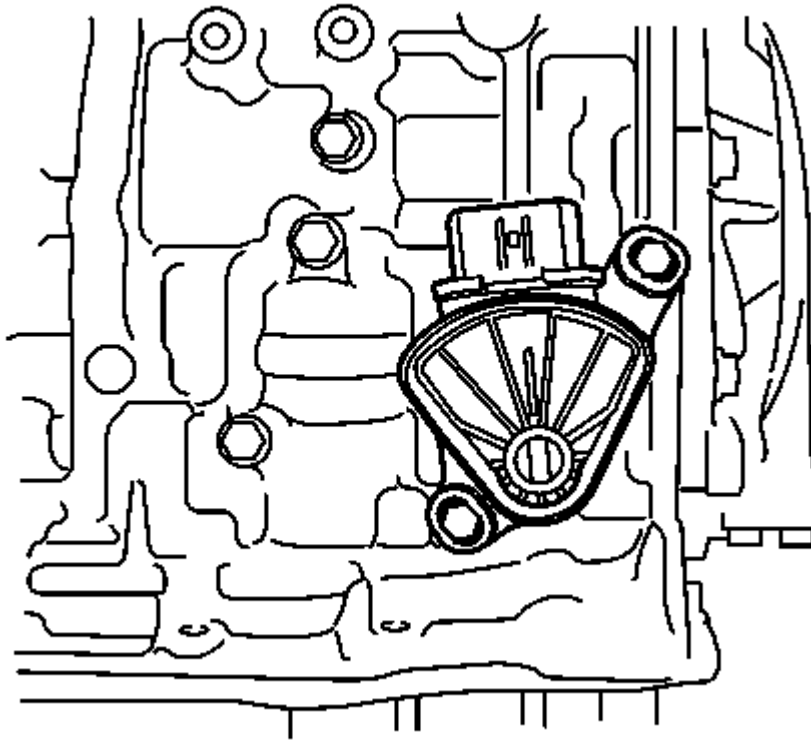


Fig. 265: Selector Lever Shaft With Neutral Basic Line
Courtesy of GENERAL MOTORS COMPANY

135. Install **DT-45404** transmission indicator alignment tool to the manual shaft.
136. Align the groove on the switch with the indicator line on DT-45404.

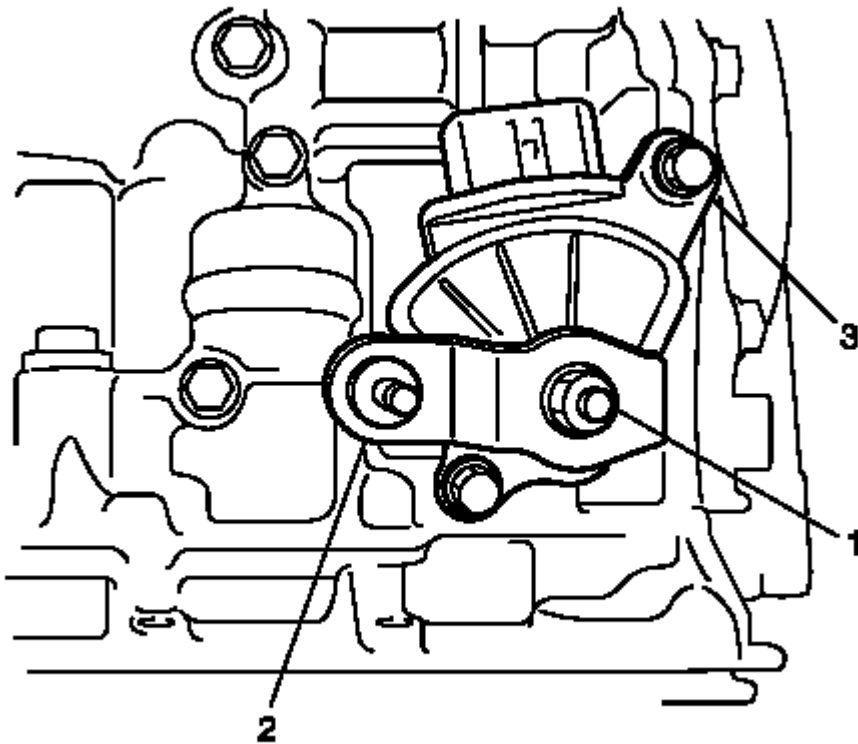


Fig. 266: Spring Washer And Control Shaft Lever
Courtesy of GENERAL MOTORS COMPANY

- 137. Install the 2 bolts (3) and tighten to 5 (44 lb in).
- 138. Remove DT-45404 from the manual shaft.
- 139. Install the control lever (2), washer and nut (1) and tighten to 12 (106 lb in).

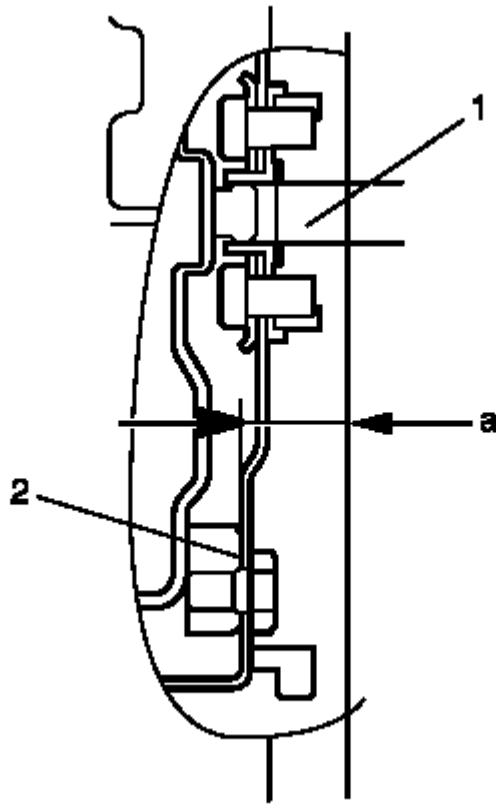


Fig. 267: Torque Converter

Courtesy of GENERAL MOTORS COMPANY

- 140. Install the torque converter (2) to the transmission housing (1).
- 141. Measure the installation depth (a) of the torque converter.

Specification

The standard value is 26.525 mm (1.044 in).

- 142. If the measured value is out of the standard value, readjust the torque converter within the specified value.

TRANSMISSION WIRING HARNESS INSPECTION

Transmission Fluid Temperature Sensor

Inspection 1

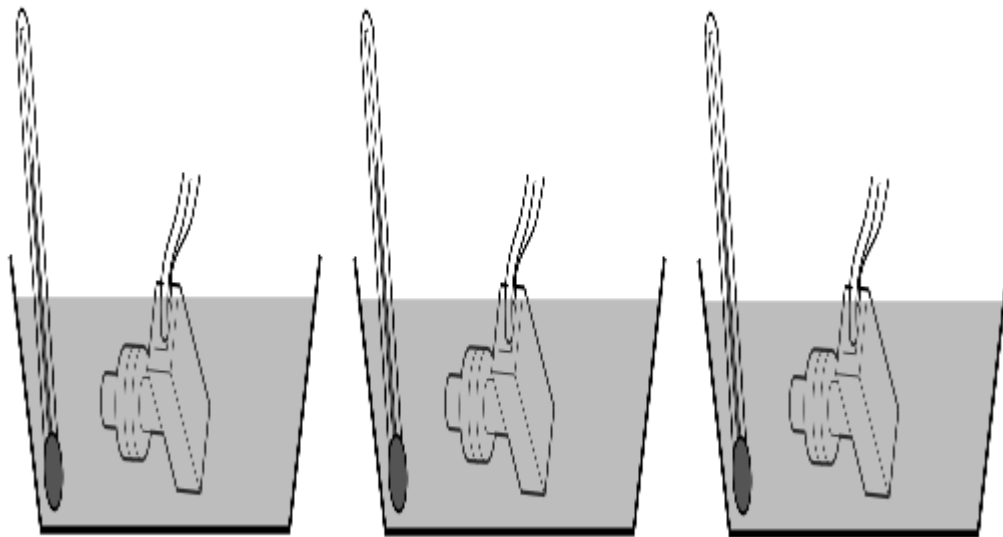


Fig. 268: Transmission Fluid Temperature (TFT) sensor
Courtesy of GENERAL MOTORS COMPANY

1. Warm up ATF and insert the transmission fluid temperature (TFT) sensor in ATF.
2. Measure the resistance between the transmission wiring harness connector terminals 1 and 7 at 10°C (50°F) and 110°C (230°F).
3. If the resistance measurement of 10°C (50°F) is not between 5.626-7.303 kohms, replace the TFT sensor.
4. If the resistance measurement of 110°C (230°F) is not between 0.224-0.271 kohms, replace the TFT sensor.

Inspection 2

With a tester, check for continuity between each of the connector terminal combinations as the specification.

Specification

Continuity between the terminal 1 (OT) or 7 (OTG) and ground is no.

Shift Solenoid (S1)

Inspection 1

Using a tester, measure the resistance between the transmission wiring harness connector terminal 10 and the body ground.

Specification

The resistance at 20°C (68°F) is between 11-15 ohms.

Linear Solenoid (SLC1, SLC2, SLB1, SLU)

Inspection 1

Using a tester, measure the resistance between the control circuit terminal and the low reference circuit terminal for each solenoid from the transmission wiring harness.

Specification

The resistance at 20°C (68°F) is between 5.0-5.6 ohms.

Inspection 2

Using a tester, check for continuity between each terminal of the transmission wiring harness connector and the body ground.

Specification

Continuity between each terminal and body ground is no.

OIL PUMP DISASSEMBLE

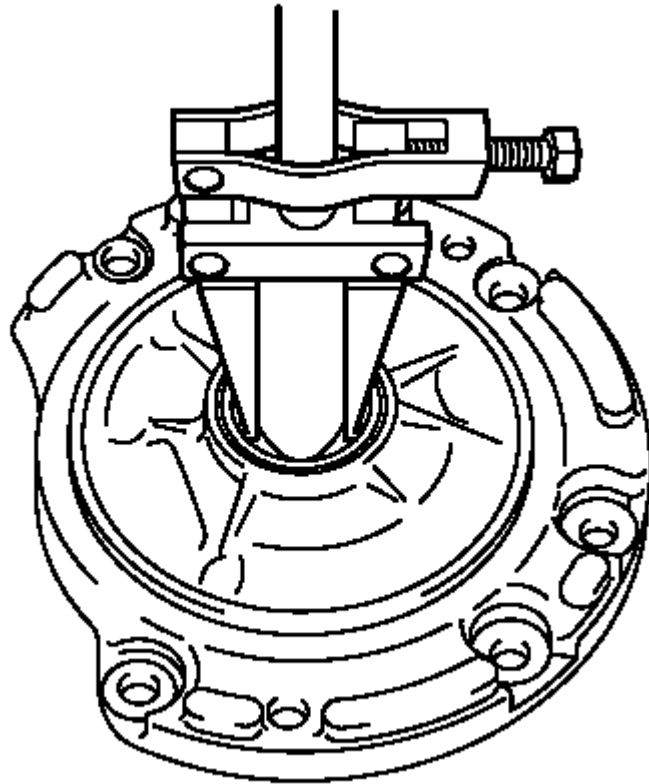


Fig. 269: O-Ring From And Oil Pum
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Do not damage the oil seal lip.**

1. Remove the O-ring from the oil pump.

NOTE: **Do not damage the bushing on the oil pump.**

2. Remove the oil seal from the oil pump.

OIL PUMP INSPECTION

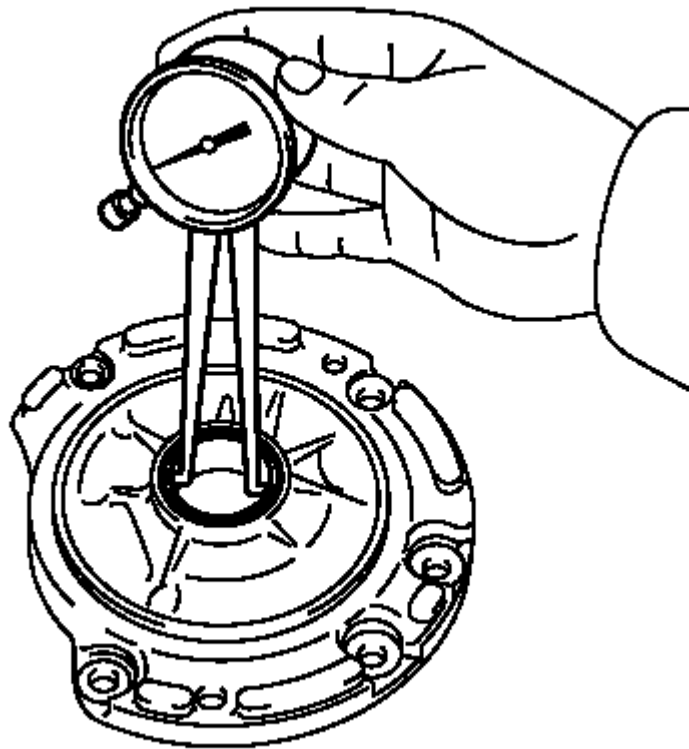


Fig. 270: Measuring Inside Diameter Of Oil Pump Bushing
Courtesy of GENERAL MOTORS COMPANY

IMPORTANT: Measure at the different places and take an average. If the measurement is greater than the maximum, replace the oil pump. When the oil pump is replaced, inspect the contact surface opposed to the torque converter. If the surface is scratched or has changed the color, replace the torque converter with a new one.

1. Using a dial indicator, measure the inside diameter of the oil pump bushing.

Specification

The standard inside diameter is 38.113-38.138 mm (1.5005-1.5014 in).

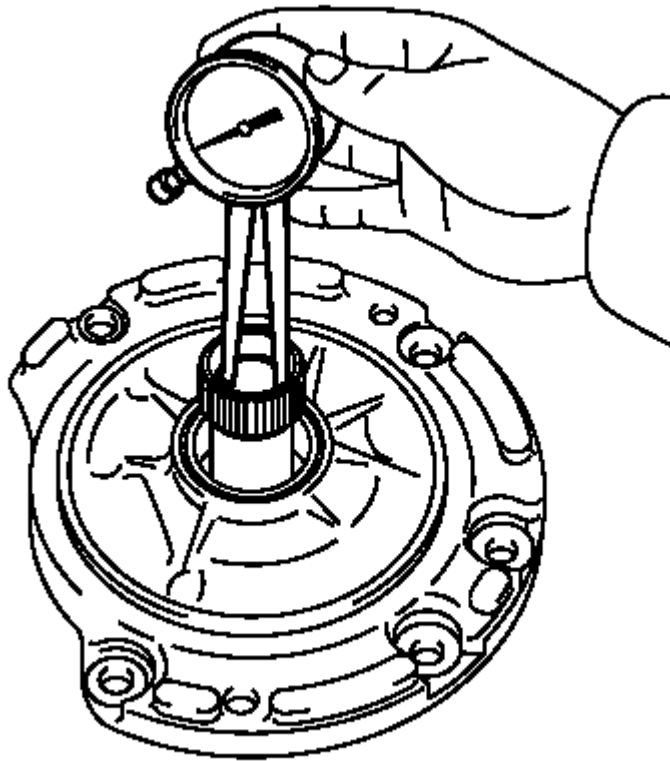


Fig. 271: Measuring Inside Diameter Of Stator Shaft Bushings
Courtesy of GENERAL MOTORS COMPANY

2. Using a dial indicator, measure the inside diameter of the stator shaft bushings.

Specification

The standard inside diameter is 17.124-17.150 mm (0.6741-0.6751 in).

OIL PUMP ASSEMBLE

Special Tools

DT-50955 (DW240-110) Oil Pump Seal Installer

For equivalent regional tools, refer to **Special Tools**.

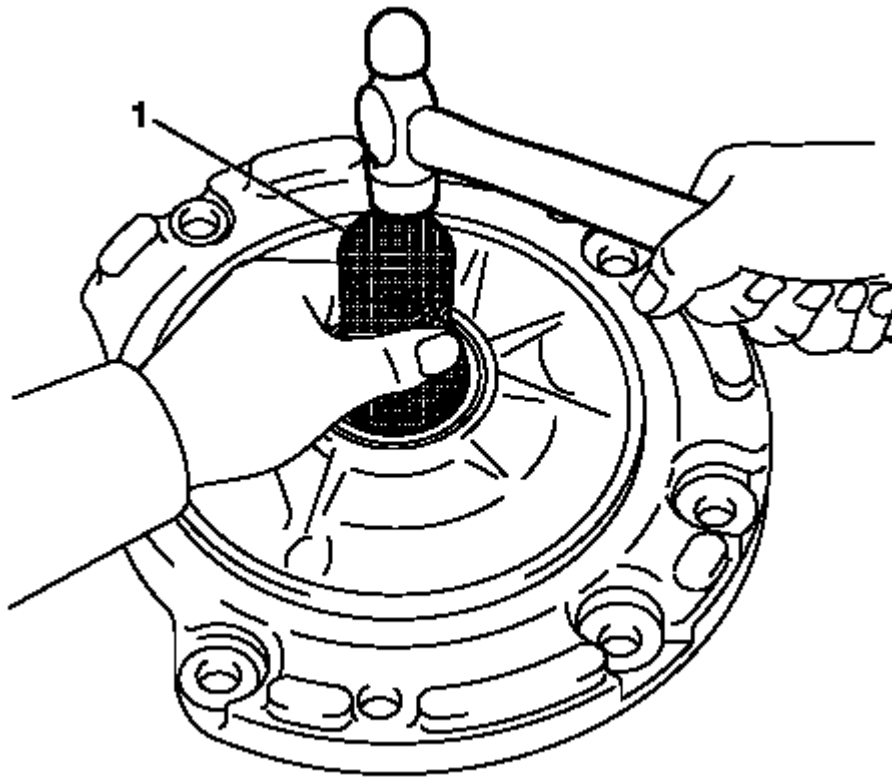


Fig. 272: Identifying DT - 50955 Oil Pump Seal Installer And A Hammer
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage the oil seal.

1. Using **DT-50955** oil pump seal installer and a hammer, install a new oil seal to the oil pump.

Specification

The oil seal in depth is 0 mm (0 in).

2. Coat a new O-ring with ATF.
3. Install the O-ring on the oil pump.

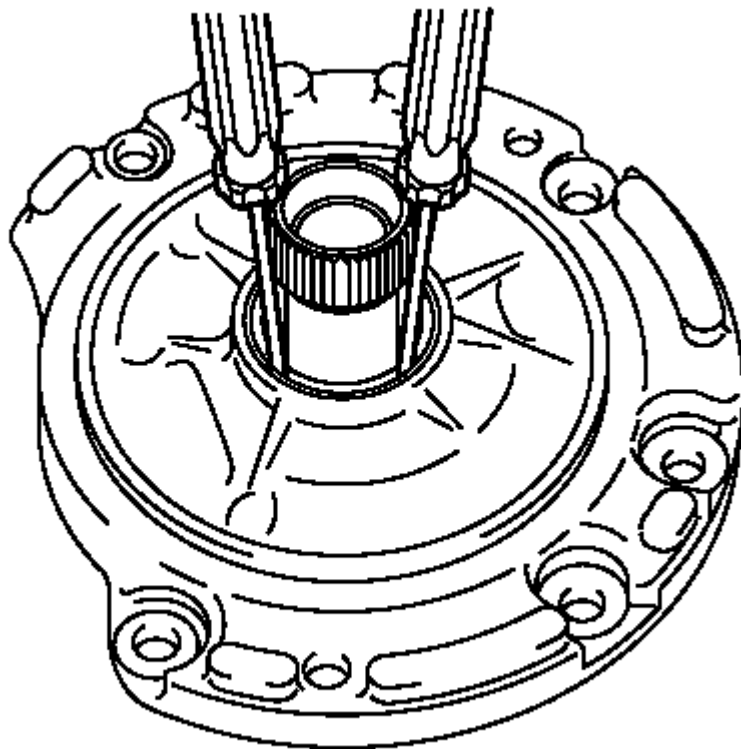


Fig. 273: Turning Drive Gear With 2 Screwdrivers
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage the oil seal lip.

4. Turn the drive gear with 2 screwdrivers and make sure it rotates smoothly.

DIRECT CLUTCH ASSEMBLY DISASSEMBLE

Special Tools

DT-46453 (DW240-040) Direct Clutch Adapter

For equivalent regional tools, refer to **Special Tools**.

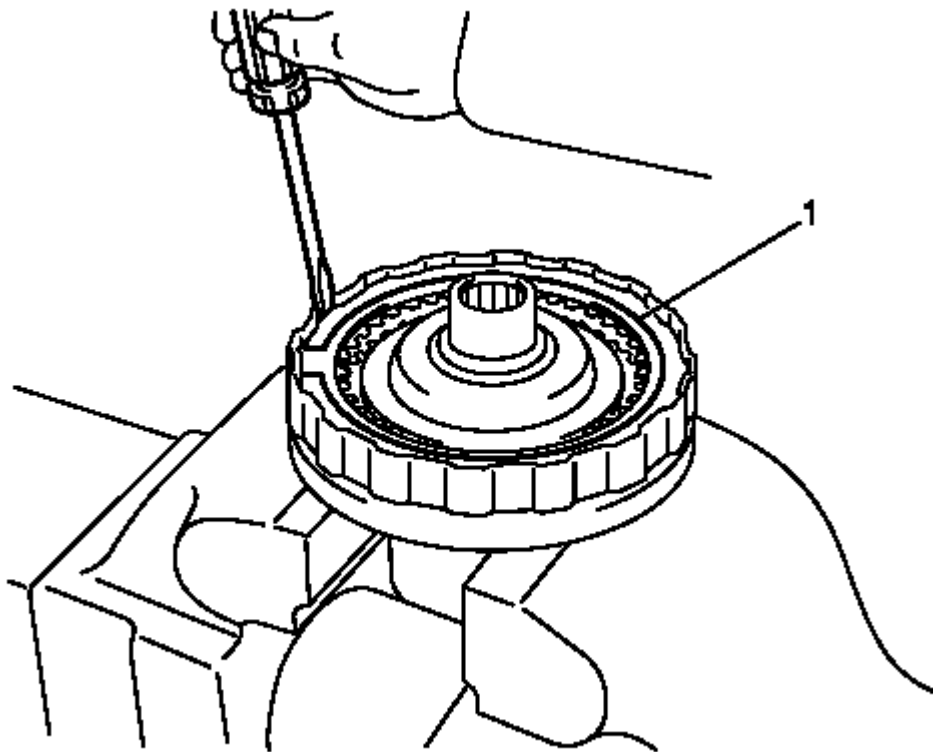


Fig. 274: Identifying Snap Ring

Courtesy of GENERAL MOTORS COMPANY

1. Using a screwdriver, remove the snap ring (1).

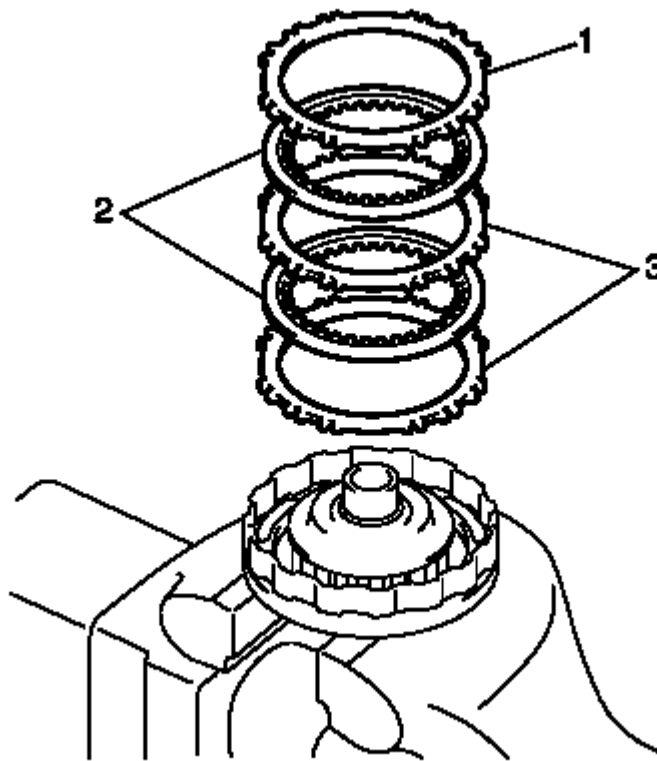


Fig. 275: Flange, 2 Discs And Plates

Courtesy of GENERAL MOTORS COMPANY

2. Remove the flange (1), 2 discs (2), and 2 plates (3).

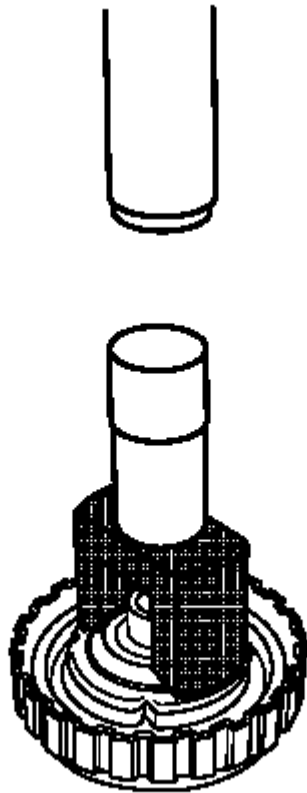


Fig. 276: View Of DT-46453 Direct Clutch Adapter On Clutch No. 2 Balancer
Courtesy of GENERAL MOTORS COMPANY

3. Place **DT-46453** direct clutch adapter on the clutch no. 2 balancer and compress the direct clutch return spring with a press.

NOTE: **Do not expand the snap ring excessively.**

4. Using a snap ring expander, remove the snap ring.

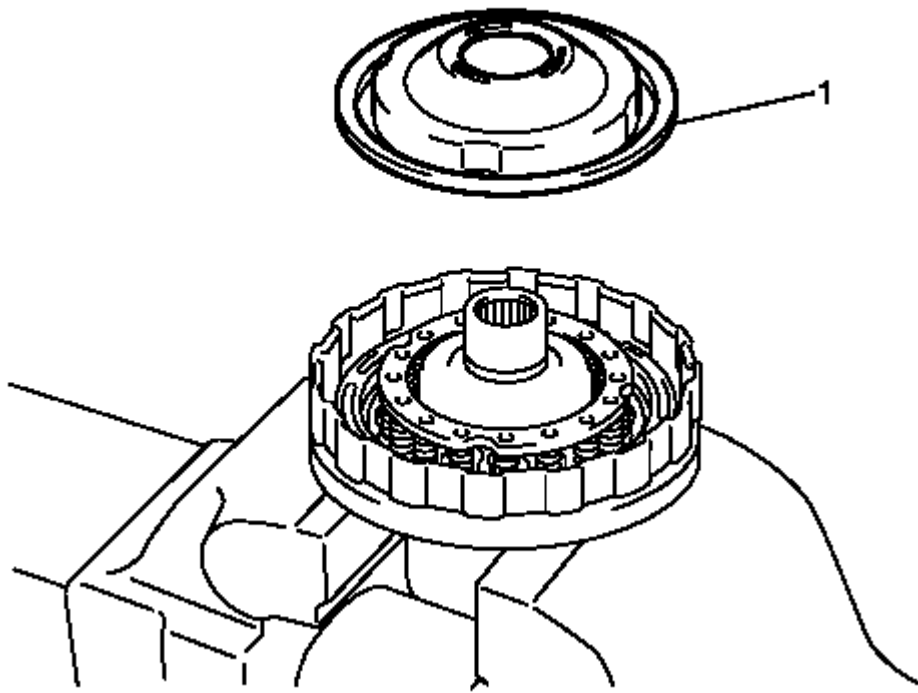


Fig. 277: Direct Clutch No. 2 Balancer
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage the seal on the clutch no. 2 balancer.

5. Remove the direct clutch no. 2 balancer (1).

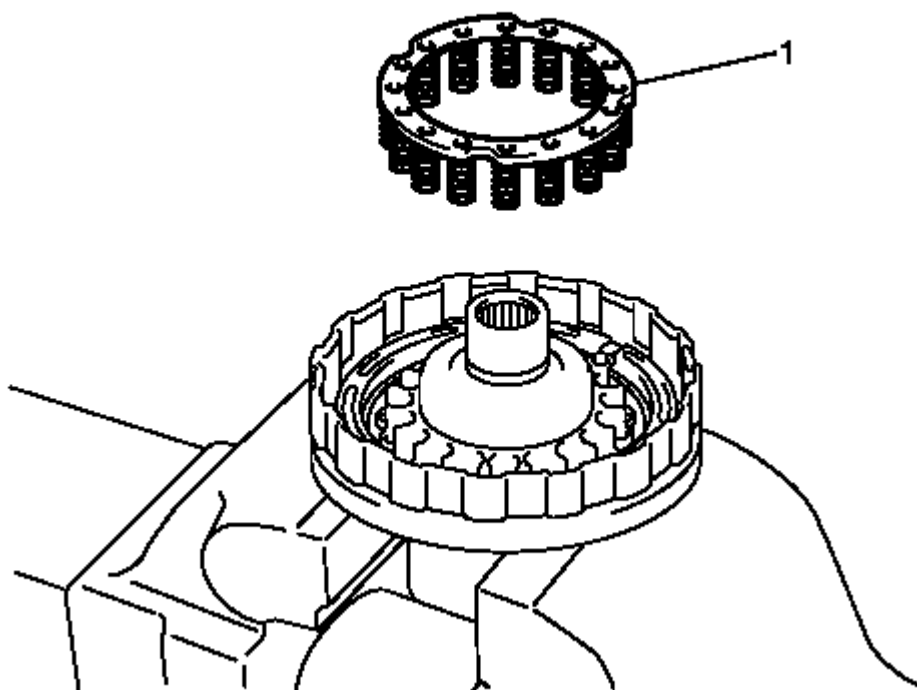


Fig. 278: Direct Clutch Return Spring
Courtesy of GENERAL MOTORS COMPANY

6. Remove the direct clutch return spring (1).

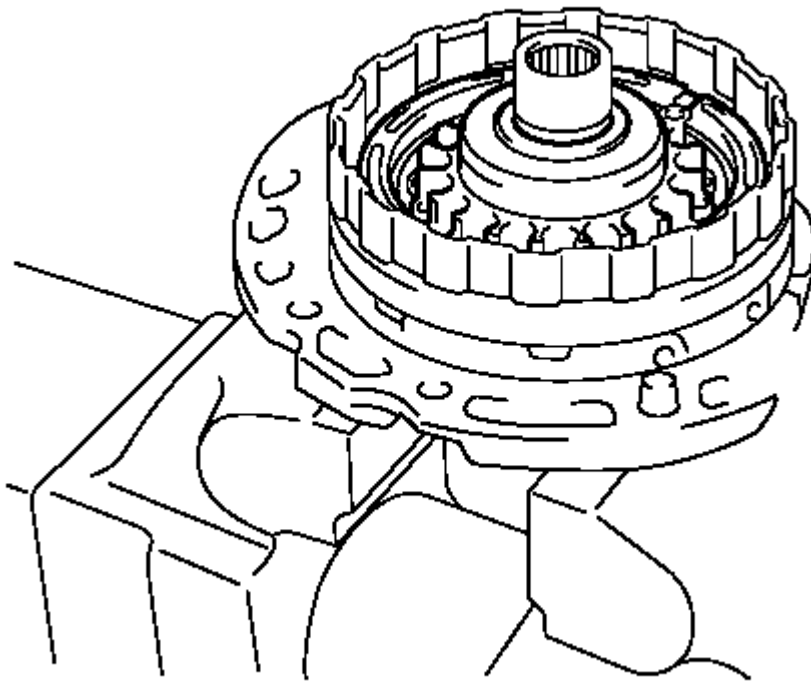


Fig. 279: Direct Clutch On Oil Pump
Courtesy of GENERAL MOTORS COMPANY

7. Install the direct clutch on the oil pump.

NOTE:

- Air pressure may cause the piston to jump out. When removing the piston, hold it with your hand using a waste cloth.
- Take care not to splash ATF when air-blowing.
- When the piston cannot be removed as it is slanted, either blow the air again with the protruding side pushed or remove the piston using the needle nose pliers with vinyl tape on the tip.

8. Apply compressed air 392 kPa (56 psi) to the oil pump to remove the direct clutch piston.

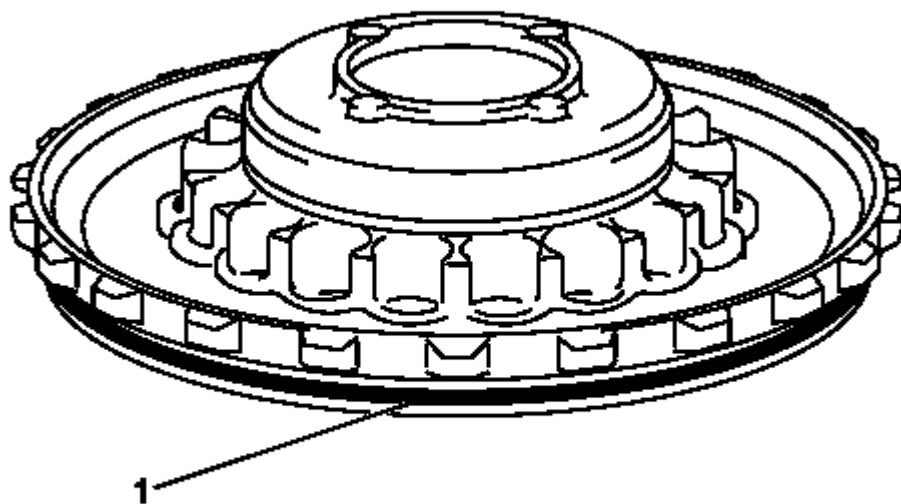


Fig. 280: O-Ring And Direct Clutch Piston
Courtesy of GENERAL MOTORS COMPANY

9. Using a small screwdriver, remove the O-ring (1) from the direct clutch piston.

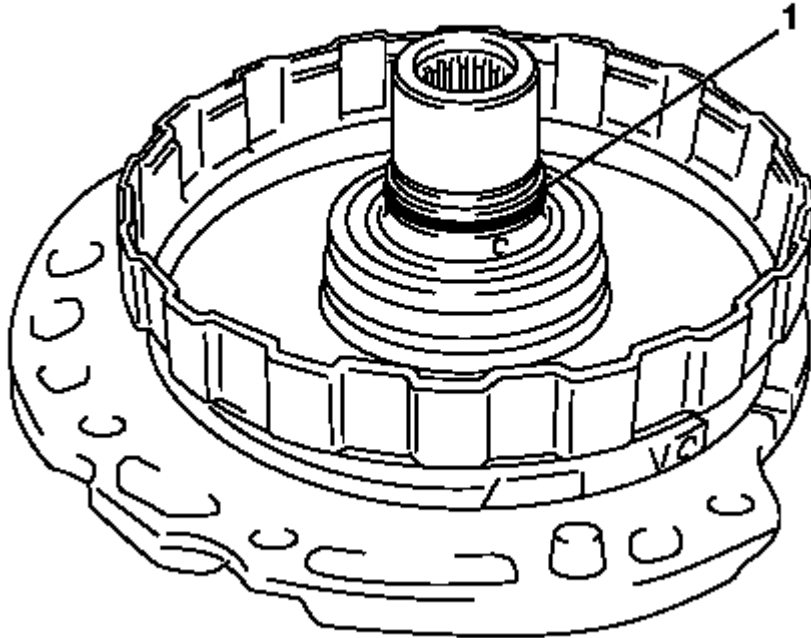


Fig. 281: O-Ring (And Input Shaft
Courtesy of GENERAL MOTORS COMPANY

10. Remove the O-ring (1) from the input shaft.

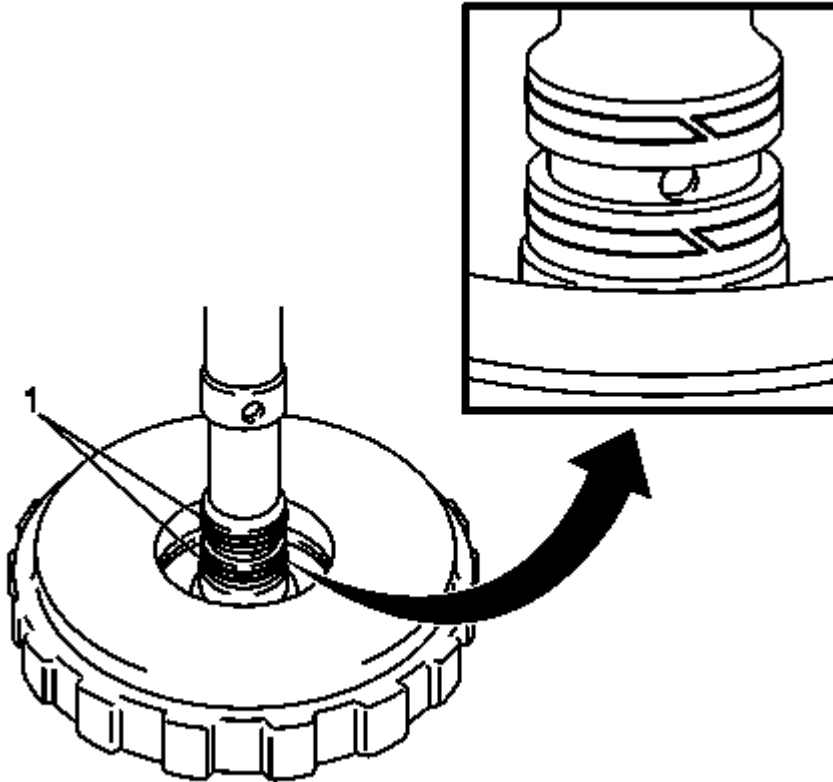


Fig. 282: Seal Rings And Input Shaft
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not expand the ring ends excessively.

11. Remove the 2 oil seal rings (1) from the input shaft.

DIRECT CLUTCH INSPECTION

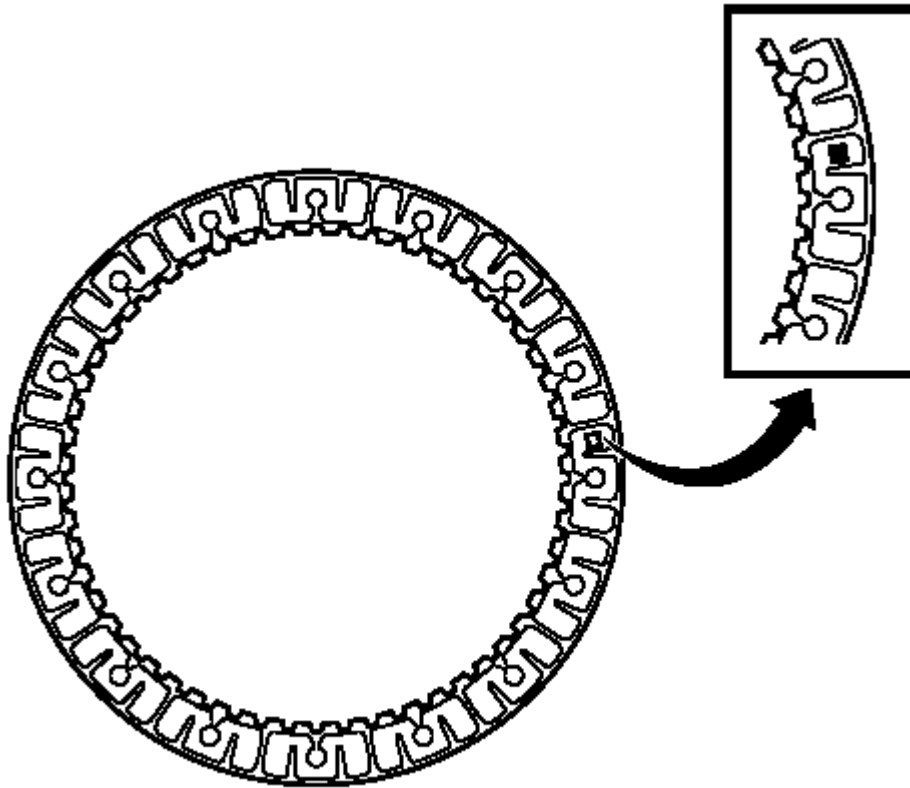


Fig. 283: Inspecting Sliding Surface Of Disc
Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to Safety Glasses Warning .

1. Check the lining of all discs.
 - If the lining of the disc is peeling off or discolored, or even if a part of the printed number is defaced, replace all discs.
 - Before assembling new discs, soak them in ATF for at least 15 minutes.

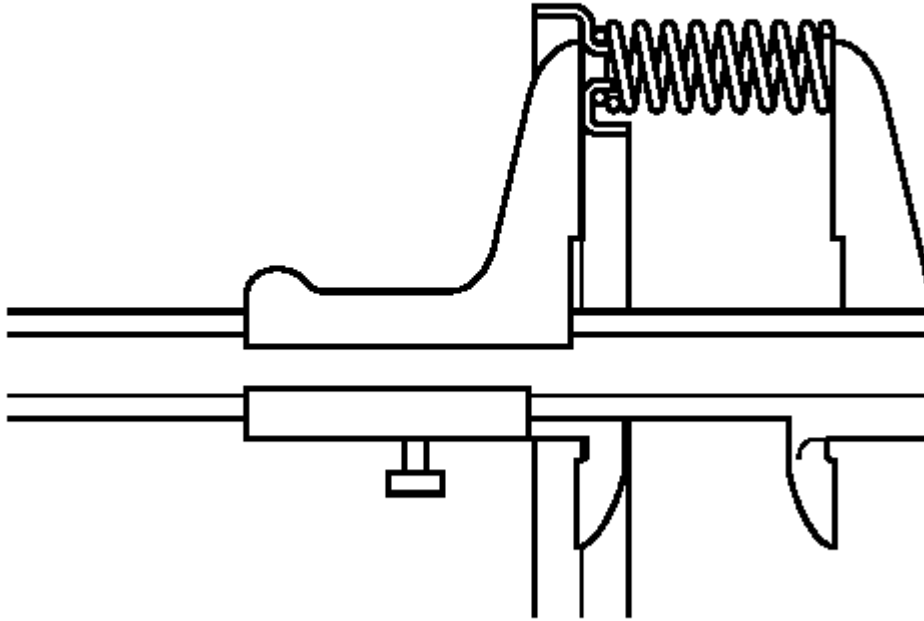


Fig. 284: Measuring Free Length Of Return Spring
Courtesy of GENERAL MOTORS COMPANY

NOTE: If the free length is smaller than the minimum, replace the return spring with a new one.

2. Using vernier calipers, measure the free length of the return spring.

Specification

Standard free length is 23.74 mm (0.935 in).

DIRECT CLUTCH ASSEMBLY ASSEMBLE

Special Tools

DT-46453 (DW240-040) Direct Clutch Adapter

For equivalent regional tools, refer to **Special Tools**.

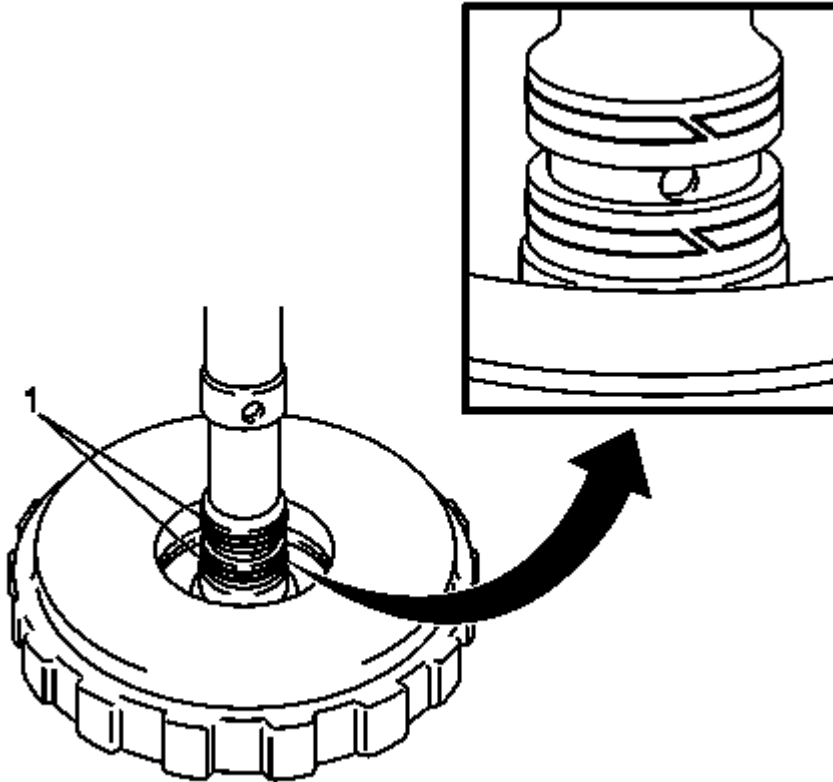


Fig. 285: Seal Rings And Input Shaft
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- Do not expand the oil seal rings excessively.
- Do not shorten the oil seal rings too much, when installing the oil seal rings.

1. Coat the 2 new oil seal rings (1) and sliding surface of the input shaft with ATF.
2. Compress the 2 oil seal rings, then install the oil seal rings to the input shaft.
3. Check that the oil seal rings rotate smoothly after installing them.

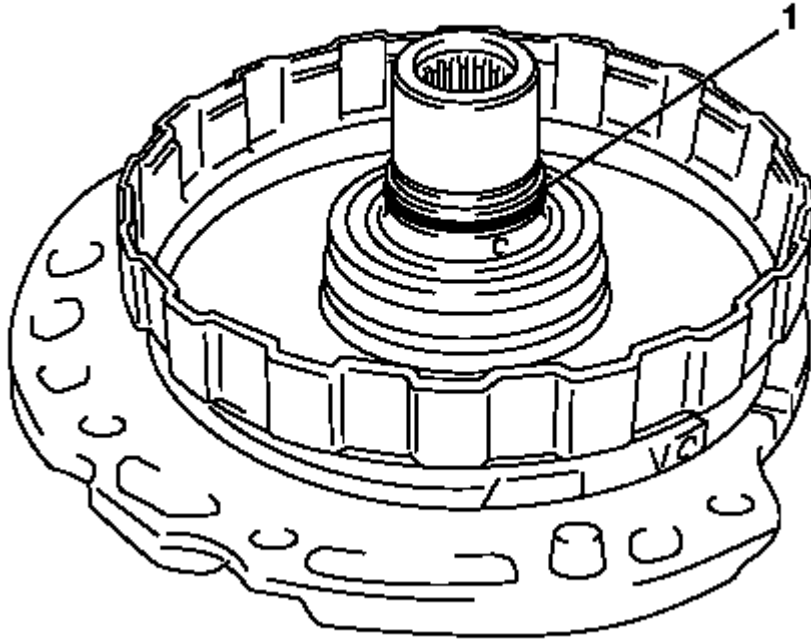


Fig. 286: O-Ring (And Input Shaft
Courtesy of GENERAL MOTORS COMPANY

4. Coat a new O-ring (1) and the input shaft with ATF.
5. Install the O-ring to the input shaft.

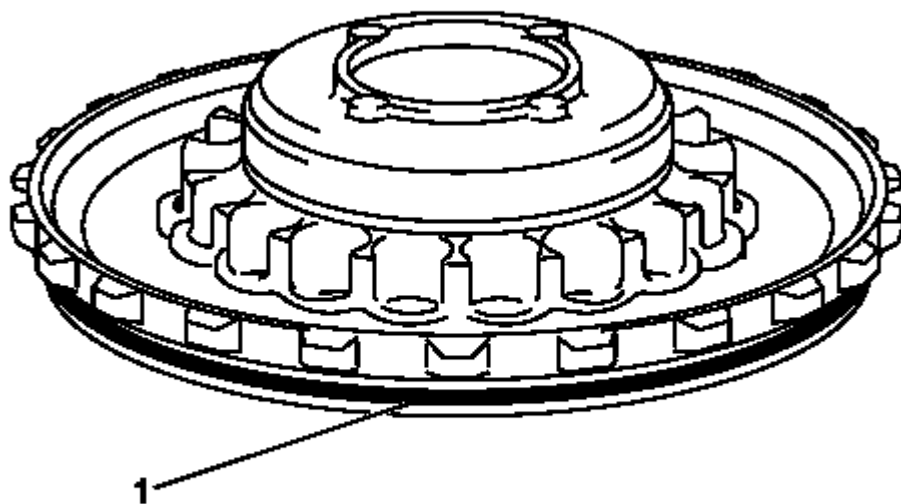


Fig. 287: O-Ring And Direct Clutch Piston
Courtesy of GENERAL MOTORS COMPANY

6. Coat a new O-ring (1) and the direct clutch piston with ATF.
7. Install the O-ring to the direct clutch piston.

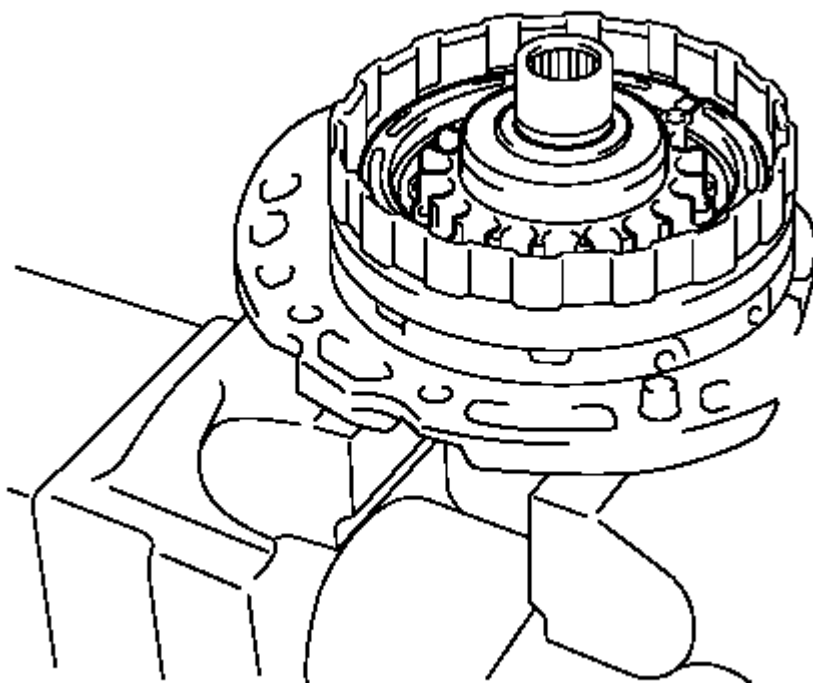


Fig. 288: Direct Clutch On Oil Pump
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage the seal of the direct clutch piston and O-ring.

8. Coat the sliding surface of the direct clutch piston with ATF.
9. Install the direct clutch piston to the direct clutch drum.

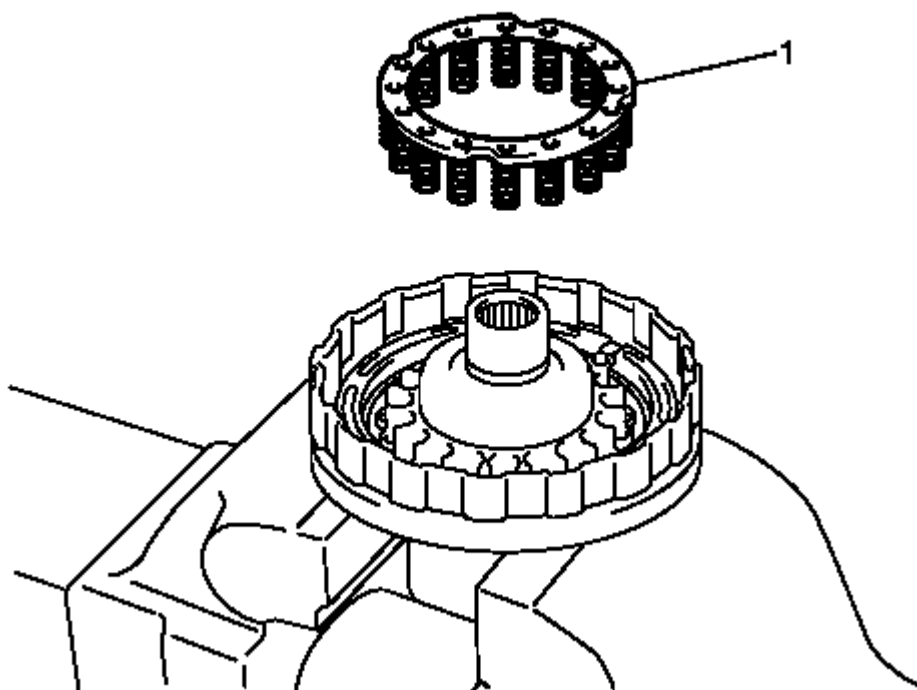


Fig. 289: Direct Clutch Return Spring
Courtesy of GENERAL MOTORS COMPANY

10. Install the direct clutch return spring (1).

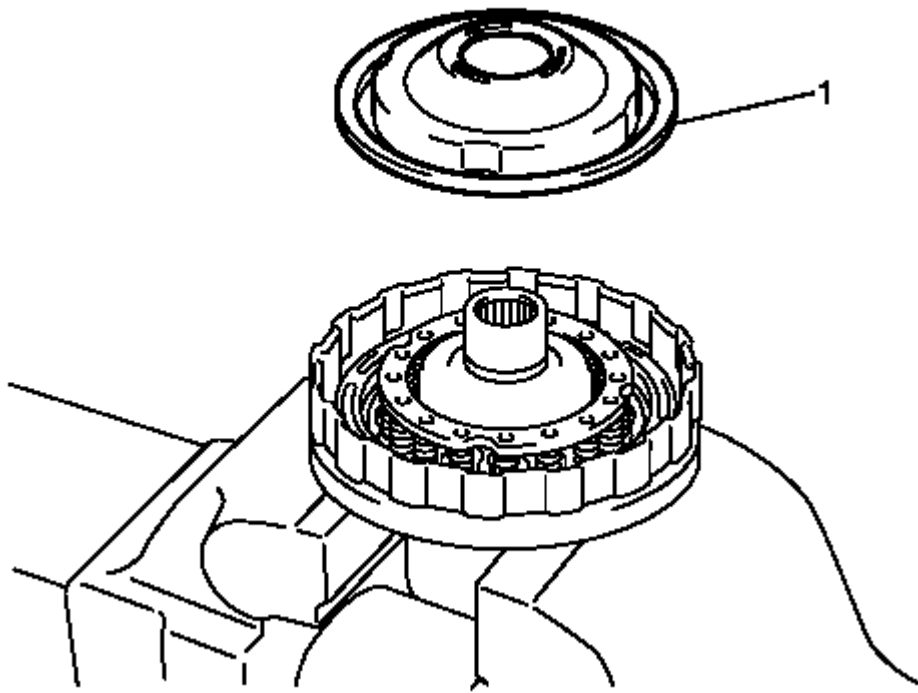


Fig. 290: Direct Clutch No. 2 Balancer
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage the seal on the clutch no. 2 balancer.

11. Install the direct clutch balancer (1).

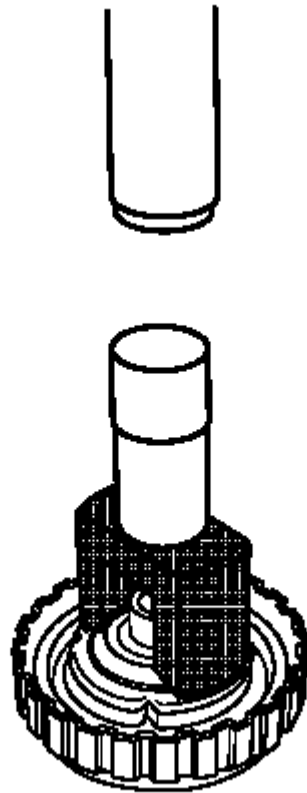


Fig. 291: View Of DT-46453 Direct Clutch Adapter On Clutch No. 2 Balancer
Courtesy of GENERAL MOTORS COMPANY

12. Place **DT-46453** direct clutch adapter on the return spring and compress the return spring with a press.

NOTE:

- When installing the snap ring, set the end gap of the snap ring facing on the mark.
- Do not expand the snap ring too much.

13. Using a snap ring expander, install the snap ring.

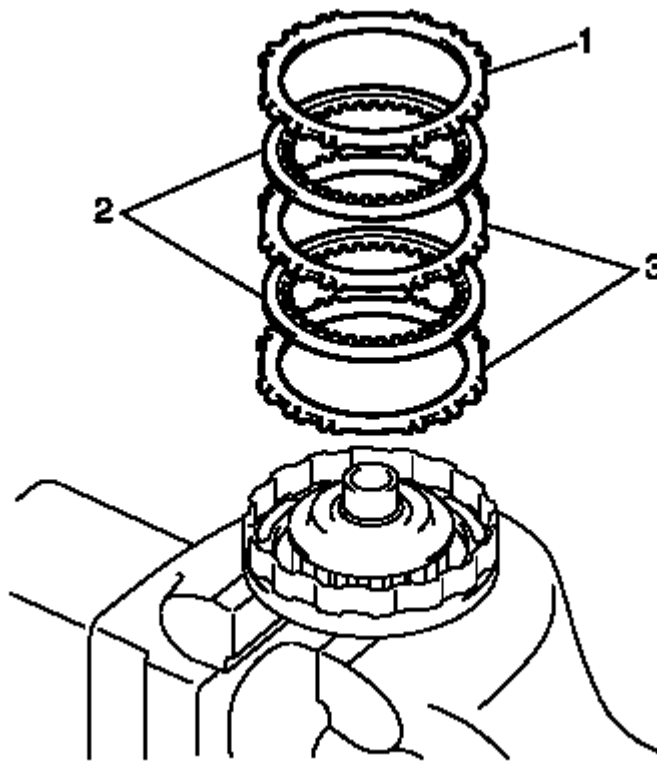


Fig. 292: Flange, 2 Discs And Plates

Courtesy of GENERAL MOTORS COMPANY

NOTE: Check the number and order of flange, discs and plates.

14. Install the 2 plates (3), 2 discs (2), and the flange (1).

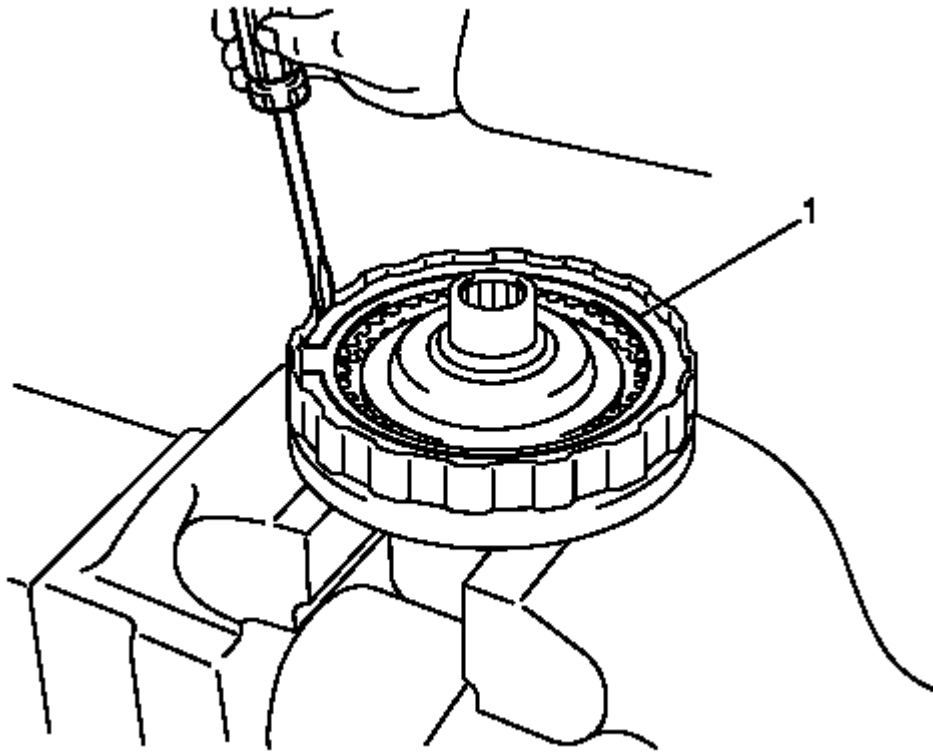


Fig. 293: Identifying Snap Ring

Courtesy of GENERAL MOTORS COMPANY

15. Using a screwdriver, install the snap ring (1) in the groove.
16. Check that the end gap of the snap ring is not aligned with one of the cutouts.

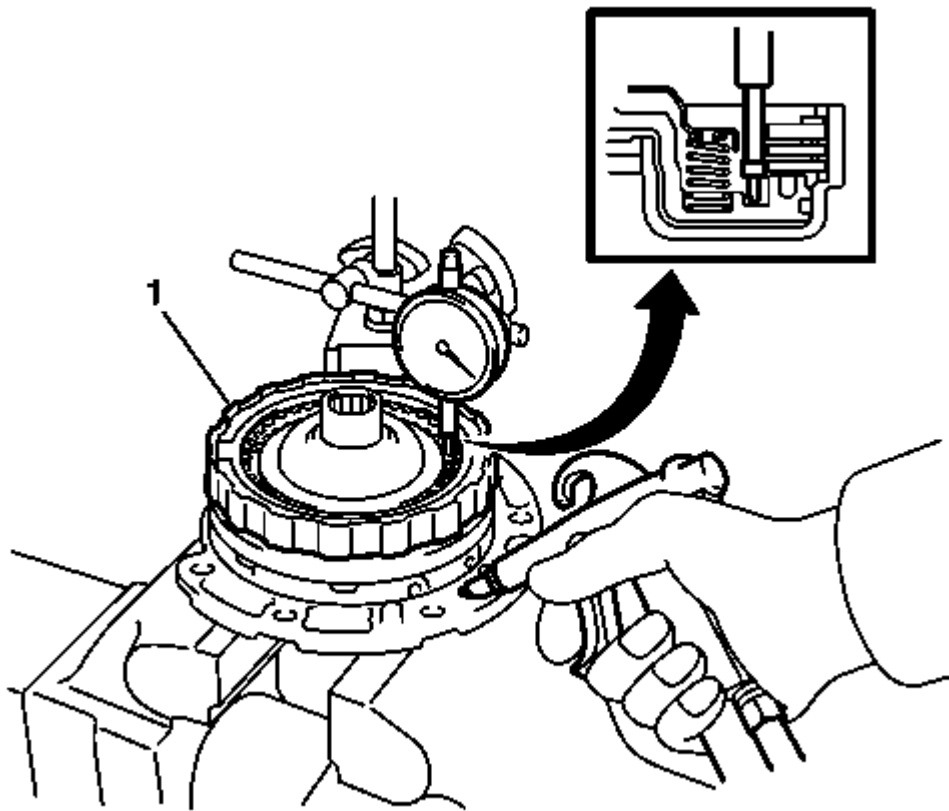


Fig. 294: Direct Clutch On Oil Pump
Courtesy of GENERAL MOTORS COMPANY

17. Install the direct clutch (1) on the oil pump.
18. Using a dial indicator, measure the direct clutch piston stroke while applying and releasing compressed air 392 kPa (56 psi).

Specification

The piston stroke is 0.4-0.7 mm (0.016-0.028 in).

19. If the piston stroke is not within the specified range, select an appropriate flange.

Specifications

- The number 1 flange thickness is 2.8 mm (0.110 in).
- The number 2 flange thickness is 3.0 mm (0.118 in).
- The number 3 flange thickness is 3.2 mm (0.126 in).

FORWARD AND REVERSE CLUTCH DISASSEMBLE

Special Tools

- **DT-46451 (DW240-020)** Brake/Clutch Spring Compressor
- **DT-46453 (DW240-040)** Direct Clutch Adapter

For equivalent regional tools, refer to **Special Tools**.

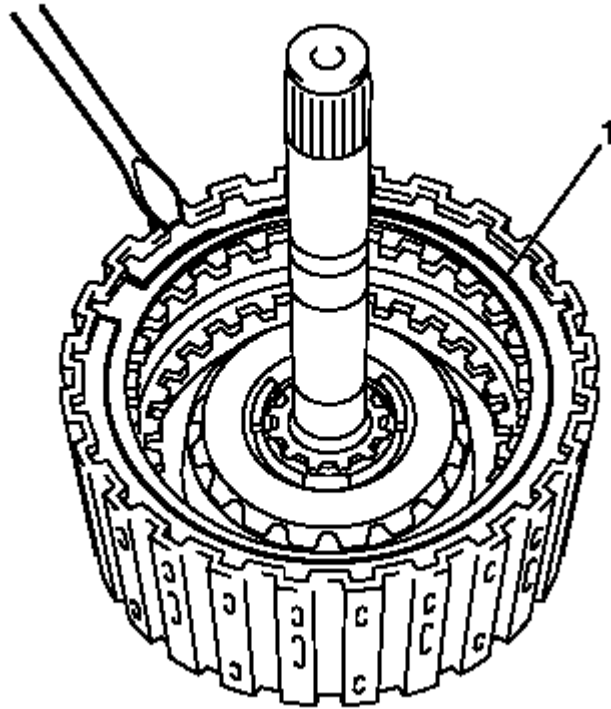


Fig. 295: Reverse Clutch Snap Ring
Courtesy of GENERAL MOTORS COMPANY

1. Using a screwdriver, remove the reverse clutch snap ring (1).

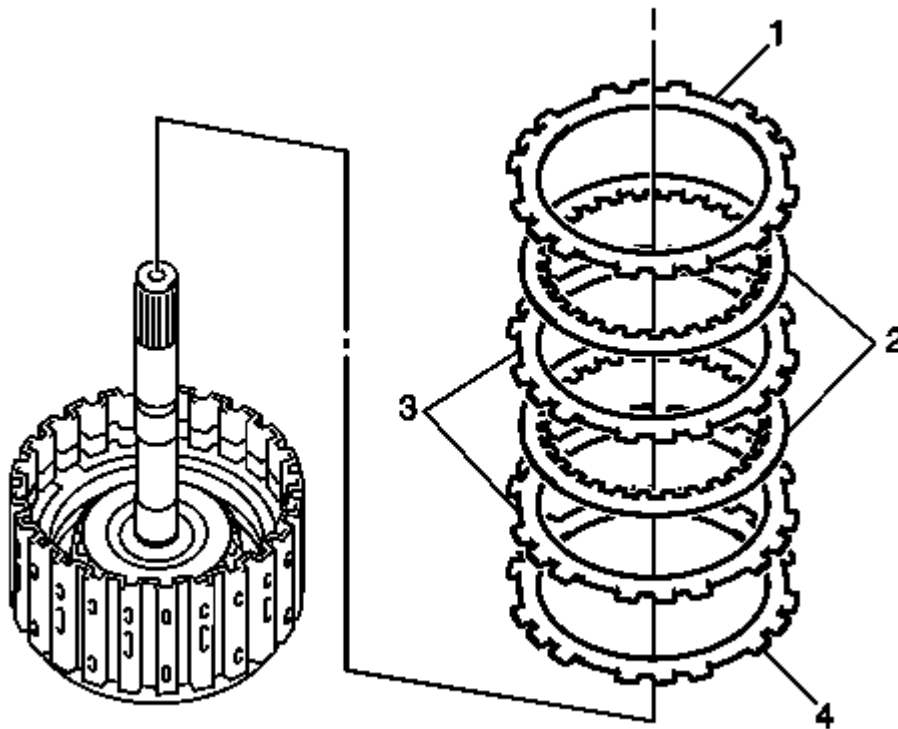


Fig. 296: Flange, Discs And Plates

Courtesy of GENERAL MOTORS COMPANY

2. Remove the flange (1), the 2 discs (2), the 2 plates (3), and the cushion plate (4) from the reverse clutch drum.

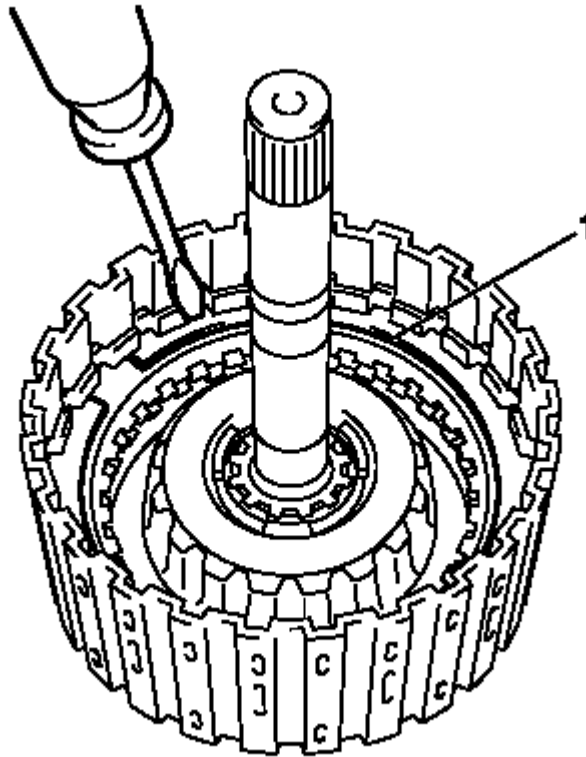


Fig. 297: Snap Ring And Groove

Courtesy of GENERAL MOTORS COMPANY

3. Using a screwdriver, remove the snap ring (1).

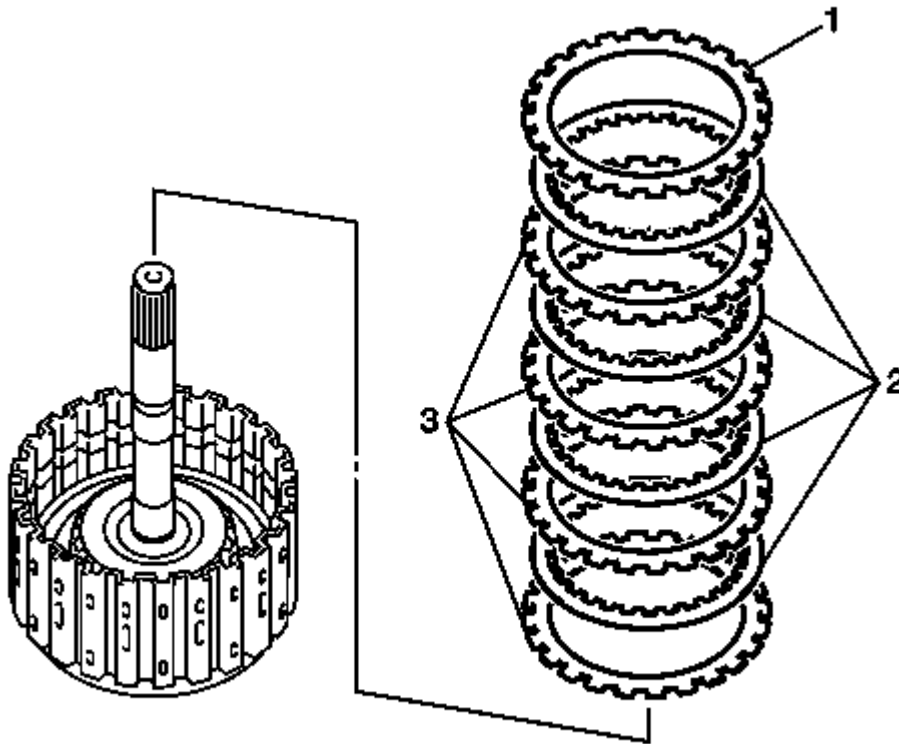


Fig. 298: Identifying Flange And Discs
Courtesy of GENERAL MOTORS COMPANY

4. Remove the flange (1), 4 discs (2), and 4 plates (3) from the forward clutch drum.

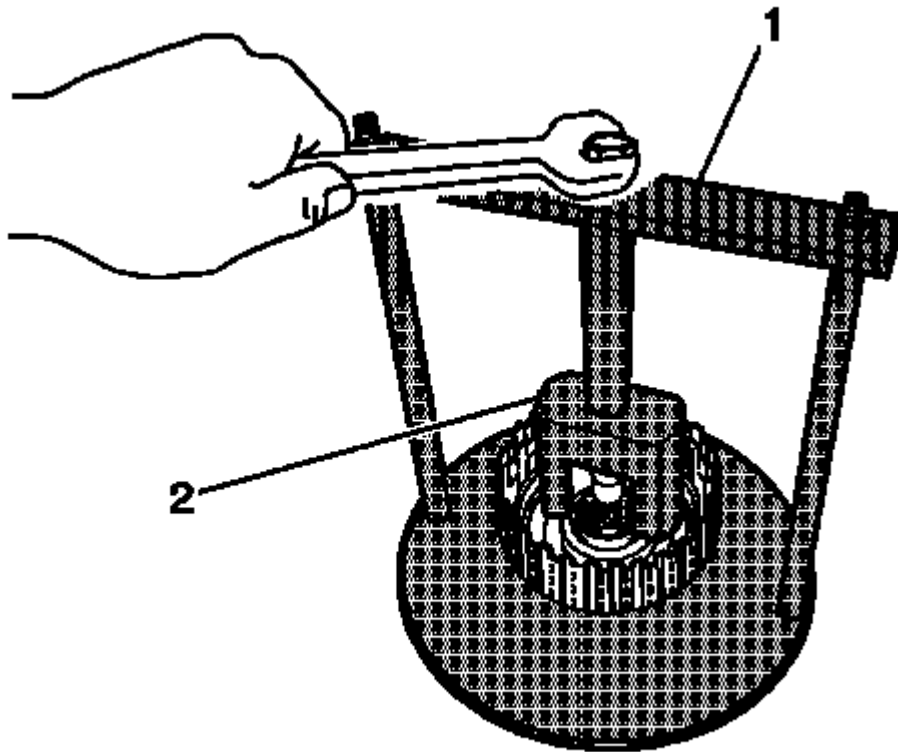


Fig. 299: Compressing Spring Using DT 46451 & DT 46452
Courtesy of GENERAL MOTORS COMPANY

5. Using **DT-46451** spring compressor (1) and **DT-46453** clutch adapter (2), compress the return spring.

NOTE: Do not expand the snap ring excessively.

6. Using a snap ring expander, remove the snap ring.

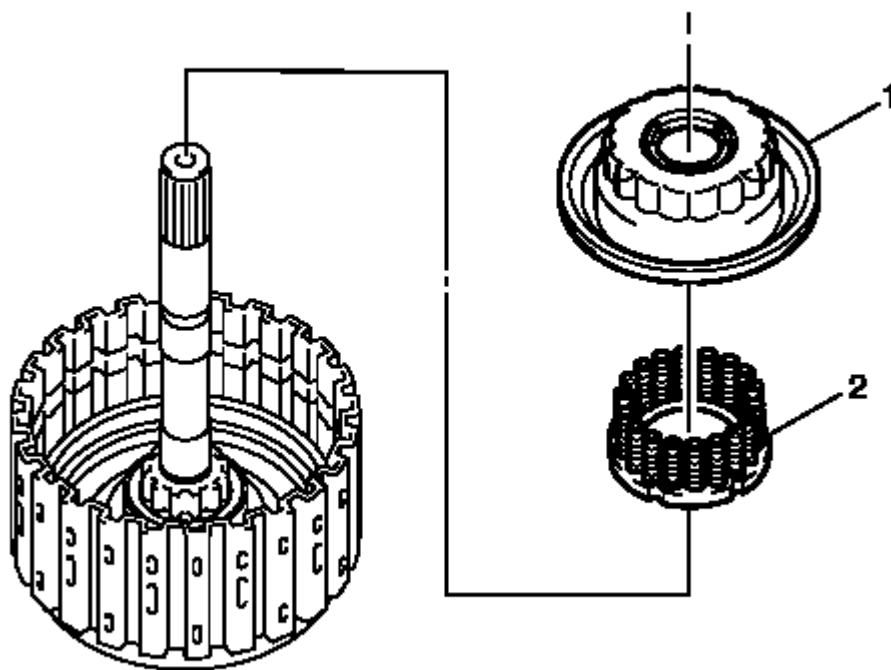


Fig. 300: Clutch Balancer

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage the seal on the clutch balancer.

7. Remove the clutch balancer (1) and forward clutch return spring (2).

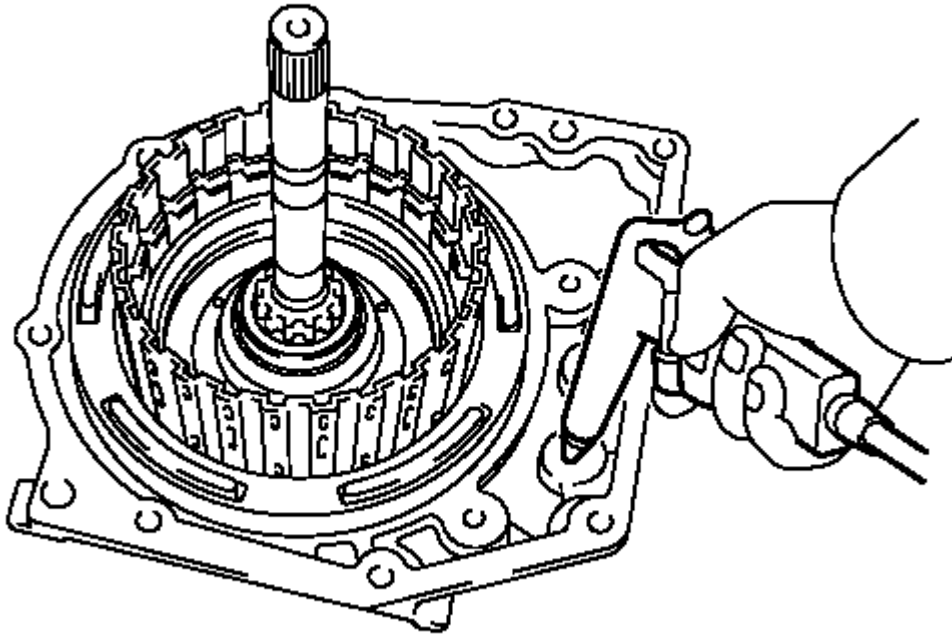


Fig. 301: Intermediate Shaft

Courtesy of GENERAL MOTORS COMPANY

8. Install the intermediate shaft on the transmission rear cover.

NOTE:

- Air pressure may cause the piston to jump out. When removing the piston, hold it with your hand using a waste cloth.
- Take care not to splash ATF when air-blowing.
- When the piston cannot be removed as it is slanted, either blow the air again with the protruding side pushed or remove the piston using the needle nose pliers with vinyl tape on the tip.

9. Apply compressed air 392 kPa (56 psi) to the transmission rear cover to remove the forward clutch piston.

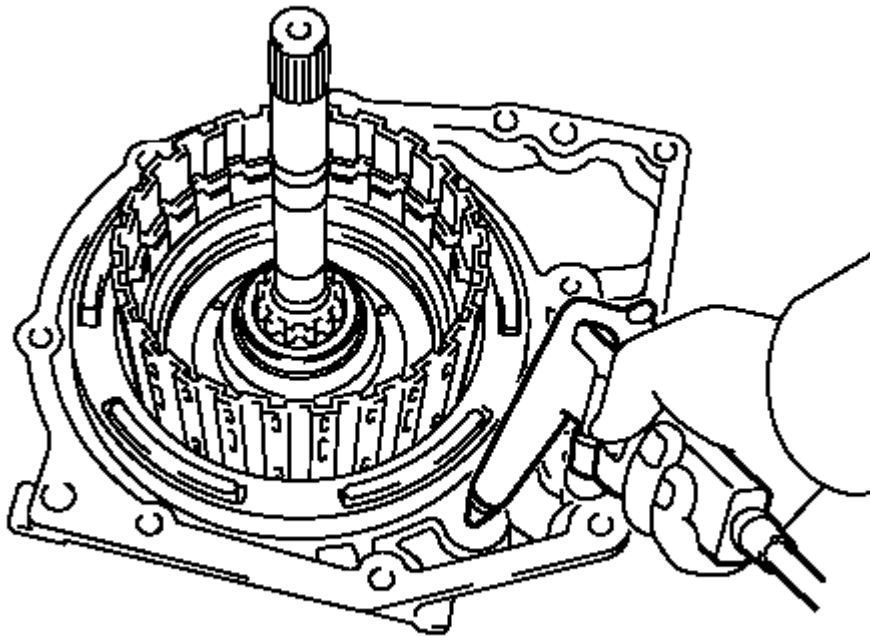


Fig. 302: Applying Compressed Air To Transmission Rear Cover
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- Air pressure may cause the drum to jump out. When removing the drum, hold it with your hand using a waste cloth.
- Take care not to splash ATF when air-blowing.
- When the drum cannot be removed as it is slanted, either blow the air again with the protruding side pushed or remove the drum using the needle nose pliers with vinyl tape on the tip.

10. Apply compressed air 392 kPa (56 psi) to the transmission rear cover to remove the forward clutch drum.

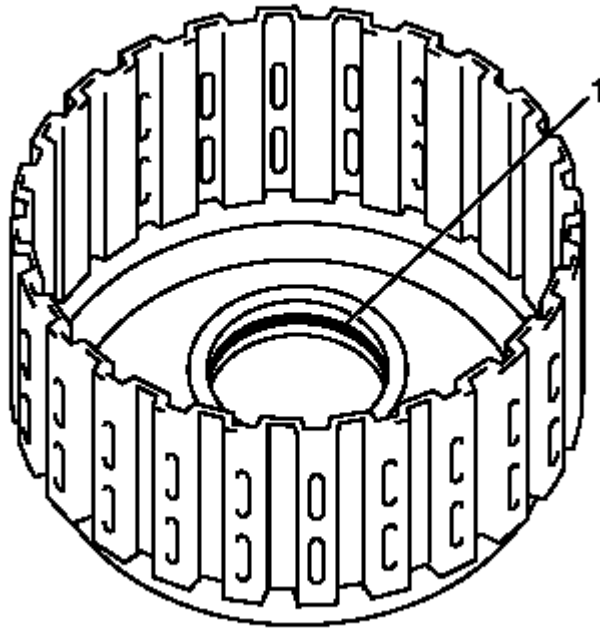


Fig. 303: Identifying O-Ring And Clutch Drum
Courtesy of GENERAL MOTORS COMPANY

11. Remove the O-ring (1) from the forward clutch drum.

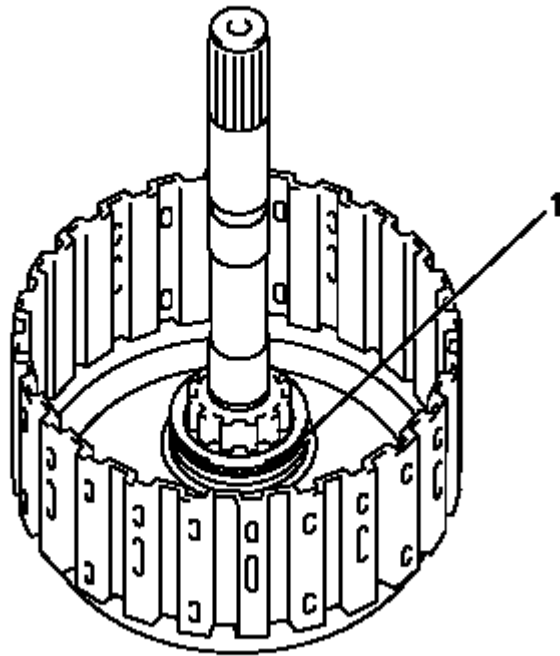


Fig. 304: O-Ring And Intermediate Shaft
Courtesy of GENERAL MOTORS COMPANY

12. Remove the O-ring (1) from the intermediate shaft.

FORWARD AND REVERSE CLUTCH INSPECTION

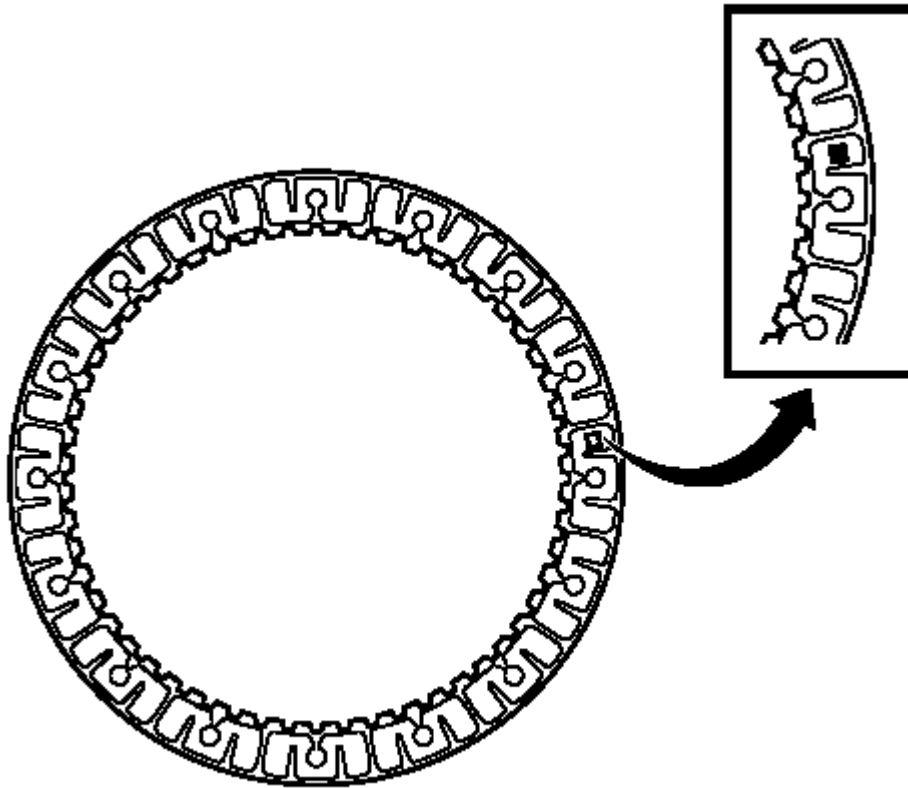


Fig. 305: Inspecting Sliding Surface Of Disc
Courtesy of GENERAL MOTORS COMPANY

1. Check the lining of all discs.
 - If the lining of the disc is peeling off or discolored, or even if a part of the printed number is defaced, replace all discs.
 - Before assembling new discs, soak them in ATF for at least 15 minutes.

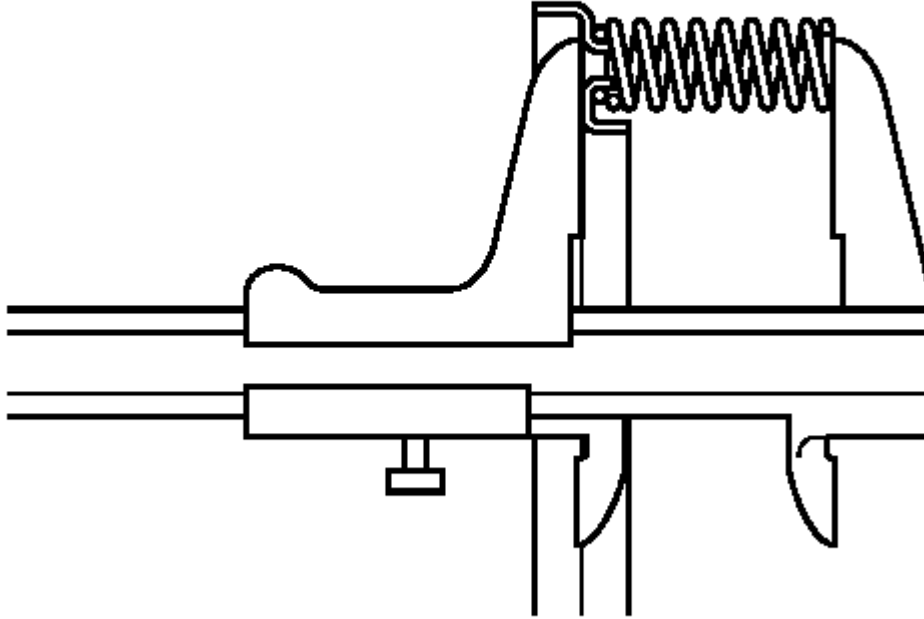


Fig. 306: Measuring Free Length Of Return Spring
Courtesy of GENERAL MOTORS COMPANY

2. Using vernier calipers, measure the free length of the return spring.

Specifications

The standard free length is 20.88 mm (0.822 in).

FORWARD AND REVERSE CLUTCH ASSEMBLE

Special Tools

- **DT-46451 (DW240-020)** Brake/Clutch Spring Compressor
- **DT-46453 (DW240-040)** Direct Clutch Adapter
- **DT-47520 (DW240-120)** Measuring Terminal

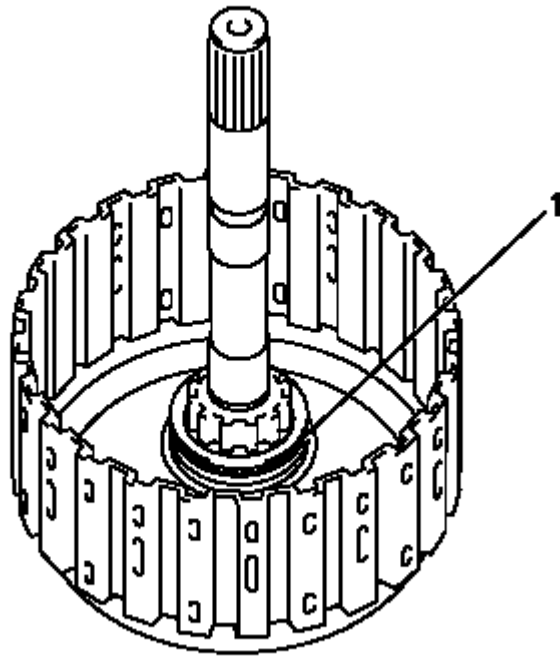


Fig. 307: O-Ring And Intermediate Shaft
Courtesy of GENERAL MOTORS COMPANY

1. Coat a new O-ring (1) with (ATF) and install it to the intermediate shaft.

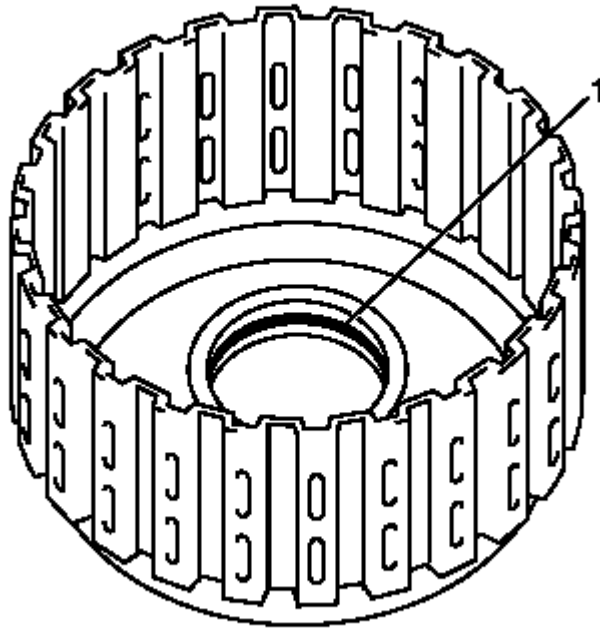


Fig. 308: Identifying O-Ring And Clutch Drum
Courtesy of GENERAL MOTORS COMPANY

2. Coat a new O-ring (1) with ATF, and install it to the forward clutch drum.

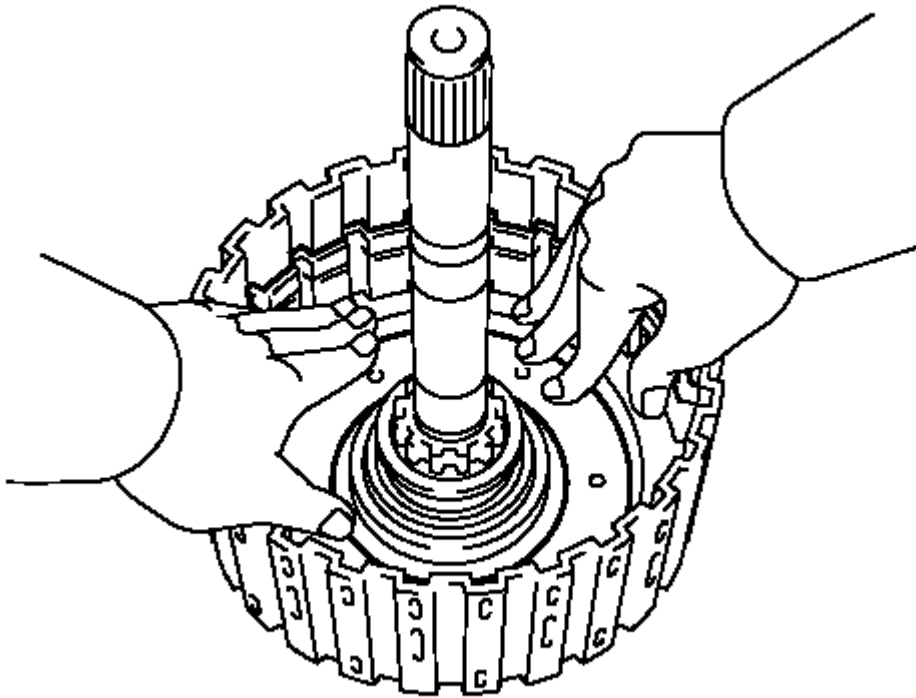


Fig. 309: Identifying Clutch Drum With ATF
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage the O-ring and seal of forward clutch drum.

3. Coat the forward clutch drum with ATF, install the forward clutch drum.

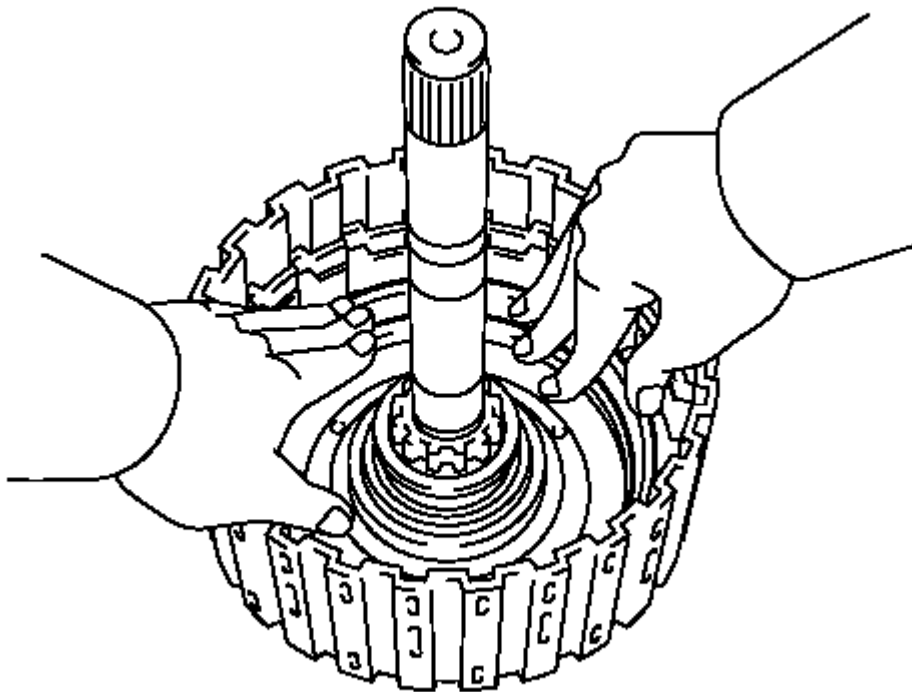


Fig. 310: Clutch Piston With ATF
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Do not damage the seal of the forward clutch piston.**

4. Coat the forward clutch piston with ATF, install the forward clutch piston.

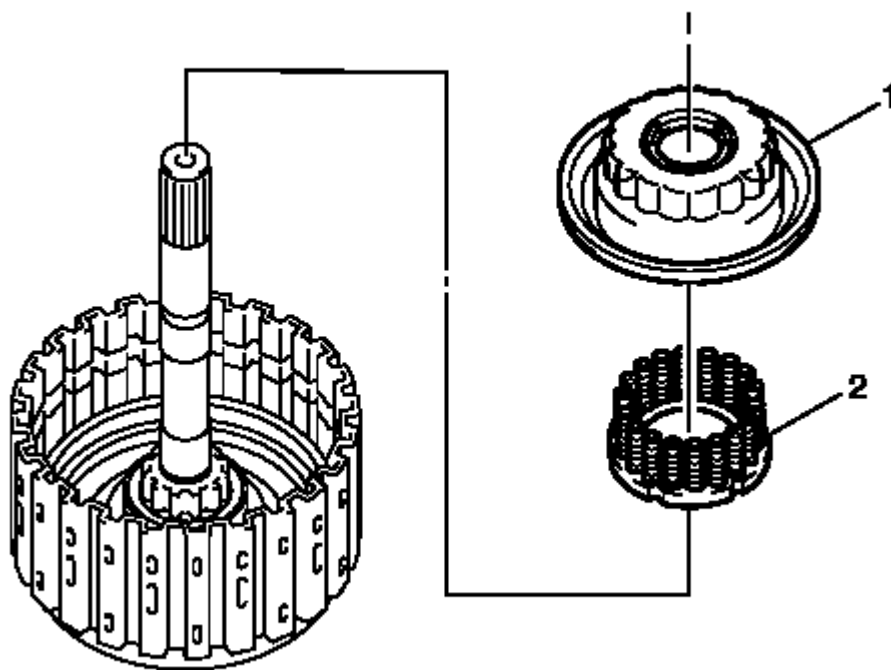


Fig. 311: Clutch Balancer

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage the seal of the forward clutch return spring.

5. Install the forward clutch return spring (2) and clutch balancer (1).

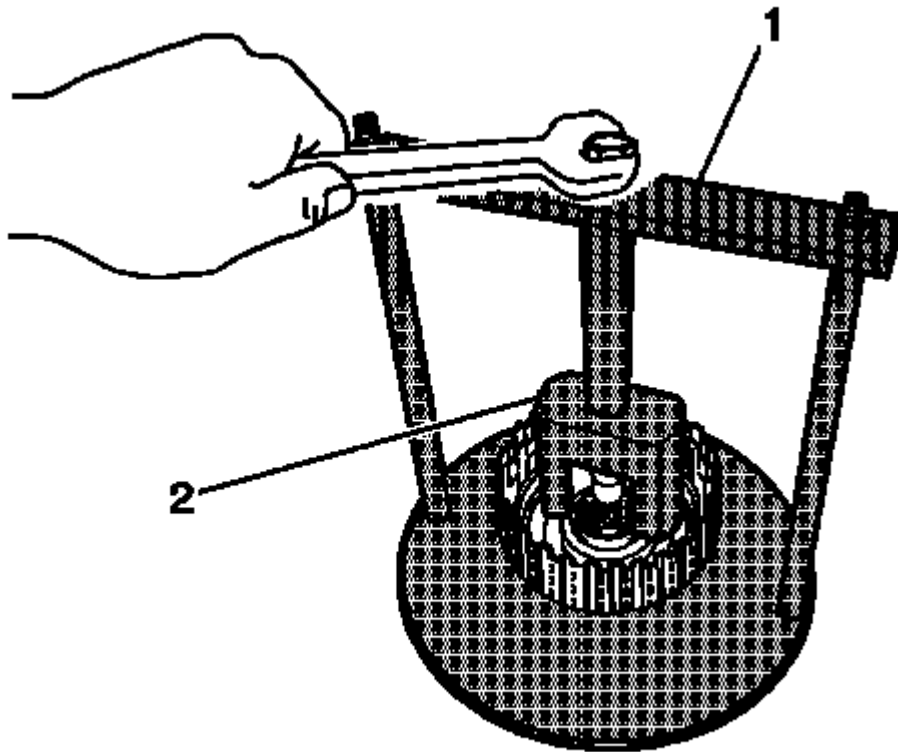


Fig. 312: Compressing Spring Using DT 46451 & DT 46452
Courtesy of GENERAL MOTORS COMPANY

6. Place **DT-46451** brake/clutch spring compressor (1) and **DT-46453** clutch adapter (2) on the clutch balancer and compress the piston return spring.

NOTE: **Do not expand the snap ring excessively.**

7. Using a snap ring expander, install the snap ring.

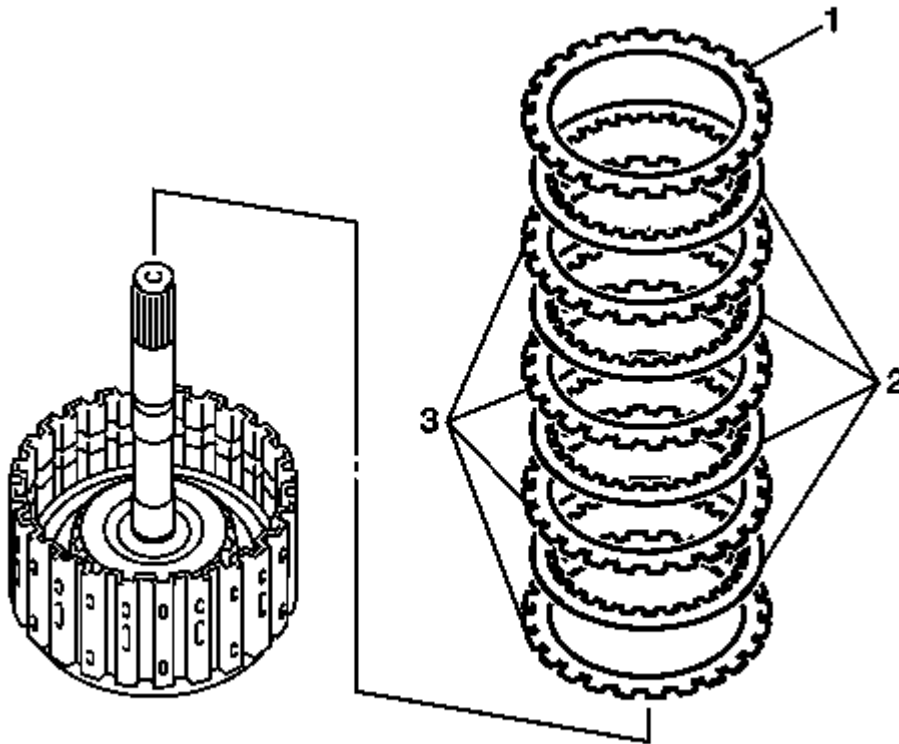


Fig. 313: Identifying Flange And Discs
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- Check the number and order of the flange, discs, and the plates.
- Install the same thickness flange as when it is removed.

8. Install the 4 plates (3), 4 discs (2), and the flange (1).

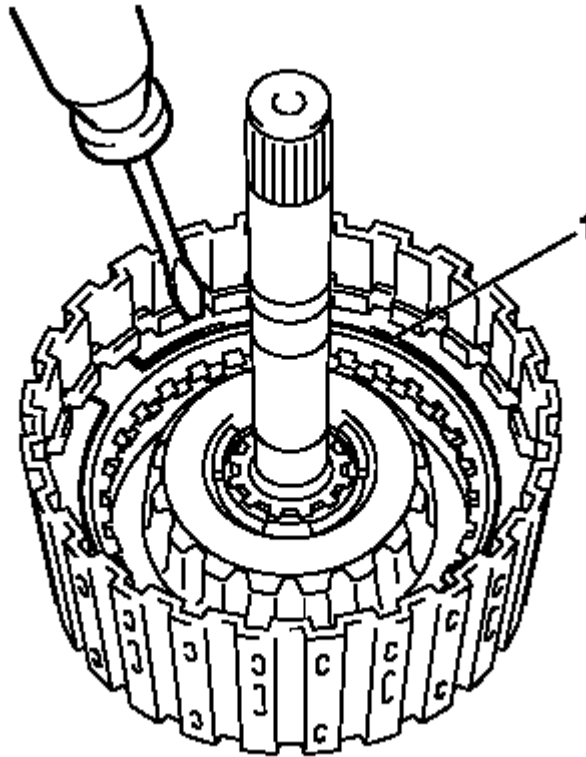


Fig. 314: Snap Ring And Groove

Courtesy of GENERAL MOTORS COMPANY

9. Using a screwdriver, install the snap ring (1) in the groove.
10. Verify that the end gap of the snap ring is not aligned with one of the cutouts.

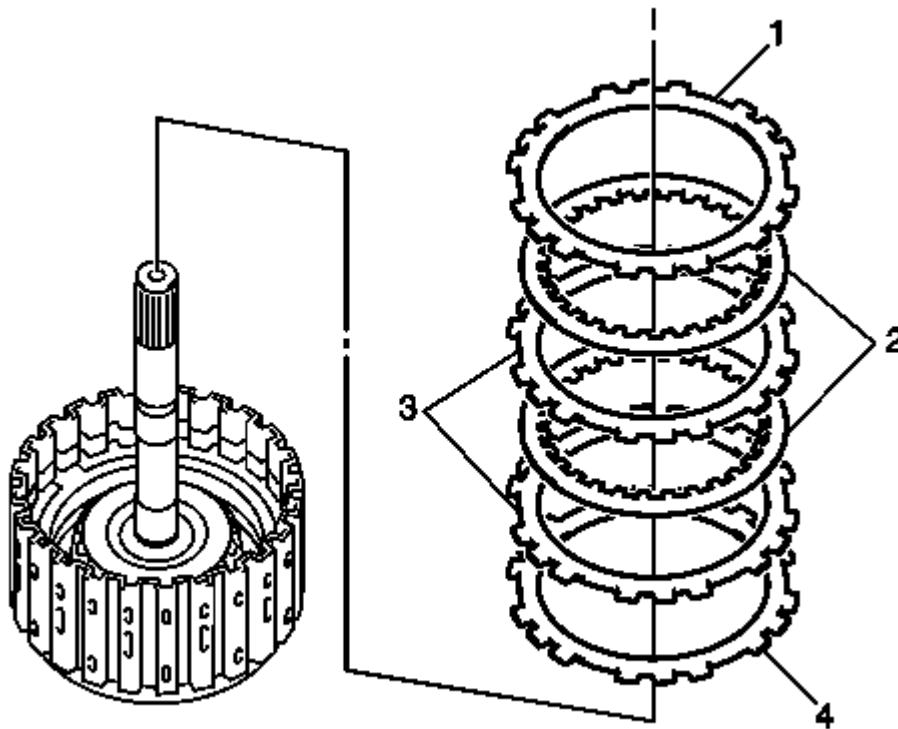


Fig. 315: Flange, Discs And Plates

Courtesy of GENERAL MOTORS COMPANY

NOTE:

- Check the number and order of the flange, discs, and the plates.
- Install the same thickness flange as when it is removed.

11. Install the cushion plate (4), the 2 plates (3), the 2 discs (2), and the flange (1).

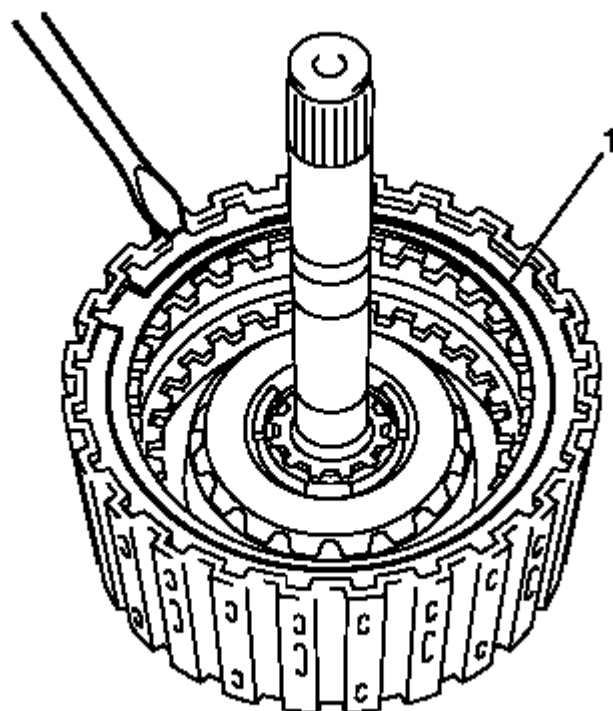


Fig. 316: Reverse Clutch Snap Ring
Courtesy of GENERAL MOTORS COMPANY

12. Using a screwdriver, install the snap ring (1) in the groove.
13. Verify that the end gap of the snap ring is not aligned with one of the cutouts.

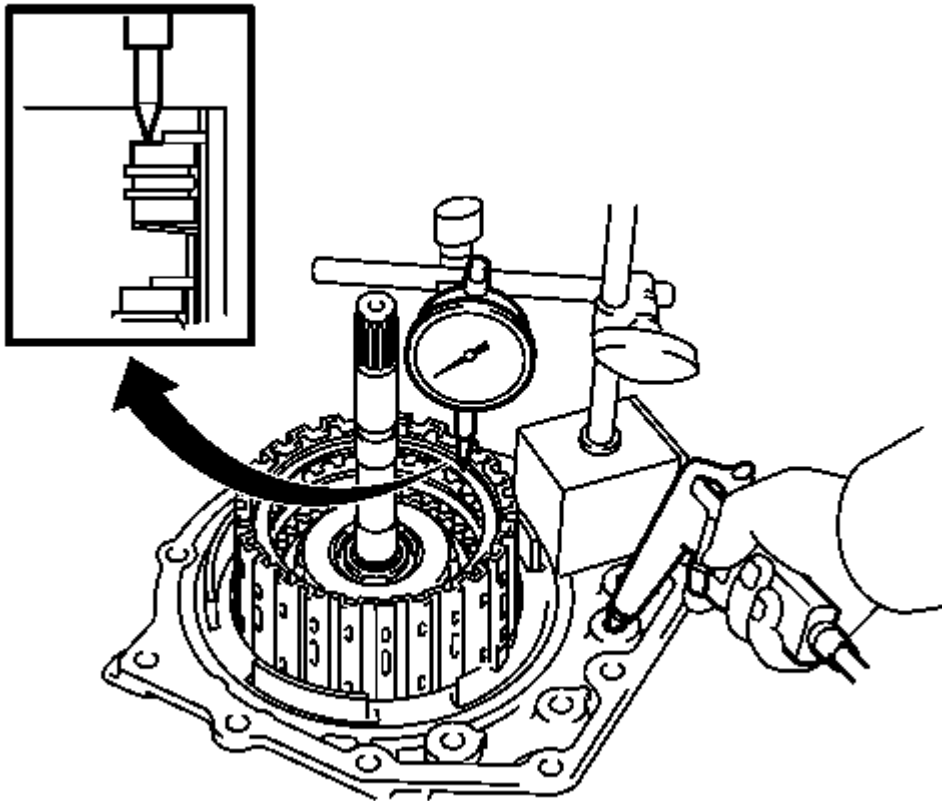


Fig. 317: Measuring Reverse Clutch Piston Stroke
Courtesy of GENERAL MOTORS COMPANY

14. Install the forward and reverse clutch and thrust needle roller bearing on the transmission rear cover.
15. Using a dial indicator, measure the reverse clutch piston stroke while applying and releasing compressed air 392 kPa (56 psi).
16. If the piston stroke is not within the specified range, select an appropriate flange.
 - If the piston stroke is longer than the upper range, install the thicker flange and measure again.
 - The piston stroke is not within the specified range even if changing to the thickest flange, replace the reverse clutch assembly.
 - If the piston stroke is shorter than the lower range, install the thinner flange and measure again.
 - The piston stroke is not within the specified range even if changing to the thinnest flange, replace the reverse clutch assembly.

Specification

The piston stroke is 1.2-1.6 mm (0.047-0.063 in).

- There are 4 flanges in different thickness.

Specifications

- The number 1 flange thickness is 3 mm (0.118 in).
- The number 2 flange thickness is 3.2 mm (0.126 in).
- The number 3 flange thickness is 3.4 mm (0.134 in).
- The number 4 flange thickness is 3.6 mm (0.142 in).

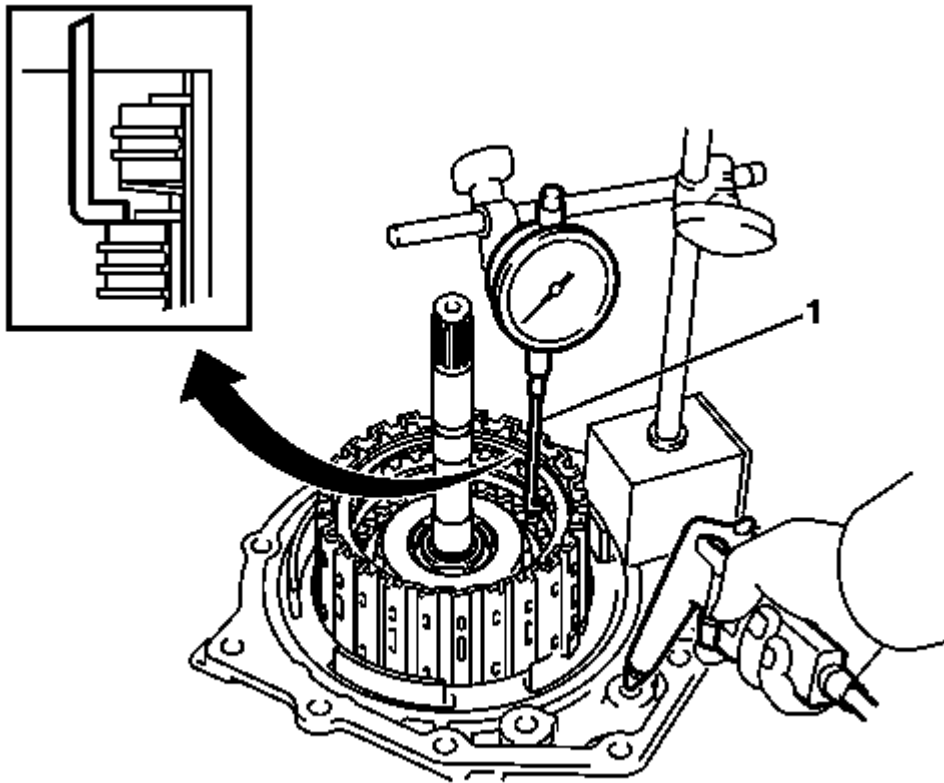


Fig. 318: Identifying DT-- 47520 Measuring Terminal
 Courtesy of GENERAL MOTORS COMPANY

17. Using a dial indicator and **DT-47520** measuring terminal (1), measure the forward clutch piston stroke while applying and releasing compressed air 392 kPa (56 psi).
18. If the piston stroke is not within the specified range, select an appropriate flange.
 - If the piston stroke is longer than the upper range, install the thicker flange and measure again.
 - The piston stroke is not within the specified range even if changing to the thickest flange, replace the reverse clutch assembly.
 - If the piston stroke is shorter than the lower range, install the thinner flange and measure again.
 - The piston stroke is not within the specified range even if changing to the thinnest flange, replace the reverse clutch assembly.
 - The forward and reverse clutch will come out as you apply the compressed air. Therefore, while the checking is being done, press on the input shaft of the forward and reverse clutch using stamping machine or alike so that the pressure is not applied on the forward and reverse clutch.

Specification

The piston stroke is 0.8-1.0 mm (0.031-0.039 in).

- There are 9 flanges in different thickness.

Specifications

- The number 1 flange thickness is 3 mm (0.118 in).
- The number 2 flange thickness is 3.1 mm (0.122 in).
- The number 3 flange thickness is 3.2 mm (0.126 in).
- The number 4 flange thickness is 3.3 mm (0.130 in).
- The number 5 flange thickness is 3.4 mm (0.134 in).
- The number 6 flange thickness is 3.5 mm (0.138 in).
- The number 7 flange thickness is 3.6 mm (0.142 in).
- The number 8 flange thickness is 3.7 mm (0.146 in).
- The number 9 flange thickness is 3.8 mm (0.150 in).

CASE COVER ASSEMBLY DISASSEMBLE

Special Tools

DT-50899 Spring Compressor

For equivalent regional tools, refer to **Special Tools**.

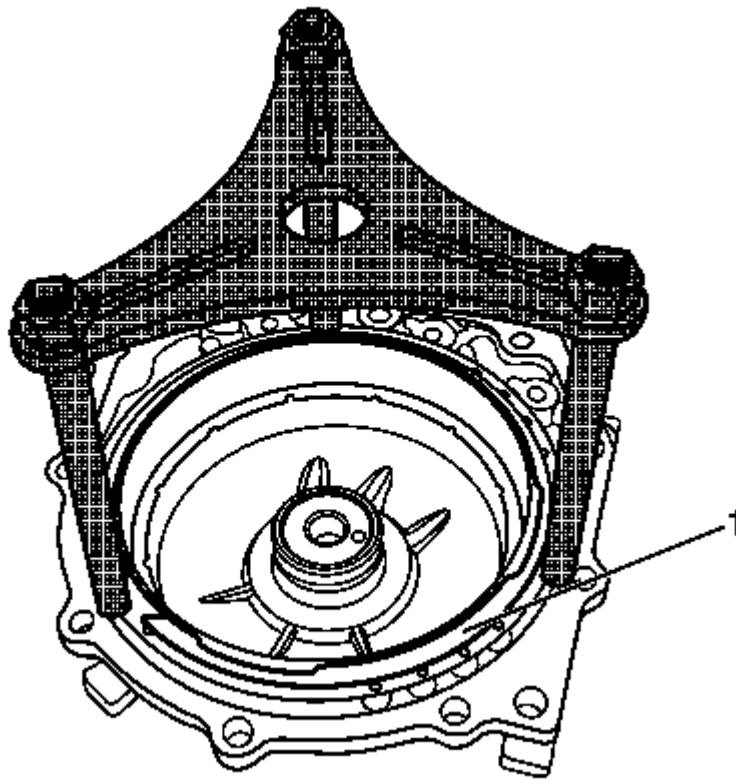


Fig. 319: View Of DT-50899 Spring Compressor And A Press
Courtesy of GENERAL MOTORS COMPANY

1. Using **DT-50899** spring compressor and a press, remove the snap ring (1).

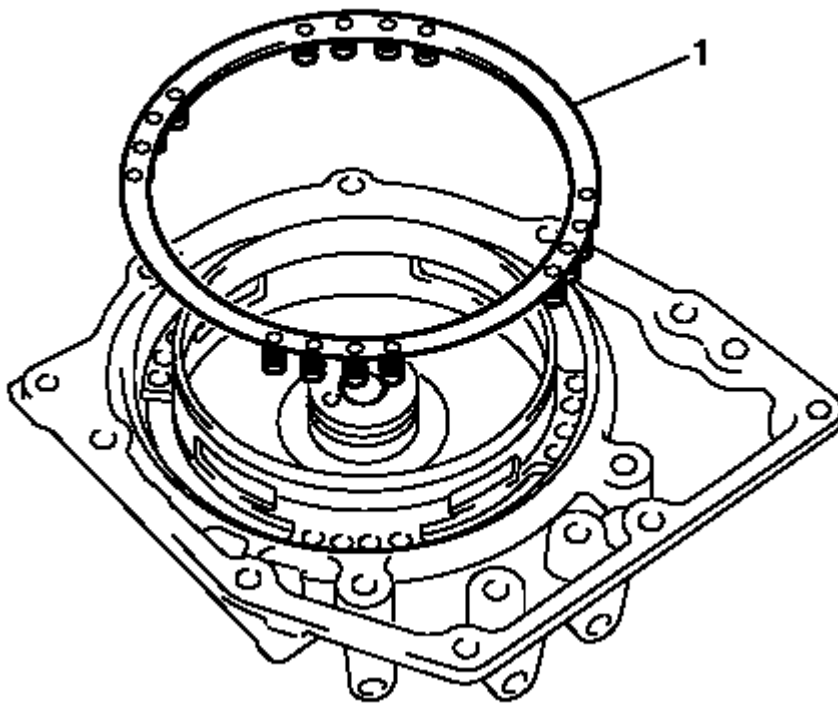


Fig. 320: Identifying O/D Brake Return Spring
Courtesy of GENERAL MOTORS COMPANY

2. Remove the O/D brake return spring (1).

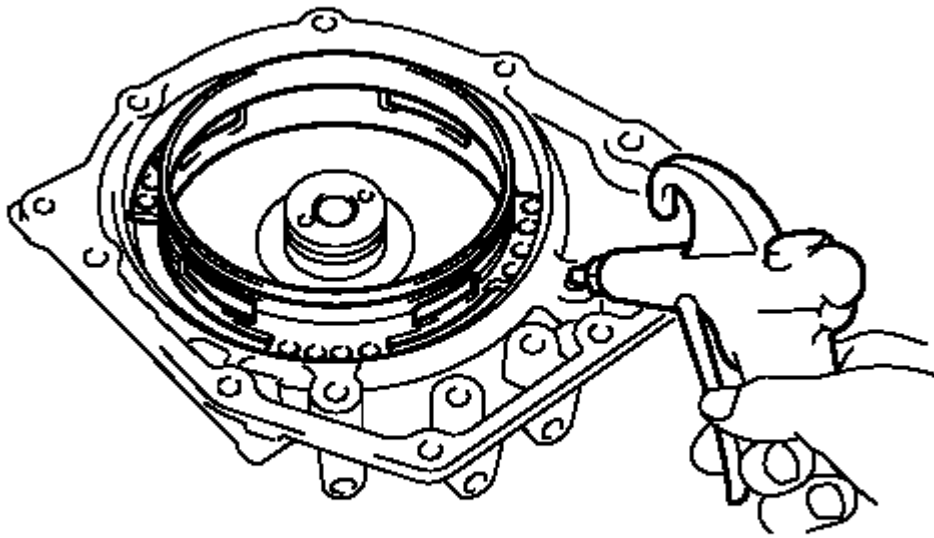


Fig. 321: Applying Compressed Air And Transmission Rear Cover
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- Air pressure may cause the piston to jump out. When removing the piston, hold it with your hand using a waste cloth.
- Take care not to splash ATF when air-blowing.

3. Apply compressed air 392 kPa (56 psi) to the transmission rear cover to remove the O/D brake piston.

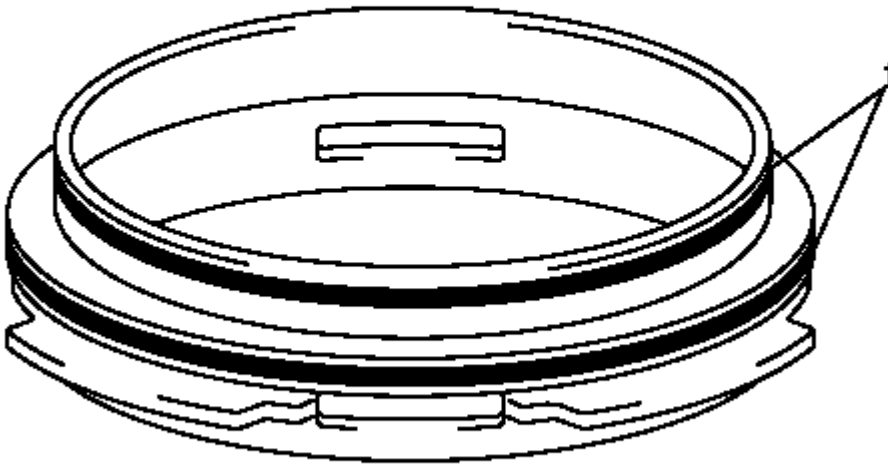


Fig. 322: Coating 2 New O-Rings With Automatic Transaxle Fluid (ATF)
Courtesy of GENERAL MOTORS COMPANY

4. Remove the 2 O-rings (1) from the O/D brake piston.

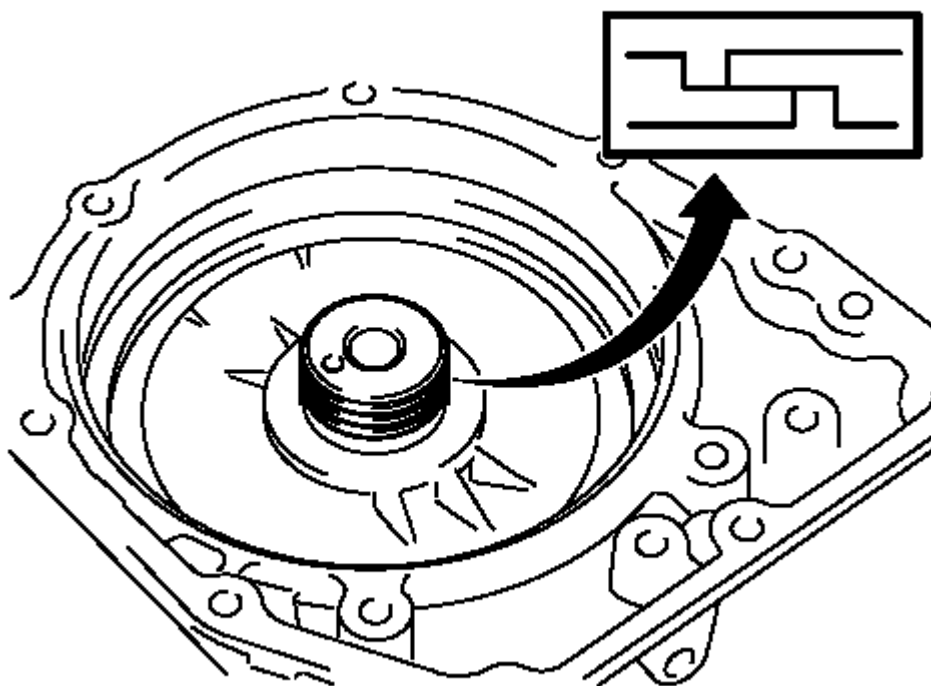


Fig. 323: Seal Rings And Transmission Rear Cover
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not expand the seal ring excessively.

5. Remove the 2 seal rings from the transmission rear cover.

CASE COVER ASSEMBLY ASSEMBLE

Special Tools

DT-50899 Spring Compressor

For equivalent regional tools, refer to **Special Tools**.

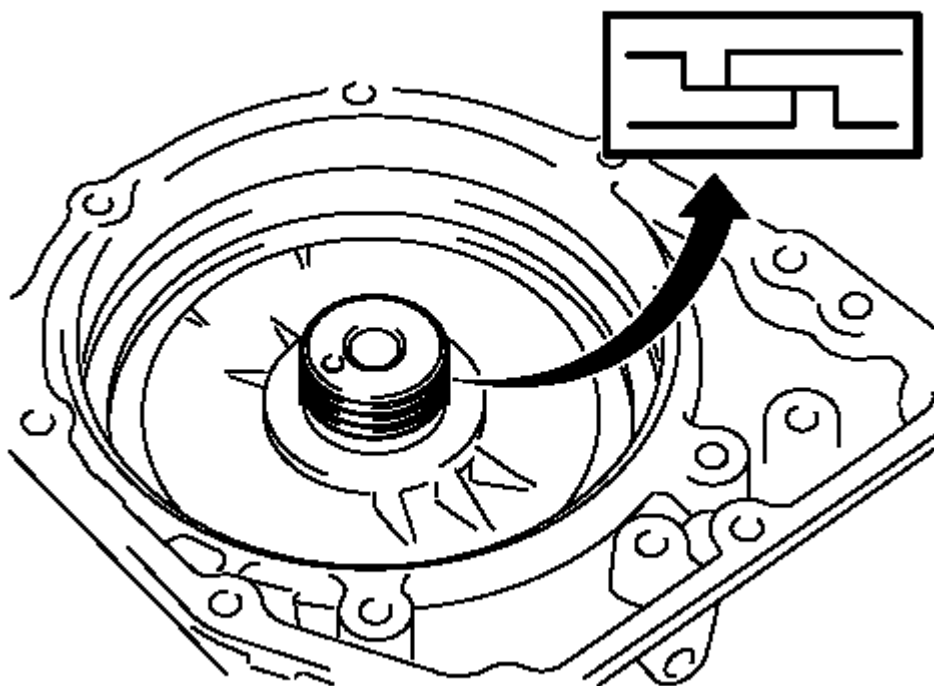


Fig. 324: Seal Rings And Transmission Rear Cover
Courtesy of GENERAL MOTORS COMPANY

1. Install the 2 seal rings to the transmission rear cover.

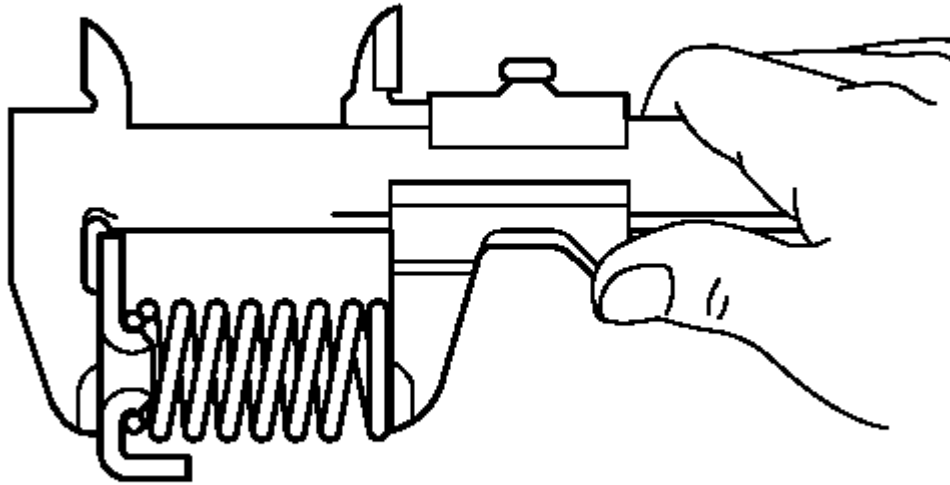


Fig. 325: Measuring Free Length Of Piston Return Spring Together
Courtesy of GENERAL MOTORS COMPANY

2. Using the vernier calipers, measure the free length of the piston return spring together with the spring seat.

Specification

The standard free length is 12.63 mm (0.497 in).

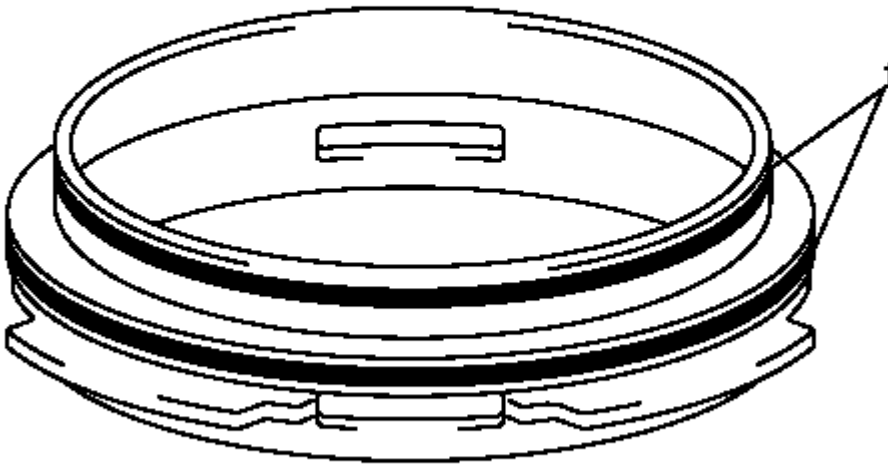


Fig. 326: Coating 2 New O-Rings With Automatic Transaxle Fluid (ATF)
Courtesy of GENERAL MOTORS COMPANY

3. Coat the 2 new O-rings (1) with automatic transaxle fluid (ATF) and install them to the O/D and 2nd coast brake piston.

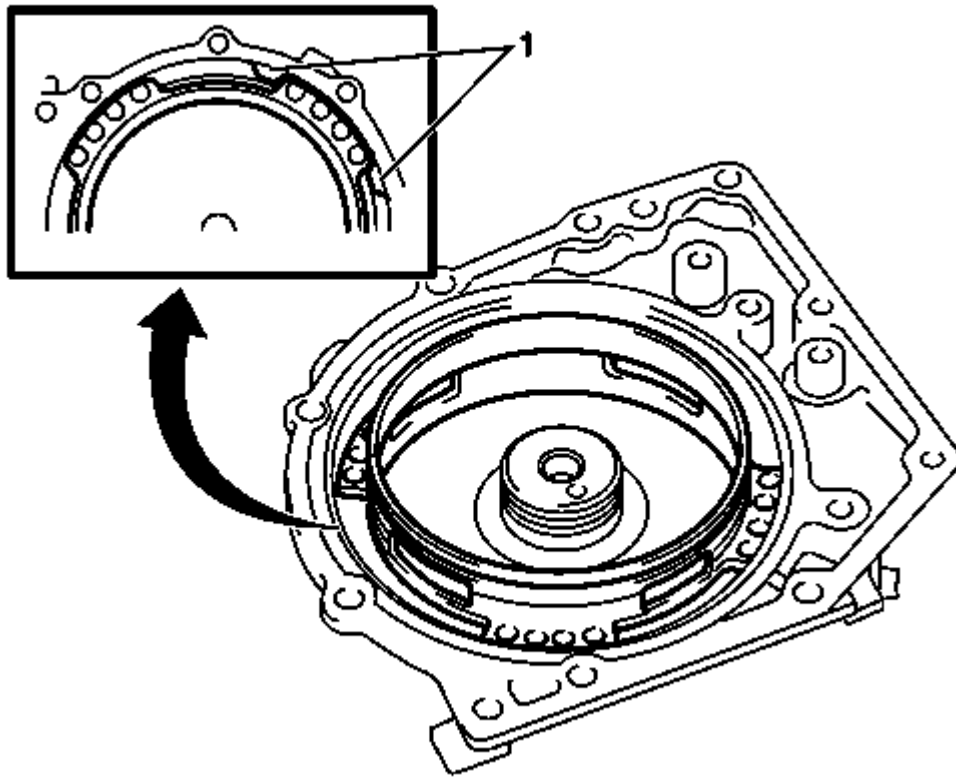


Fig. 327: Coat O/D And 2Nd Coast Brake Piston With ATF
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage the O-rings of the O/D and 2nd coast brake piston.

4. Coat the O/D and 2nd coast brake piston with ATF, install it to get into the range (1) of anti-rotation surface of the piston spring seat.

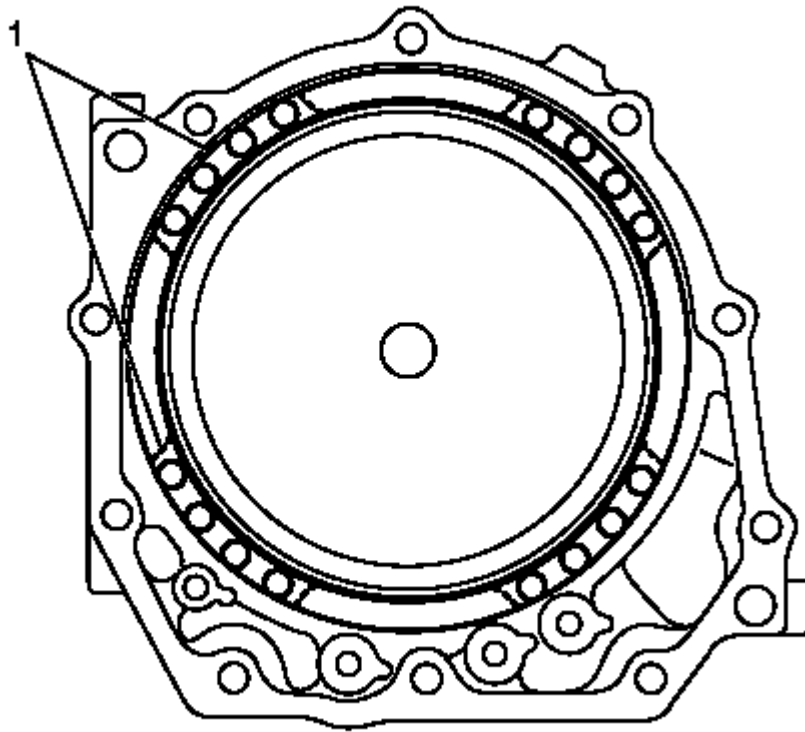


Fig. 328: Identifying O/D Brake Return Spring
Courtesy of GENERAL MOTORS COMPANY

5. Set the O/D brake return spring into the piston seat (1).

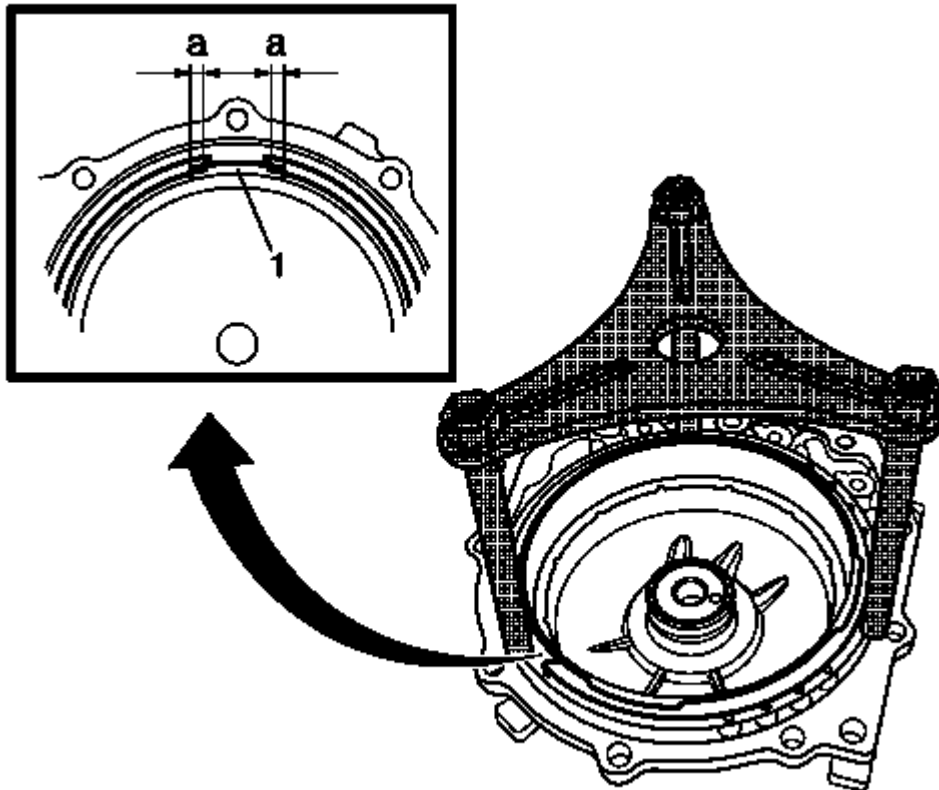


Fig. 329: Identifying O/D And 2nd Coast Brake Return Spring
Courtesy of GENERAL MOTORS COMPANY

6. Using **DT-50899** spring compressor and a press, install the O/D and 2nd coast brake return spring and the snap ring to the transmission rear cover.
7. Verify that one notch (1) is aligned with the gap between the end of the snap ring.

Specification

The dimension (a) is 3 mm (0.118 in) or more.

FINAL DRIVE RING GEAR INSPECTION

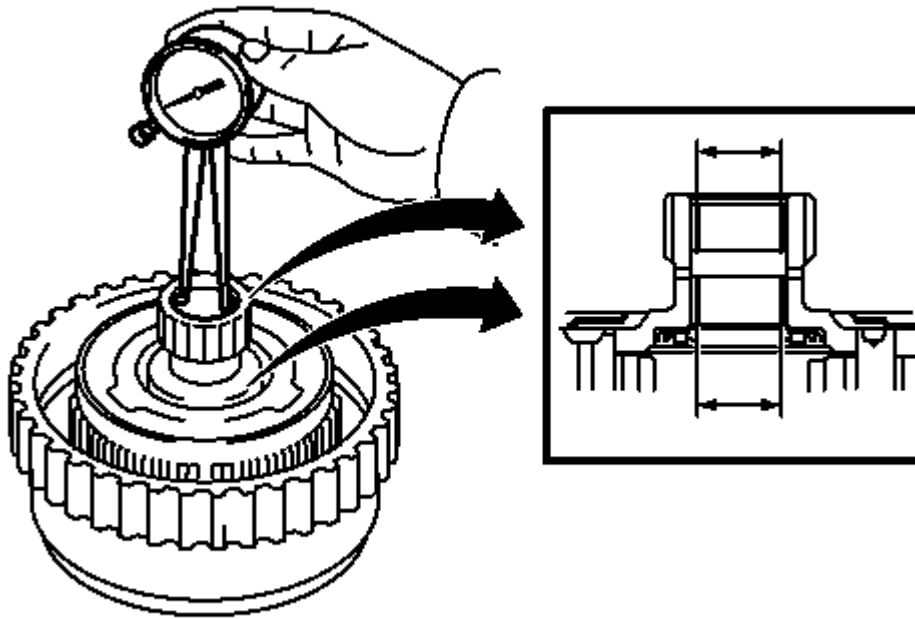


Fig. 330: Measuring Inside Diameter Of Planetary Gear Bushing Using A Dial Indicator
Courtesy of GENERAL MOTORS COMPANY

NOTE: Measure at the different places and take an average. If the measurement is greater than the maximum, replace it with a new one.

1. Using a dial indicator, measure the inside diameter of the planetary gear bushing.

Specification

The standard inside diameter is 18.025-18.046 mm (0.7096-0.7104 in).

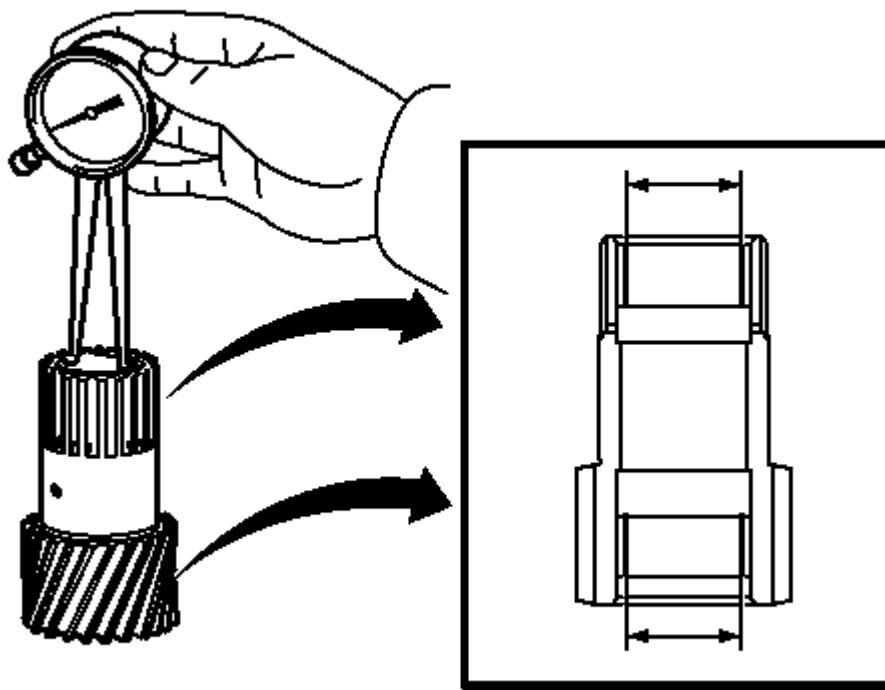


Fig. 331: Measuring Inside Diameter Of Front Planetary Sun Gear Bushing Using A Dial Indicator
Courtesy of GENERAL MOTORS COMPANY

NOTE: Measure at the different places and take an average. If the measurement is greater than the maximum, replace it with a new one.

2. Using a dial indicator, measure the inside diameter of the front planetary sun gear bushing.

Specification

The standard inside diameter is 18.025-18.046 mm (0.7096-0.7104 in).

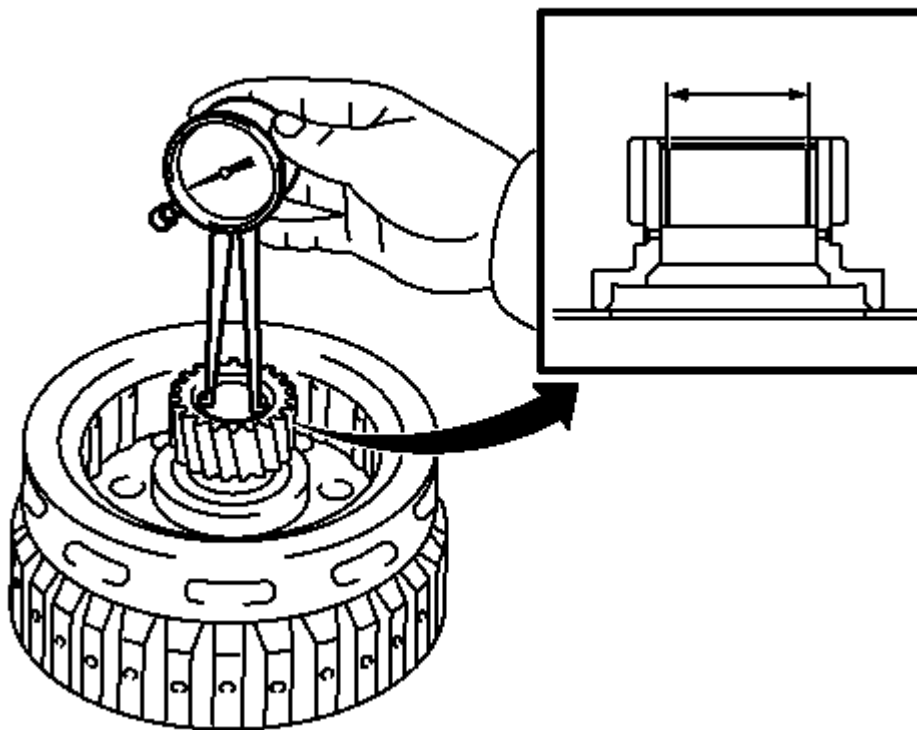


Fig. 332: Measuring Inside Diameter Of Rear Planetary Sun Gear Bushing Using A Dial Indicator
Courtesy of GENERAL MOTORS COMPANY

NOTE: Measure at the different places and take an average. If the measurement is greater than the maximum, replace it with a new one.

3. Using a dial indicator, measure the inside diameter of the rear planetary sun gear bushing.

Specification

The standard inside diameter is 26.625-26.646 mm (1.0482-1.0490 in).

CONTROL VALVE BODY DISASSEMBLE

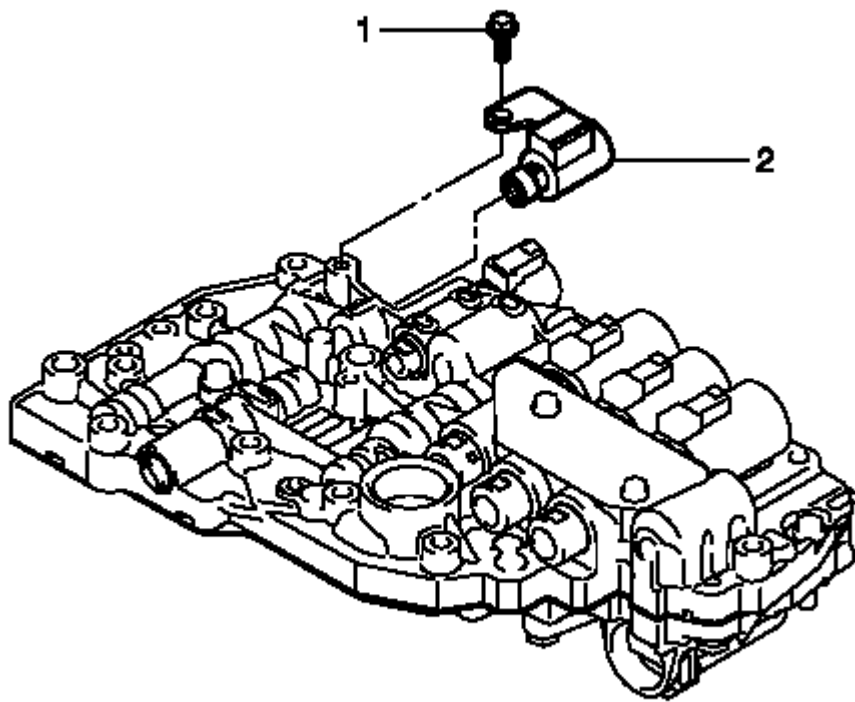


Fig. 333: Identifying Solenoid And Control Valve Body
Courtesy of GENERAL MOTORS COMPANY

1. Remove the shift solenoid bolt (1).
2. Remove the solenoid (2) from the control valve body.

CONTROL VALVE BODY ASSEMBLY

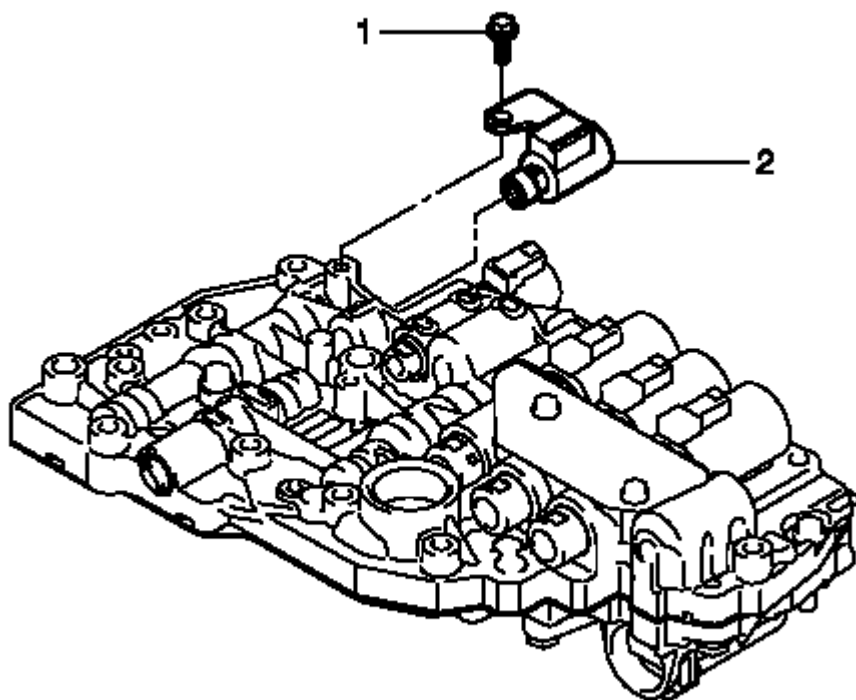


Fig. 334: Identifying Solenoid And Control Valve Body
 Courtesy of GENERAL MOTORS COMPANY

1. Install the shift solenoid (2) to the control valve body.
2. Install the shift solenoid bolt (2) and tighten to 7 (62 lb in).

DESCRIPTION AND OPERATION

MANUAL FOURTH GEAR

Manual Fourth Gear

Shift Position		Clutch			Brake		One-way Clutch
		C1	C2	C3	B1	B3	F2
D	4th	OFF	ON	OFF	ON	OFF	OFF

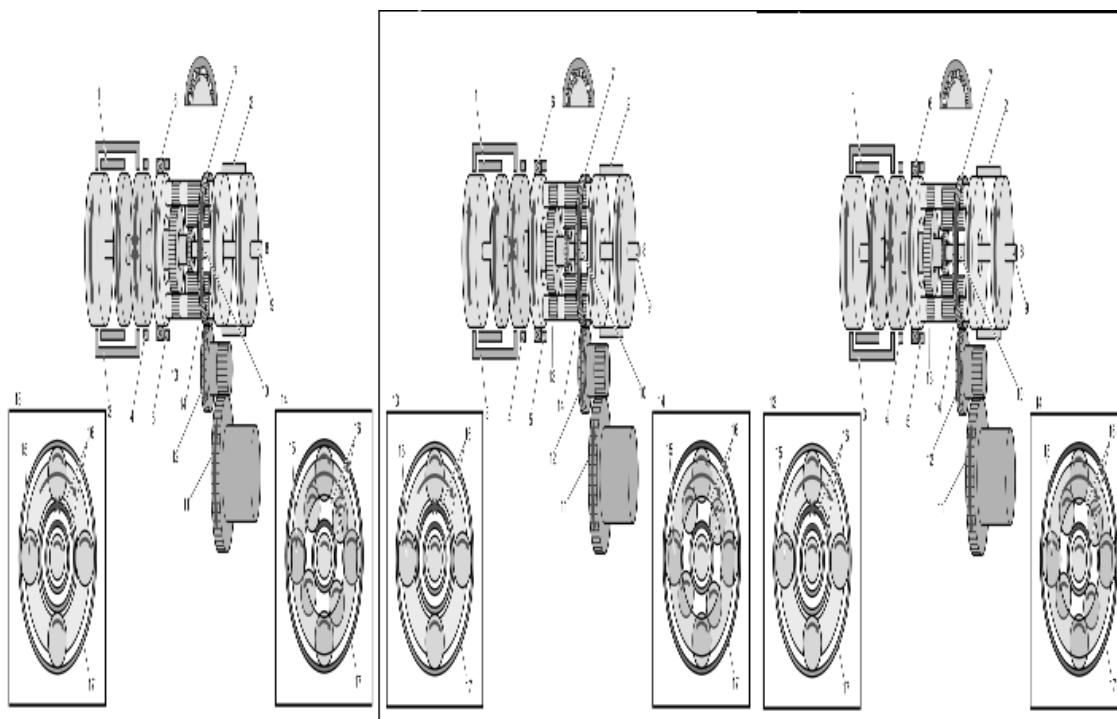


Fig. 335: Manual Fourth Gear
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Forward Clutch (C1)
2	Direct Clutch (C2)
3	Reverse Clutch (C3)
4	2nd Coast and 4th Brake (B1)
5	1st and Reverse Brake (B3)
6	One Way Clutch No. 2 (F2)
7	Counter Drive Gear
8	From Torque Converter
9	Input Shaft
10	Intermediate Shaft
11	Differential Gear
12	Counter Driven Gear
13	Rear Planetary Gear
14	Front Planetary Gear
15	Pinion Gear
16	Sun Gear
17	Ring Gear

D - 4th Gear

	Input, Locked, Output
--	-----------------------

Planetary Gear Unit	Input: Planetary Carrier Locked: Rear Sun Gear Output: Ring Gear
---------------------	--

1. The input shaft rotates clockwise.
2. When the direct clutch (C2) rotates clockwise, it connects the input shaft to the planetary carrier.
3. The planetary carrier rotates clockwise.
4. The 2nd coast and 4th brake (B1) operation prevents the rotation of the rear sun gear.
5. The planetary long pinion rotates clockwise on its axis while rotating clockwise orbitally.
6. The planetary short pinion rotates counterclockwise on its axis.
7. The front sun gear rotates clockwise.
8. The ring gear rotates clockwise.
9. The counter drive gear rotates clockwise.
10. The counter driven gear rotates counterclockwise.
11. The differential gear rotates clockwise.

MANUAL THIRD GEAR

Manual Third Gear

Shift Position		Clutch			Brake		One-way Clutch
		C1	C2	C3	B1	B3	F2
D	3rd	ON	ON	OFF	OFF	OFF	OFF

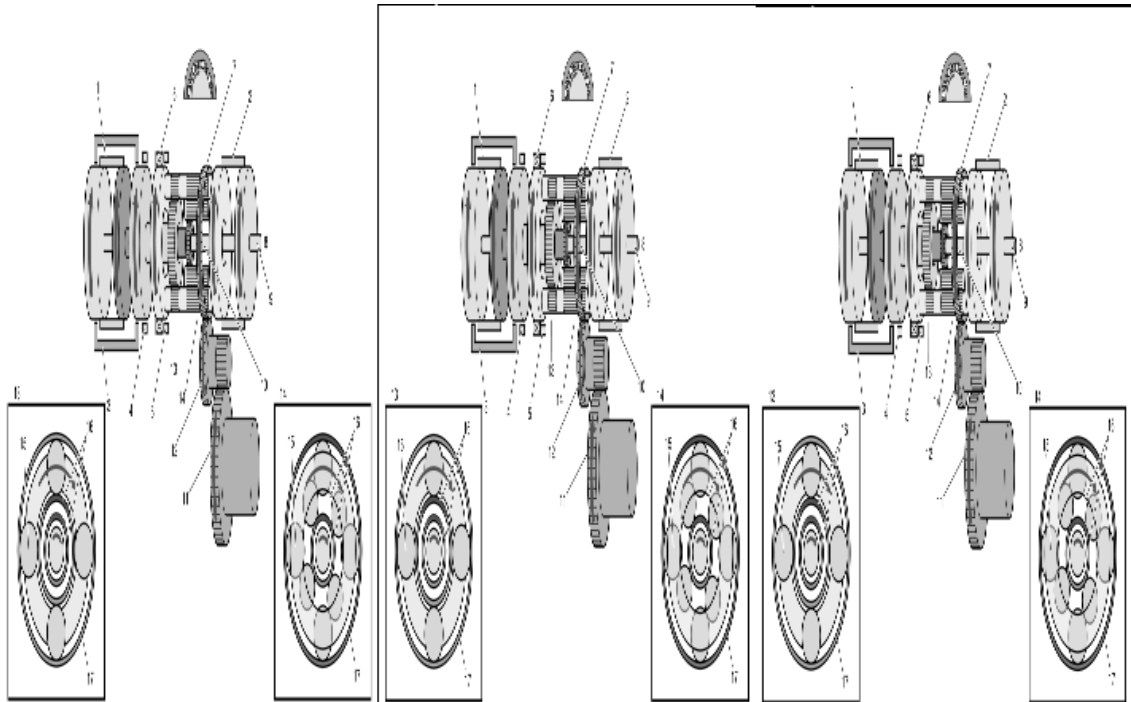


Fig. 336: Manual Third Gear

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Forward Clutch (C1)
2	Direct Clutch (C2)
3	Reverse Clutch (C3)
4	2nd Coast and 4th Brake (B1)
5	1st and Reverse Brake (B3)
6	One Way Clutch No. 2 (F2)
7	Counter Drive Gear
8	From Torque Converter
9	Input Shaft
10	Intermediate Shaft
11	Differential Gear
12	Counter Driven Gear
13	Rear Planetary Gear
14	Front Planetary Gear
15	Pinion Gear
16	Sun Gear
17	Ring Gear

D - 3rd Gear

Planetary Gear Unit	Input, Locked, Output
	Input: Front Sun Gear, Planetary Carrier Locked: - Output: Ring Gear

1. The input shaft rotates clockwise.
2. When the forward clutch (C1) rotates clockwise, it connects the intermediate shaft to the front sun gear.
3. When the direct clutch (C2) rotates clockwise, it connects the input shaft to the planetary carrier.
4. The planetary carrier rotates clockwise. The planetary short pinion and the planetary long pinion cannot rotate itself, so the planetary gear unit rotates clockwise as one.
5. The counter drive gear rotates clockwise.
6. The counter driven gear rotates counterclockwise.
7. The differential gear rotates clockwise.

MANUAL SECOND GEAR

Manual Second Gear

	Clutch			Brake		One-way Clutch

Shift Position		C1	C2	C3	B1	B3	F2
D	2nd	ON	OFF	OFF	ON	OFF	OFF

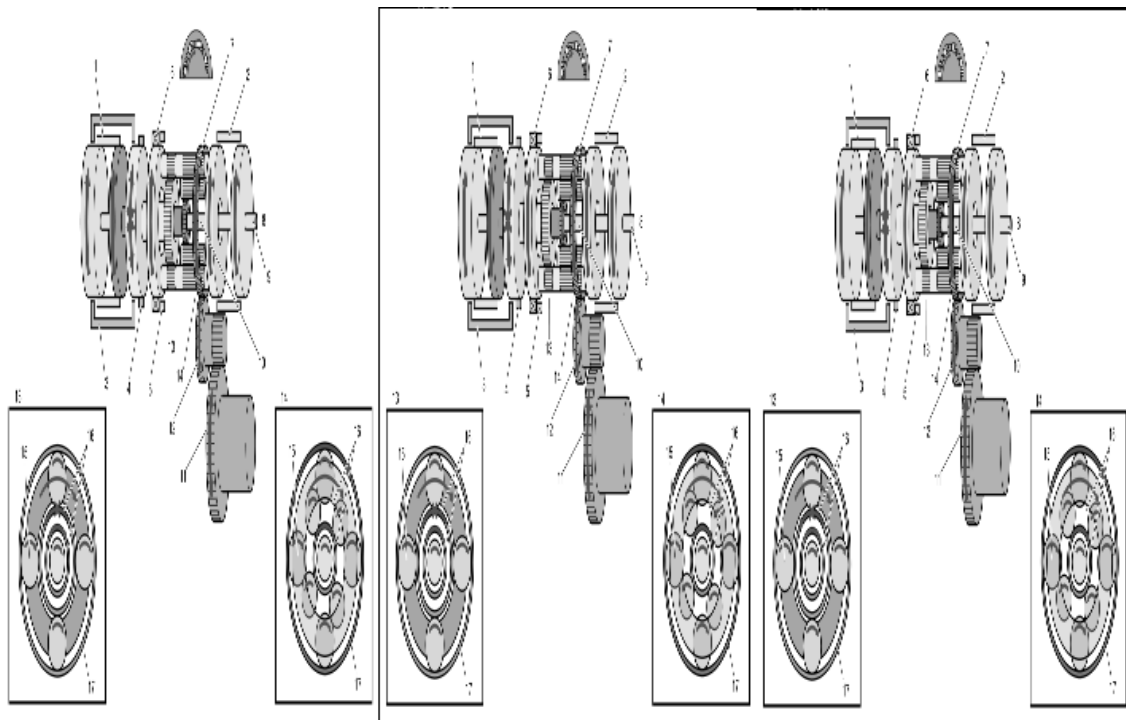


Fig. 337: Manual Second Gear
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Forward Clutch (C1)
2	Direct Clutch (C2)
3	Reverse Clutch (C3)
4	2nd Coast and 4th Brake (B1)
5	1st and Reverse Brake (B3)
6	One Way Clutch No. 2 (F2)
7	Counter Drive Gear
8	From Torque Converter
9	Input Shaft
10	Intermediate Shaft
11	Differential Gear
12	Counter Driven Gear
13	Rear Planetary Gear
14	Front Planetary Gear
15	Pinion Gear
16	Sun Gear
17	Ring Gear

D - 2nd Gear

Planetary Gear Unit	Input, Locked, Output
	Input: Sun Gear Locked: Rear Sun Gear Output: Ring Gear

1. The input shaft rotates clockwise.
2. When the forward clutch (C1) rotates clockwise, it connects the intermediate shaft to the front sun gear.
3. The front sun gear rotates clockwise.
4. The planetary short pinion rotates itself counterclockwise.
5. The planetary long pinion rotates itself clockwise.
6. The 2nd coast and 4th brake (B1) operation prevents the rotation of the rear sun gear.
7. The planetary carrier rotates clockwise.
8. The ring gear rotates clockwise.
9. The counter drive gear rotates clockwise.
10. The counter driven gear rotates counterclockwise.
11. The differential gear rotates clockwise.

MANUAL FIRST GEAR

Manual First Gear

Shift Position		Clutch			Brake		One-way Clutch
		C1	C2	C3	B1	B3	F2
D	1st	ON	OFF	OFF	OFF	OFF	ON

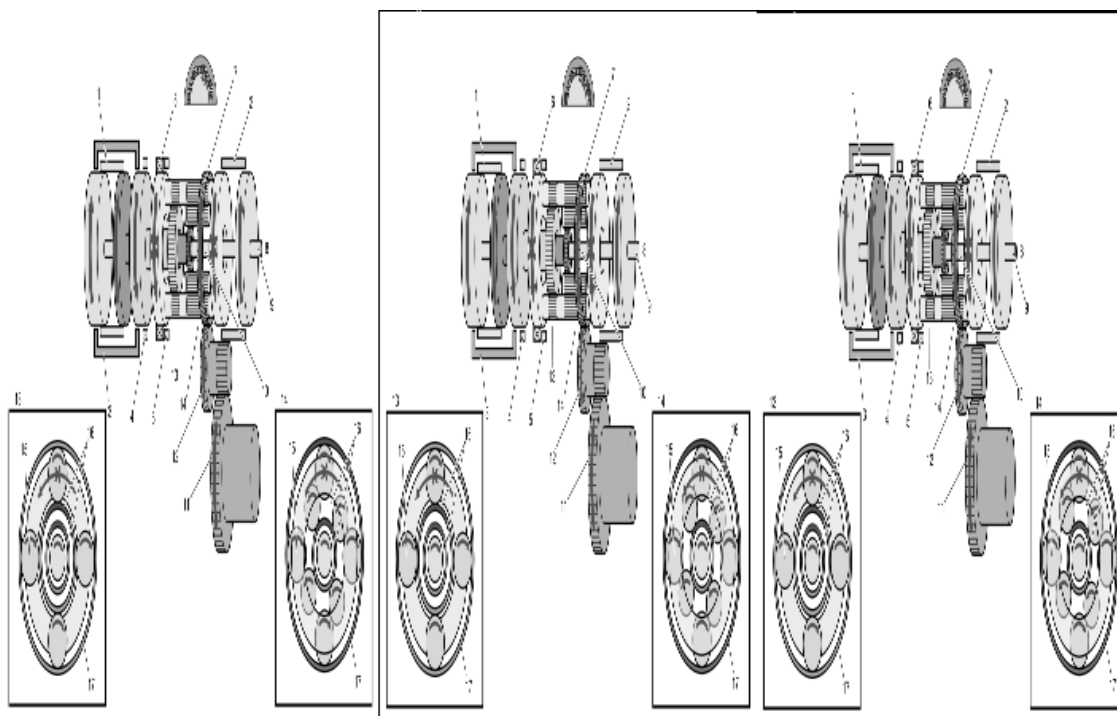


Fig. 338: Manual First Gear
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Forward Clutch (C1)
2	Direct Clutch (C2)
3	Reverse Clutch (C3)
4	2nd Coast and 4th Brake (B1)
5	1st and Reverse Brake (B3)
6	One Way Clutch No. 2 (F2)
7	Counter Drive Gear
8	From Torque Converter
9	Input Shaft
10	Intermediate Shaft
11	Differential Gear
12	Counter Driven Gear
13	Rear Planetary Gear
14	Front Planetary Gear
15	Pinion Gear
16	Sun Gear
17	Ring Gear

D - 1st Gear

	Input, Locked, Output
--	-----------------------

Planetary Gear Unit	Input: Sun Gear Locked: Carrier Output: Ring Gear
---------------------	---

1. The input shaft rotates clockwise.
2. When the forward clutch (C1) rotates clockwise, it connects the intermediate shaft to the front sun gear.
3. The front sun gear rotates clockwise.
4. The planetary short pinion rotates itself counterclockwise.
5. The planetary long pinion rotates itself clockwise.
6. The one-way clutch (F2) operation prevents the counterclockwise rotation of the planetary carrier.
7. The ring gear rotates clockwise.
8. The counter drive gear rotates clockwise.
9. The counter driven gear rotates counterclockwise.
10. The differential gear rotates clockwise.

REVERSE

Reverse

Shift Position		Clutch			Brake		One-way Clutch
		C1	C2	C3	B1	B3	F2
R	V less than or equal to 7 km/h (4 mph)	OFF	OFF	ON	OFF	ON	OFF
	V greater than 7 km/h (4 mph)	OFF	OFF	ON	OFF	OFF	OFF

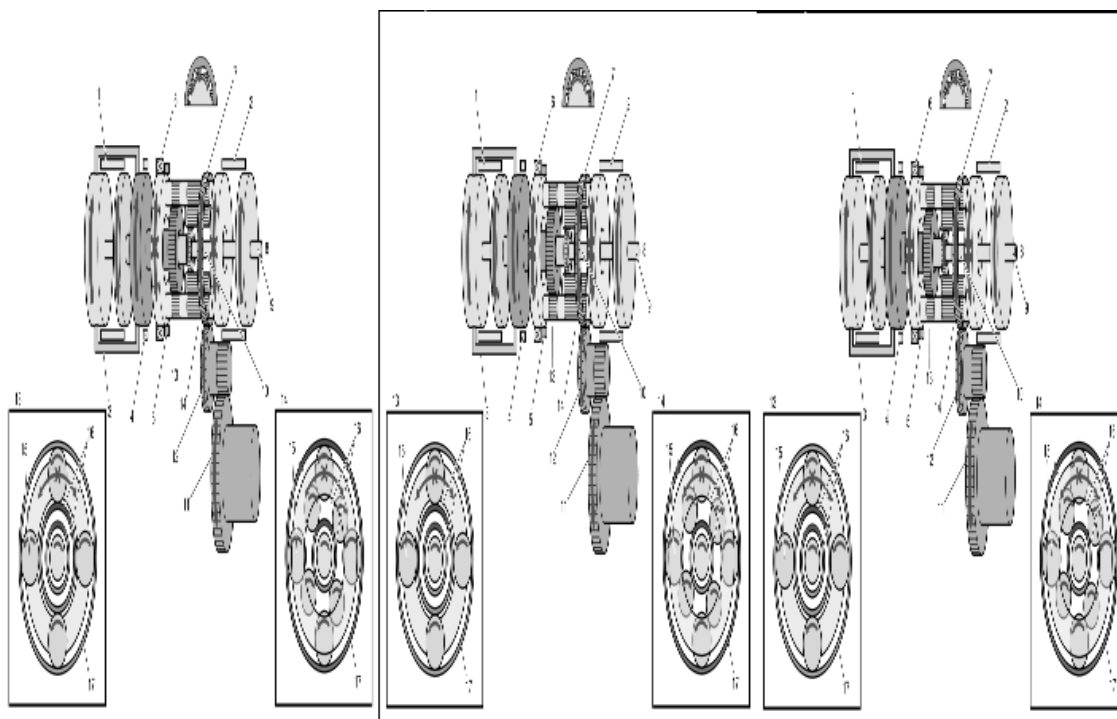


Fig. 339: Reverse Clutch
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Forward Clutch (C1)
2	Direct Clutch (C2)
3	Reverse Clutch (C3)
4	2nd Coast and 4th Brake (B1)
5	1st and Reverse Brake (B3)
6	One Way Clutch No. 2 (F2)
7	Counter Drive Gear
8	From Torque Converter
9	Input Shaft
10	Intermediate Shaft
11	Differential Gear
12	Counter Driven Gear
13	Rear Planetary Gear
14	Front Planetary Gear
15	Pinion Gear
16	Sun Gear
17	Ring Gear

Reverse Gear

	Input, Locked, Output
--	-----------------------

Planetary Gear Unit	Input: Rear Sun Gear Locked: Planetary Carrier Output: Ring Gear
---------------------	--

1. The input shaft rotates clockwise.
2. When the reverse clutch (C3) rotates clockwise, it connects the intermediate shaft to the rear planetary sun gear.
3. The 1st and reverse brake (B3) operation prevents the rotation of the planetary carrier.
4. The planetary long pinion rotates itself counterclockwise.
5. The planetary short pinion rotates itself clockwise.
6. The front sun gear rotates counterclockwise.
7. The ring gear rotates counterclockwise.
8. The counter drive gear rotates counterclockwise.
9. The counter driven gear rotates clockwise.
10. The differential gear rotates counterclockwise.

TRANSMISSION IDENTIFICATION INFORMATION

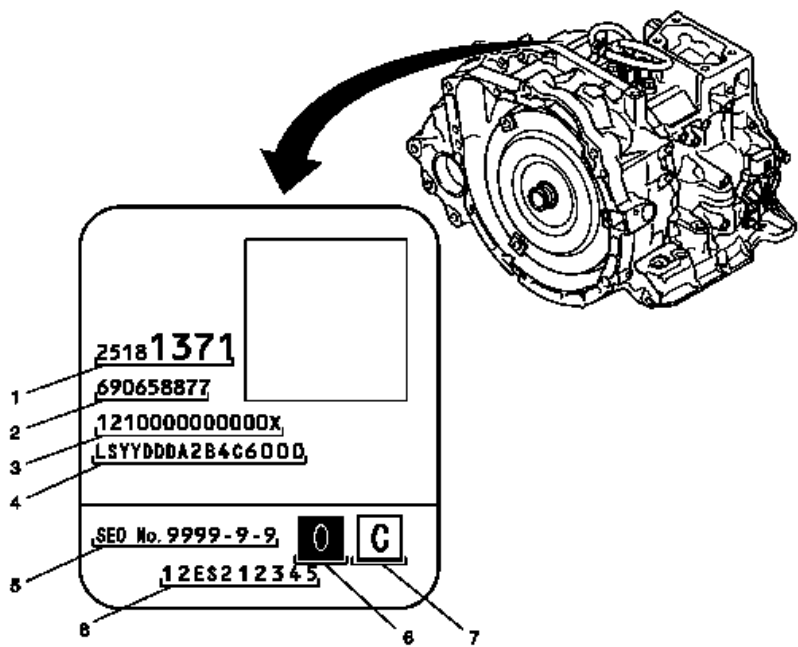


Fig. 340: Transmission Identification
 Courtesy of GENERAL MOTORS COMPANY

Transmission Identification Information

Position	Data
1	Parts number

2	DUNS number
3	VPPS number
4	Trace code L = Line ID S = Shift YY = Year DDD = Julian day A2B4C6000 = Aisin AW assigned serial number/lot/batch
5	Sequence number
6	Product category
7	Spec. category
8	Serial number 12 = Year of production (2012) E = Month of production • A: January • B: February • C: March • D: April • E: May • F: June • G: July • H: August • J: September • K: October • L: November • M: December S2 = Transmission Model 12345 = Sequence number per each month

TRANSMISSION GENERAL DESCRIPTION

The 80-40LE Gen-II is a compact, lightweight, electronically controlled 4-speed automatic transmission that employs a ravigneaux-type planetary gear. Based on a conventional highly efficient 4-speed automatic transmission, the gear train has been simplified to realize further enhanced efficiency.

Based on a conventional 4-speed automatic transmission, pressure control solenoids (SLC1, SLC2, SLB1 and SLU) have been adopted in place of the brake (B2) and one-way clutch (F1).

Lock Up and Slip Control

Based on output speed signals, signals from the ECM (engine speed and throttle opening amount) and the

vehicle speed, the lock up control solenoid assembly (SLU) is linearly controlled to perform lock up control smoothly. In addition, the slip rate of the lock-up clutch is detected by monitoring input speed signals, and slip control is performed.

Learning Control

The TCM performs gear shift control learning and garage shift control learning to provide smooth engagement when performing a garage shift as well as smooth engagement when shifting while driving.

Neutral Control

By disengaging the lock-up clutch when the vehicle is stationary and the shift lever is in the drive (D) position, the transmission effectively changes to neutral, reducing torque converter drag losses. This reduces engine load and vibration at idle and enhances fuel economy.

TRANSMISSION COMPONENT AND SYSTEM DESCRIPTION

Control Functions of the TCM

Automatic Gear Shift Control

Based on each gear shift pattern, shift solenoid (S1) turns ON or OFF and pressure control solenoids (SLC1, SLC2 and SLB1) are operated linearly according to information that includes the vehicle speed, the accelerator position, and brake signals.

Gear and Solenoid Operation

Gear	SLC1	SLC2	SLB1	S1
1st	A (B)	ON	OFF	C
1st Engine Brake	A (B)	A	OFF	ON
2nd	A (B)	ON	A	C
3rd	A	A (B)	OFF	OFF
4th	ON	A (B)	A	OFF
A: Controlled (Neutral Control), B: Controlled (Line Pressure), C: ON: (V < or ==14 km/h (8 mph)) / OFF: (V >14 km/h (8 mph))				

Driver Adaptive Mode Control

The 80-40LE GEN II is always in adaptive mode. It does not have a switch to allow the driver to select a driving mode.

When certain conditions are met, the TCM selects a suitable shift mode for the driving condition, and switches the modes automatically to provide the smooth gear shifts.

Mode	Description
Upslope	When driven on an uphill, the TCM determines the uphill driving based on information such as the signals from the ECM and output speed sensor, and

	switches the driving mode to upslope mode. This prevents the drive force from dropping.
Altitude	At the high ground to which the engine power falls, in order to secure the driving force, a shift point and a lock-up point are changed based on the atmospheric pressure signal transmitted from the ECM.
Cruise Mode	In order to prevent the busy shift under cruise run, based on the cruise signal transmitted from the ECM, a shift point and a lock-up point are changed.
Cruise Uphill Mode	It is the control for driving force reservation on the uphill in cruise control. A shift point is changed when the uphill is detected in the cruise mode.

Lock Up Control and Slip Control

Based on the output speed signals, signals from the ECM (engine speed and throttle opening amount) and the vehicle speed, the lock up control solenoid (SLU) is linearly controlled to perform the lock up control smoothly. In addition, the slip rate of the lock-up clutch is detected by monitoring input speed signals, and slip control is performed.

By allowing the lock-up clutch to slip when lock-up is OFF, slip control extends the lock-up range into lower vehicle speeds. This suppresses a rise in the engine speed and increases transmission efficiency, improving fuel economy. At the same time, through the slipping of the lock-up clutch, engine speed fluctuations can be absorbed by the torque converter.

Control	Description
Lock-Up Control	This control is performed using a lock-up control solenoid (SLU). The lock-up control solenoid (SLU) is linearly turned ON and OFF, the lock-up clutch inside the torque converter is operated, and the pump impeller and turbine runner are connected. This enables the coupling of the engine and the automatic transmission. The engine output is transmitted directly to the automatic transmission, eliminating transmission losses and enhancing fuel economy.
Slip Control	This control is performed using the lock-up control solenoid (SLU). The lock-up control solenoid (SLU) is linearly turned ON and OFF and the lock-up clutch inside the torque converter is operated outside of the lock-up range. The lock-up clutch slips without being completely engaged, increasing transmission efficiency and enhancing fuel economy. However, as the lock-up clutch is slipping, the specified ATF must be used in order for lock-up control to operate correctly.

Neutral Control

By disengaging the lock-up clutch when the vehicle is stationary and the shift lever is in the drive (D) position, the transmission effectively changes to neutral, reducing torque converter drag losses. This reduces engine load and vibration at idle and enhances fuel economy. If the brake pedal is then released, normal creep force will be generated, enabling smooth starting OFF.

- The C1 clutch is controlled separately by the linear solenoid during neutral control.

- If the vehicle is stopped on an uphill creep force is not generated because the transmission is in neutral when neutral control is active. As such, the B1 solenoid operates to keep the vehicle in the same position so that the vehicle can safely start off even on uphills. This is referred to as hill-hold.
- Neutral control is only available when the engine is warm.
- When driven on a steep hill, neutral control is not available.

Garage Shift Control

After the engine is started, when the shift lever is moved from the neutral (N) position to the drive (D) position or from the neutral (N) position to the reverse (R) position, the pressure control solenoids (SLC1 and SLC2) supply the optimal amount of hydraulic pressure to the C1 and C3 clutches, realizing smooth engagement without shift shock.

- When the engine is cold, the stroke resistance of the C1 clutch piston during the first shift operation increases, this in turn creates a lag in shift operation. In order to reduce the amount of lag, control is not performed.
- By controlling the hydraulic pressure according to the piston stroke, smooth engagement without shock is possible.

Reverse Control

If the shift lever is moved from the neutral (N) position to the reverse (R) position while the vehicle is traveling and the transmission shifts into reverse, the wheels may lock up, which is extremely dangerous. In order to avoid this, the TCM prohibits the transmission from shifting into reverse while traveling.

- Even when the shift lever is moved from the neutral (N) position to the reverse (R) position, the transmission does not shift into reverse if the vehicle speed is 7 km/h (4 mph) or more.
- When this control is activated, the B3 brake is released so that the transmission does not shift into reverse.
- Reverse control takes precedence over shift control between the neutral (N) and reverse (R) ranges.

Hydraulic Components

Hydraulic pressure is generated at the oil pump, and the valve body supplies the hydraulic pressure by switching the fluid passages. Based on the control signal from the TCM, the solenoid valves are activated to control the hydraulic pressure to the clutches and brakes, performing gear shifting and lock-up control. In addition, the appropriate amount of fluid is supplied to the torque converter, planetary gears and lubricating parts.

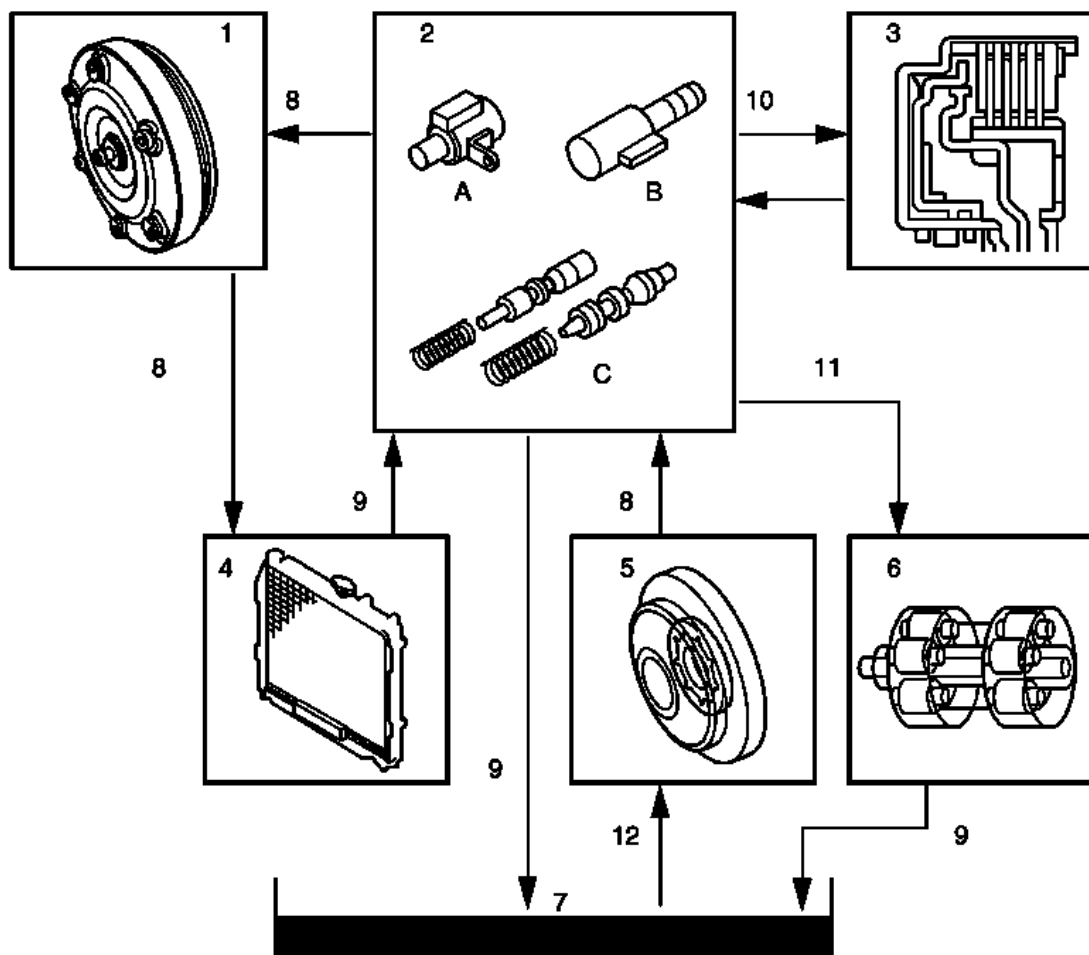


Fig. 341: Identifying Hydraulic Components
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Torque Converter
2	Valve Body
2a	Solenoid
2b	Linear Solenoid
2c	Control Valve
3	Clutch, Brake
4	Oil Cooler
5	Oil Pump
6	Planetary Gear
7	Oil
8	Sending ATF
9	Return

10	Operating Pressure
11	Lubrication
12	Oil Pump Pressure

Mechanical Components

The torque converter consists of the converter case, pump impeller, turbine runner, stator, one-way clutch, and lock-up clutch. The torque converter transmits and amplifies the torque by means of the ATF inside it. By operating the lock-up clutch, the engine and automatic transmission are directly connected, enhancing power transmission and improving fuel efficiency.

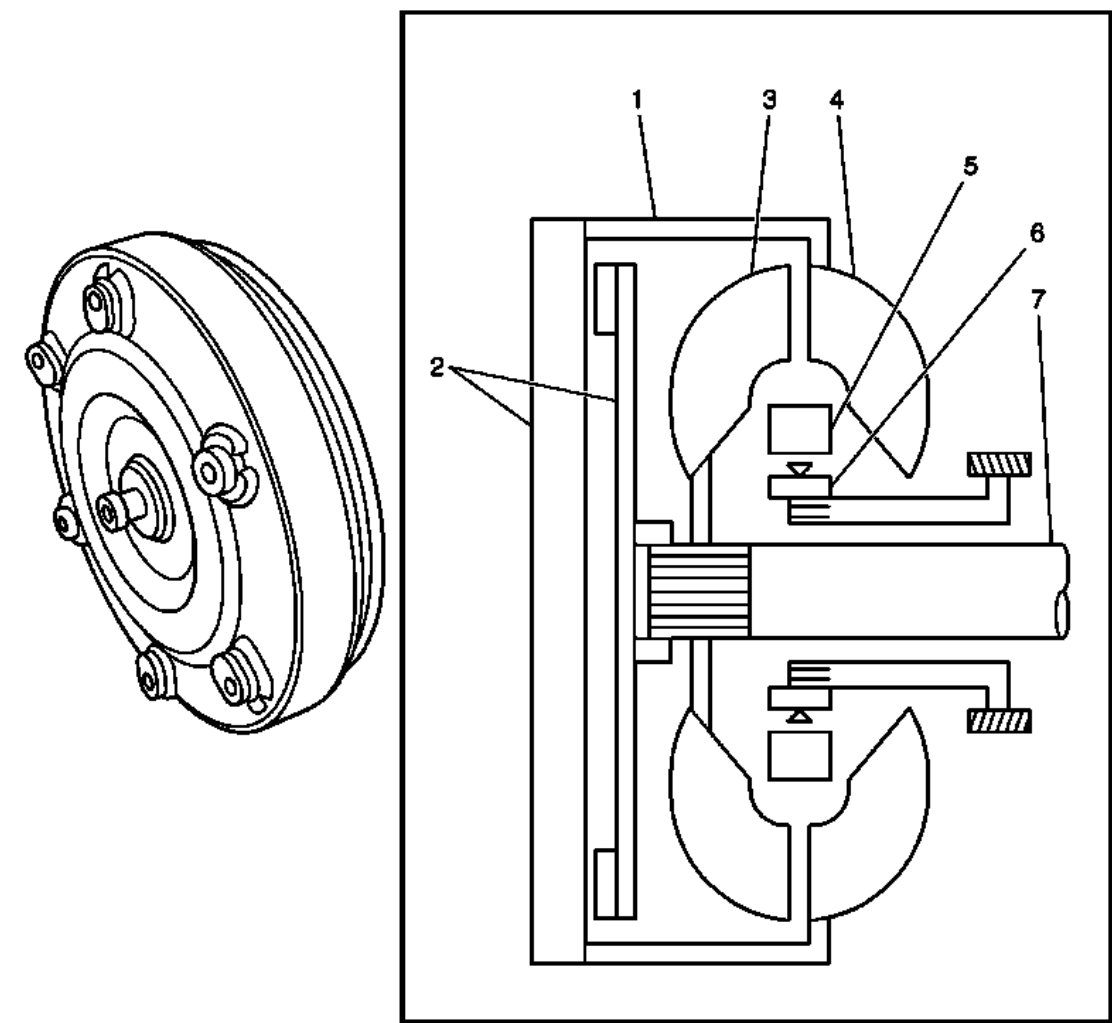


Fig. 342: Torque Converter Components
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Torque Converter Housing
2	Torque Converter Clutch

3	Turbine
4	Pump Impeller
5	Stator
6	Oil Pump
7	Input Shaft

Operation of Clutches and Brakes

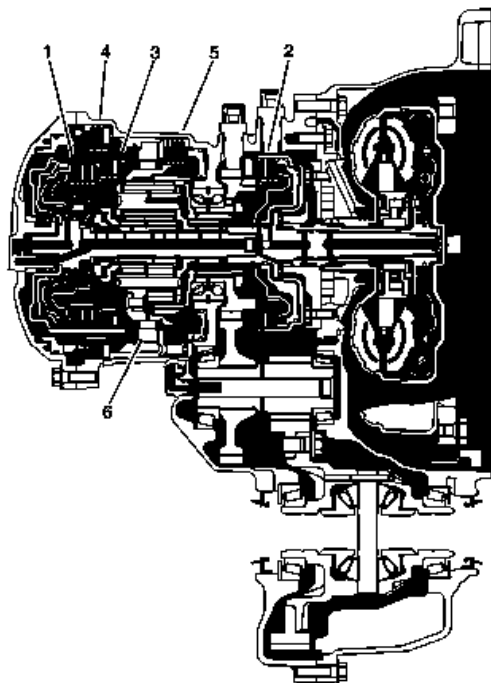


Fig. 343: Operation of Clutches and Brakes
Courtesy of GENERAL MOTORS COMPANY

Clutch and Brake		Operation
1	C1 - Forward Clutch	Connects intermediate shaft to front sun gear
2	C2 - Direct Clutch	Connects input shaft to planetary carrier
3	C3 - Reverse Clutch	Connects intermediate shaft to rear sun gear
4	B1 - 2nd Coast and 4th Brake	Prevents rotation of rear sun gear
5	B3 - 1st and Reverse Brake	Prevents rotation of planetary carrier
6	F2 - One-way Clutch No. 2	Prevents counterclockwise rotation of planetary carrier

Transmission Range Reference

Shift Position		Clutch			Brake		One-way Clutch
		C1	C2	C3	B1	B3	F2
P		OFF	OFF	OFF	OFF	OFF	OFF

R	V less than or equal to 7 km/h (4 mph)	OFF	OFF	ON	OFF	ON	OFF
	V greater than 7 km/h (4 mph)	OFF	OFF	ON	OFF	OFF	OFF
N		OFF	OFF	OFF	OFF	OFF	OFF
D	1st	ON	OFF	OFF	OFF	OFF	ON
	1st Engine Brake	ON	OFF	OFF	OFF	ON	ON
	2nd	ON	OFF	OFF	ON	OFF	OFF
	2nd-3rd	ON	OFF-ON	OFF	ON-OFF	OFF	OFF
	3rd	ON	ON	OFF	OFF	OFF	OFF
	3rd-4th	ON-OFF	ON	OFF	OFF-ON	OFF	OFF
	4th	OFF	ON	OFF	ON	OFF	OFF

ELECTRONIC COMPONENT DESCRIPTION

Park/Neutral Position (PNP) Switch

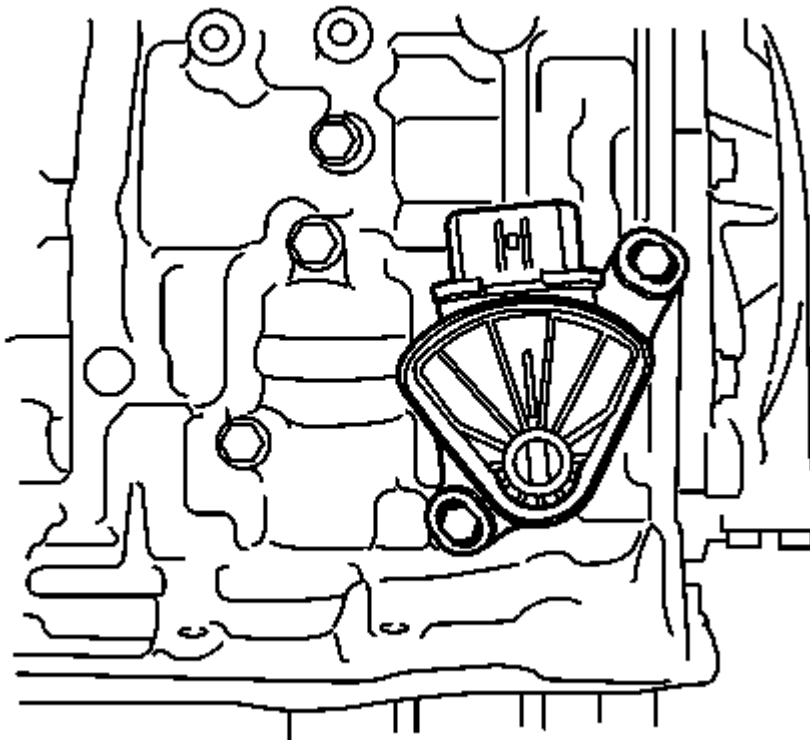


Fig. 344: Selector Lever Shaft With Neutral Basic Line
Courtesy of GENERAL MOTORS COMPANY

The park/neutral position (PNP) switch uses the combination of the circuit terminals to transmit information to the TCM about which range the automatic transmission is in.

The engine is only allowed to start with the shift lever in the park (P) or neutral (N) position. The signals are used for the gear shift control.

Automatic Transmission Wiring Harness

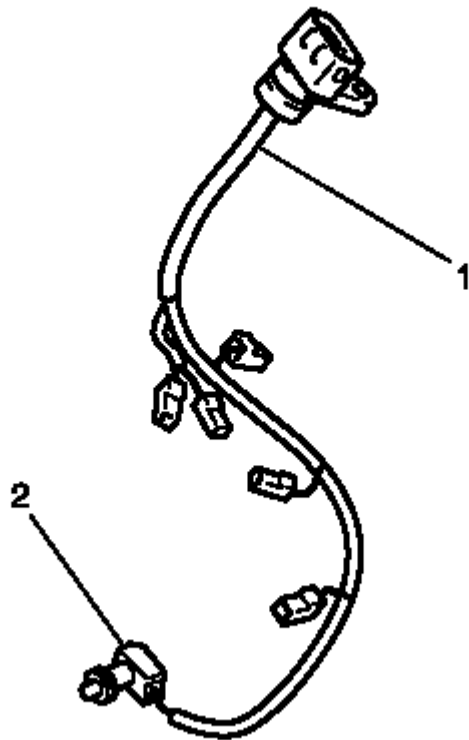


Fig. 345: A/T Wiring Harness And TFT Sensor
Courtesy of GENERAL MOTORS COMPANY

The A/T wiring harness (1) is installed on the transmission case and connects to the transmission fluid temperature (TFT) sensor and each solenoid.

The TFT sensor (2), which is integrated into the A/T wiring harness, is installed on the valve body. It directly detects the oil temperature within the hydraulic pressure control circuit and, based on that temperature, it transmits a signal to the TCM. In response to changes in oil temperature, the TCM controls the gear shifting for the smooth shifting across a wide range of temperatures.

Shift Solenoid Valve

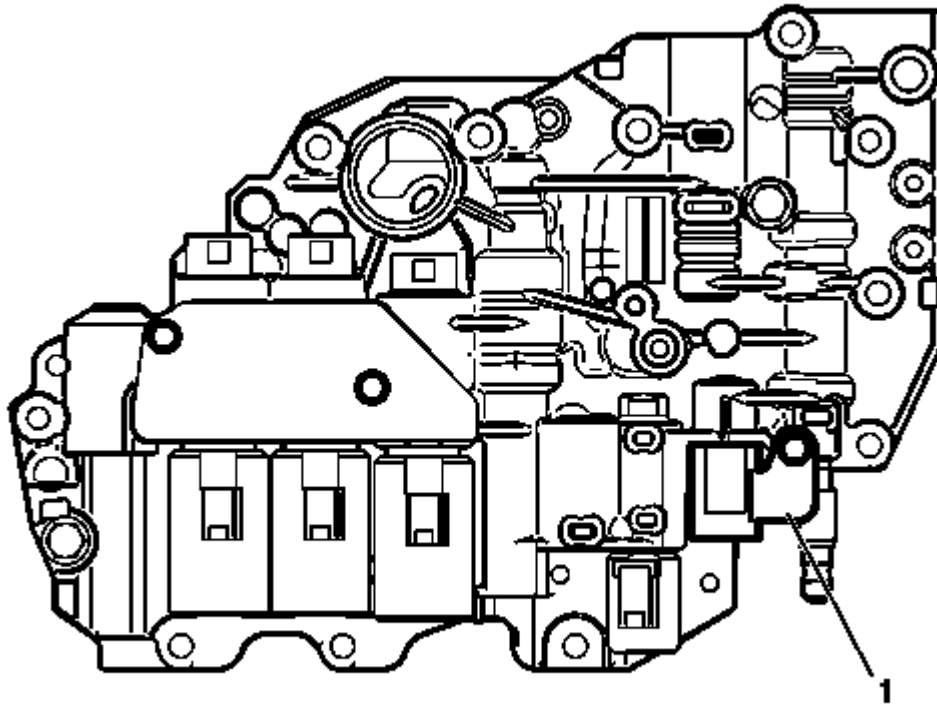


Fig. 346: Shift Solenoid Valve

Courtesy of GENERAL MOTORS COMPANY

The shift solenoid (S1) valve (1) is installed on the valve body, and turns ON and OFF based on signals received from the TCM. According to the ON or OFF status of the S1 solenoid valve, the oil passages are switched to realize fuel efficiency. As a fail-safe function, if a S1 solenoid valve abnormality occurs, the TCM will shut off current to the solenoid.

Pressure Control Solenoid Valve (SLC1, SLC2 and SLB1)

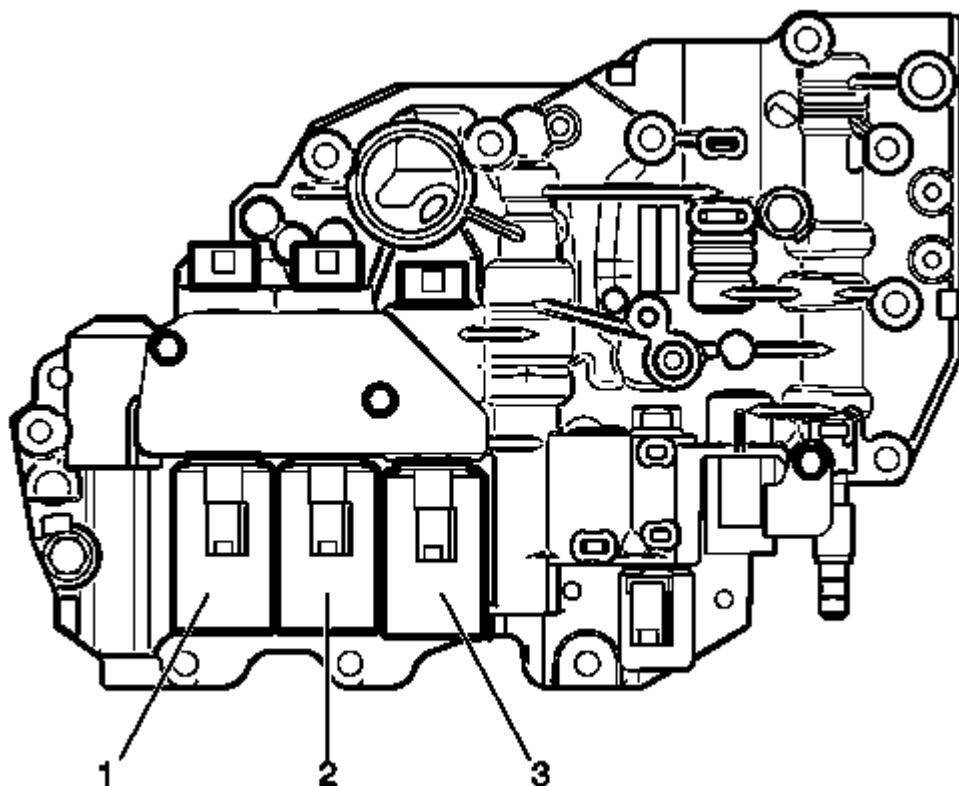


Fig. 347: Pressure Control Solenoid Valve (SLC1, SLC2 And SLB1)
Courtesy of GENERAL MOTORS COMPANY

The pressure control solenoids (SLC1(1), SLC2(2) and SLB1(3)) are installed on the valve body, and linearly control hydraulic pressure based on the signals output from the TCM. In this way, hydraulic pressure to the clutches (C1, C2, and C3) and brakes (B1 and B3) is controlled, realizing smooth gear shifts.

Each solenoid performs the gear shifting between 1st and 4th gears and at the same time performs the line pressure control.

As a fail-safe function, if a solenoid abnormality occurs, the TCM will shut off the current to the relevant line pressure control solenoids.

Lock-up Control Solenoid Valve (SLU)

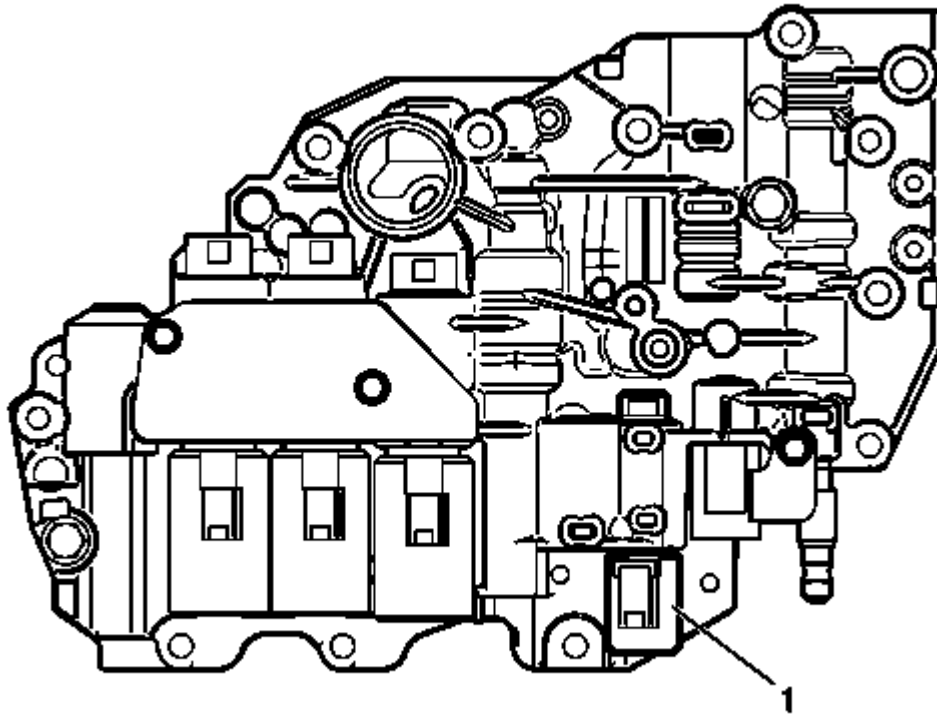


Fig. 348: Lock-up Control Solenoid Valve (SLU)
Courtesy of GENERAL MOTORS COMPANY

The lock-up control solenoid (SLU) (1) is installed on the valve body. Based on the engine speed signal, throttle opening amount signal, input speed sensor signal and output speed sensor signal, the TCM applies current to the lock-up control solenoid (SLU) to linearly control lock-up clutch hydraulic pressure. In this way, lock up control and slip control is performed. As a fail-safe function, if a lock-up control solenoid (SLU) abnormality occurs, then the TCM will shut off the current to the solenoid.

Input and Output Speed Sensor

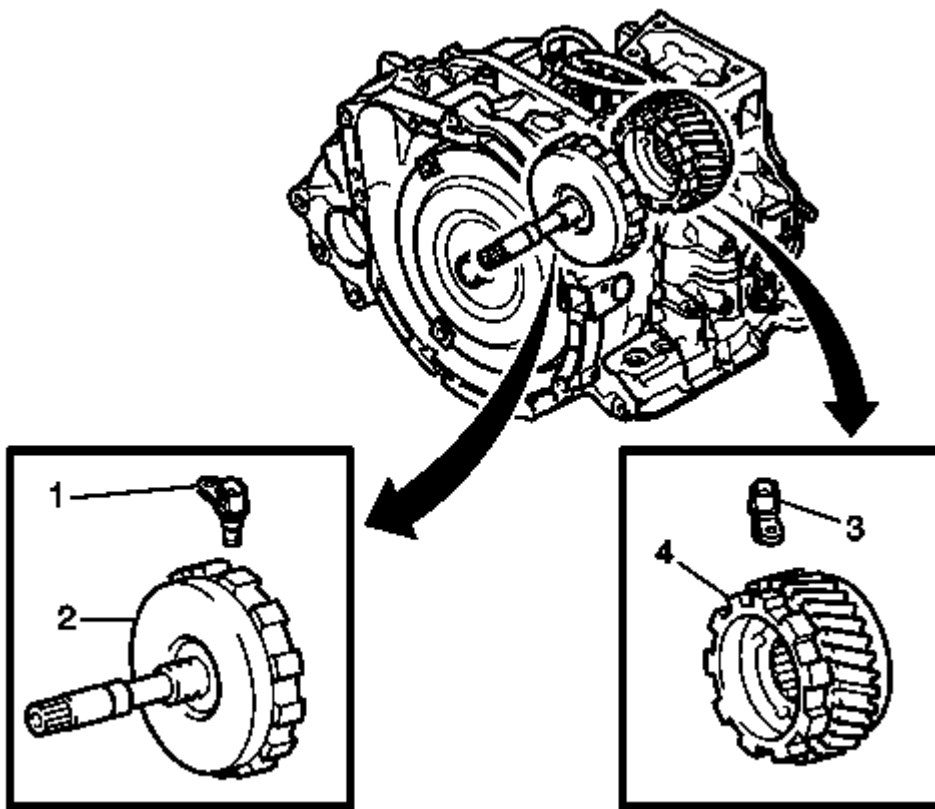


Fig. 349: Input Speed Sensor And Output Speed Sensor
 Courtesy of GENERAL MOTORS COMPANY

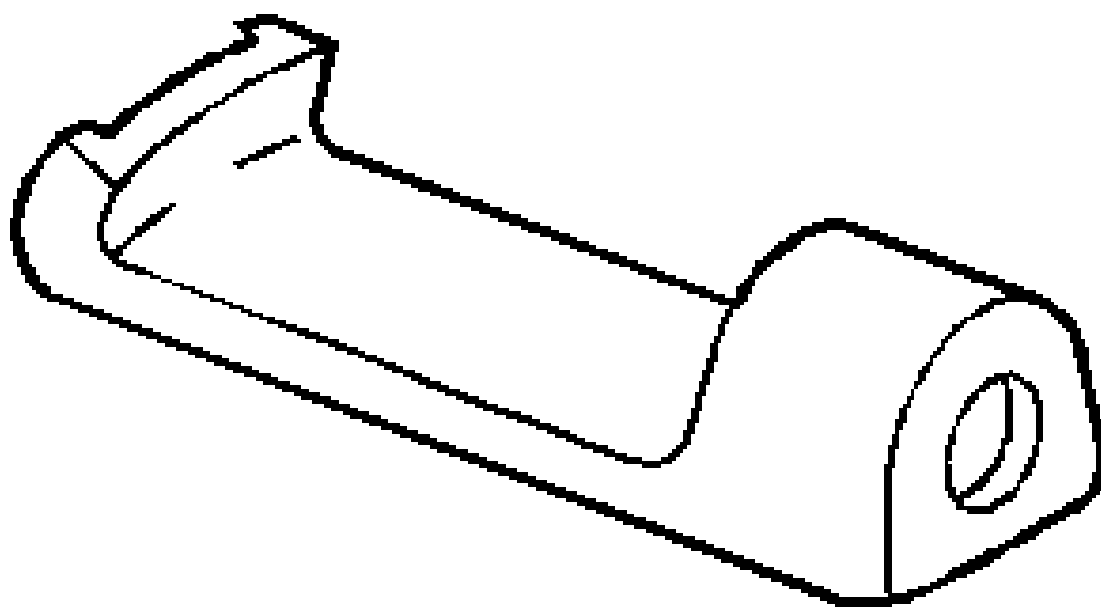
The speed sensors are installed in the transmission case. The input speed sensor (1) detects the revolution speed of the intermediate shaft C2 drum (2) as the input shaft speed. The output speed sensor (3) detects the revolution speed of the counter drive gear (4) as the output shaft speed. These signals are transmitted to the TCM.

Based on those signals, the TCM controls engine torque, shift timing, and lock-up.

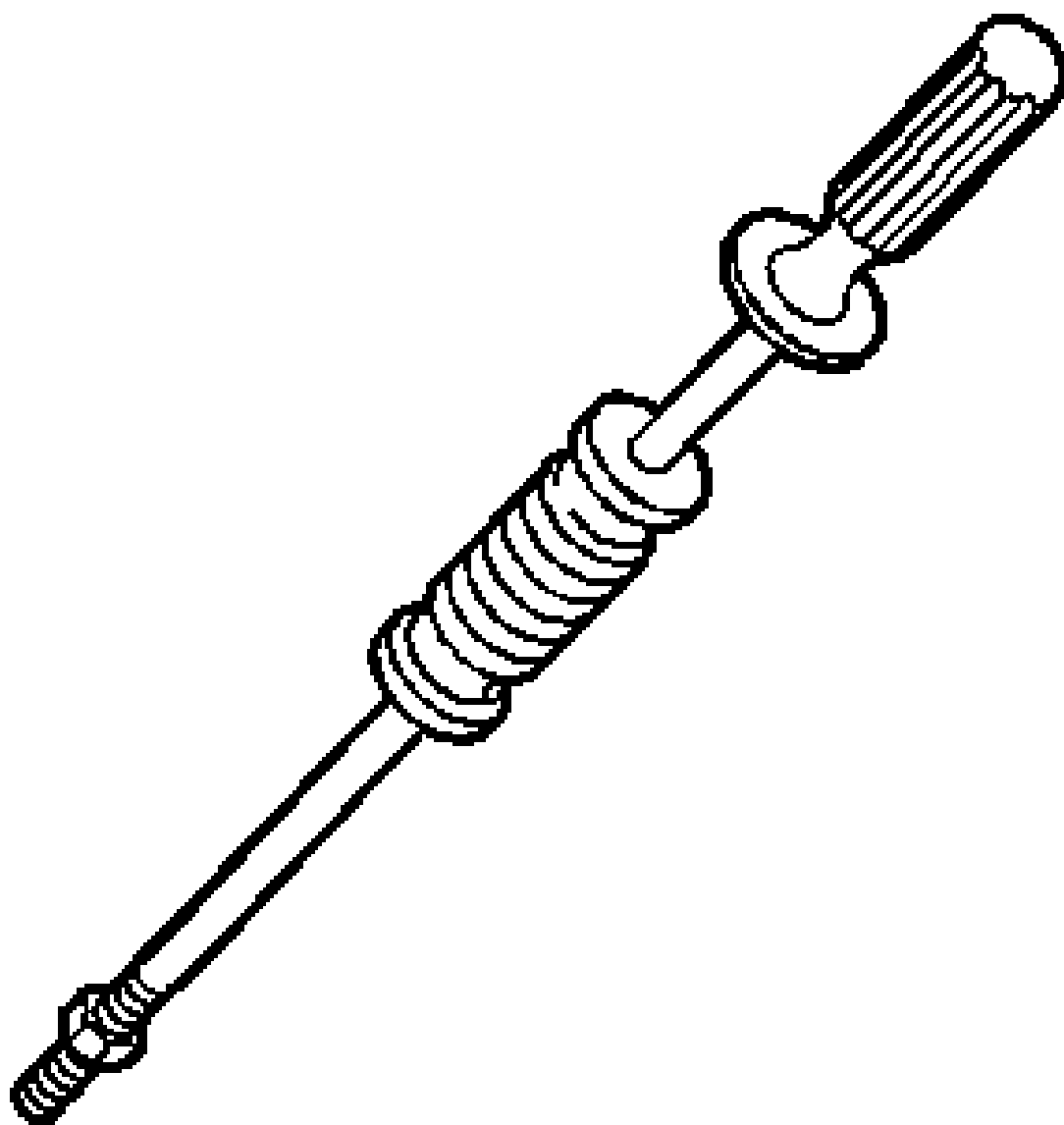
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

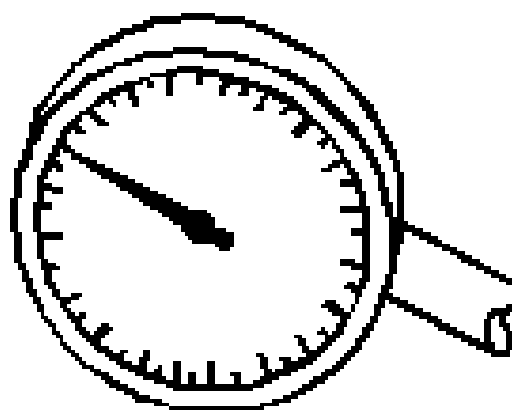
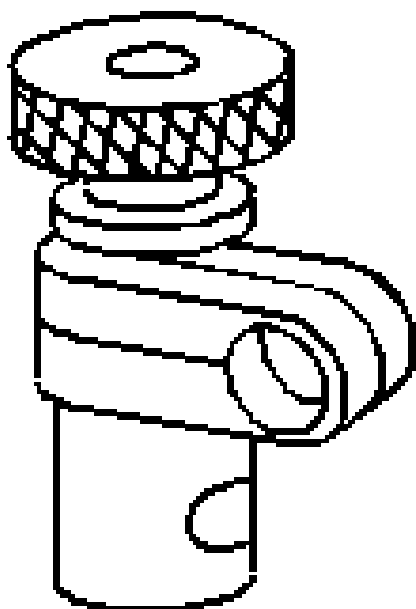
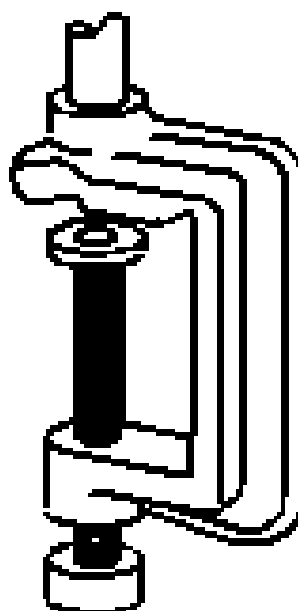
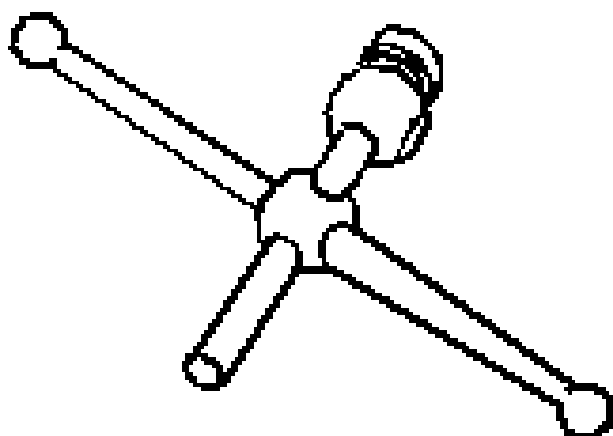
Illustration	Tool Number/ Description



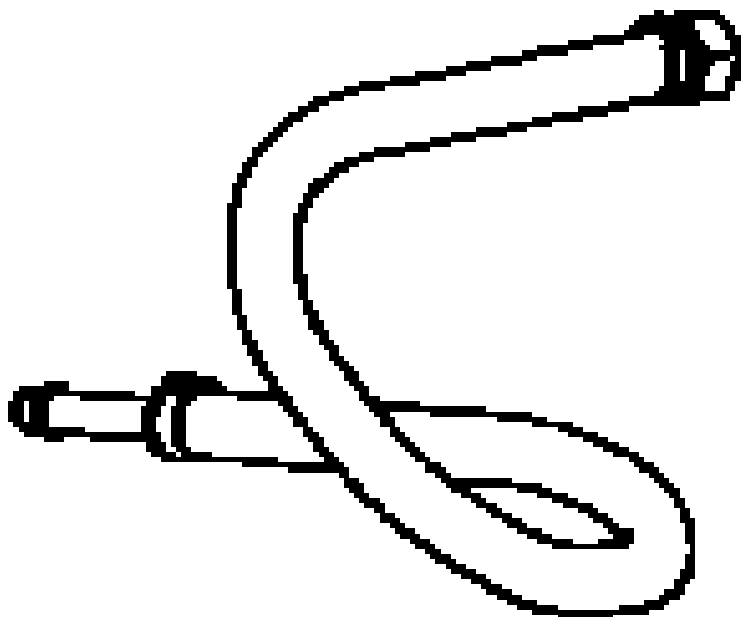
DT-586 (J-2312)
Universal Seal
Remover



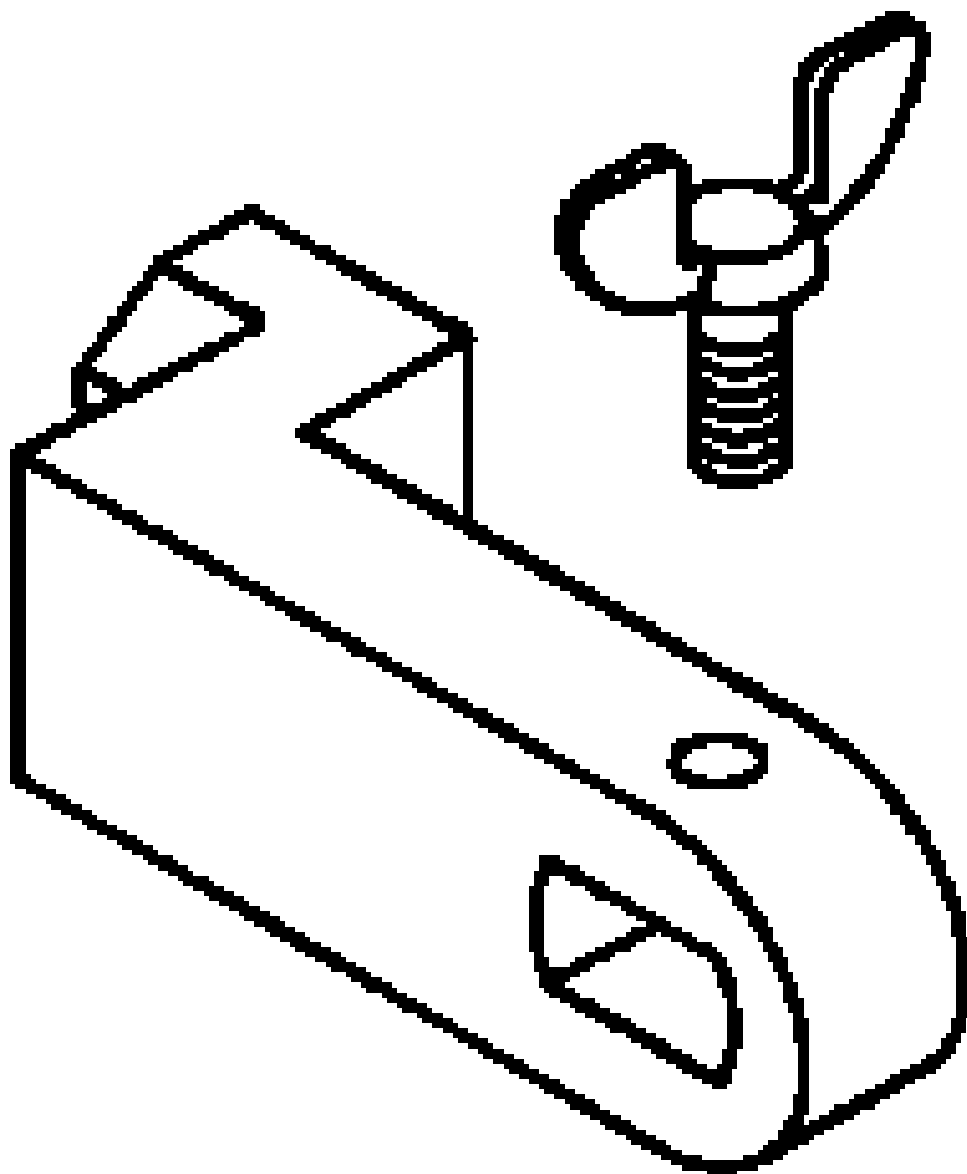
DT-7004 (J-612!
1B)
Slide Hammer w.
Adapter



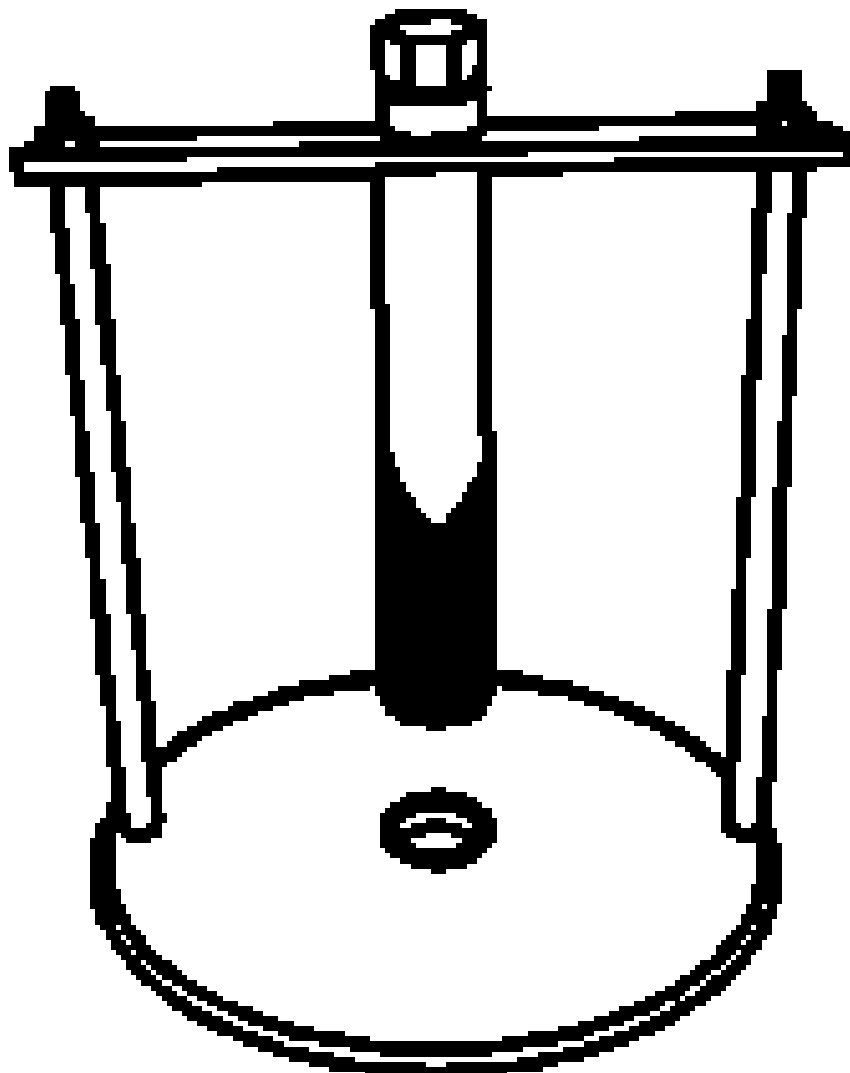
DT-45096 (J-450)
Transmission O
Cooling System
Flush and Flow T
Tool



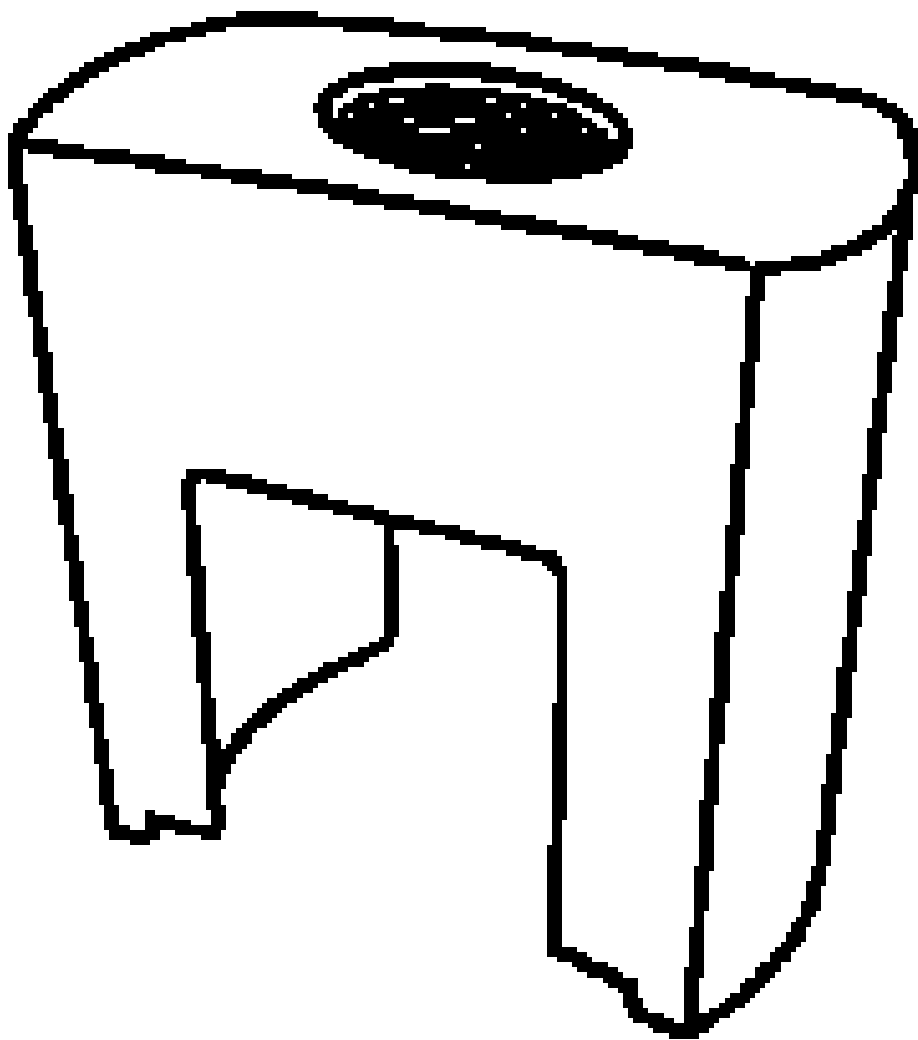
DT-45096-55 (J
45096-55)
Transmission Coc
Flush Adapter



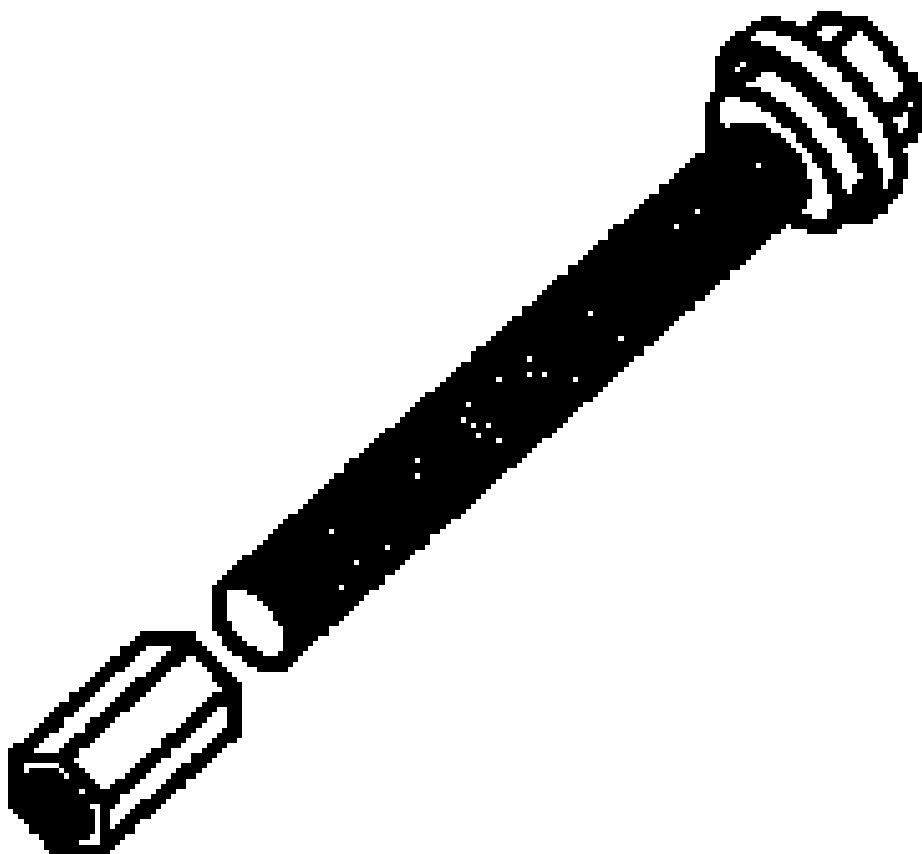
DT-45404 (J-454)
Transmission
Indicator Alignment
Tool



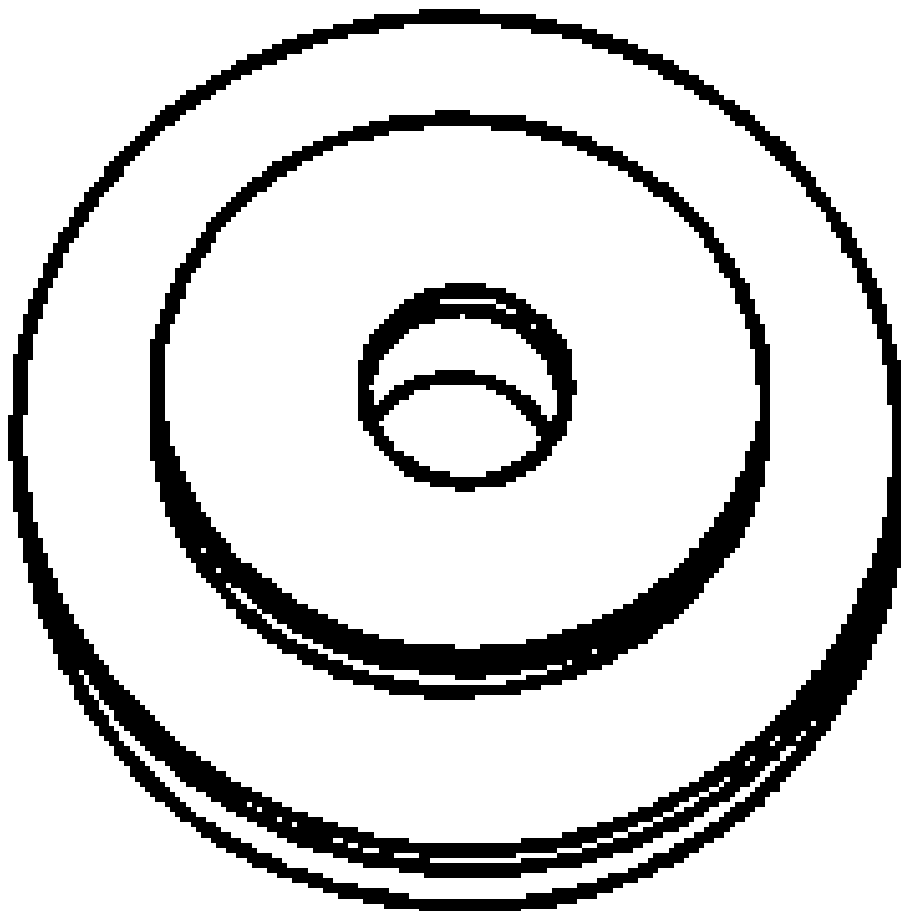
DT-46451 (DW
240-020)
Brake/Clutch Spring
Compressor



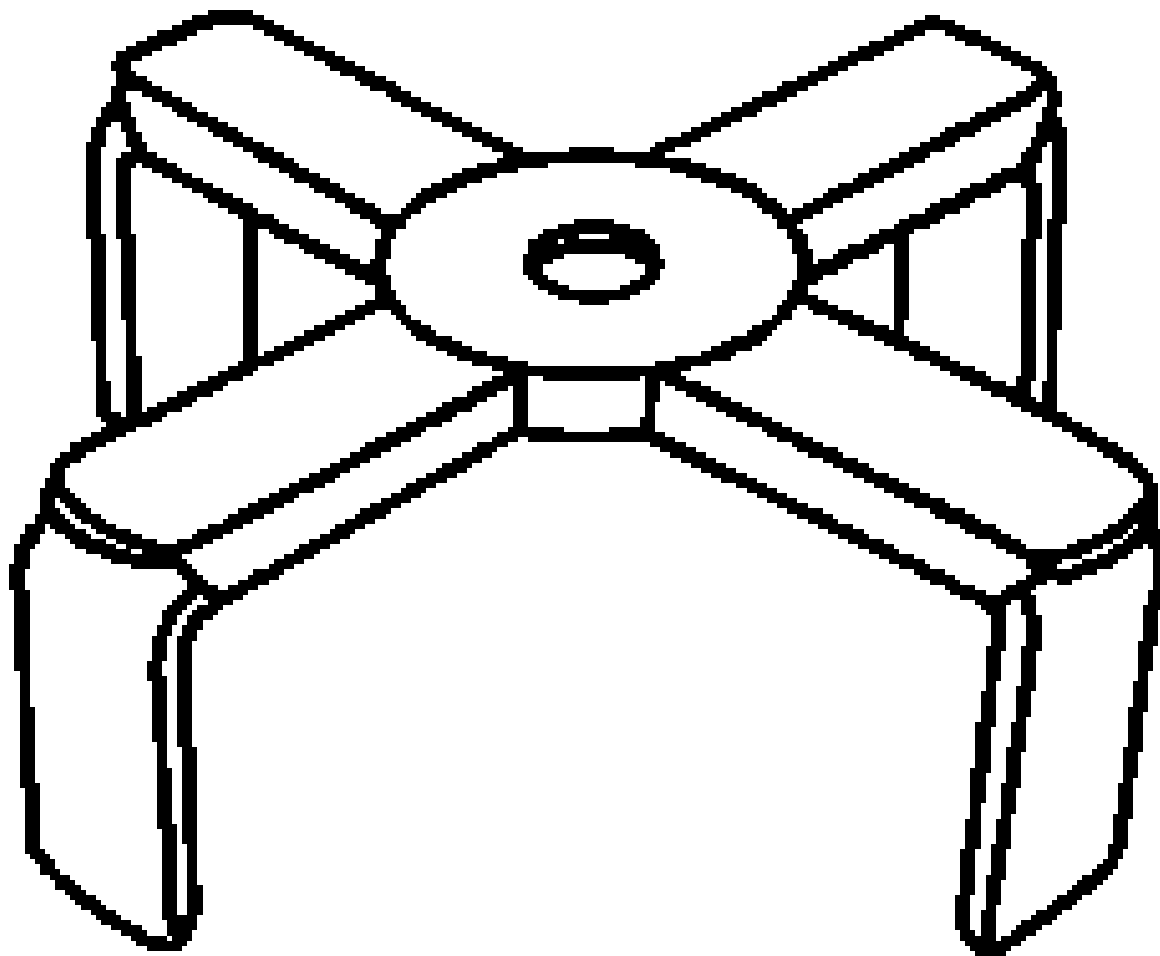
DT-46453 (DW
240-040)
Direct Clutch
Adapter



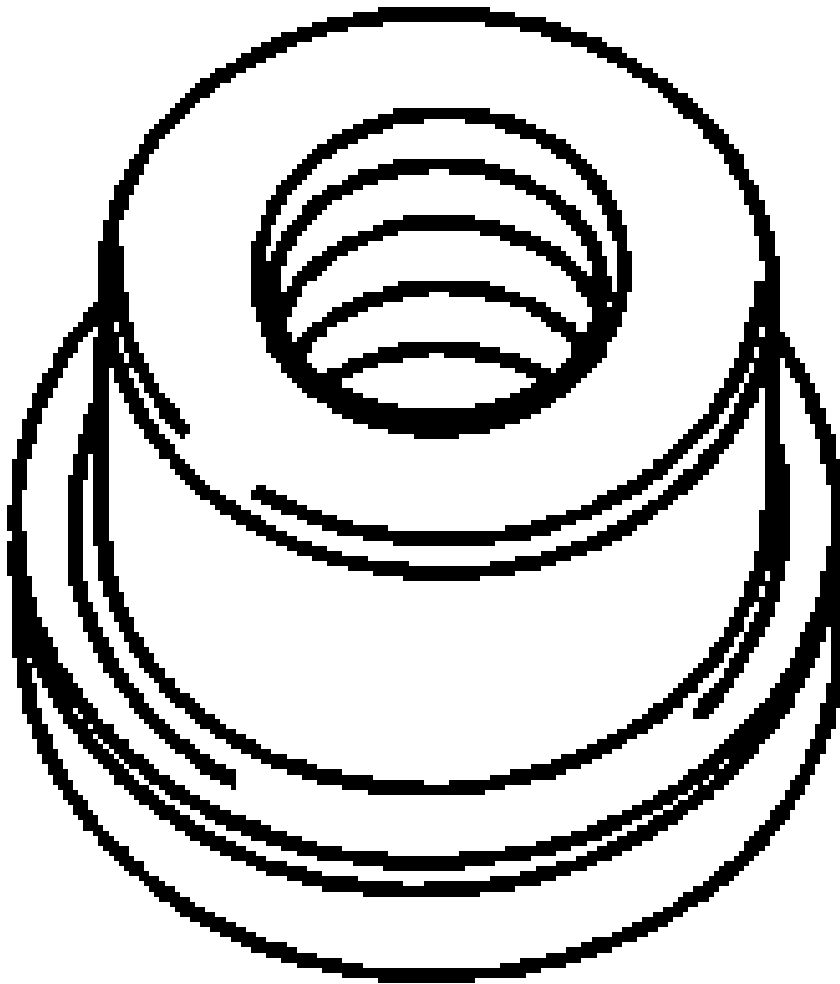
DT-46455 (DW
240-060-01)
Brake Spring
Compressor
Bolt/Nut



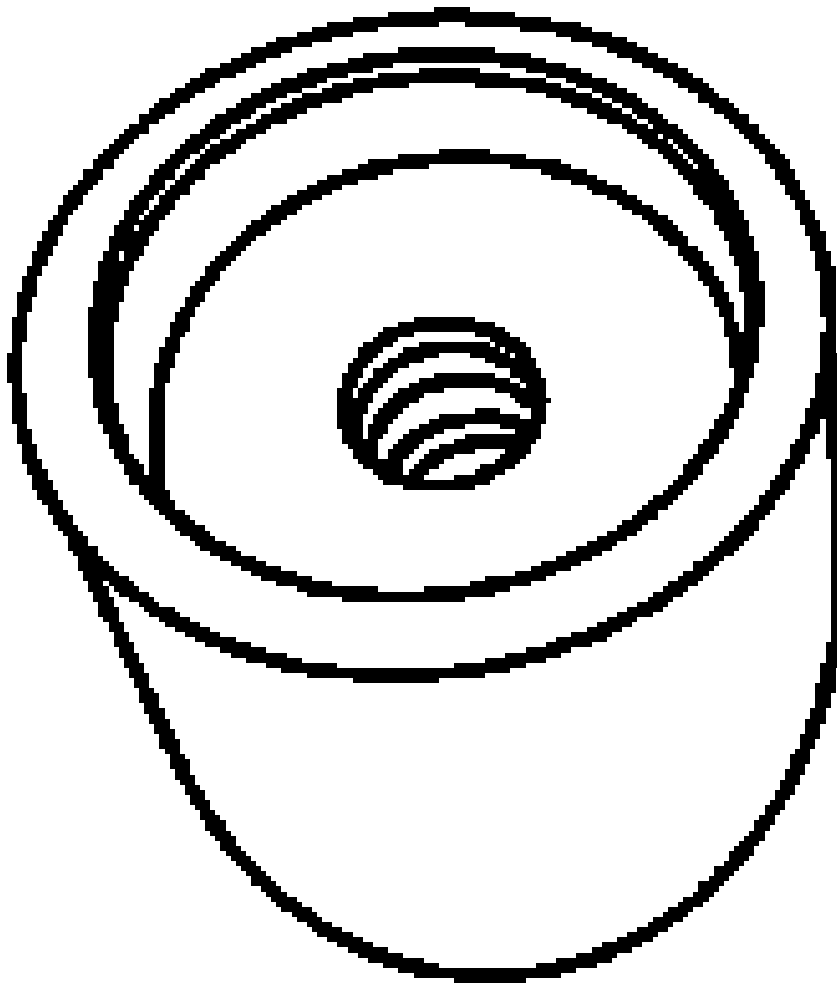
DT-46456 (DW
240-060-02)
Brake Spring
Compressor Plate



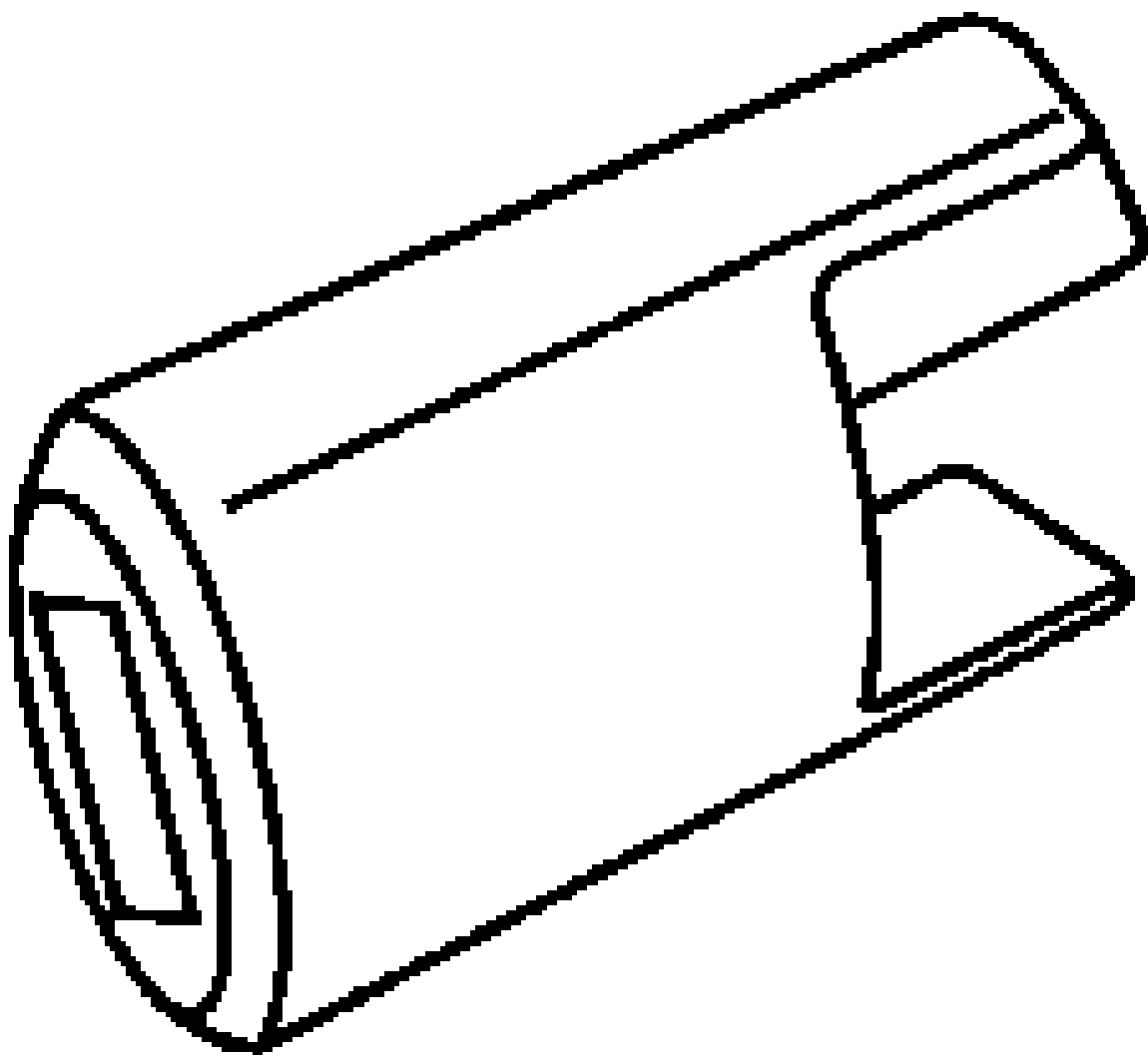
DT-46457 (DW
240-070)
1st/Reverse Brak
Adapter



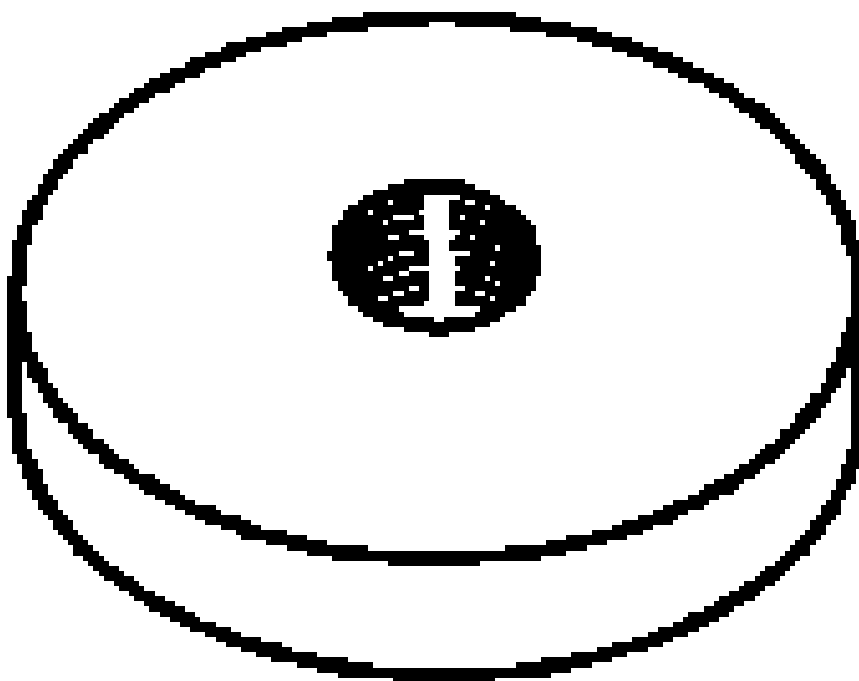
DT-46459 (DW
240-090)
Planetary Ring G
Remover



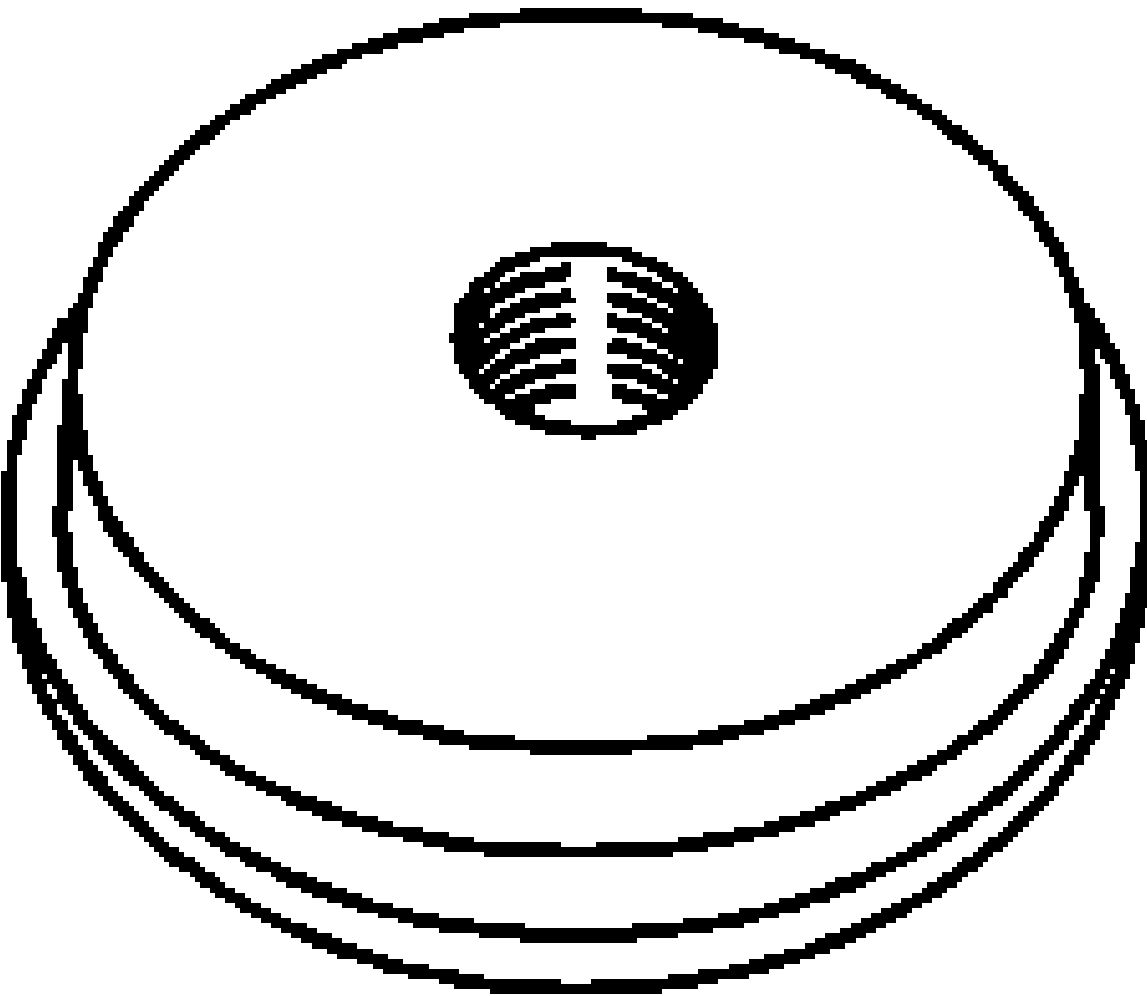
DT-46460 (DW
240-100)
Counter Drive Ge
Installation Adap



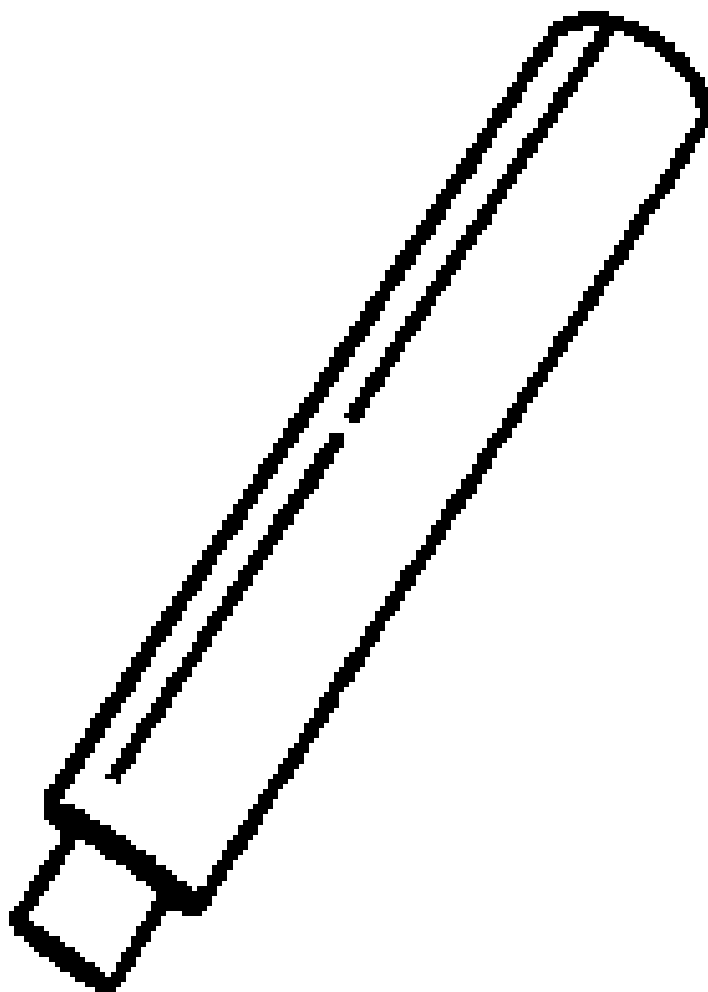
DT-46461 (DW
240-130)
Differential Preload
Adapter



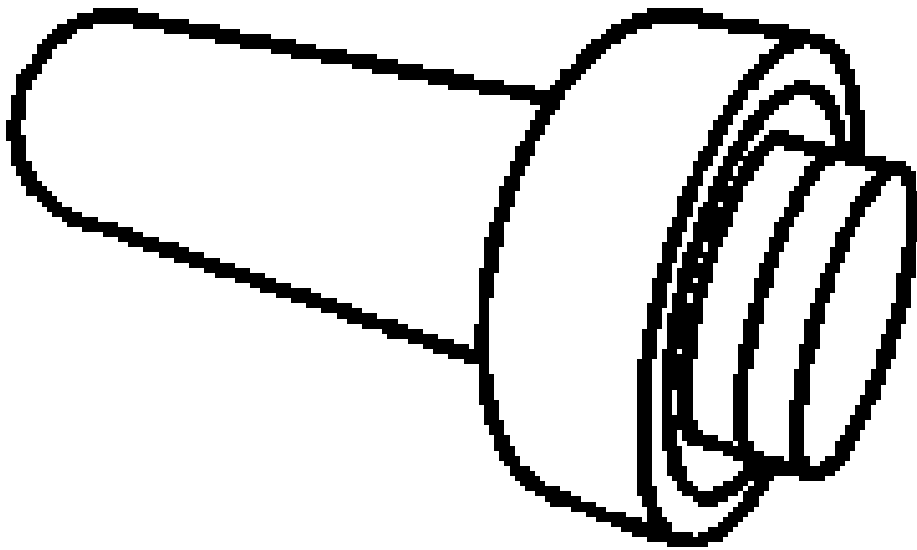
DT-46463 (DW
240-150)
Transaxle Case S:
Bearing Outer Ra
Adapter



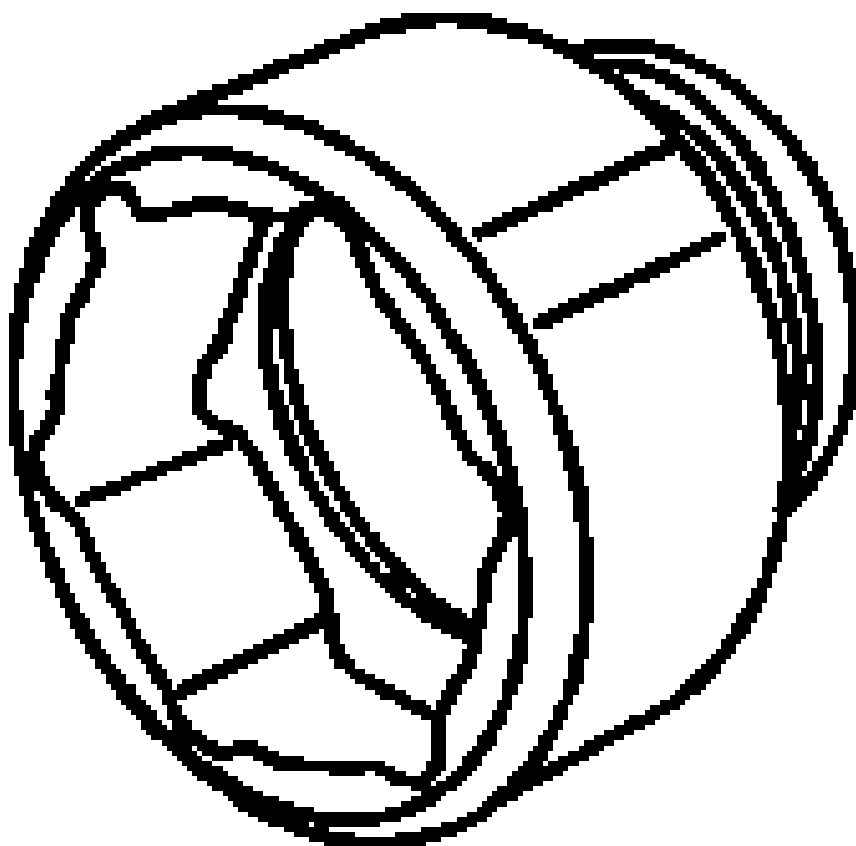
DT-46464 (DW
240-160)
Transaxle Case
Outer Tapered
Roller Bearing R:
Adapter



DT-46465 (DW
240-170)
Adapter Handle



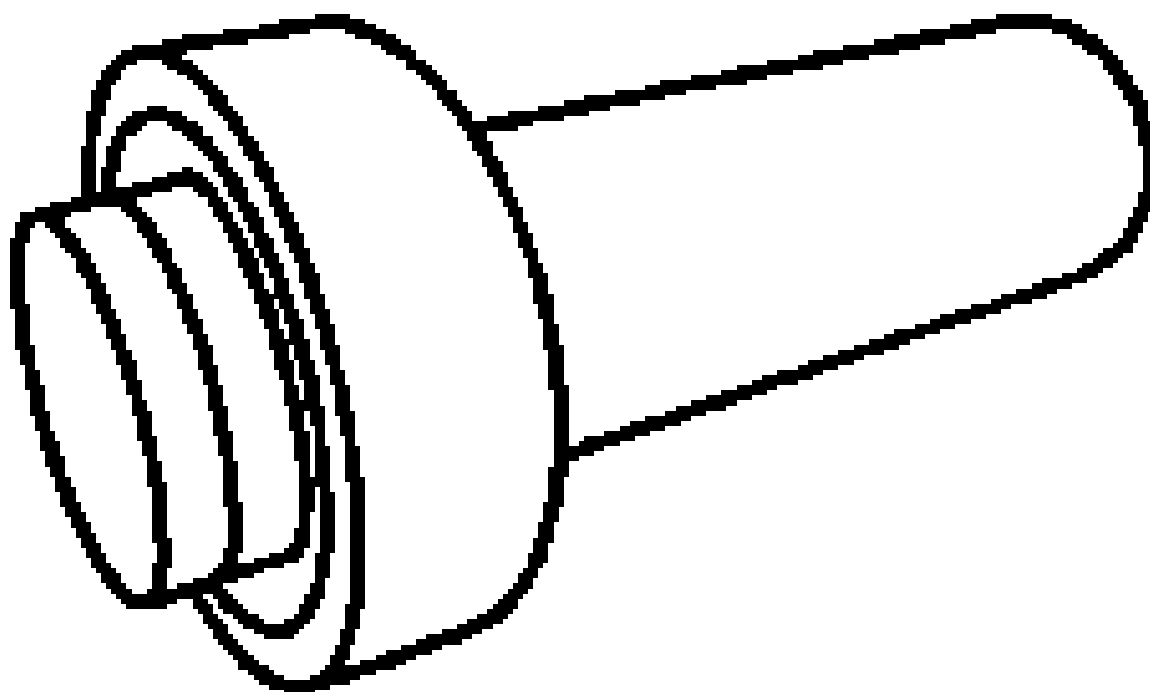
DT-46471 (DW
260-031-01)
Transaxle Housin
Oil Seal Install



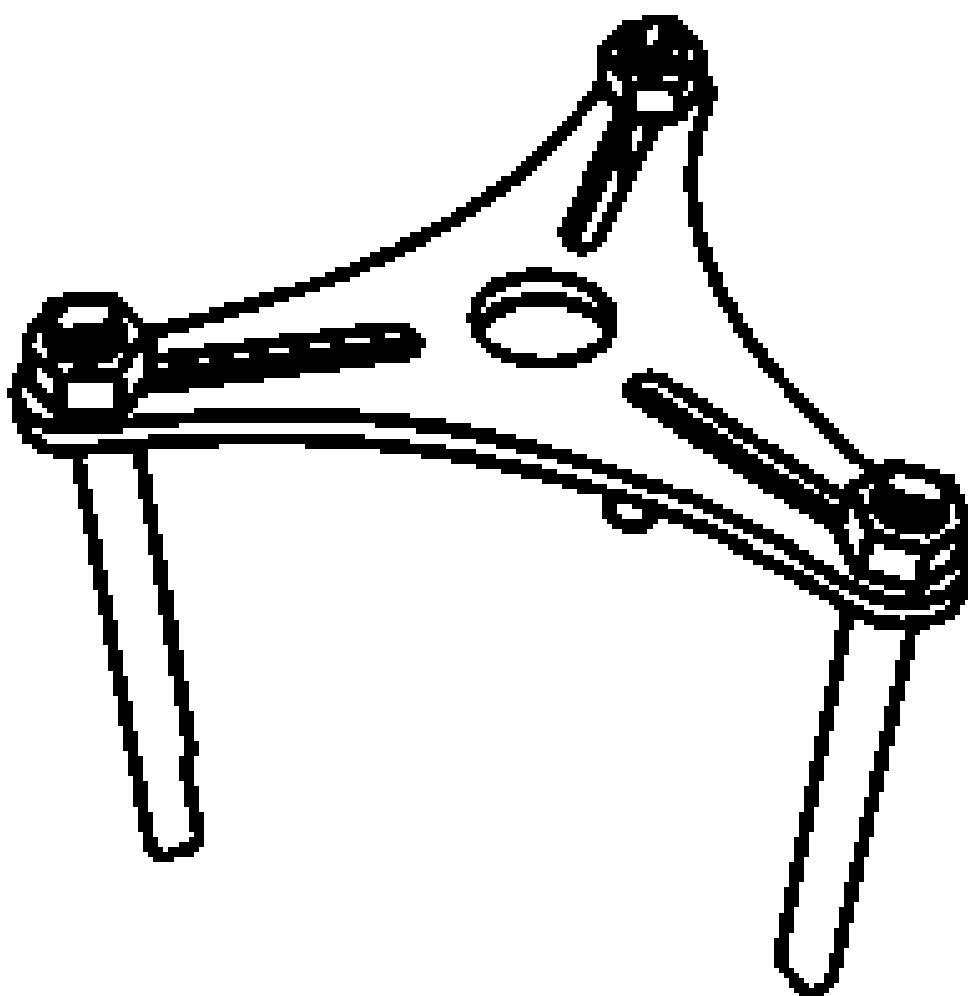
DT-46472 (DW
260-041)
Planetary Ring Gear
Nut
Removal/Installation
Socket (52 mm)



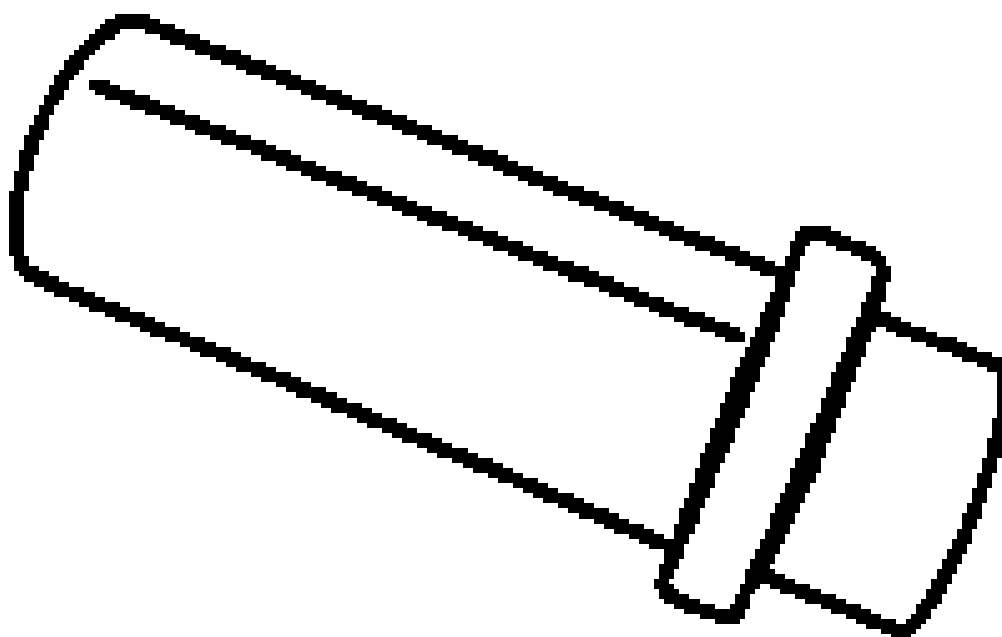
DT-47520 (DW
240-120)
Measuring Termi



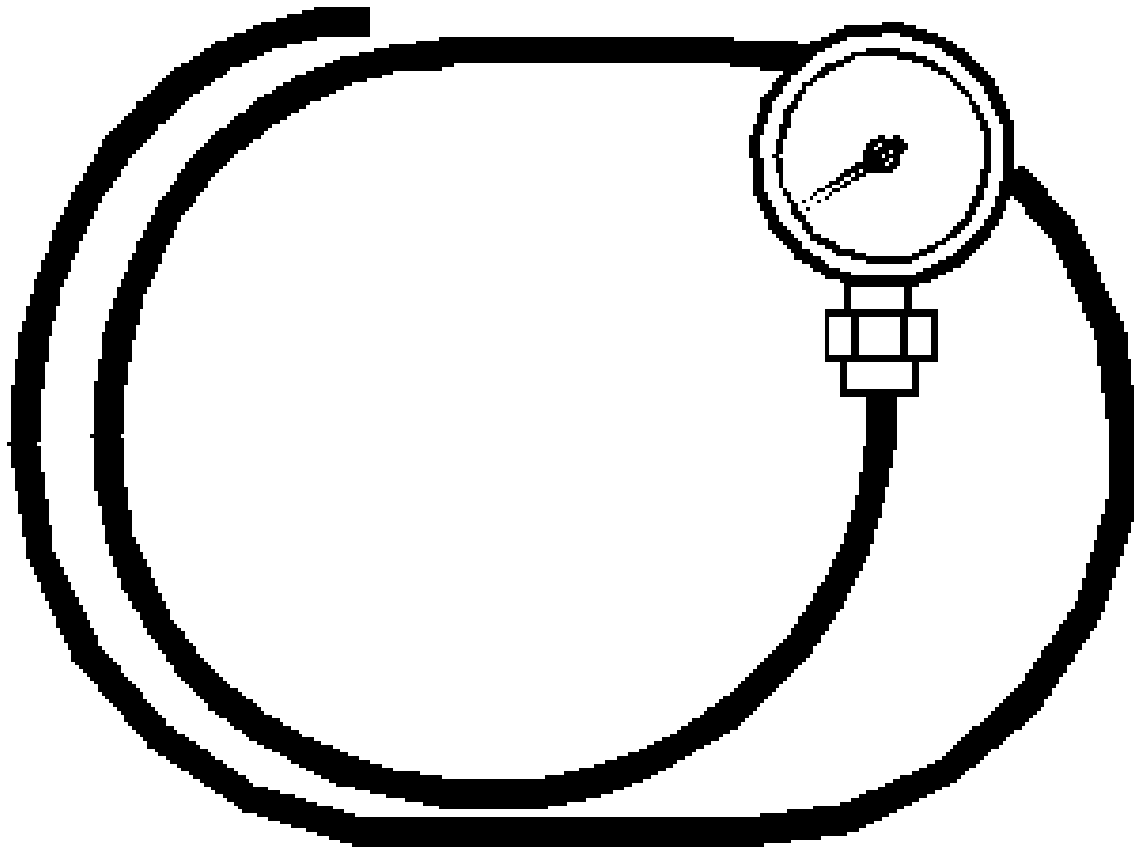
DT-47521 (DW
260-031-02)
Transaxle Case C
Seal Installer



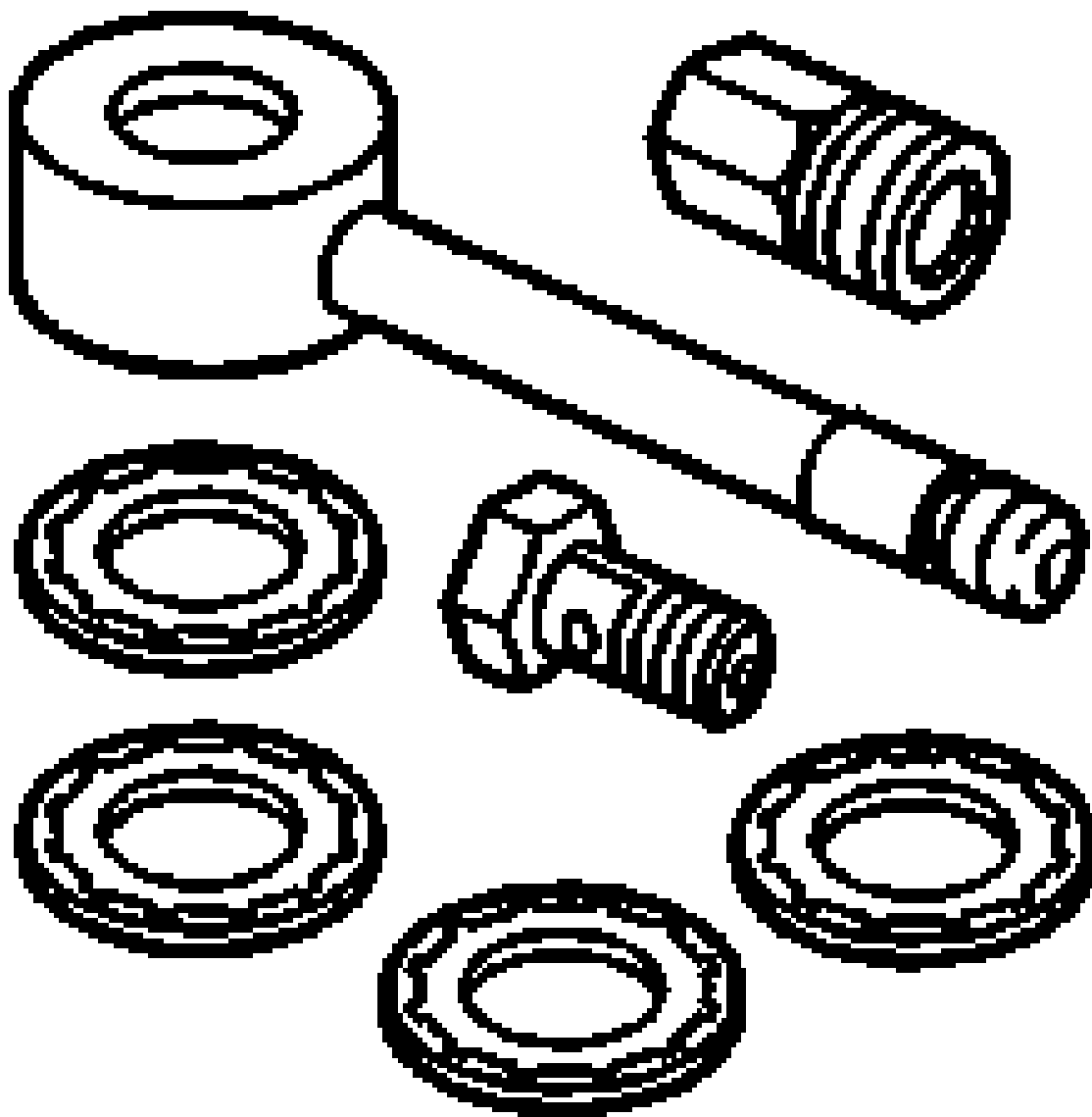
DT-50899
Spring Compress



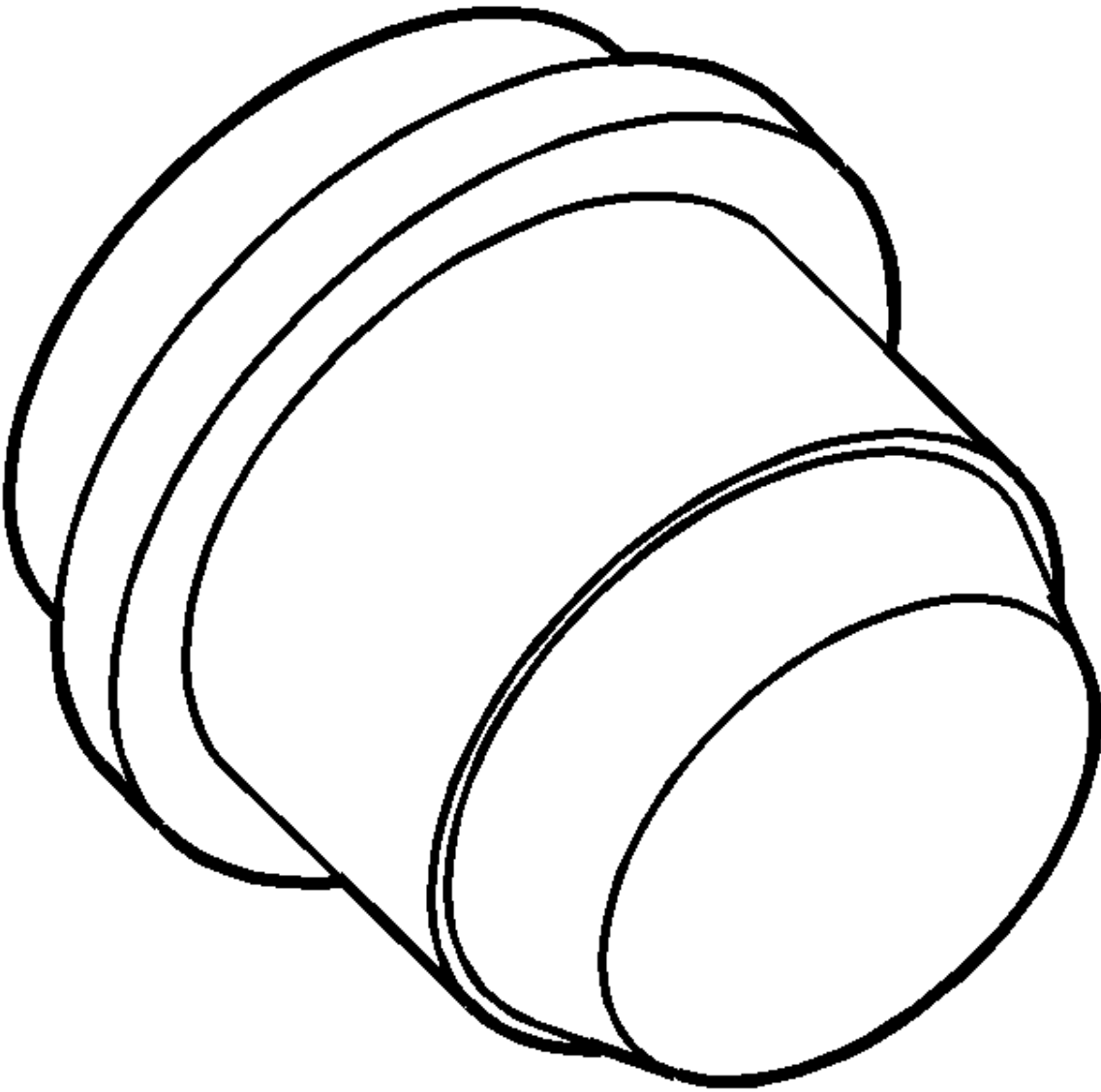
DT-50955 (DW
240-110)
Oil Pump Seal
Installer



J-21867
Pressure Gauge



J-21867-50
Transmission Lin
Pressure Adapter



J-44908
Bearing Race
Installer

TRANSMISSION

Automatic Transmission - Jatco CVT- Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Automatic Transmission Range Selector Lever Nut	17	13 lb ft
Control Valve Body Cover Bolt	6	53 lb in
Drain Plug	34	25 lb ft
Output Speed Sensor Bolt	6	53 lb in
Overflow Tube	15	11 lb ft
PNP Switch Bolt	6	53 lb in
Primary Speed Sensor	6	53 lb in
Secondary Speed Sensor	6	53 lb in
Selector Control Cable Clamp Bolt	22	16 lb ft
Torque Converter Bolt	60	44 lb ft
Torque Converter Cover Plate Bolt	10	89 lb in
Transmission Bracket Mount to Mount Through Bolt - Rear	80	59 lb ft
Transmission Bracket Mount to Mount Through Nut - Rear	80	59 lb ft
Transmission Control Lever Knob Bolt	3	27 lb in
Transmission Control Module (TCM) Nut	7	62 lb in
Transmission Fluid Cooler Pipe Nut	11	97 lb in
Transmission Lower Bolt	61	44 lb ft
Transmission Lower Nut	61	44 lb ft
Transmission Mount Bolt - Left	95	70 lb ft
Transmission Mount Bracket Bolt - Left	60	44 lb ft
Transmission Mount Nut - Left	95	70 lb ft
Transmission Mount to Body Bolt - Left	50	37 lb ft
Transmission Mount to Frame Bolt - Rear	100	74 lb ft
Transmission Mount to Transmission Bolt - Rear	60	44 lb ft
Transmission Range Selector Lever Cable Bracket Bolt	22	16 lb ft
Transmission Range Selector Lever Cable Grommet Nut	9	80 lb in
Transmission Shift Control Bolt	9	80 lb in
Transmission Shift Control Nut	9	80 lb in
Transmission Upper Bolt	61	44 lb ft

TRANSMISSION GENERAL SPECIFICATIONS

Transmission General Specifications

Transmission General Specifications			
Name			Jatco CVT
Transmission Drive			Front Wheel Drive
Type			Forward: Two-step and Continuously Variable Speed Reverse: One-step - Steel Belt Type
Operation Method			Remote Control Floor Shift
Shift Position	P		Fixed (Engine Starting is Possible)
	R		Reverse
	N		Neutral (Engine Starting is Possible)
	D		Forward: Two-step and Continuously Variable Speed
	L		Low (Engine Brake)
Gear Ratio	Pulley Ratio	Forward	2.200 - 0.550
		Reverse	2.200
	Auxiliary Gearbox	1st Gear	1.821
		2nd Gear	1.000
		Reverse	1.714
	Counter Gear Ratio		1.178 (1.0 Engine) 0.967 (1.2 Engine)
	Final Gear Ratio		3.882
Transmission Fluid Type			CVTF I-GREEN-2 US/Canada - ACDELCO CVT Fluid P/N 19260800
Transmission Fluid Capacity - Approximately			5.88 L (6.21 qt)
Oil Pump			Vane Type Pump
Driving System			Driven by Engine, Sprocket and Chain

LINE PRESSURE

Line Pressure

Application	Specification	
	Metric	English
At P and N Range		
• Idling	500 kPa	72.5 psi
• Stall	-	-
At R and D Range		
• Idling	500 kPa	72.5 psi
• Stall	4500-5000 kPa: 1.2 Engine 4280-4780 kPa: 1.0 Engine	652.7-725.2 psi: 1.2 Engine 620.8-693.3 psi: 1.0 Engine

SCHEMATIC WIRING DIAGRAMS

AUTOMATIC TRANSMISSION CONTROLS WIRING SCHEMATICS

Power, Ground and Serial Data Wiring Schematics

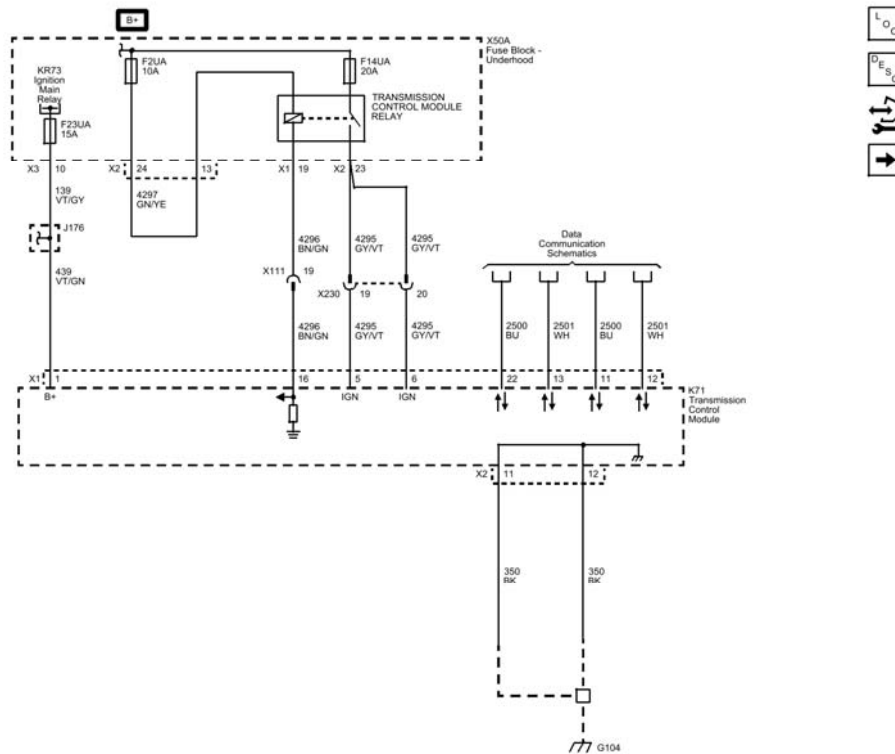


Fig. 1: Power, Ground and Serial Data Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Speed and Temperature Sensors, Pressure and Shift Controls Wiring Schematics

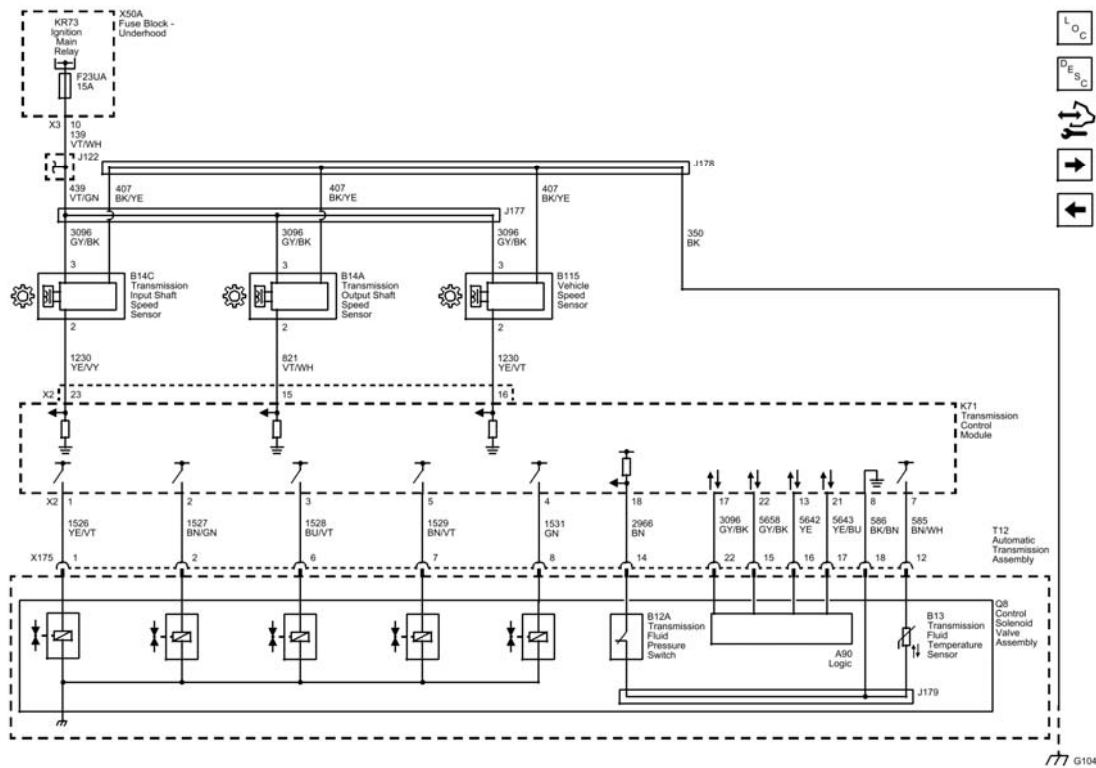


Fig. 2: Speed and Temperature Sensors, Pressure and Shift Controls Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Park/Neutral Position Switch Wiring Schematics

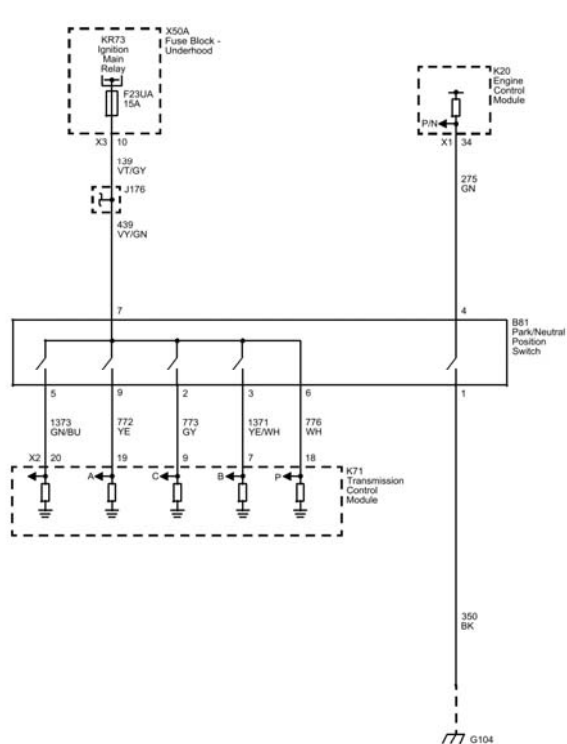


Fig. 3: Park/Neutral Position Switch Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

COMPONENT LOCATOR

DISASSEMBLED VIEWS

Case and Associated Parts

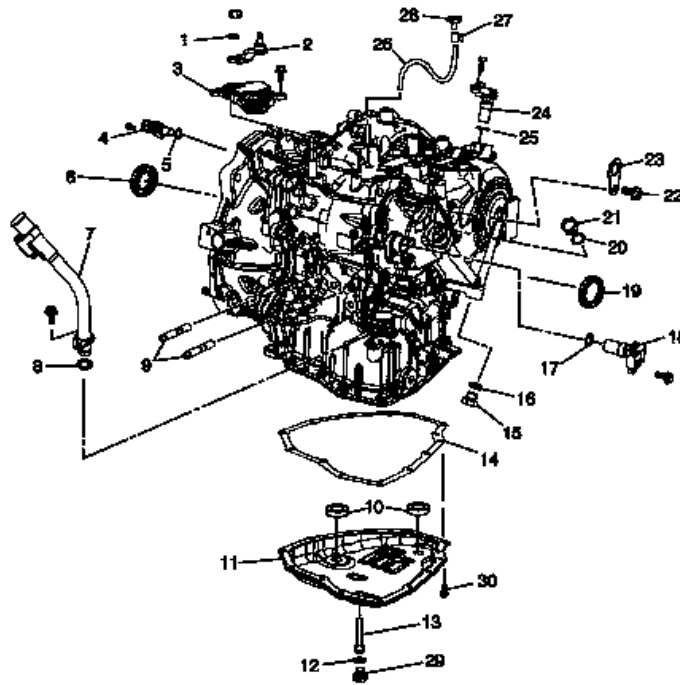


Fig. 4: Case and Associated Parts
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Washer
2	Manual Lever
3	Transmission Range Switch
4	Output Speed Sensor
5	O-Ring
6	Front Drive Shaft Seal
7	Charging Pipe
8	O-Ring
9	Stud Bolt
10	Magnet
11	Oil Pan
12	Drain Plug Gasket
13	Overflow Tube
14	Oil Pan Gasket
15	Plug
16	O-Ring
17	O-Ring
18	Primary Speed Sensor
19	Front Drive Shaft Seal
20	O-Ring

21	Plug
22	Engine Hook Bolt
23	Engine Hook
24	Secondary Speed Sensor
25	O-Ring
26	Air Breather Hose
27	Clip
28	Air Breather Plug
29	Drain Plug
30	Oil Pan Bolt

DIAGNOSTIC INFORMATION AND PROCEDURES

TRANSMISSION FLUID LEVEL AND CONDITION CHECK

CAUTION: Use correct transmission fluid only. Failure to use the proper fluid may result in transmission internal damage.

1. The vehicle must be on a flat surface.
2. Move the selector lever into park (P) position and then completely engage the parking brake.
3. Start the engine.
4. Wait until transmission temperature reaches 50°C (122°F).

NOTE: The CVT fluid is largely affected by temperature, therefore be sure to use the diagnostic tool to check the fluid temperature while adjusting.

5. Move through the selector lever positions with the foot brake depressed. Switch the selector lever from position P to L and back to P. Hold each position for at least 5 seconds.
6. Check that there is no transmission fluid leakage.

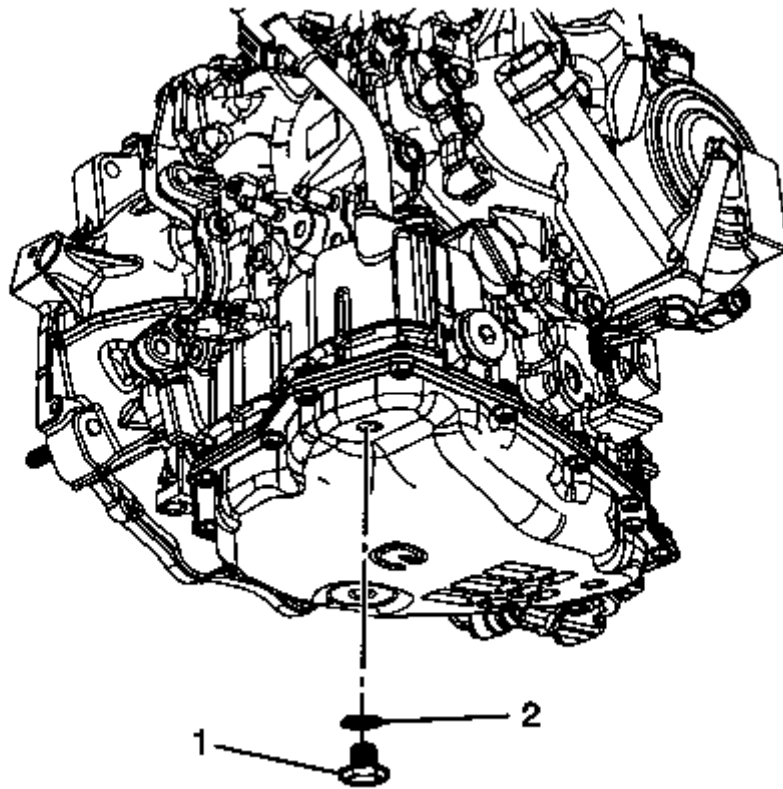


Fig. 5: Drain Plug

Courtesy of GENERAL MOTORS COMPANY

NOTE:

- Perform this work with the engine idling.
- Do not re-use drain plug gasket, replace with a NEW gasket.

7. Check the transmission fluid temperature with the diagnostic tool.
 1. If the transmission fluid temperature has reached about 50-80°C (122-176°F), raise the vehicle.
 2. Remove the drain plug (1). Remove and DISCARD the drain plug gasket (2).
 3. If the fluid is flowing as a steady stream, wait until the fluid begins to drip. If no fluid comes out, add the fluid until it drips out.
 4. If the fluid drips out from overflow tube, install the drain plug (1) with a NEW gasket (2) and tighten to 34 (25 lb ft).
8. Lower the vehicle.
9. Stop the engine.

LINE PRESSURE CHECK

1. Check the engine oil level. Refill if necessary.
2. With the engine warmed up, drive the vehicle.

NOTE: When ambient temperature is 20°C (68°F), it takes about 10 minutes for the CVT fluid to warm up to 50-80°C (122-176°F).

3. Check the CVT fluid level and condition. Refill if necessary. Refer to **Transmission Fluid Level and Condition Check**.
4. Block the front and rear wheels and apply the parking brake fully.
5. Start the engine.
6. Set the scan tool.
7. Select "Line Pressure" in data menu.

NOTE: Keep the brake pedal pressed all the way down during the measurement.

8. Measure the line pressure at both idle and stall speed.

Line Pressure Test Result

Engine Operation	P and N Range	R and D Range
Idling	500 kPa (72.5 psi)	500 kPa (72.5 psi)
Stall	-	4500-5000 kPa (652.7-725.2 psi): 1.2 Engine 4280-4780 kPa (620.8-693.3 psi): 1.0 Engine

Line Pressure Test Diagnosis

Result	Possible Cause	
Idle Speed	Low for all positions (P, R, N, D)	Possible causes include malfunctions in the pressure supply system and low oil pump output: • Oil pump wear • Damage of chain and sprocket • Pressure regulator valve or plug stuck or spring fatigue • Pressure regulator valve passage oil leak • Engine idle speed too low
	Only low for a specific position	Possible causes include an oil pressure leak in a passage or device related to the position after the pressure is distributed by the manual valve.
	High	Possible causes include a sensor malfunction or malfunction in the line pressure adjustment function: • Accelerator pedal position signal malfunction • CVT fluid temperature sensor malfunction • Line pressure solenoid malfunction (stuck in OFF state, open circuit, short circuit)

		• Pressure regulator valve stuck
Stall Speed	Line pressure does not rise higher than the line pressure for idle	Possible causes include a sensor malfunction or malfunction in the pressure adjustment function: • TCM malfunction • Line pressure solenoid malfunction (short circuit, stuck in ON state) • Pressure regulator valve stuck
	The pressure rises, but does not enter the standard position	Possible causes include malfunctions in the pressure supply system and malfunction in the pressure adjustment function: • Oil pump wear • Line pressure solenoid malfunction (stuck) • Pressure regulator valve stuck
	Only low for a specific position	Possible causes include an oil pressure leak in a passage or device related to the position after the pressure is distributed by the manual valve.

STALL SPEED TEST

1. Check the engine oil level. Refill if necessary.
2. With the engine warmed up, drive the vehicle.

NOTE: When ambient temperature is 20°C (68°F), it takes about 10 minutes for the CVT fluid to warm up to 50-80°C (122-176°F).

3. Check the CVT fluid level and condition. Refill if necessary. Refer to Transmission Fluid Level and Condition Check.
4. Block the front and rear wheels and apply the parking brake fully.
5. Start the engine.
6. Depress the brake pedal and shift the selector lever to the D position.
7. While depressing the brake pedal, depress the accelerator pedal gradually.
8. Read the stall speed quickly. Then, release your foot from the accelerator pedal quickly.

NOTE: Never depress the accelerator pedal for 5 seconds or more during the test.

9. Shift the selector lever to the N position.
10. Cool the CVT fluid.

NOTE: Run the engine with the idle speed for at least 1 minute.

11. Shift the selector lever to the R position and perform Steps 7-10.

Stall Speed (RPM)

- 2, 270-2, 730 (for 1.2 engine)
- 2, 080-2, 620 (for 1.0 engine)

Result	Probable Cause
Higher than the specified value in "D" or within the specified value in "R"	Low Brake
Within the specified value in "D" or higher than the specified value in "R"	Reverse Brake
Lower than the specified value in "D" and "R"	Engine
Higher than the specified value in "D" and "R"	• Low line pressure • Primary Pulley • Secondary Pulley • Steel Belt

FLUID LEAK DIAGNOSIS

General Method

1. Verify that the leak is transmission fluid.
2. Thoroughly clean the suspected leak area.
3. Operate the vehicle until normal operating temperatures are reached.
4. Park the vehicle over clean paper or cardboard.
5. Shut OFF the engine.
6. Look for fluid spots on the paper.
7. Make the necessary repairs.

Powder Method

1. Thoroughly clean the suspected leak area with solvent.
2. Apply an aerosol type leak tracing powder to the suspected leak area.
3. Operate the vehicle until normal operating temperatures are reached.
4. Shut OFF the engine.
5. Inspect the suspected leak area.
6. Trace the leak path through the powder in order to find the source of the leak.
7. Make the necessary repairs.

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC P0603</u>	DTC P0603 Control Module Long Term Memory Reset
<u>DTC P0705, P0706 or P0851</u>	DTC P0705 Transmission Range Switch Circuit - Invalid Range DTC P0706 Transmission Range Switch Performance - Park/Neutral Position DTC P0851 Park/Neutral Position Switch Circuit Low Voltage
<u>DTC P0711-P0713</u>	DTC P0711 Transmission Fluid Temperature Sensor Performance DTC P0712 Transmission Fluid Temperature Sensor Circuit Low Voltage DTC P0713 Transmission Fluid Temperature Sensor Circuit High Voltage
<u>DTC P0717</u>	DTC P0717 Input Speed Sensor Circuit No Signal - Primary Pulley Speed Sensor
<u>DTC P0721</u>	DTC P0721 Output Speed Sensor Performance
<u>DTC P0741</u>	DTC P0741 Torque Converter Clutch (TCC) System - Stuck Off - Transmission Hydraulic/Mechanical Performance
<u>DTC P0792</u>	DTC P0792 Intermediate Shaft Speed Sensor Circuit Performance - Secondary Pulley Speed Sensor
<u>DTC P0796 or P0797</u>	DTC P0796 Pressure Control Solenoid Valve 3 - Stuck Off - Transmission Hydraulic/Mechanical Performance DTC P0797 Pressure Control Solenoid Valve 3 - Stuck On - Transmission Hydraulic/Mechanical Performance
<u>DTC P0841-P0843</u>	DTC P0841 Transmission Fluid Pressure Switch Performance - Secondary Pulley Pressure DTC P0842 Transmission Fluid Pressure Switch Circuit Low Voltage - Secondary Pulley Pressure DTC P0843 Transmission Fluid Pressure Switch Circuit High Voltage - Secondary Pulley Pressure
<u>DTC P0863</u>	DTC P0863 Transmission Control Module (TCM) Communication Circuit - (ROM Assembly)
<u>DTC P0871</u>	DTC P0871 Transmission Fluid Pressure Switch 3 System Performance
<u>DTC P0885</u>	DTC P0885 Transmission Control Module (TCM) Power Relay Control Circuit
<u>DTC P0961-P0963</u>	DTC P0961 Line Pressure Control Solenoid Valve Performance DTC P0962 Line Pressure Control Solenoid Valve Control Circuit Low Voltage DTC P0963 Line Pressure Control Solenoid Valve Control Circuit High Voltage
	DTC P0965 Pressure Control Solenoid Valve 2 System

<u>DTC P0965-P0967</u>	Performance DTC P0966 Pressure Control Solenoid Valve 2 Control Circuit Low Voltage DTC P0967 Pressure Control Solenoid Valve 2 Control Circuit High Voltage
<u>DTC P0970 or P0971</u>	DTC P0970 Pressure Control Solenoid Valve 3 Control Circuit Low Voltage DTC P0971 Pressure Control Solenoid Valve 3 Control Circuit High Voltage
<u>DTC P1790</u>	DTC P1790 Transmission Control Module Checksum Error - ROM Assembly
<u>DTC P2714 or P2715</u>	DTC P2714 Pressure Control Solenoid Valve 4 - Stuck Off - Transmission Hydraulic/Mechanical Performance DTC P2715 Pressure Control Solenoid Valve 4 - Stuck On - Transmission Hydraulic/Mechanical Performance
<u>DTC P2720 or P2721</u>	DTC P2720 Pressure Control Solenoid 4 Control Circuit Low Voltage DTC P2721 Pressure Control Solenoid 4 Control Circuit High Voltage
<u>DTC P2763 or P2764</u>	DTC P2763 Torque Converter Clutch (TCC) Pressure Control Solenoid Valve Control Circuit High Voltage DTC P2764 Torque Converter Clutch (TCC) Pressure Control Solenoid Valve Control Circuit Low Voltage

DTC P0603: CONTROL MODULE LONG TERM MEMORY

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0603

Control Module Long Term Memory Reset

Circuit/System Description

This is an internal fault detection of the transmission control module. This fault is handled inside the transmission control module. No external circuits are involved.

Conditions for Running the DTC

- Ignition ON.

- System voltage 10.0-16.0 V.
- DTC P0603 is run during transmission control module power up.

Conditions for Setting the DTC

- The long-term memory reset for the transmission control module has failed a non-volatile flash ROM memory checksum.
- At each ignition ON, the transmission control module compares the calculated value stored in the flash ROM with the value stored in the transmission control module. If the calculated value does not agree with the stored value a checksum error is logged and DTC C0603 is set.

Action Taken When the DTC Sets

P0603 is a Type A DTC.

Conditions for Clearing the DTC

P0603 is a Type A DTC.

Diagnostic Aids

Low voltage or a momentary loss of power or ground to the transmission control module may cause this DTC to set. Verify the following:

- The battery cables are clean and tight and the battery is fully charged. Refer to **Battery Inspection/Test** .
- The transmission control module ground circuits do not have an open or high resistance.
- The transmission control module power circuits do not have an open, short to ground or high resistance.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **Inline Harness Connector End Views**

Description and Operation

Electronic Component Description

Electrical Information Reference

- **Circuit Testing**

- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition OFF for at least one minute to allow for the complete shutdown of the K71 Transmission Control Module. Ignition ON.
2. Verify that DTC P0885 is not set.
 - **If P0885 is set**

Refer to **DTC P0885**.

- **If P0885 is not set**

NOTE: **After inspection, apply Nyogel lubricant 760G to each connector terminal. Ensure each connector and CPA is correctly seated.**

3. Visually inspect each connector terminal of the K71 Transmission Control Module connector for damage or corrosion. Repair as necessary.
4. Clear DTC P0603.
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data. The DTC should not set.
 - **If the DTC sets**

Replace the K71 Transmission Control Module. Refer to **Control Module References** .

- **If the DTC does not set**

6. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for K71 Transmission Control Module replacement, setup and programming.

DTC P0705, P0706 OR P0851: TRANSMISSION RANGE SWITCH/PARK/NEUTRAL POSITION SWITCH

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0705

Transmission Range Switch Circuit - Invalid Range

DTC P0706

Transmission Range Switch Performance - Park/Neutral Position

DTC P0851

Park/Neutral Position Switch Circuit Low Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Transmission Shift Selector Mode Signal	P0705	P0705	P0705	-
Transmission Position Switch Bit 2 Signal	P0705	P0705	P0705	-
Transmission Position Switch Bit 3 Signal	P0705	P0705	P0705	-
Transmission Position Switch Bit 4 Signal	P0705	P0705	P0705	-
Transmission Position Parity Bit Signal	P0705	P0705	P0705	-
Park Neutral Position Switch Park Signal	P0851	-	-	-
Ground	-	-	-	-

Typical Scan Tool Data

Transmission Range Switch Logic

Gear Selector Position	Signal A	Signal B	Signal C	Signal P

Park (P)	HIGH	HIGH	HIGH	LOW
Reverse (R)	HIGH	HIGH	LOW	HIGH
Neutral (N)	HIGH	LOW	HIGH	HIGH
Drive (D)	LOW	HIGH	HIGH	HIGH
LOW (L)	HIGH	HIGH	HIGH	HIGH
HIGH = Ignition voltage LOW = 0 volts				

Circuit/System Description

DTC P0705 or P0706

The transmission range switch is a sliding contact switch which is part of the B81 Park/Neutral Position Switch assembly and is externally mounted on the transmission manual shaft. The transmission range switch is a multi-signal switch. The Ignition Main Relay in the Fuse Block - Underhood supplies ignition voltage to the transmission range switch on a Run/Crank Ignition 1 circuit. The transmission control module provides individual grounds for each of the transmission range position circuits. Each transmission shift lever position grounds one of the switch circuits. In order to determine the gear range selected by the driver, the transmission control module compares the voltage combinations on the signal circuits to a transmission range switch combination look up table stored in the TCM memory. Refer to Transmission Range Switch Logic below.

DTC P0851

The park/neutral position switch is an ON/OFF switch which is part of the B81 Park/Neutral Position Switch assembly and is externally mounted on the transmission manual shaft. The Engine Control Module supplies ignition voltage to the park/neutral position switch on the Park Neutral Position Switch Park Signal circuit. When in Park or Neutral the B81 Park/Neutral Position Switch assembly provides a chassis ground for the circuit. This indicates to the engine control module that the transmission is in an acceptable gear to allow engine start up.

Conditions for Running the DTC

P0705

System voltage 10-16 V.

P0706

System voltage 10-16 V.

P0851

- System voltage 10-16 V.
- Selector lever position P or N.
- Vehicle speed greater than 10 km/h (6 mph).
- Engine Torque greater than 60 N.m (44 lb ft).

- Accelerator pedal position greater than 10%.
- Torque Converter Clutch Slip Speed between -20 RPM and +20 RPM.
- This DTCs runs continuously within the enabling conditions.

Conditions for Setting the DTC

P0705

The transmission control module detects an invalid combination of transmission range signals for more than 30 s.

or

The transmission range switch indicates more than one transmission range for more than 2 s - multiple signals.

P0706

The transmission control module detects engine start-up in a drive range for more than 2 s.

or

The transmission control module detects output shaft speed when the transmission range switch indicates Park.

P0851

The engine control module detects vehicle speed when the park/neutral position switch indicates Park or Neutral for more than 2 s.

Action Taken When the DTC Sets

- DTC P0705 and P0706 are Type B DTCs.
- DTC P0851 is a Type C DTC.
- Auxiliary gear-box is held in 2nd gear.
- Lock-up prohibited.
- Pulley ratio limited to 0.55.

Conditions for Clearing the DTC

- DTC P0705 and P0706 are Type B DTCs.
- DTC P0851 is a Type C DTC.

Diagnostic Aids

By disconnecting the transmission range switch, all ground paths of the TR switch circuits would be removed and the TCM would recognize all circuits as open. The scan tool will display High for all range signals.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **Inline Harness Connector End Views**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Description and Operation

- **Electronic Component Description**
- **Transmission General Description**
- **Transmission Component and System Description**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON. Engine OFF. Transmission in Park.
2. Verify the scan tool Park/Neutral Position Switch parameter displays Park/Neutral.
 - **If the parameter does NOT display Park/Neutral**

Refer to Circuit/System Testing.
 - **If the parameter does display Park/Neutral**
3. Using the S3 Transmission Shift Lever, shift the transmission to Drive.
4. Verify the scan tool Park/Neutral Position Switch parameter displays In-Gear.
 - **If the parameter does NOT display In-Gear**

Refer to Circuit/System Testing.

- **If the parameter does display In-Gear**

5. Verify that the scan tool Transmission Range Switch A/B/C/P parameter displays as described below in the Transmission Range Switch Logic table while moving the S3 Transmission Shift Lever through each position.

- **If the Transmission Range Switch A/B/C/P parameter does NOT display as described**

Refer to Circuit/System Testing.

- **If the Transmission Range Switch A/B/C/P parameter displays as described**

6. Verify that the scan tool Transmission Range Switch parameter matches each position S3 Transmission Shift Lever.

- **If the Transmission Range Switch parameter does NOT match each position of the S3 Transmission Shift Lever**

Refer to Circuit/System Testing.

- **If the Transmission Range Switch parameter does match each position of the S3 Transmission Shift Lever**

7. Verify DTC P0705, P0706 or P0851 is only set as a history DTC.

- **If any of the DTCs are set as current**

Refer to Circuit/System Testing.

- **If any of the DTCs are only set as history**

NOTE: After inspection, apply Nyogel lubricant 760G to each connector terminal. Ensure each connector and CPA is correctly seated.

8. Visually inspect each connector terminal of the K71 transmission control module X2 connector and the B81 Park/Neutral Position Switch assembly connector for damage or corrosion. Repair as necessary.
9. Clear DTC P0705, P0706 or P0851 from history.
10. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data. The DTC should not set.
 - **If any of the DTCs are set**

Refer to Circuit/System Testing.

- **If none of the DTCs are set**

11. All OK.

Transmission Range Switch Logic

Gear Selector Position	Signal A	Signal B	Signal C	Signal P

Park (P)	HIGH	HIGH	HIGH	LOW
Reverse (R)	HIGH	HIGH	LOW	HIGH
Neutral (N)	HIGH	LOW	HIGH	HIGH
Drive (D)	LOW	HIGH	HIGH	HIGH
LOW (L)	HIGH	HIGH	HIGH	HIGH
HIGH = Ignition voltage LOW = 0 volts				

Circuit/System Testing

1. Ignition OFF, disconnect the B81 Park/Neutral Position Switch connector.

NOTE:

- When test probing harness terminals, it is imperative to use the proper test probe from the most current version of the J 35616 GM-Approved Terminal Test Kit. Use of an improper test probe may deform the terminal, resulting in intermittent open conditions.
- Testing for steps 3-6 is performed on the B81 Park/Neutral Position Switch harness connector using the J 35616-2A GY probe.
- Chassis ground to Battery ground 25-35 ohms.

2. Ignition ON, engine OFF.
3. Using a fused jumper wire, test for B+ between the B+ terminal of the battery and the ground circuit of the B81 Park/Neutral Position Switch harness connector terminal 1.

- If less than B+

Repair the open/high resistance in the circuit.

- If B+

4. Using a fused jumper wire, test for B+ between the Park/Neutral Position Switch Park Signal circuit, terminal 4 and chassis ground.

- If less than B+

1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module.
2. Test for less than 10 ohms in the signal circuit end to end.
 - If 10 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 10 ohms
3. Test for infinite resistance between the signal circuit and chassis ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance
4. Test for infinite resistance between the signal circuit and all other terminals of the B81 Park/Neutral Position Switch harness connector.
 - If less than infinite resistance, repair the shorted together condition in the affected circuits.
 - If infinite resistance, replace the K20 Engine Control Module. Refer to **Engine Control**

Module Replacement .

○ If B+

5. Using a fused jumper wire, test for B+ between the Run/Crank Ignition 1 Voltage circuit terminal 7 and chassis ground.

○ If less than B+

1. Ignition OFF, disconnect the X3 harness connector at the X50A Fuse Block - Underhood.
2. Test for less than 10 ohms in the Ignition 1 circuit end to end.
 - If 10 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 10 ohms
3. Test for infinite resistance between the Ignition 1 circuit and chassis ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance
4. Test for infinite resistance between the Ignition 1 circuit and all other terminals of the X50A Fuse Block - Underhood harness connector X3.
 - If less than infinite resistance, repair the shorted together condition in the affected circuits.
 - If infinite resistance, replace the Transmission Control Module Relay. Refer to **X50A Fuse Block - Underhood Top View .**

○ If B+

NOTE: The Transmission Control Module provides a low current diagnostic voltage on the following circuits.

6. Test for 0.18-0.25 V between the following circuits and chassis ground.

- Transmission Position Switch Bit 1 Signal circuit, terminal 5
- Transmission Position Switch Bit 2 Signal circuit, terminal 9
- Transmission Position Switch Bit 3 Signal circuit, terminal 2
- Transmission Position Switch Bit 4 Signal circuit, terminal 3
- Transmission Position Switch Parity Bit Signal circuit, terminal 6

○ If less than 0.18 V

1. Ignition OFF, disconnect the X2 harness connector at the K71 Transmission Control Module.
2. Test for less than 10 ohms in the affected control circuit end to end.
 - If 10 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 10 ohms
3. Test for infinite resistance between the affected control and chassis ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance
4. Test for infinite resistance between the affected control circuit and all other terminals of B81 Park/Neutral Position Switch harness connector.
 - If less than infinite resistance, repair the shorted together condition in the affected circuits.

- If infinite resistance, replace the K71 Transmission Control Module. Refer to **Transmission Control Module Replacement**.
 - **If greater than the specified range**
 1. Ignition OFF, disconnect the X2 harness connector at the K71 Transmission Control Module.
 2. Test for infinite resistance between the affected control circuit and all other terminals of B81 Park/Neutral Position Switch harness connector.
 - If less than infinite resistance, repair the shorted together condition in the affected circuits.
 - If infinite resistance, replace the K71 Transmission Control Module. Refer to **Transmission Control Module Replacement**.
 - **If within the specified range**
7. Replace the B81 Park/Neutral Position Switch. Refer to **Park/Neutral Position Switch Replacement**.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Transmission Replacement** for transmission replacement.
- Refer to **Park/Neutral Position Switch Replacement**
- Refer to **Park/Neutral Position Switch Adjustment**
- **Control Module References** for K71 Transmission Control Module replacement, setup and programming.

DTC P0711-P0713: TRANSMISSION FLUID TEMPERATURE SENSO

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0711

Transmission Fluid Temperature Sensor Performance

DTC P0712

Transmission Fluid Temperature Sensor Circuit Low Voltage

DTC P0713

Transmission Fluid Temperature Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Sensor Signal	P0712	P0713	P0713	P0711
Low Reference	-	P0713 and/or P0842	-	P0711

Typical Scan Tool Data

Circuit	Normal Range	Short to Ground	Open/High Resistance	Short to Voltage
Operating Conditions: Engine running in PARK, normal operating temperature				
Trans. Fluid Temp.	Varies near coolant temperature	150°C (304°F)	-40°C (-40°F)	-40°C (-40°F)

Circuit/System Description

The transmission fluid sensor is a negative coefficient thermistor mounted to the Control Solenoid Valve Assembly which has no serviceable parts.

The transmission control module supplies a 2.6 V reference signal circuit and a low reference circuit to the transmission fluid sensor. When the transmission fluid is cold, the sensor resistance is high and the transmission control module senses a high signal voltage. As the transmission fluid warms, the sensor resistance lowers and the transmission control module senses lower voltage. The transmission control module uses the transmission fluid sensor reading in order to control the torque converter clutch, line pressure adjustments and temperature compensated shifts.

Conditions for Running the DTC

P0711

- System voltage 10-16 V.
- Transmission fluid temperature at start up between -40 and +10°C (-40 and +50°F).
- Selector lever in D position.
- Engine speed greater than 450 RPM.
- Vehicle speed greater than 10 km/h (6 mph).
- Accelerator pedal position greater than 12.5%.
- No transmission range switch DTC P0705 or P0706.
- This DTCs runs continuously within the enabling conditions.

P0712

- System voltage 10-16 V.

- This DTCs runs continuously within the enabling conditions.

P0713

- System voltage 10-16 V.
- Vehicle speed greater than 10 km/h (6 mph).
- Engine coolant temperature/intake air temperature greater than -40°C (-40°F)
- This DTCs runs continuously within the enabling conditions.

Conditions for Setting the DTC

P0711

- This diagnostic monitors the transmission fluid sensor circuit. The circuit may be functional but not in the normal operating range. This diagnostic indicates stuck, erratic, intermittent or skewed values, resulting in reduced system performance.
- The transmission fluid temperature remains between -40 and +10°C (-40 and +50°F) after 600 s/10 minutes of driving.

P0712

The transmission fluid temperature is 180°C (356°F) or greater for 5 s.

P0713

The transmission fluid temperature is -40°C (-40°F) or less for 5 s.

Action Taken When the DTC Sets

Condition 1

Engine coolant less than -35°C (-31°F) and engine run time from ignition ON less than 900 s (15 minutes).

- Pulley ratio limited to 2.2.
- Sub shift control is prohibited.
- Turbine torque is limited depending on actual secondary pressure.
- Line pressure is controlled to 0.5 MPa.

Condition 2

Engine coolant less than 10°C (50°F) and engine run time from ignition ON less than 1500 s.

- Pulley ratio limited to 1.0-2.2.
- Sub shift control is prohibited.
- Turbine torque is limited depending on actual secondary pressure.

- Line pressure is controlled to 0.5 MPa.

Condition 3

Engine coolant greater than 10°C (50°F) and engine run time from ignition ON greater than 1500 s.

- Vehicle speed greater than 7 km/h (4.5 mph).
- Turbine torque limited to 30.
- Turbine speed limited to less than 1800 RPM.
- Turbine torque is limited depending on actual secondary pressure.
- Line pressure is controlled to 0.5 MPa.

Conditions for Clearing the DTC

DTCs P0711, P0712 and P0713 are Type B DTCs.

Diagnostic Aids

- The DIC, if equipped, will display TRANSMISSION HOT - IDLE ENGINE when the transmission fluid temperature reaches 132°C (270°F).
- Ask the customer about possible overloading.
- During a road test, the transmission fluid temperature should steadily increase to a normal operating temperature and then stabilize.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **Inline Harness Connector End Views**

Description and Operation

- **Electronic Component Description**
- **Transmission General Description**
- **Transmission Component and System Description**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

J-35616 GM-Approved Terminal Test Kit

For equivalent regional tools, refer to **Special Tools**.

Circuit/System Verification

1. Verify that the transmission fluid level is at the proper level by performing the **Transmission Fluid Level and Condition Check**.
2. Verify that DTC P0111, P0112, P0113, P0114, P0117, P0118 or P0119 is not set.
 - **If DTC P0111, P0112, P0113, P0114, P0117, P0118 or P0119 is set**

Diagnose that DTC first. Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If DTC P0111, P0112, P0113, P0114, P0117, P0118 or P0119 is not set**

NOTE: **During a road test, the transmission fluid temperature should steadily increase to a normal operating temperature and then stabilize.**

3. Verify the Transmission Fluid Temperature parameter increases greater than 2°C (3.5°F) after operating the vehicle at 64 km/h (40 mph) for 10 minutes.
 - **If the temperature does not increase greater than 2°C (3.5°F)**

Refer to Circuit/System Testing.

- **If the temperature does increase greater than 2°C (3.5°F)**

4. Verify that the transmission fluid temperature parameter is at or near the engine coolant temperature parameter.
 - **If the transmission fluid temperature parameter is NOT at or near the engine coolant temperature parameter**

Refer to Circuit/System Testing.

- **If the transmission fluid temperature parameter IS at or near the engine coolant temperature parameter**

5. Verify DTC P0711, P0712 or P0713 is only set as a history DTC.

- **If any of the DTCs are set as current**

Refer to Circuit/System Testing.

- **If any of the DTCs are only set as history**

NOTE: After inspection, apply Nyogel lubricant 760G to each connector terminal. Ensure each connector and CPA is correctly seated.

6. Visually inspect each connector terminal of the K71 transmission control module and the Q8 Control Solenoid Valve Assembly connectors for damage or corrosion. Repair as necessary.
7. Clear DTC P0711, P0712 or P0713 from history.
8. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data. The DTC should not set.
 - **If any of the DTCs are set**

Refer to Circuit/System Testing.

- **If none of the DTCs set**

9. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the Q8 Control Solenoid Valve Assembly connector.

NOTE:

- **When test probing harness terminals, it is imperative to use the proper test probe from the most current version of the J-35616 GM-Approved Terminal Test Kit. Use of an improper test probe may deform the terminal, resulting in intermittent open conditions.**
- **Testing for steps 2-5 is performed on the Q8 Control Solenoid Valve Assembly harness connector using the GY probe J-35616-2A.**
- **Chassis ground to battery ground 25-35 ohms.**

2. Test for less than 10 ohms between the low reference circuit terminal 18 and chassis ground.
 - **If 10 ohms or greater**
 1. Disconnect the X2 harness connector at the K71 Transmission Control Module.
 2. Test for less than 10 ohms in the low reference circuit end to end.
 - If 10 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 10 ohms, replace the transmission control module.
 - **If less than 10 ohms**

3. Ignition ON, engine OFF.
4. Test for 2.4-2.8 V between the sensor signal circuit terminal 12 and chassis ground.
 - **If less than the specified range**
 1. Ignition OFF, disconnect the X2 harness connector at the K71 Transmission Control Module.
 2. Test for less than 10 ohms in the Sensor Signal circuit end to end.
 - If 10 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 10 ohms.
 3. Test for infinite resistance between the Sensor Signal circuit terminal 12 and chassis ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance.
 4. Test for infinite resistance between the Sensor Signal circuit terminal 12 and all other terminals of Q8 Control Solenoid Valve Assembly harness connector.
 - If less than infinite resistance, repair the shorted together condition in the affected circuits.
 - If infinite resistance, test the K71 Transmission Control Module. Refer to Component Testing - K71 Transmission Control Module.
 - **If greater than the specified range**
 1. Ignition OFF, disconnect the X2 harness connector at the K71 Transmission Control Module.
 2. Test for infinite resistance between the Sensor Signal circuit terminal 12 and all other terminals of Q8 Control Solenoid Valve Assembly harness connector.
 - If less than infinite resistance, repair the shorted together condition in the affected circuits.
 - If infinite resistance, test the K71 Transmission Control Module. Refer to Component Testing - K71 Transmission Control Module.
5. Test for 2.4-2.8 V between the Sensor Signal circuit terminal 12 and the low reference circuit terminal 18.
 - **If less than the specified range**
 1. Test for infinite resistance between the low reference circuit terminal 18 and all other terminals of the Q8 Control Solenoid Valve Assembly harness connector.
 - If less than infinite resistance, repair the shorted together condition in the affected circuits.
 - If infinite resistance, test the K71 Transmission Control Module. Refer to Component Testing - K71 Transmission Control Module.
 - **If greater than the specified range**
 1. Test for infinite resistance between the low reference circuit terminal 18 and all other terminals of the Q8 Control Solenoid Valve Assembly harness connector.
 - If less than infinite resistance, repair the shorted together condition in the affected circuits.
 - If infinite resistance, test the K71 Transmission Control Module. Refer to Component Testing - K71 Transmission Control Module.
 - **If within the specified range**
6. Sensor signal circuit, low reference circuit and K71 Transmission Control Module OK.

Component Testing

B109 Transfer Case Fluid Temperature Sensor

1. Disconnect the Q8 Control Solenoid Valve Assembly harness connector.

NOTE:

- When test probing harness terminals, it is imperative to use the proper test probe from the most current version of the J-35616 GM-Approved Terminal Test Kit. Use of an improper test probe may deform the terminal, resulting in intermittent open conditions.
- Testing for Step 2 is performed on the Q8 Control Solenoid Valve Assembly connector using the GY probe J 35616-3.

2. Measure the resistance between the transmission fluid temperature sensor signal circuit, terminal 12 and the low reference circuit, terminal 18. Refer to **Temperature Versus Resistance (ECT)** for resistance values.

- If the resistance is not within the specified range for the given temperature. Replace the T12 Automatic Transmission Assembly

Refer to **Transmission Replacement**.

- If the resistance IS within the specified range for the given temperature

3. B109 transmission fluid temperature sensor OK.

K71 Transmission Control Module - CVT

NOTE:

Circuit/System Testing must be performed before proceeding to K71 Transmission Control Module testing.

1. Ignition OFF.
2. Disconnect the Q8 Control Solenoid Valve Assembly harness connector.

NOTE:

- When test probing harness terminals, it is imperative to use the proper test probe from the most current version of the J-35616 GM-Approved Terminal Test Kit. Use of an improper test probe may deform the terminal, resulting in intermittent open conditions.
- Testing for steps 3-x is performed on the Q8 Control Solenoid Valve Assembly harness using the GY probe J-35616-2A.

3. Ignition ON engine OFF. Verify the scan tool Transmission Fluid Temperature parameter displays -40°C (-40°F).

- If the Transmission Fluid Temperature parameter does not display -40°C (-40°F). Replace the K71 Transmission Control Module

Refer to **Transmission Control Module Replacement**.

- If the **Transmission Fluid Temperature** parameter does display **-40°C (-40°F)**
- 4. Using a fused jumper harness, short the signal circuit terminal 12, to the low reference circuit terminal 18. Verify the scan tool **Transmission Fluid Temperature** parameter displays **180°C (356°F)**.
 - If the **Transmission Fluid Temperature** parameter does not display **180°C (356°F)**. Replace the **K71 Transmission Control Module**

Refer to **Transmission Control Module Replacement**.

- If the **Transmission Fluid Temperature** parameter does display **180°C (356°F)**
- 5. K71 transmission control module OK.

Temperature Versus Resistance

Temp (°C/°F)	Normal Range ohms	Nominal
20/68	6825-6175	6500
30/86	4750-4300	4520
40/104	3300-3000	3145
50/122	2310-2090	2200
60/140	1700-1540	1615
70/158	1250-1125	1185
80/176	910-825	870

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Control Module References** for K71 Transmission Control Module replacement, setup and programming.
- Refer to **Transmission Replacement** for transmission replacement.

DTC P0717: INPUT SPEED SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0717

Input Speed Sensor Circuit No Signal - Primary Pulley Speed Sensor

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition 1 Voltage	P0717	P0717	-	P0717
Sensor Signal	P0717	P0717	-	P0717
Low Reference	-	P0717	-	-

Typical Scan Tool Data

Parameter	Normal Range	Short to Ground	Open/High Resistance	Short to Voltage
Operating Conditions: Engine idling, normal operating temperature				
Ignition Voltage	10-16 V	0 V	0 V	10-16 V
Engine Speed	500-1050 RPM	500-1050 RPM	500-1050 RPM	500-1050 RPM
Primary Pulley Speed	500-1, 000 RPM	35 RPM or 3616 RPM	35 RPM or 3616 RPM	500-1, 000 RPM
Transmission ISS	55-130 RPM (11-13% of Primary Pulley Speed)	0 RPM	0 RPM	55-130 RPM

Circuit/System Description

The Input Speed Sensor, also known as Primary Pulley Speed Sensor, is a three wire hall-effect sensor. The primary pulley speed sensor provides primary pulley speed information to the transmission control module. The primary pulley speed sensor is mounted on the upper left front of the transmission near the B81 Park Neutral Position Switch facing the primary pulley reluctor wheel. As the primary pulley rotates, the toothed rotor wheel passes through the magnetic field of the primary pulley speed sensor and produces an AC voltage. The AC voltage level and the number of pulses increase as the speed of the pulley increases. The transmission control module converts the voltage to primary pulley speed. The transmission control module uses the primary pulley speed to control engine torque, torque converter lock-up and determine pulley ratios. The transmission control module supplies a B+ (+0.0/-2.0 V) sensor signal circuit, an Ignition 1 voltage circuit and a low reference circuit to the primary pulley speed sensor.

Conditions for Running the DTC

Condition 1

- Engine running.
- Ignition voltage 10-16 V.
- Secondary pulley speed greater than or equal to 1000 RPM.

Condition 2

- Engine running.
- Ignition voltage 10-16 V.

- 10 ms ago, primary pulley speed greater than or equal to 1000 RPM.

Conditions for Setting the DTC

Condition 1 (Low Speed)

- Primary pulley speed parameter is less than 150 RPM for 5 s.
- The transmission control module detects a low pulse signal from the primary pulley speed sensor when there is a high pulse signal coming from the secondary pulley speed sensor for 5 s.

Condition 2 (During Driving)

- Primary pulley speed sensor value is 0 RPM for 500 ms.
- The transmission control module detects no pulse signal from the primary pulley speed sensor when there are pulses from the secondary pulley speed sensor for 500 ms.

Action Taken When the DTC Sets

- P0717 is a Type A DTC.
- Pulley ratio limited to 0.55-2.2.
- Lock-up prohibited.
- Engine torque limited to 100.
- If not in 2nd gear, current gear forced to 2nd gear once wheel speed equals 0 km/h (0 mph).

Conditions for Clearing the DTC

P0717 is a Type A DTC.

Diagnostic Aids

DTC P0717 detects a very low primary pulley speed when the secondary pulley speed is greater than a calibrated value.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **Inline Harness Connector End Views**

Description and Operation

Electronic Component Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

J-38522 Variable Signal Generator

For equivalent regional tools, refer to **Special Tools**.

Circuit/System Verification

1. Verify fuse F23 is not open, Fuse Block - Underhood.

- **If the fuse is open**

Test the Run/Crank Ignition 1 voltage circuit for a short to ground. Refer to **Testing for Short to Ground**.

- **If the fuse is not open**

2. Ignition ON, engine OFF.
3. Verify P0562 or P0563 is not set.
 - **If the DTC is set**

Refer to DTC P0562 or P0563.

- **If the DTC is not set**

4. Engine running. Transmission in Park. Brake NOT applied.
5. Verify the scan tool Primary Pulley Speed parameter varies with engine RPM and does not drop out.
 - **If the Primary Pulley Speed does not vary with engine speed or drops out**

Refer to Circuit/System Testing.

- **If the Primary Pulley Speed varies with engine speed and does not drop out**
- 6. Verify P0717 is only set as a history DTC.
 - **If the DTC is set as current**

Refer to Circuit/System Testing.

- **If the DTC is set as history**

NOTE: **After inspection, apply Nyogel lubricant 760G to each connector terminal. Ensure each connector and CPA is correctly seated.**

- 7. Visually inspect each connector terminal of the B14C Input Speed Sensor/Primary Pulley Speed Sensor connector and the K71 Transmission Control Module for damage or corrosion. Repair as necessary.
- 8. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data. The DTC should not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

- 9. All OK.

Circuit/System Testing

- 1. Verify fuse F23 is not open, Fuse Block - Underhood.
 - **If the fuse is open**

Test the Ignition 1 voltage circuit and all components connected to the Ignition 1 circuit for a short to ground.

- **If the fuse is not open**

- 2. Ignition OFF, disconnect the harness connector at the B14C Input Speed Sensor/Primary Pulley Speed Sensor.

NOTE:

- **Testing for steps 3-6 is performed on the B14C Input Speed Sensor/Primary Pulley Speed Sensor harness connector using the GY probes J-35616-2A.**
- **Chassis ground to battery ground 25-35 ohms.**

- 3. Test for less than 10 ohms between the low reference circuit terminal 1 and chassis ground or test for less than 50 ohms if between the low reference circuit terminal 1 and the battery ground.
 - **If 10 ohms or greater**

Repair the open/high resistance in the circuit

- **If less than 10 ohms**

4. Ignition ON. Engine OFF.
5. Using a fused jumper wire, test for B+ (+0.0/-0.5 V) between the Ignition 1 voltage circuit terminal 3 and the low reference circuit terminal 1.
 - **If less than B+ (+0.0/-0.5 V)**

Repair the open/high resistance in the circuit

- **If B+ (+0.0/-0.5 V)**

6. Test for B+ (+0.0/-2.5 V) between the sensor signal circuit terminal 2 and the low reference terminal 1.
 - **If less than B+ (+0.0/-2.5 V)**
 1. Ignition OFF, disconnect the X2 harness connector at the K71 Transmission Control Module.
 2. Test for less than 10 ohms in the sensor signal circuit end to end.
 - If 10 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 10 ohms.
 3. Test for infinite resistance between the sensor signal circuit, terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance
 4. Test for infinite resistance between the sensor signal circuit terminal 2 and all other terminals of the B14C Input Speed Sensor/Primary Pulley Speed Sensor harness connector.
 - If less than infinite resistance, repair the short together in the affected circuits.
 - If infinite resistance
 5. Connect the red lead of the **J-38522** variable signal generator to the sensor signal circuit terminal 2. Connect the black lead of the **J-38522** variable signal generator to the low reference circuit terminal 1. Plug the power cord of the **J-38522** variable signal generator into the cigar lighter.
 6. Set the **J-38522** variable signal generator to 12 volts, the Frequency to 300 and the Duty Cycle to 50%.
 7. Ignition ON. Verify the scan tool Primary Pulley Speed parameter is between 540-660 RPM.
 - If not within the specified range, replace the K71 Transmission Control Module.
 - If within the specified range, test the K71 Transmission Control Module for proper operation. Refer to Component Testing - K71 Transmission Control Module.
 - **If B+ (+0.0/-2.5 V)**
7. Replace the B14C Input Speed Sensor/Primary Pulley Speed Sensor.

Component Testing

NOTE: **You must perform the Circuit/System Testing first.**

K71 Transmission Control Module

1. Ignition OFF, disconnect the harness connector at the B14C Input Speed Sensor/Primary Pulley Speed

Sensor.

NOTE: Testing for steps 2-4 is performed on the B14C Input Speed Sensor/Primary Pulley Speed Sensor harness connector using the GY probes J-35616-2A.

2. Connect the red lead of the J-38522 variable signal generator to the sensor signal circuit terminal 2. Connect the black lead of the J-38522 variable signal generator to the low reference circuit terminal 1. Plug the power cord of the J-38522 variable signal generator into the cigar lighter.
3. Set the J-38522 variable signal generator to 12 volts, the Frequency to 30 and the Duty Cycle to 50%.
4. Ignition ON. Verify the scan tool Primary Pulley Speed parameter is between the following specified ranges as you rotate the frequency switch through the various selections.
 - If not within the specified range, replace the K71 Transmission Control Module.
 - If within the specified range.
5. K71 Transmission Control Module OK.

Primary Pulley Parameter

Frequency	Range	Nominal
30	55-65	60
60	105-135	120
120	215-265	240
250	225-275	250
300	540-660	600
600	1080-1320	1200
1000	1800-2200	2000
5000	9000-11000	10000
10000	18000-22000	20000

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Control Module References** for K71 Transmission Control Module replacement, setup and programming.
- Refer to **Primary Input Speed Sensor Replacement** for Primary Pulley Speed Sensor replacement.

DTC P0721: OUTPUT SPEED SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0721

Output Speed Sensor Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition 1 Voltage	P0721	P0721	-	P0721
Sensor Signal	P0721	P0721	-	P0721
Low Reference	-	P0721	-	-

Typical Scan Tool Data

Parameter	Normal Range	Short to Ground	Open/High Resistance	Short to Voltage
Operating Conditions: Vehicle moving, normal operating temperature				
Transmission OSS	20-50 RPM	0 RPM	0 RPM	20-50 RPM
Vehicle Speed	5-10 km/h (3-6 mph)	0 km/h (0 mph)	0 km/h (0 mph)	5-10 km/h (3-6 mph)

Circuit/System Description

The B14A Output Shaft Speed Sensor is a three wire hall-effect sensor. The output shaft speed sensor provides output shaft speed information to the transmission control module. The output shaft speed sensor is mounted on the middle right rear of the transmission above the right output shaft facing the final gear reluctor wheel. As the final gear rotates, the toothed rotor wheel passes through the magnetic field of the output shaft speed sensor and produces an AC voltage. The AC voltage level and the number of pulses increase as the speed of the final gear increases. The transmission control module converts the voltage to output shaft speed. The transmission control module uses the output shaft speed to determine vehicle speed. The transmission control module supplies a B+ (+0.0/-2.0 V) sensor signal circuit, an Ignition 1 voltage circuit and a low reference circuit to the output Shaft speed sensor.

Conditions for Running the DTC

Condition 1

- Engine running.
- Ignition voltage 10-16 V.
- Selector lever in D, L or R position.

Condition 2

- Engine running.

- Ignition voltage 10-16 V.
- Selector lever in D, L or R position.

Conditions for Setting the DTC

Condition 1 (Low Speed)

- The transmission control module detects a low pulse signal from the output shaft speed sensor when there is a high pulse signal coming from the secondary pulley speed sensor for 5 ms.
- Transmission OSS parameter 250 RPM or less.
- Secondary pulley speed parameter is 1500 RPM or greater for 10 s.

Condition 2 (During Driving)

- The transmission control module detects no pulse signal from the output shaft speed sensor when there are pulses from the secondary speed sensor for 500 ms.
- Output shaft speed sensor parameter is 0 RPM for 500 ms.

Action Taken When the DTC Sets

- P0721 is a Type A DTC.
- Pulley ratio limited to 0.55-2.2.
- Lock-up prohibited.
- Engine torque limited to 100.
- If not in 2nd gear, current gear forced to 2nd gear once wheel speed equals 0 km/h (0 mph).

Conditions for Clearing the DIC/DTC

P0721 is a Type A DTC.

Diagnostic Aids

The transmission control module detects no pulse signal from the output shaft speed sensor when there are pulses from the secondary speed sensor.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **Inline Harness Connector End Views**

Description and Operation

Electronic Component Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

J-38522 Variable Signal Generator

For equivalent regional tools, refer to **Special Tools**.

Circuit/System Verification

1. Verify fuse F23 is not open, Fuse Block - Underhood.
 - **If the fuse is open**

Test the Run/Crank Ignition 1 voltage circuit for a short to ground. Refer to **Testing for Short to Ground** .

- **If the fuse is not open**
2. Ignition ON, engine OFF.
 3. Verify P0562 or P0563 is not set.
 - **If the DTC is set**

Refer to DTC P0562 or P0563.

- **If the DTC is not set**
4. Engine running, Transmission in Park. Brake NOT applied.
 5. Verify while driving at low speed that the scan tool Transmission OSS parameter varies with actual vehicle speed and does not drop out.
 - **If the Transmission OSS does not vary with actual vehicle speed or drops out**

Refer to Circuit/System Testing.

- **If the Transmission OSS does vary with actual vehicle speed and does not drop out**

6. Verify P0721 is only set as a history DTC.

- **If the DTC is set as current**

Refer to Circuit/System Testing.

- **If the DTC is set as history**

NOTE: After inspection, apply Nyogel lubricant 760G to each connector terminal. Ensure each connector and CPA is correctly seated.

7. Visually inspect each connector terminal of the B14A Output Shaft Speed Sensor connector and the K71 Transmission Control Module for damage or corrosion. Repair as necessary.
8. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data. The DTC should not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

9. All OK.

Circuit/System Testing

1. Verify fuse F23 is not open, Fuse Block - Underhood.

- **If the fuse is open**

Test the Ignition 1 voltage circuit and all components connected to the Ignition 1 circuit for a short to ground.

- **If the fuse is not open**

2. Ignition OFF, disconnect the harness connector at the B14A Output Shaft Speed Sensor.

NOTE:

- **Testing for steps 3-6 is performed on the B14A Output Shaft Speed Sensor harness connector using the GY probes J-35616-2A.**
- **Chassis ground to battery ground 25-35 ohms.**

3. Test for less than 10 ohms between the low reference circuit terminal 1 and chassis ground or test for less than 50 ohms if between the low reference circuit terminal 1 and the battery ground.

- **If 10 ohms or greater**

Repair the open/high resistance in the circuit

- **If less than 10 ohms**

4. Ignition ON. Engine OFF.
5. Using a fused jumper wire, test for B+ (+0.0/-0.5 V) between the Ignition 1 Voltage circuit terminal 3 and the low reference circuit terminal 1.
 - **If less than B+ (+0.0/-0.5 V)**

Repair the open/high resistance in the circuit

- **If B+ (+0.0/-0.5 V)**

6. Test for B+ (+0.0/-2.5 V) between the sensor signal circuit terminal 2 and the low reference terminal 1.
 - **If less than B+ (+0.0/-2.5 V)**
 1. Ignition OFF, disconnect the X2 harness connector at the K71 Transmission Control Module.
 2. Test for less than 10 ohms in the sensor signal circuit end to end.
 - If 10 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 10 ohms.
 3. Test for infinite resistance between the sensor signal circuit, terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance
 4. Test for infinite resistance between the sensor signal circuit terminal 2 and all other terminals of the B14A Output Shaft Speed Sensor harness connector.
 - If less than infinite resistance, repair the short together in the affected circuits.
 - If infinite resistance
 5. Connect the red lead of the **J-38522** variable signal generator to the sensor signal circuit terminal 2. Connect the black lead of the **J-38522** variable signal generator to the low reference circuit terminal 1. Plug the power cord of the **J-38522** variable signal generator into the cigar lighter.
 6. Set the **J-38522** variable signal generator to 12 volts, the Frequency to 300 and the Duty Cycle to 50%.
 7. Ignition ON. Verify the scan tool Transmission OSS parameter is between 540-660 RPM.
 - If not within the specified range, replace the K71 Transmission Control Module.
 - If within the specified range, test the K71 Transmission Control Module for proper operation. Refer to Component Testing - K71 Transmission Control Module.
 - **If B+ (+0.0/-2.5 V)**
7. Replace the B14A Output Shaft Speed Sensor.

Component Testing

NOTE: **You must perform the Circuit/System Testing first.**

K71 Transmission Control Module

1. Ignition OFF, disconnect the harness connector at the B14A Output Shaft Speed Sensor.

NOTE: Testing for steps 2-4 is performed on the B14A Output Shaft Speed Sensor harness connector using the GY probes J-35616-2A.

2. Connect the red lead of the J-38522 variable signal generator to the sensor signal circuit terminal 2. Connect the black lead of the J-38522 variable signal generator to the low reference circuit terminal 1. Plug the power cord of the J-38522 variable signal generator into the cigar lighter.
3. Set the J-38522 variable signal generator to 12 volts, the Frequency to 30 and the Duty Cycle to 50%.
4. Ignition ON. Verify the scan tool Transmission OSS parameter is between the following specified ranges as you rotate the frequency switch through the various selections.
 - If not within the specified range, replace the K71 Transmission Control Module.
 - If within the specified range.
5. K71 Transmission Control Module OK.

Transmission OSS Parameter

Frequency	Range	Nominal
30	55-65	60
60	105-135	120
120	215-265	240
250	225-275	250
300	540-660	600
600	1080-1320	1200
1000	1800-2200	2000
5000	9000-11000	10000
10000	18000-22000	20000

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Control Module References** for K71 Transmission Control Module replacement, setup and programming.
- Refer to **Output Speed Sensor Replacement** for Output Shaft Speed Sensor replacement.

DTC P0741: TORQUE CONVERTER CLUTCH

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0741

Torque Converter Clutch (TCC) System - Stuck Off - Transmission Hydraulic/Mechanical Performance

Circuit/System Description

The torque converter clutch pressure control solenoid valve is part of the control solenoid valve assembly which has no serviceable parts.

The transmission control module (TCM) controls the torque converter clutch (TCC) pressure control solenoid pressure by regulating the current flow through the torque converter clutch pressure control solenoid valve windings. The transmission control module determines the appropriate pressure for a given load by monitoring the throttle position sensor voltage, the engine speed and other inputs. The transmission control module then varies the duty cycle on the high side of the torque converter clutch pressure control solenoid valve to control current flow to the solenoid. The magnetic field produced by the coil moves the solenoid's internal valve which varies pressure to the torque converter clutch control valve.

When vehicle operating conditions are appropriate to apply the torque converter clutch, the transmission control module will increase current flow to the torque converter clutch pressure control solenoid valve. The torque converter clutch pressure control solenoid valve directs fluid pressure to move the torque converter clutch control valve to the apply position and moves the torque converter regulator valve to the regulating position. The torque converter regulator valve controls torque converter clutch apply fluid pressure proportional to torque converter clutch solenoid pressure. When the torque converter clutch is fully applied the engine is coupled directly to the transmission. Torque converter clutch release is accomplished by the transmission control module decreasing current flow to the torque converter clutch pressure control solenoid valve. This results in decreasing the apply pressure which allows the torque converter clutch control valve to move to the release position. The transmission control module calculates torque converter slip speed based on engine speed and transmission input shaft speed.

Conditions for Running the DTC

- TCM DTC P0717 is not set.
- System voltage 10-16 V.
- TCC lock-up commanded.
- TCC Pressure Control Solenoid Valve Pressure Command greater than 0.2 MPa.
- DTC P0741 runs continuously.

Conditions for Setting the DTC

The TCC Slip Speed is greater than $40 \text{ rpm} + (\text{Engine Speed}/1.25)$ for 30 s.

Action Taken When the DTC Sets

P0741 is a Type B DTC.

Conditions for Clearing the DTC/DTC

P0741 is a Type B DTC.

Diagnostic Aids

- DTC P0741 sets due to non-electrical transmission hydraulic/mechanical performance issues.
- If the torque converter clutch pressure control solenoid valve has no electrical faults but the transmission control module detects greater than acceptable pressure or to less than acceptable pressure DTC P0741 is set.

Reference Information

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **Inline Harness Connector End Views**

Description and Operation

- **Electronic Component Description**
- **Transmission Component and System Description**
- **Transmission General Description**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the transmission fluid level and condition are correct. Refer to **Transmission Fluid Level and Condition Check**.
2. Verify DTC P2763 or P2764 is not set.
 - **If DTC P2763 or P2764 is set**

Refer to **DTC P2763 or P2764**.
 - **If DTC P2763 or P2764 is not set**

NOTE: After inspection, apply Nyogel lubricant 760G to each connector terminal. Ensure each connector and CPA is correctly seated.

3. Visually inspect each connector terminal of the K71 transmission control module X2 connector and the Q8 Control Solenoid Valve Assembly connector for damage or corrosion. Repair as necessary.

4. Clear DTC P0741 from history.
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data. The DTC should not set.
 - **If any of the DTCs are set**

Replace the T12 Automatic Transmission Assembly. Refer to **Transmission Replacement**.

- **If none of the DTCs set**
6. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Control Module References** for control solenoid valve assembly replacement, programming and setup.
- Refer to **Transmission Replacement** for transmission replacement.
- Refer to **Transmission Fluid Level and Condition Check**

DTC P0792: INTERMEDIATE SHAFT SPEED SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0792

Intermediate Shaft Speed Sensor Circuit Performance - Secondary Pulley Speed Sensor

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition 1 Voltage	P0792	P0792	-	P0792
Sensor Signal	P0792	P0792	-	P0792
Low Reference	-	P0792	-	-

Typical Scan Tool Data

Parameter	Normal Range	Short to Ground	Open/High Resistance	Short to Voltage
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Operating Conditions: Engine idling, normal operating temperature

Ignition Voltage	10-16 V	0 V	0 V	10-16 V
Engine Speed	550-1050 RPM	550-1050 RPM	550-1050 RPM	550-1050 RPM
Primary Pulley Speed	500-1, 000 RPM	35 RPM or 3616 RPM	35 RPM or 3616 RPM	500-1, 000 RPM
Secondary Pulley Speed	200-500 RPM (40-50% of Primary Pulley Speed)	0 RPM	0 RPM	200-500 RPM

Circuit/System Description

The Secondary Pulley Speed Sensor, also known as the Intermediate Shaft Speed Sensor or the B14B Transmission Turbine Speed Sensor, is a three wire hall-effect sensor. The secondary pulley speed sensor provides secondary pulley speed information to the transmission control module. The secondary pulley speed sensor is mounted on the upper left rear of the transmission facing the secondary pulley reluctor wheel. As the secondary pulley rotates, the toothed rotor wheel passes through the magnetic field of the secondary pulley speed sensor and produces an AC voltage. The AC voltage level and the number of pulses increase as the speed of the pulley increases. The transmission control module converts the voltage to secondary pulley speed. The transmission control module uses the secondary pulley speed to control and determine pulley ratios. The transmission control module supplies a B+ (+0.0/-2.0 V) sensor signal circuit, an Ignition 1 voltage circuit and a low reference circuit to the secondary pulley speed sensor.

Conditions for Running the DTC**Condition 1**

- Engine running.
- Ignition voltage 10-16 V.
- Primary pulley speed greater than or equal to 1000 RPM.

Condition 2

- Engine running.
- Ignition voltage 10-16 V.
- 10 ms ago, secondary pulley speed greater than or equal to 1000 RPM.

Conditions for Setting the DTC**Condition 1 (Low Speed)**

- Secondary pulley speed parameter is less than 150 RPM for 5 s.
- The transmission control module detects a low pulse signal from the secondary pulley speed sensor when there is a high pulse signal coming from the primary pulley speed sensor for 5 s.

Condition 2 (During Driving)

- Secondary pulley speed sensor value is 0 RPM for 500 ms.
- The transmission control module detects no pulse signal from the secondary pulley speed sensor when there are pulses from the primary pulley speed sensor for 500 ms.

Action Taken When the DTC Sets

- P0792 is a Type A DTC.
- Pulley ratio limited to 0.55-2.2.
- Lock-up prohibited.
- Engine torque limited to 100.
- If not in 2nd gear, current gear forced to 2nd gear once wheel speed equals 0 km/h (0 mph).

Conditions for Clearing the DIC/DTC

P0792 is a Type A DTC.

Diagnostic Aids

DTC P0792 detects a very low secondary pulley speed when the primary pulley speed is greater than a calibrated value.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **Inline Harness Connector End Views**

Description and Operation

Electronic Component Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

J-38522 Variable Signal Generator

For equivalent regional tools, refer to **Special Tools**.

Circuit/System Verification

1. Verify fuse F23 is not open, Fuse Block - Underhood.

- **If the fuse is open**

Test the Run/Crank Ignition 1 voltage circuit for a short to ground. Refer to **Testing for Short to Ground**.

- **If the fuse is not open**

2. Ignition ON, engine OFF.
3. Verify P0562 or P0563 is not set.

- **If the DTC is set**

Refer to DTC P0562 or P0563.

- **If the DTC is not set**

4. Engine running. Transmission in Park. Brake NOT applied.
5. Verify while driving at low speed that the scan tool Secondary Pulley Speed parameter varies with the engine speed and does not drop out. The Secondary Pulley Speed parameter should be 30-60% of the engine speed parameter.

- **If the Secondary Pulley Speed does not vary with Primary Pulley Speed or drops out**

Refer to Circuit/System Testing.

- **If the Secondary Pulley Speed varies with engine speed and does not drop out**

6. Verify P0792 is only set as a history DTC.

- **If the DTC is set as current**

Refer to Circuit/System Testing.

- **If the DTC is set as history**

NOTE: After inspection, apply Nyogel lubricant 760G to each connector terminal.

Ensure each connector and CPA is correctly seated.

7. Visually inspect each connector terminal of the B14B Transmission Turbine Speed Sensor/Secondary Pulley Speed Sensor connector and the K71 Transmission Control Module for damage or corrosion. Repair as necessary.
8. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data. The DTC should not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

9. All OK.

Circuit/System Testing

1. Verify fuse F23 is not open, Fuse Block - Underhood.

- **If the fuse is open**

Test the Ignition 1 voltage circuit and all components connected to the Ignition 1 circuit for a short to ground.

- **If the fuse is not open**

2. Ignition OFF, disconnect the harness connector at the B14B Transmission Turbine Speed Sensor/Secondary Pulley Speed Sensor.

NOTE:

- **Testing for steps 3-6 is performed on the B14B Transmission Turbine Speed Sensor/Secondary Pulley Speed Sensor harness connector using the GY probes J-35616-2A.**
- **Chassis ground to battery ground 25-35 ohms.**

3. Test for less than 10 ohms between the low reference circuit terminal 1 and chassis ground or test for less than 50 ohms if between the low reference circuit terminal 1 and the battery ground.

- **If 10 ohms or greater**

Repair the open/high resistance in the circuit

- **If less than 10 ohms**

4. Ignition ON. Engine OFF.

5. Using a fused jumper wire, test for B+ (+0.0/-0.5 V) between the Ignition 1 voltage circuit terminal 3 and the low reference circuit terminal 1.

- **If less than B+ (+0.0/-0.5 V)**

Repair the open/high resistance in the circuit

- **If B+ (+0.0/-0.5 V)**
- 6. Tests for B+ (+0.0/-2.5 V) between the sensor signal circuit terminal 2 and the low reference terminal 1.
 - **If less than B+ (+0.0/-2.5 V)**
 - 1. Ignition OFF, disconnect the X2 harness connector at the K71 Transmission Control Module.
 - 2. Test for less than 10 ohms in the sensor signal circuit end to end.
 - If 10 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 10 ohms.
 - 3. Test for infinite resistance between the sensor signal circuit, terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance
 - 4. Test for infinite resistance between the sensor signal circuit terminal 2 and all other terminals of the B14B Transmission Turbine Speed Sensor/Secondary Pulley Speed Sensor harness connector.
 - If less than infinite resistance, repair the short together in the affected circuits.
 - If infinite resistance
 - 5. Connect the red lead of the **J-38522** variable signal generator to the sensor signal circuit terminal 2. Connect the black lead of the **J-38522** variable signal generator to the low reference circuit terminal 1. Plug the power cord of the **J-38522** variable signal generator into the cigar lighter.
 - 6. Set the **J-38522** variable signal generator to 12 volts, the Frequency to 300 and the Duty Cycle to 50%.
 - 7. Ignition ON. Verify the scan tool Secondary Pulley Speed parameter is between 540-660 RPM.
 - If not within the specified range, replace the K71 Transmission Control Module.
 - If within the specified range, test the K71 Transmission Control Module for proper operation. Refer to Component Testing - K71 Transmission Control Module.
 - **If B+ (+0.0/-2.5 V)**
- 7. Replace the B14B Transmission Turbine Speed Sensor/Secondary Pulley Speed Sensor.

Component Testing

NOTE: You must perform the Circuit/System Testing first.

K71 Transmission Control Module

1. Ignition OFF, disconnect the harness connector at the B14B Transmission Turbine Speed Sensor/Secondary Pulley Speed Sensor.

NOTE: Testing for steps 2-4 is performed on the B14B Transmission Turbine Speed Sensor/Secondary Pulley Speed Sensor harness connector using the GY probes J-35616-2A.

2. Connect the red lead of the **J-38522** variable signal generator to the sensor signal circuit terminal 2. Connect the black lead of the **J-38522** variable signal generator to the low reference circuit terminal 1. Plug the power cord of the **J-38522** variable signal generator into the cigar lighter.

3. Set the **J-38522** variable signal generator to 12 volts, the Frequency to 30 and the Duty Cycle to 50%.
4. Ignition ON. Verify the scan tool Secondary Pulley Speed parameter is between the following specified ranges as you rotate the frequency switch through the various selections.
 - If not within the specified ranges, replace the K71 Transmission Control Module.
 - If within the specified range.
5. K71 Transmission Control Module OK.

Secondary Pulley Parameter

Frequency	Range	Nominal
30	55-65	60
60	105-135	120
120	215-265	240
250	225-275	250
300	540-660	600
600	1080-1320	1200
1000	1800-2200	2000
5000	9000-11000	10000
10000	18000-22000	20000

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Control Module References** for K71 Transmission Control Module replacement, setup and programming.
- Refer to **Secondary Input Speed Sensor Replacement** for Secondary Speed Sensor replacement.

DTC P0796 OR P0797: PRESSURE CONTROL SOLENOID VALVE 3

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0796

Pressure Control Solenoid Valve 3 - Stuck Off - Transmission Hydraulic/Mechanical Performance

DTC P0797

Pressure Control Solenoid Valve 3 - Stuck On - Transmission Hydraulic/Mechanical Performance

Circuit/System Description

The pressure control solenoid valve 3 is part of the control solenoid valve assembly.

The transmission control module controls pressure solenoid 3 pressure by regulating the current flow through the pressure control solenoid valve 3 windings. The transmission control module determines the appropriate pressure for a given load by monitoring the throttle position sensor voltage, the engine speed and other inputs. The transmission control module then varies the duty cycle on the high side of the pressure control solenoid valve 3 to control current flow to the solenoid. The magnetic field produced by the coil moves the solenoid's internal valve which varies pressure to the pressure regulator valve. The transmission control module controls the pressure control solenoid valve 3 by applying a varying amount of amperage to the solenoid. Current is controlled from about 20 mA for maximum line pressure to 1200 mA for minimum pressure. The transmission control module monitors the actual current to the solenoid as compared to the requested current.

Conditions for Running the DTC

P0796

- TCM DTC P0705, P0706, P0721, P0792, P0796, P0797, P2714, P2715 or U0100 is not set.
- System voltage 10-16 V.
- Engine Speed greater than 550 rpm.
- Transmission Output Shaft Speed greater than 300 rpm.
- Secondary Pulley Speed greater than 300 rpm.
- Transmission Range D or L.
- Auxiliary gear box in 1st gear.
- Throttle position sensor greater than 7.8%.
- DTC P0796 runs continuously.

P0797

- TCM DTC P0705, P0706, P0721, P0792, P0796, P0797, P2714, P2715 or U0100 is not set.
- System voltage 10-16 V.
- Engine Speed greater than 550 rpm.
- Transmission Output Shaft Speed greater than 300 rpm.
- Secondary Pulley Speed greater than 300 rpm.
- Transmission Range D or L.
- Vehicle Speed greater than 10 km/h (7 mph).
- Auxiliary gear box in 2nd gear.
- Vehicle decelerating for - Condition 1.
- Throttle position sensor greater than 7.8% - Condition 2.
- DTC P0797 runs continuously.

Conditions for Setting the DTC

P0796

The auxiliary gearbox ratio is greater than 2.231 for 2 s.

P0797 - Condition 1

The auxiliary gearbox ratio is greater than 50% of the 1st gear design ratio for 200 ms.

P0797 - Condition 2

The auxiliary gearbox ratio is less than 10% of the 2nd gear design ratio for 500 ms.

Action Taken When the DTC Sets

P0796

- P0796 is a Type B DTC.
- The transmission control module commands the auxiliary gearbox into Neutral until vehicle speed is less than 40 km/h (25 mph). Then the TCM commands the auxiliary gearbox into 2nd gear.

P0797

- P0797 is a Type B DTC.
- The transmission control module commands the auxiliary gearbox into 1st gear.

Conditions for Clearing the DTC

P0796 and P0797 are Type B DTCs.

Diagnostic Aids

- DTC P0796 or P0797 set due to non-electrical transmission hydraulic/mechanical performance issues.
- If the pressure control solenoid valve 3 has no electrical faults but the transmission control module detects greater than acceptable pressure or to less than acceptable pressure DTC P0796 or P0797 is set.

Reference Information

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **Inline Harness Connector End Views**

Description and Operation

- **Electronic Component Description**

- **Transmission General Description**
- **Transmission Component and System Description**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

For equivalent regional tools, refer to Special Tools.

Circuit/System Verification

1. Verify the transmission fluid level and condition are correct. Refer to **Transmission Fluid Level and Condition Check**.
2. Verify DTC P0970 or P0971 is not set.
 - **If DTC P0970 or P0791 is set**

Refer to **DTC P0970 or P0971**.

- **If DTC P0970 or P0791 is not set**

NOTE: After inspection, apply Nyogel lubricant 760G to each connector terminal. Ensure each connector and CPA is correctly seated.

3. Visually inspect each connector terminal of the K71 transmission control module X2 connector and the Q8 Control Solenoid Valve Assembly connector for damage or corrosion. Repair as necessary.
4. Clear DTC P0796 or P0797 from history.
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observe from the Freeze Frame/Failure Records data. The DTC should not set.
 - **If any of the DTCs are set**

Replace the T12 Automatic Transmission Assembly. Refer to **Transmission Replacement**.

- **If none of the DTCs set**

6. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Control Module References** for control solenoid valve assembly replacement, programming and setup.

- Refer to **Transmission Replacement** for transmission replacement.
- Refer to **Transmission Fluid Level and Condition Check**.

DTC P0841-P0843: TRANSMISSION FLUID PRESSURE SWITCH

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0841

Transmission Fluid Pressure Switch Performance - Secondary Pulley Pressure

DTC P0842

Transmission Fluid Pressure Switch Circuit Low Voltage - Secondary Pulley Pressure

DTC P0843

Transmission Fluid Pressure Switch Circuit High Voltage - Secondary Pulley Pressure

Diagnostic Fault Information

Circuit/Component	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Transmission Auxiliary Oil Pressure Switch Signal	P0842	P0843	P0843	P0841
Transmission Oil Temperature Sensor Low Reference	-	P0713 and/or P0842	-	P0841

Circuit/System Description

The Transmission Fluid Pressure Switch, also known as the Transmission Fluid Pressure Switch 1 or the Secondary Pulley Pressure Sensor, is part of the control solenoid valve assembly which has no serviceable parts.

The Transmission Control Module supplies a signal circuit and a shared ground to the Transmission Fluid Pressure Switch. The Transmission Fluid Pressure Switch shares a ground with the Transmission Fluid Temperature Sensor. When the transmission control module determines that more pressure is needed at the secondary pulley, the transmission control module increases voltage to the transmission fluid pressure switch. When the transmission control module determines that less pressure is needed at the secondary pulley, the transmission control module decreases voltage to the transmission fluid pressure switch.

Conditions for Running the DTC

P0841 - Condition 1

- TCM DTC P0705, P0706, P0717, P0961, P0962, P0963 or U0100 is not set.
- System voltage 10-16 V.
- Transmission Range D.
- Primary Pulley Speed less than 306 rpm.
- Secondary Pulley Speed greater than 230 rpm.
- Vehicle Speed less than 50 km/h (31 mph).
- Rate of change in pulley ratio less than 0.1.
- Calculated throttle position less than 21%.
- DTC P0841 runs continuously.

P0841 - Condition 2

- TCM DTC P0705, P0706, P0717, P0961, P0962, P0963 or U0100 is not set.
- System voltage 10-16 V.
- Engine Speed greater than 450 rpm.
- Transmission Range D.
- Vehicle Speed greater than 10 km/h (6 mph).
- Throttle position sensor greater than 12.5%.
- Transmission Fluid Temperature 20-180°C (68-356°F).
- Target secondary pressure greater than 0 MPa.
- DTC P0841 runs continuously.

P0842

- System voltage 10-16 V.
- Transmission Fluid Temperature greater than -20°C (-4°F).
- DTC P0842 runs continuously.

P0843

- System voltage 10-16 V.
- Transmission Fluid Temperature greater than -20°C (-4°F).
- Target secondary pressure less than 5.7 MPa.
- DTC P0842 runs continuously.

Conditions for Setting the DTC

P0841 - Condition 1

The Secondary Pulley Pressure is greater than 0.675 MPa from what the transmission control module commanded for at least 5 s.

P0841 - Condition 2

The Secondary Pulley Pressure is less than 1.2 MPa from what the transmission control module commanded for at least 30 s.

P0842

Secondary Pulley Pressure Sensor voltage greater than 4.7 V for 5 s or more.

P0843

Secondary Pulley Pressure Sensor voltage less than 0.09 V for 5 s or more.

Action Taken When the DTC Sets

- P0841, P0842 and P0843 are Type B DTCs.
- Secondary pressure feedback control inhibited.

Conditions for Clearing the DTC

P0841, P0842 and P0843 are Type B DTCs.

Diagnostic Aids

A Transmission Fluid Pressure Switch may malfunction due to normal debris in the transmission fluid causing a Transmission Fluid Pressure Switch DTC to intermittently set.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **Inline Harness Connector End Views**

Description and Operation

- **Electronic Component Description**
- **Transmission General Description**
- **Transmission Component and System Description**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that the scan tool Secondary Pulley Pressure Sensor parameter displays 0.09-4.7 V.
 - **If the Secondary Pulley Pressure Sensor parameter does NOT display 0.09-4.7V**
2. Verify that the scan tool Secondary Pulley Pressure parameter changes as vehicle speed changes.
 - **If the Secondary Pulley Pressure parameter does NOT change as vehicle speed changes**

Refer to Circuit/System Testing.

- **If the Secondary Pulley Pressure Sensor parameter does display 0.09-4.7V**

3. Verify DTC P0841, P0842 or P0843 is only set as a history DTC.
 - **If any of the DTCs are set as current**

Refer to Circuit/System Testing.

- **If any of the DTCs are only set as history**

NOTE: **After inspection, apply Nyogel lubricant 760G to each connector terminal. Ensure each connector and CPA is correctly seated.**

4. Visually inspect each connector terminal of the K71 transmission control module X2 connector and the Q8 Control Solenoid Valve Assembly connector for damage or corrosion. Repair as necessary.
5. Clear DTC P0841, P0842 or P0843 from history.
6. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observe from the Freeze Frame/Failure Records data. The DTC should not set.

- **If any of the DTCs are set**

Refer to Circuit/System Testing.

- **If none of the DTCs set**

7. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the Q8 Control Solenoid Valve Assembly connector.

NOTE:

- **When test probing harness terminals, it is imperative to use the proper test probe from the most current version of the J-35616 GM-Approved Terminal Test Kit. Use of an improper test probe may deform the terminal, resulting in intermittent open conditions.**
- **Testing for steps 2-5 is performed on the Q8 Control Solenoid Valve Assembly harness connector using the J-35616-2A GY probe.**
- **Chassis ground to Battery ground 25-35 ohms.**

2. Test for less than 10 ohms between the low reference circuit terminal 18 and chassis ground.

- **If 10 ohms or greater**

1. Disconnect the X2 harness connector at the K71 Transmission Control Module.
2. Test for less than 10 ohms in the low reference circuit end to end.
 - If 10 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 10 ohms, replace the transmission control module.

- **If less than 10 ohms**

3. Engine at Idle. Parking brake engaged. Transmission in Neutral.

4. Test for 0.75-1.00 V between the switch signal circuit terminal 14 and chassis ground.

- **If less than 0.75 V**

1. Ignition OFF, disconnect the X2 harness connector at the K71 Transmission Control Module.
2. Test for less than 10 ohms in the switch signal circuit end to end.
 - If 10 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 10 ohms
3. Test for infinite resistance between the switch signal circuit terminal 14 and chassis ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance
4. Test for infinite resistance between the switch signal circuit terminal 14 and all other terminals of Q8 Control Solenoid Valve Assembly harness connector.
 - If less than infinite resistance, repair the shorted together condition in the affected circuits.
 - If infinite resistance, replace the K71 Transmission Control Module. Refer to **Transmission Control Module Replacement**.

- **If greater than 1.00 V**
- 1. Ignition OFF, disconnect the X2 harness connector at the K71 Transmission Control Module.
- 2. Test for infinite resistance between the switch signal circuit terminal 14 and all other terminals of Q8 Control Solenoid Valve Assembly harness connector.
 - If less than infinite resistance, repair the shorted together condition in the affected circuits.
 - If infinite resistance, replace the K71 Transmission Control Module. Refer to **Transmission Control Module Replacement**.
- **If between 0.75-1.00 V**
- 5. Test for 0.75-1.00 V between the switch signal circuit terminal 14 and the low reference circuit terminal 18.
 - **If less than 0.75 V**
 - Test for infinite resistance between the low reference circuit terminal 18 and all other terminals of the Q8 Control Solenoid Valve Assembly harness connector.
 - If less than infinite resistance, repair the shorted together condition in the affected circuits.
 - If infinite resistance, replace the K71 Transmission Control Module. Refer to **Transmission Control Module Replacement**.
 - **If greater than 1.00 V**
 - Test for infinite resistance between the low reference circuit terminal 18 and all other terminals of the Q8 Control Solenoid Valve Assembly harness connector.
 - If less than infinite resistance, repair the shorted together condition in the affected circuits.
 - If infinite resistance, replace the K71 Transmission Control Module. Refer to **Transmission Control Module Replacement**.
 - **If between 0.75-1.00 V**
- 6. Replace the T12 Automatic Transmission Assembly. Refer to **Transmission Replacement**.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Control Module References** for K71 Transmission Control Module replacement, programming and setup.
- Refer to **Transmission Replacement** for transmission replacement.

DTC P0863: TRANSMISSION CONTROL MODULE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.

- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0863

Transmission Control Module (TCM) Communication Circuit - (ROM Assembly)

Diagnostic Fault Information

Circuit/Component	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Transmission Manual/Automatic Data Output	P0863	P0863	P0863	-
Transmission Manual/Automatic Data Clock	P0863	P0863	P0863	-
Transmission Manual/Automatic Select Direction	P0863	P0863	P0863	-

Circuit/System Description

At each ignition ON, the transmission control module reads the oil pressure calibration data stored in the CVT ROM assembly.

Conditions for Running the DTC

Condition A - Unable to read oil pressure calibration data

- TCM power supply voltage greater than or equal to 6.5 V.
- Gear selector position: P or N.
- Output speed equals 0.0 km/h/mph.

Condition B - Transmission control module unable to communicate with CVT ROM memory

- TCM power supply voltage 10-16 V.
- Gear selector position: P or N.
- Output speed equals 0.0 km/h/mph.

Conditions for Setting the DTC

At each ignition ON, the transmission control module tries to read the transmission fluid pressure control calibration data stored in the CVT flash ROM assembly. If the transmission control module is unable to read the CVT flash ROM assembly DTC C0863 is set.

Action Taken When the DTC Sets

- P0863 is a Type A DTC.
- Auxiliary gearbox is held in 2nd gear.
- Pulley ratio is fixed at 0.55.
- Lock-up is prohibited.
- Engine torque is limited to 100.

Conditions for Clearing the DTC

P0863 is a Type A DTC.

Diagnostic Aids

Low voltage or a momentary loss of power or ground to the transmission control module may cause this DTC to set. Verify the following:

- The battery cables are clean and tight and the battery is fully charged. Refer to **Battery Inspection/Test** .
- The transmission control module ground circuits do not have an open or high resistance.
- The transmission control module power circuits do not have an open, short to ground or high resistance.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

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- **Inline Harness Connector End Views**

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition OFF for at least one minute to allow for the complete shutdown of the K71 Transmission Control Module. Ignition ON.
2. Using a scan tool, erase the CVT calibration data in the TCM.
3. Using a scan tool, run the CVT calibration process.
4. Clear DTC P0863.
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data. The DTC should not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**
6. All OK.

Circuit/System Testing

1. Ignition OFF.
2. Disconnect the Q8 Control Solenoid Valve Assembly connector.
3. Test for greater than 1.0 M ohms between each of the following circuits and ground.
 - Transmission Manual/Automatic Data Output circuit, terminal 17
 - Transmission Manual/Automatic Data Clock circuit, terminal 16
 - Transmission Manual/Automatic Select Direction circuit, terminal 15

○ **If 1.0 M ohms or less**

Repair the short to ground in the affected circuit.

○ **If greater than 1.0 M ohms**

4. Test for infinite resistance between each of the following circuits and all other terminals of the Q8 Control Solenoid Valve Assembly connector.
 - Transmission Manual/Automatic Data Output circuit, terminal 17
 - Transmission Manual/Automatic Data Clock circuit, terminal 16
 - Transmission Manual/Automatic Select Direction circuit, terminal 15

○ **If less than infinite resistance**

Repair the short together in the affected circuits.

○ **If infinite resistance**

5. Disconnect the K71 Transmission Control Module X2 harness connector.
6. Test for less than 5 ohms resistance in the following circuits end to end.
 - Transmission Manual/Automatic Data Output circuit, Q8 Control Solenoid Valve Assembly connector terminal 17 to K71 Transmission Control Module harness connector X2 terminal 21
 - Transmission Manual/Automatic Data Clock circuit, Q8 Control Solenoid Valve Assembly connector terminal 16 to K71 Transmission Control Module harness connector X2 terminal 13
 - Transmission Manual/Automatic Select Direction circuit, Q8 Control Solenoid Valve Assembly connector terminal 15 to K71 Transmission Control Module harness connector X2 terminal 22
 - **If 5 ohms or greater**

Repair the open/high resistance in the affected circuit.
 - **If less than 5 ohms**
7. Connect the Q8 Control Solenoid Valve Assembly connector and the K71 Transmission Control Module X2 harness connector.
8. Ignition ON.
9. Using a scan tool, erase the CVT calibration data in the TCM.
10. Using a scan tool, run the CVT calibration process.
11. Clear DTC P0863.
12. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data. The DTC should not set.
 - **If the DTC sets**

Replace the T12 Automatic Transmission Assembly (CVT). Refer to **Transmission Replacement**.
 - **If the DTC does not set**
13. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Transmission Replacement** for Automatic Transmission Assembly Replacement.
- Refer to **Control Module References** for Transmission Control Module Programming and Setup.

DTC P0871: TRANSMISSION FLUID PRESSURE SWITCH

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0871

Transmission Fluid Pressure Switch 3 System Performance

Diagnostic Fault Information

Circuit/Component	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Transmission Manual/Automatic Data Output	P0871	P0871	P0871	-

Typical Scan Tool Data

Transmission Fluid Pressure Switch 3

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON. Transmission in Park.			
Transmission Fluid Pressure Switch 3	LOW	HIGH	HIGH

Circuit/System Description

The Transmission Fluid Pressure Switch 3 also known as the Oil Pressure Switch is part of the control solenoid valve assembly which has no serviceable parts.

The Transmission Fluid Pressure Switch 3 shares the Transmission Manual/Automatic Date Output circuit with the ROM Assembly in the transmission. The ROM Assembly uses the Transmission Manual/Automatic Date Output circuit as a low speed serial data circuit between the ROM Assembly in the transmission and the transmission control module. The ROM Assembly only communicates with the transmission control module when the RUN/CRANK circuit goes high. Data is transmitted once during the drive cycle and happens quickly. After that data exchange, the function of the Transmission Manual/Automatic Date Output circuit becomes the Transmission Fluid Pressure Switch 3. The Transmission Fluid Pressure Switch 3 reflects the status of the high clutch oil pressure. The Transmission Fluid Pressure Switch 3 is normally open. When the clutch is commanded ON the Transmission Fluid Pressure Switch 3 closes. The DTC sets if there is a mismatch between the TCM commanded high clutch position and the status of the switch.

Conditions for Running the DTC

Condition 1

- TCM DTC P0705, P0706, P0796, P0797, P0961, P0962, P0963, P2714 or P2715 is not set.
- System voltage 10-16 V.
- Transmission Range P, N or R.
- High clutch pressure command 0 MPa.
- ROM assembly not communicating.
- DTC P0871 runs continuously.

Condition 2

- TCM DTC P0705, P0706, P0796, P0797, P0961, P0962, P0963, P2714 or P2715 is not set.
- System voltage 10-16 V.
- Transmission Range D or L.
- High clutch pressure command 0 MPa.
- Engine Speed greater than 400 RPM.
- Vehicle Speed less than 10 km/h (7 mph).
- Current commanded auxiliary gear 1st gear.
- ROM assembly not communicating.
- DTC P0871 runs continuously.

Condition 3

- TCM DTC P0705, P0706, P0796, P0797, P0961, P0962, P0963, P2714 or P2715 is not set.
- System voltage 10-16 V.
- Transmission Range D or L.
- High clutch pressure command greater than 0.2 MPa.
- Engine Speed greater than 550 RPM.
- Output gear speed greater than 300 RPM.
- Secondary pulley speed greater than 300 RPM.
- Throttle position sensor greater than 7.8%.
- Current commanded auxiliary gear 2nd gear.
- Actual auxiliary gear ratio less than 1.1.
- Vehicle Speed less than 10 km/h (7 mph).
- ROM assembly not communicating.
- DTC P0871 runs continuously.

Conditions for Setting the DTC

Condition 1 and 2

The High Clutch Pressure Switch status displays ON for greater than 1.5 s.

Condition 3

The High Clutch Pressure Switch status displays OFF for greater than 1.5 s.

Action Taken When the DTC Sets

- P0871 is a Type A DTC.
- Auxiliary gearbox held in 2nd gear.

- Neutral idle disabled.

Conditions for Clearing the DTC

P0871 is a Type A DTC.

Diagnostic Aids

CAUTION: Use correct transmission fluid only. Failure to use the proper fluid may result in transmission internal damage.

A Transmission Fluid Pressure Switch may malfunction due to normal debris in the transmission fluid causing a Transmission Fluid Pressure Switch DTC to intermittently set. If DTC P0871 continues to intermittently set, replacing the transmission fluid may correct the problem. Refer to **Transmission Fluid Level and Condition Check** for transmission draining and filling.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **Inline Harness Connector End Views**

Description and Operation

- **Electronic Component Description**
- **Transmission General Description**
- **Transmission Component and System Description**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON. Engine OFF. Transmission in Park.
2. Verify that the Transmission Fluid Pressure Switch 3 scan tool parameter displays HIGH.
 - **If the parameter does NOT display HIGH**

Refer to Circuit/System Testing.

- **If the parameter does display HIGH**
3. Using the S3 Transmission Shift Lever, shift the transmission to Low.
 4. While monitoring the Transmission Fluid Pressure Switch 3 parameter, accelerate the vehicle to 60 km/h (37 mph). Maintain that speed for at least 15 s with the Calculated Throttle Position parameter displaying less than 20%.
 5. Verify that the Transmission Fluid Pressure Switch 3 parameter continues to display High.
 - **If the parameter does NOT display High**

Refer to Circuit/System Testing.

- **If the parameter does display High**
6. Stop the vehicle.
 7. Using the S3 Transmission Shift Lever, shift the transmission to Drive.
 8. While monitoring the Transmission Fluid Pressure Switch 3 parameter, accelerate the vehicle to 60 km/h (37 mph). Maintain that speed for at least 15 s with the Calculated Throttle Position parameter displaying less than 20%.
 9. Verify that the Transmission Fluid Pressure Switch 3 scan tool parameter displays LOW.
 - **If the parameter does NOT display LOW**
- Refer to Circuit/System Testing.
- **If the parameter does display LOW**
10. Verify DTC P0871 is only set as a history DTC.
 - **If the DTC is set as current**
- Refer to Circuit/System Testing.

- **If the DTC is only set as history**

NOTE: **After inspection, apply Nyogel lubricant 760G to each connector terminal. Ensure each connector and CPA is correctly seated.**

11. Visually inspect each connector terminal of the K71 transmission control module X2 connector and the Q8 Control Solenoid Valve Assembly connector for damage or corrosion. Repair as necessary.

12. Clear DTC P0871 from history.
13. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data. The DTC should not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

14. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the Q8 Control Solenoid Valve Assembly connector and the K71 Transmission Control Module X2 connector.

NOTE:

- **When test probing harness terminals, it is imperative to use the proper test probe from the most current version of the J 35616 GM-Approved Terminal Test Kit. Use of an improper test probe may deform the terminal, resulting in intermittent open conditions.**
- **Testing for steps 2-4 is performed on the Q8 Control Solenoid Valve Assembly harness connector using the GY probe J 35616-2A.**
- **Chassis ground to Battery ground 25-35 ohms.**

2. Test for infinite resistance between the Transmission Manual/Automatic Date Output circuit terminal 21 and chassis ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance.
3. Test for infinite resistance between the Transmission Manual/Automatic Date Output circuit terminal 21 and all other terminals of the Q8 Control Solenoid Valve Assembly connector.
 - If less than infinite resistance, repair the shorted together condition in the affected circuits.
 - If infinite resistance.
4. Test for less than 10 ohms in the Transmission Manual/Automatic Date Output circuit end to end.
 - **If 10 ohms or greater**

Repair the open/high resistance in the circuit.

- **If less than 10 ohms**

5. Connect all disconnected connectors.
6. Ignition ON. Engine OFF. Transmission in Park.
7. Verify that the Transmission Fluid Pressure Switch 3 scan tool parameter displays HIGH.
 - **If the parameter does NOT display HIGH**

Replace the T12 Automatic Transmission Assembly. Refer to **Transmission Replacement**.

- **If the parameter does display HIGH**

8. Using the S3 Transmission Shift Lever, shift the transmission to Drive.

9. Verify that the Transmission Fluid Pressure Switch 3 scan tool parameter displays LOW.

- **If the parameter does NOT display LOW**

Replace the T12 Automatic Transmission Assembly. Refer to **Transmission Replacement**.

- **If the parameter does display LOW**

10. Transmission Manual/Automatic Date Output circuit and ROM Assembly OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Control Module References** for control solenoid valve assembly replacement, programming and setup.
- Refer to **Transmission Replacement** for transmission replacement.
- Refer to **Transmission Fluid Level and Condition Check** for transmission draining and filling.

DTC P0885: TRANSMISSION CONTROL MODULE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0885

Transmission Control Module (TCM) Power Relay Control Circuit

Diagnostic Fault Information

Circuit/Component	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Transmission Main Relay Fused supply 1	P0885	P0885	-	P0885
Transmission Main Relay Fused supply 1	P0885	P0885	-	P0885
Transmission Main Relay Control	P0885	P0885	-	P0885
Ground	-	P0885	-	-

Circuit/System Description

The Transmission Control Module Relay supplies 3 ignition voltage signals to the transmission control module.

Two of the ignition voltage circuits are Transmission Main Relay Fused Supply 1 circuits which are protected by fuse F14UA, X50A Fuse Block - Underhood. The other voltage circuit is the Transmission Main Relay Control circuit which is protected by fuse F2UA, X50A Fuse Block - Underhood.

Conditions for Running the DTC

- Battery voltage greater than 11 V.
- DTC P0885 runs continuously.

Conditions for Setting the DTC

System voltage is less than 8.4 V for 200 ms.

Action Taken When the DTC Sets

- P0885 is a Type A DTC.
- Pulley ratio limited to 0.55.
- Lock-up prohibited.
- Engine torque limited to 100.
- If not in 2nd gear, current gear forced to 2nd gear.

Conditions for Clearing the DTC

P0885 is a Type A DTC.

Diagnostic Aids

An open TCM fuse or a malfunctioning transmission control module relay can cause P0885 to set.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **Inline Harness Connector End Views**

Description and Operation

Electronic Component Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Verify that the Ignition Voltage parameter displays greater than 8.4 V.
 - **If the Ignition Voltage parameter does NOT display greater than 8.4 V**

Refer to Circuit/System Testing.

- **If the Ignition Voltage parameter does display greater than 8.4 V**

2. Verify DTC P0885 is only set as a history DTC.
 - **If DTC P0885 is set as current**

Refer to Circuit/System Testing.

- **If DTC P0885 is only set as history**

NOTE: **After inspection, apply Nyogel lubricant 760G to each connector terminal. Ensure each connector and CPA is correctly seated.**

3. Visually inspect each connector terminal of the K71 transmission control module X1 and X2 connectors for damage or corrosion. Repair as necessary.
4. Clear DTC P0885 from history.
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observe from the Freeze Frame/Failure Records data. The DTC should not set.
 - **If any of the DTCs set**

Refer to Circuit/System Testing.

- **If none of the DTCs set**

6. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the K71 Transmission Control Module X1 connector.

NOTE:

- When test probing harness terminals, it is imperative to use the proper test probe from the most current version of the J 35616 GM-Approved Terminal Test Kit. Use of an improper test probe may deform the terminal, resulting in intermittent open conditions.
- Testing for step 3-4 is performed on the K71 Transmission Control Module X1 harness connector using the J 35616-64B LT BU probe.
- Chassis ground to Battery ground 25-35 ohms.

2. Ignition ON, engine OFF.
3. Using a fused jumper, test for B+ (+0.0/-1.0 V) between the Transmission Main Relay Control circuit, terminal 16 and chassis ground.
 - If less than B+ (+0.0/-1.0 V)
 1. Ignition OFF, disconnect the X1 harness connector at the X50A Fuse Block - Underhood.
 2. Test for less than 10 ohms in the affected circuit end to end.
 - If 10 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 10 ohms
 3. Test for infinite resistance between the affected circuit and chassis ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance
 4. Test for infinite resistance between the affected circuit and all other terminals of the X50A Fuse Block - Underhood harness connector X1.
 - If less than infinite resistance, repair the shorted together condition in the affected circuits.
 - If infinite resistance, replace the Transmission Control Module Relay.

Refer to **X50A Fuse Block - Underhood Top View** .

- If B = (+0.0/-1.0 V)
4. Using a fused jumper, ground the Transmission Main Relay Control circuit, terminal 16 to chassis ground.

NOTE:

- NOT grounding the Transmission Main Relay Control circuit, terminal 16 to chassis ground will leave the Transmission Main Relay Fused supply 1 circuits, terminal 5 & 6 at 0 V.
- Grounding the Transmission Main Relay Control circuit, terminal 16 to chassis ground will energize the relay and cause the Transmission Main Relay Fused supply 1 circuits, terminal 5 & 6 to go to B+ (+0.0/-1.0 V).

5. Using a fused jumper, test for B+ (+0.0/-1.0 V) between the following circuits and chassis ground.
 - Transmission Main Relay Fused supply 1 circuit, terminal 5

- Transmission Main Relay Fused supply 1 circuit, terminal 6

- **If less than B+ (+0.0/-1.0 V)**

1. Ignition OFF, disconnect the X2 harness connector at the X50A Fuse Block - Underhood.
2. Test for less than 10 ohms in the affected circuit end to end.
 - If 10 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 10 ohms
3. Test for infinite resistance between the affected circuit and chassis ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance
4. Test for infinite resistance between the affected circuit and all other terminals of the X50A Fuse Block - Underhood harness connector X2.
 - If less than infinite resistance, repair the shorted together condition in the affected circuits.
 - If infinite resistance, replace the Transmission Control Module Relay.

Refer to **X50A Fuse Block - Underhood Top View** .

- **If B = (+0.0/-1.0 V)**

6. Ignition OFF, disconnect the K71 Transmission Control Module X2 connector.
7. Ignition ON, engine OFF.
8. Using a fused jumper, test for B+ (+0.0/-1.0 V) between the Transmission Main Relay Control circuit, Transmission Control Module X1 connector terminal 16 and the following circuits.
 - Ground circuit, Transmission Control Module X2 connector terminal 11
 - Ground circuit, Transmission Control Module X2 connector terminal 12
 - **If less than B+ (+0.0/-1.0 V)**
1. Ignition OFF, disconnect the G104 ground connector.

Refer to **G104 and G107** .

2. Test for less than 10 ohms in the affected circuit end to end.
 - If 10 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 10 ohms
3. Test for infinite resistance between the affected circuit and chassis ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance
4. Test for infinite resistance between the affected circuit and all other terminals of the Transmission Control Module X2 connector.
 - If less than infinite resistance, repair the shorted together condition in the affected circuits.
 - If infinite resistance, replace the K71 Transmission Control Module.

- **If B+ (+0.0/-1.0 V)**

9. Transmission Main Relay Fused supply 1 circuits, Transmission Main Relay Control circuit and Ground

circuits OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Control Module References** for transmission control module replacement, programming and setup.
- Refer to **Transmission Replacement** for transmission replacement.
- Refer to **X50A Fuse Block - Underhood Top View** for fuse and relay location.

DTC P0961-P0963: LINE PRESSURE CONTROL SOLENOID

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0961

Line Pressure Control Solenoid Valve Performance

DTC P0962

Line Pressure Control Solenoid Valve Control Circuit Low Voltage

DTC P0963

Line Pressure Control Solenoid Valve Control Circuit High Voltage

Diagnostic Fault Information

Circuit/Component	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	P0962	P0963	P0963	P0961

Typical Scan Tool Data

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Operating Conditions: Engine running, normal operating temperature Parameter Normal Range: OK				
Line Pressure Control				

Solenoid Valve Control Circuit Low Voltage Test Status	Malfunction	OK	OK	OK
Line Pressure Control Solenoid Valve Control Circuit High Voltage Test Status	OK	Malfunction	Malfunction	OK

Circuit/System Description

The line pressure control solenoid is part of the control solenoid valve assembly which has no serviceable parts.

The transmission control module controls transmission line pressure by regulating the current flow through the pressure control solenoid valve windings. The transmission control module determines the appropriate line pressure for a given load by monitoring the throttle position sensor voltage, the engine speed and other inputs. The transmission control module then varies the duty cycle on the high side of the line pressure control solenoid valve to control current flow to the solenoid. The magnetic field produced by the coil moves the solenoids internal valve which varies pressure to the pressure regulator valve. The transmission control module controls the pressure control solenoid valve by applying a varying amount of amperage to the solenoid. Current is controlled from about 20 mA for maximum line pressure to 1200 mA for minimum line pressure. The transmission control module compares the actual current to the solenoid to the requested current.

Conditions for Running the DTC

P0961

- System voltage 10-16 V.
- Line pressure control solenoid valve output current 750 mA or more.
- DTC P0717 or P0721 not set.
- Engine speed greater than 600 RPM.
- Selector lever position D, L or R.
- Accelerator pedal position greater than 10%.
- Primary pulley speed greater than 500 RPM.
- Transmission OSS parameter less than 108 or secondary pulley speed greater than 61 RPM.
- This DTCs runs continuously within the enabling conditions

P0962

- System voltage 10-16 V.
- Line pressure control solenoid valve output current 750 mA or more.
- This DTCs runs continuously within the enabling conditions.

P0963

- System voltage 10-16 V.

- Line pressure control solenoid valve output current 750 mA or more.
- DTC P0962 not set.
- This DTCs runs continuously within the enabling conditions.

Conditions for Setting the DTC

P0961 - Condition 1

The actual pulley ratio of the primary pulley speed to secondary pulley speed is greater than 2.55 for 200 msec. Condition must happen twice within 1 s.

P0961 - Condition 2

The actual pulley ratio of the primary pulley speed to secondary pulley speed is greater than 3.35 for 100 msec. Condition must happen twice within 1 s.

P0962

- The transmission control module has determined that there is a short to ground in the circuit.
- The line pressure solenoid valve current is 200 mA or less for 200 ms.

P0963

- The transmission control module has determined that there is an open or short to voltage in the circuit.
- The line pressure solenoid valve current is 200 mA or less for 200 ms.

Action Taken When the DTC Sets

- DTC P0961, P0962 and P0963 are Type B DTCs.
- Pulley ratio limited to 0.55.
- Lock-up prohibited.
- Engine torque limited to 100.
- If not in 2nd gear, current gear forced to 2nd gear once wheel speed equals 0 km/h (0 mph).

Conditions for Clearing the DIC/DTC

DTC P0961, P0962 and P0963 are Type B DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **Inline Harness Connector End Views**

Description and Operation

- **Electronic Component Description**
- **Transmission Component and System Description**
- **Transmission General Description**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that all of the following scan tool parameters display OK.
 - Line Pressure Control Solenoid Valve Control Circuit Low Voltage Test Status
 - Line Pressure Control Solenoid Valve Control Circuit High Voltage Test Status
 - **If any of the parameters do NOT display OK**

Refer to Circuit/System Testing.

- **If all of the parameters display OK**

2. Verify DTC P0961, P0962 or P0963 is only set as a history DTC.

- **If any of the DTCs are set as current**

Refer to Circuit/System Testing.

- **If any of the DTCs are only set as history**

NOTE: After inspection, apply Nyogel lubricant 760G to each connector terminal. Ensure each connector and CPA is correctly seated.

3. Visually inspect each connector terminal of the K71 transmission control module X2 connector and the Q8 Control Solenoid Valve Assembly connector for damage or corrosion. Repair as necessary.
4. Clear DTC P0961, P0962 or P0963 from history.
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data. The DTC should not set.
 - **If any of the DTCs are set**

Refer to Circuit/System Testing.

- **If none of the DTCs set**
6. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the Q8 Control Solenoid Valve Assembly connector.

NOTE:

- **When test probing harness terminals, it is imperative to use the proper test probe from the most current version of the J-35616 GM-Approved Terminal Test Kit. Use of an improper test probe may deform the terminal, resulting in intermittent open conditions.**
- **Testing for step 3 is performed on the Q8 Control Solenoid Valve Assembly harness connector using the GY probe J-35616-2A.**
- **Chassis ground to battery ground 25-35 ohms.**

2. Ignition ON, engine OFF.
3. Test for 2.4-2.8 V between the control circuit terminal 1 and chassis ground.
 - **If less than the specified range**
 1. Ignition OFF, disconnect the X2 harness connector at the K71 Transmission Control Module.
 2. Test for less than 10 ohms in the control circuit end to end.
 - If 10 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 10 ohms.
 3. Test for infinite resistance between the control circuit terminal 1 and chassis ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance.
 4. Test for infinite resistance between the control circuit terminal 1 and all other terminals of Q8 Control Solenoid Valve Assembly harness connector.
 - If less than infinite resistance, repair the shorted together condition in the affected circuits.
 - If infinite resistance, replace the K71 Transmission Control Module. Refer to **Transmission Control Module Replacement**.
 - **If greater than the specified range**
 1. Ignition OFF, disconnect the X2 harness connector at the K71 Transmission Control Module.

2. Test for infinite resistance between the control circuit terminal 1 and all other terminals of Q8 Control Solenoid Valve Assembly harness connector.
 - If less than infinite resistance, repair the shorted together condition in the affected circuits.
 - If infinite resistance, replace the K71 Transmission Control Module. Refer to **Transmission Control Module Replacement**.
 - **If within the specified range**
4. Sensor signal circuit, low reference circuit and K71 Transmission Control Module OK.

Component Testing

Line Pressure Control Solenoid Valve

1. Disconnect the Q8 Control Solenoid Valve Assembly harness connector.

NOTE:

- When test probing harness terminals, it is imperative to use the proper test probe from the most current version of the J-35616 GM-Approved Terminal Test Kit. Use of an improper test probe may deform the terminal, resulting in intermittent open conditions.
- Testing for Step 2 is performed on the Q8 Control Solenoid Valve Assembly connector using the GY probe J-35616-3.

2. Measure the resistance between the control circuit, terminal 1 and chassis ground. Refer to **Temperature Versus Resistance (ECT)** for resistance values.
 - **If the resistance is not within the specified range for the given temperature**

Replace the T12 Automatic Transmission Assembly. Refer to **Transmission Replacement**.
 - **If the resistance IS within the specified range for the given temperature**
3. Line pressure control solenoid OK.

Temperature Versus Resistance

Temp (°C/°F)	Normal Range ohms	Nominal ohms
20/68	5.1-5.5	5.3
30/86	5.3-5.7	5.5
40/104	5.6-6.0	5.8
50/122	5.8-6.2	6.0
60/140	6.0-6.4	6.2
70/158	6.3-6.7	6.5
80/176	6.5-6.9	6.7

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Control Module References** for K71 Transmission Control Module replacement, programming and setup.
- Refer to **Transmission Replacement** for transmission replacement.

DTC P0965-P0967: PRESSURE CONTROL SOLENOID VALVE 2

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0965

Pressure Control Solenoid Valve 2 System Performance

DTC P0966

Pressure Control Solenoid Valve 2 Control Circuit Low Voltage

DTC P0967

Pressure Control Solenoid Valve 2 Control Circuit High Voltage

Diagnostic Fault Information

Circuit/Component	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	P0966	P0977	P0977	P0965

Typical Scan Tool Data

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Operating Conditions: Engine running, normal operating temperature Parameter Normal Range: OK				
Pressure Control Solenoid Valve 2 Control Circuit Low Voltage Test Status	Malfunction	OK	OK	OK
Pressure Control Solenoid Valve 2 Control Circuit High Voltage Test Status	OK	Malfunction	Malfunction	OK

Circuit/System Description

The pressure control solenoid valve 2 is part of the control solenoid valve assembly which has no serviceable parts.

The transmission control module controls pressure solenoid 2 pressure by regulating the current flow through the pressure control solenoid valve 2 windings. The transmission control module determines the appropriate pressure for a given load by monitoring the throttle position sensor voltage, the engine speed and other inputs. The transmission control module then varies the duty cycle on the high side of the pressure control solenoid valve 2 to control current flow to the solenoid. The magnetic field produced by the coil moves the solenoid's internal valve which varies pressure to the pressure regulator valve. The transmission control module controls the pressure control solenoid valve 2 by applying a varying amount of amperage to the solenoid. Current is controlled from about 20 mA for maximum line pressure to 1200 mA for minimum pressure. The transmission control module monitors the actual current to the solenoid as compared to the requested current.

Conditions for Running the DTC

P0965

- System voltage 10-16 V.
- DTC P0717, P0792, P0841, P0842, P0843, P0961, P0962, P0963 or P0965 not set.
- Engine speed greater than 500 RPM.
- Selector lever position D, L or R.
- This DTC runs continuously within the enabling conditions.

P0966

- System voltage 10-16 V.
- Pressure control solenoid valve 2 output current 750 mA or more.
- This DTC runs continuously within the enabling conditions.

P0967

- System voltage 10-16 V.
- Pressure control solenoid valve 2 output current 750 mA or more.
- DTC P0966 not set.
- This DTC runs continuously within the enabling conditions.

Conditions for Setting the DTC

P0965 - Condition 1

The actual pulley ratio of the primary pulley speed to secondary pulley speed is 2.0-2.4 when the target pulley ratio is less than 1.2 for 5 s.

P0965 - Condition 2

The actual pulley ratio of the primary pulley speed to secondary pulley speed is 0.35-0.75 when the target pulley ratio is greater than 1.55 for 5 s.

P0966

- The transmission control module has determined that there is a short to ground in the circuit.
- The line pressure solenoid valve current is 200 mA or less for 200 ms when 750 mA is commanded.

P0967

- The transmission control module has determined that there is an open or short to voltage in the circuit.
- The line pressure solenoid valve current is 200 mA or less for 200 ms when 750 mA is commanded.

Action Taken When the DTC Sets

- DTC P0965, P0966 and P0967 are Type B DTCs.
- Pulley ratio limited to 0.55.
- Lock-up prohibited.
- Engine torque limited to 100.
- If not in 2nd gear, current gear forced to 2nd gear once wheel speed equals 0 km/h (0 mph).

Conditions for Clearing the DTC

DTC P0965, P0966 and P0967 are Type B DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **Inline Harness Connector End Views**

Description and Operation

- **Electronic Component Description**
- **Transmission Component and System Description**
- **Transmission General Description**

Electrical Information Reference

- **Circuit Testing**

- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that all of the following scan tool parameters display OK.
 - Pressure Control Solenoid Valve 2 Control Circuit Low Voltage Test Status
 - Pressure Control Solenoid Valve 2 Control Circuit High Voltage Test Status
 - **If any of the parameters do NOT display OK**

Refer to Circuit/System Testing.

- **If all of the parameters display OK**

2. Verify DTC P0965, P0966 or P0967 is only set as a history DTC.
 - **If any of the DTCs are set as current**

Refer to Circuit/System Testing.

- **If any of the DTCs are only set as history**

NOTE: After inspection, apply Nyogel lubricant 760G to each connector terminal. Ensure each connector and CPA is correctly seated.

3. Visually inspect each connector terminal of the K71 transmission control module X2 connector and the Q8 Control Solenoid Valve Assembly connector for damage or corrosion. Repair as necessary.
4. Clear DTC P0965, P0966 or P0967 from history.
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data. The DTC should not set.
 - **If any of the DTCs are set**

Refer to Circuit/System Testing.

- **If none of the DTCs set**

6. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the Q8 Control Solenoid Valve Assembly connector.

NOTE:

- When test probing harness terminals, it is imperative to use the proper test probe from the most current version of the J-35616 GM-Approved Terminal Test Kit. Use of an improper test probe may deform the terminal, resulting in intermittent open conditions.
- Testing for step 3 is performed on the Q8 Control Solenoid Valve Assembly harness connector using the GY probe J-35616-2A.
- Chassis ground to battery ground 25-35 ohms.

2. Ignition ON, engine OFF.
3. Test for 2.4-2.8 V between the control circuit terminal 2 and chassis ground.
 - If less than the specified range
 1. Ignition OFF, disconnect the X2 harness connector at the K71 Transmission Control Module.
 2. Test for less than 10 ohms in the control circuit end to end.
 - If 10 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 10 ohms.
 3. Test for infinite resistance between the control circuit terminal 2 and chassis ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance.
 4. Test for infinite resistance between the control circuit terminal 2 and all other terminals of Q8 Control Solenoid Valve Assembly harness connector.
 - If less than infinite resistance, repair the shorted together condition in the affected circuits.
 - If infinite resistance, replace the K71 Transmission Control Module. Refer to Transmission Control Module Replacement.
 - If greater than the specified range
 1. Ignition OFF, disconnect the X2 harness connector at the K71 Transmission Control Module.
 2. Test for infinite resistance between the control circuit terminal and all other terminals of Q8 Control Solenoid Valve Assembly harness connector.
 - If less than infinite resistance, repair the shorted together condition in the affected circuits.
 - If infinite resistance, replace the K71 Transmission Control Module. Refer to Transmission Control Module Replacement.
 - If within the specified range
4. Sensor signal circuit, low reference circuit and K71 Transmission Control Module OK.

Component Testing

Pressure Control Solenoid Valve 2

1. Disconnect the Q8 Control Solenoid Valve Assembly harness connector.

NOTE:

- When test probing harness terminals, it is imperative to use the proper test probe from the most current version of the J-35616 GM-Approved Terminal Test Kit. Use of an improper test probe may deform the terminal, resulting in intermittent open conditions.
- Testing for Step 2 is performed on the Q8 Control Solenoid Valve Assembly connector using the GY probe J-35616-3.

2. Measure the resistance between the control circuit, terminal 2 and chassis ground. Refer to **Temperature Versus Resistance (ECT)** for resistance values.

- If the resistance is not within the specified range for the given temperature

Replace the T12 Automatic Transmission Assembly. Refer to **Transmission Replacement**.

- If the resistance IS within the specified range for the given temperature

3. Pressure control solenoid valve 2 OK.

Temperature Versus Resistance

Temp (°C/°F)	Normal Range ohms	Nominal ohms
20/68	5.1-5.5	5.3
30/86	5.3-5.7	5.5
40/104	5.6-6.0	5.8
50/122	5.8-6.2	6.0
60/140	6.0-6.4	6.2
70/158	6.3-6.7	6.5
80/176	6.5-6.9	6.7

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Control Module References** for K71 Transmission Control Module replacement, programming and setup.
- Refer to **Transmission Replacement** for transmission replacement.

DTC P0970 OR P0971: PRESSURE CONTROL SOLENOID VALVE 3**Diagnostic Instructions**

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0970

Pressure Control Solenoid Valve 3 Control Circuit Low Voltage

DTC P0971

Pressure Control Solenoid Valve 3 Control Circuit High Voltage

Diagnostic Fault Information

Circuit/Component	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	P0970	P0971	P0971	-

Typical Scan Tool Data

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Operating Conditions: Engine running, normal operating temperature Parameter Normal Range: OK				
Pressure Control Solenoid Valve 3 Control Circuit Low Voltage Test Status	Malfunction	OK	OK	OK
Pressure Control Solenoid Valve 3 Control Circuit High Voltage Test Status	OK	Malfunction	Malfunction	OK

Circuit/System Description

The pressure control solenoid valve 3 is part of the control solenoid valve assembly which has no serviceable parts.

The transmission control module controls pressure solenoid 3 pressure by regulating the current flow through the pressure control solenoid valve 3 windings. The transmission control module determines the appropriate pressure for a given load by monitoring the throttle position sensor voltage, the engine speed and other inputs. The transmission control module then varies the duty cycle on the high side of the pressure control solenoid valve 3 to control current flow to the solenoid. The magnetic field produced by the coil moves the solenoids internal valve which varies pressure to the pressure regulator valve. The transmission control module controls the pressure control solenoid valve 3 by applying a varying amount of amperage to the solenoid. Current is controlled from about 20 mA for maximum line pressure to 1200 mA for minimum pressure. The transmission control module monitors the actual current to the solenoid as compared to the requested current.

Conditions for Running the DTC

P0970

- System voltage 10-16 V.

- Pressure control solenoid valve 3 output current 750 mA or more.
- This DTCs runs continuously within the enabling conditions.

P0971

- System voltage 10-16 V.
- Pressure control solenoid valve 3 output current 750 mA or more.
- DTC 2720 not set.
- This DTCs runs continuously within the enabling conditions.

Conditions for Setting the DTC

P0970

- The transmission control module has determined that there is a short to ground in the circuit.
- The pressure control solenoid valve 3 current is 200 mA or less for 200 ms when 700 mA is commanded.

P0971

- The transmission control module has determined that there is an open or short to voltage in the circuit.
- The pressure control solenoid valve 3 current is 200 mA or less for 200 ms when 700 mA is commanded.

Action Taken When the DTC Sets

P0970

- P0970 is a Type B DTC.
- If not in 2nd gear, current gear forced to 2nd gear once wheel speed equals 40 km/h (25 mph).
- If in 2nd gear, 2nd held until wheel speed equals 0 km/h (0 mph).

P0971

- P0971 is a Type B DTC.
- When the transmission control module has determined that there is an open in the circuit, if commanding 1st gear the auxiliary gearbox will be in a neutral state until wheel speed equals 40 km/h (25 mph).
- When the transmission control module has determined that there is a short to voltage in the circuit, the auxiliary gearbox is held in 1st gear.

Conditions for Clearing the DTC

DTC P0970 and P0971 are Type B DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

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- **Electronic Component Description**
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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that all of the following scan tool parameters display OK.
 - Pressure Control Solenoid Valve 3 Control Circuit Low Voltage Test Status
 - Pressure Control Solenoid Valve 3 Control Circuit High Voltage Test Status
 - **If any of the parameters do NOT display OK**

Refer to Circuit/System Testing.

- **If all of the parameters display OK**

2. Verify DTC P0970 or P0971 is only set as a history DTC.
 - **If any of the DTCs are set as current**

Refer to Circuit/System Testing.

- **If any of the DTCs are only set as history**

NOTE: After inspection, apply Nyogel lubricant 760G to each connector terminal. Ensure each connector and CPA is correctly seated.

3. Visually inspect each connector terminal of the K71 transmission control module X2 connector and the Q8 Control Solenoid Valve Assembly connector for damage or corrosion. Repair as necessary.
4. Clear DTC P0970 or P0971 from history.
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data. The DTC should not set.
 - **If any of the DTCs are set**

Refer to Circuit/System Testing.

- **If none of the DTCs set**

6. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the Q8 Control Solenoid Valve Assembly connector.

- NOTE:**
- **When test probing harness terminals, it is imperative to use the proper test probe from the most current version of the J-35616 GM-Approved Terminal Test Kit. Use of an improper test probe may deform the terminal, resulting in intermittent open conditions.**
 - **Testing for step 3 is performed on the Q8 Control Solenoid Valve Assembly harness connector using the GY probe J 35616-2A.**
 - **Chassis ground to Battery ground 25-35 ohms.**

2. Ignition ON, engine OFF.
3. Test for 2.4-2.8 V between the control circuit terminal 6 and chassis ground.
 - **If less than the specified range**
 1. Ignition OFF, disconnect the X2 harness connector at the K71 Transmission Control Module.
 2. Test for less than 10 ohms in the control circuit end to end.
 - If 10 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 10 ohms.
 3. Test for infinite resistance between the control circuit terminal 6 and chassis ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance.
 4. Test for infinite resistance between the control circuit terminal 6 and all other terminals of Q8 Control Solenoid Valve Assembly harness connector.
 - If less than infinite resistance, repair the shorted together condition in the affected circuits.
 - If infinite resistance, replace the K71 Transmission Control Module. Refer to **Transmission Control Module Replacement**.

- **If greater than the specified range**

1. Ignition OFF, disconnect the X2 harness connector at the K71 Transmission Control Module.
2. Test for infinite resistance between the control circuit terminal 6 and all other terminals of Q8 Control Solenoid Valve Assembly harness connector.
 - If less than infinite resistance, repair the shorted together condition in the affected circuits.
 - If infinite resistance, replace the K71 Transmission Control Module. Refer to **Transmission Control Module Replacement**.

- **If within the specified range**

4. Sensor signal circuit, low reference circuit and K71 Transmission Control Module OK.

Component Testing

Pressure Control Solenoid Valve 3

1. Disconnect the Q8 Control Solenoid Valve Assembly harness connector.

NOTE:

- **When test probing harness terminals, it is imperative to use the proper test probe from the most current version of the J-35616 GM-Approved Terminal Test Kit. Use of an improper test probe may deform the terminal, resulting in intermittent open conditions.**
- **Testing for Step 2 is performed on the Q8 Control Solenoid Valve Assembly connector using the GY probe J-35616-3.**

2. Measure the resistance between the control circuit, terminal 6 and chassis ground. Refer to **Temperature Versus Resistance (ECT)** for resistance values.

- **If the resistance is not within the specified range for the given temperature**

Replace the T12 Automatic Transmission Assembly. Refer to **Transmission Replacement**.

- **If the resistance IS within the specified range for the given temperature**

3. Pressure control solenoid valve 3 OK.

Temperature Versus Resistance

Temp (°C/°F)	Normal Range ohms	Nominal ohms
20/68	5.1-5.5	5.3
30/86	5.3-5.7	5.5
40/104	5.6-6.0	5.8
50/122	5.8-6.2	6.0
60/140	6.0-6.4	6.2
70/158	6.3-6.7	6.5
80/176	6.5-6.9	6.7

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Control Module References** for K71 Transmission Control Module replacement, programming and setup.
- Refer to **Transmission Replacement** for transmission replacement.

DTC P1790: TRANSMISSION CONTROL MODULE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1790

Transmission Control Module Checksum Error - ROM Assembly

Circuit/System Description

At each ignition ON, the transmission control module compares the calibration data stored in the CVT ROM assembly with the calibration data stored in the transmission control module. If the ROM assembly data does not agree with the transmission control module data a checksum error is logged and DTC P1790 is set.

This is an internal fault of the CVT ROM assembly in the transmission detected by the transmission control module. No external circuits are involved.

Conditions for Running the DTC

- Ignition ON.
- Ignition voltage 10.0-16.0 V.
- DTC P1790 is run during transmission control module power up.

Conditions for Setting the DTC

- The read only memory (ROM) assembly on the control solenoid valve assembly has been successfully read by the transmission control module
- Transmission output speed equals 0.0 km/h/mph.
- The ROM checksum test has failed 5 or more times.

Action Taken When the DTC Sets

- P1790 is a Type B DTC.
- Auxiliary gearbox is held in 2nd gear.
- Pulley ratio is fixed at 0.55.
- Lock-up is prohibited.
- Engine torque is limited to 100.

Conditions for Clearing the DTC

P1790 is a Type B DTC.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

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- **Inline Harness Connector End Views**

Description and Operation

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Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition OFF for at least one minute to allow for the complete shutdown of the K71 Transmission Control Module. Ignition ON.
2. Using a scan tool, erase the CVT calibration data in the TCM.

3. Using a scan tool, run the CVT calibration process.
4. Clear DTC P1790.
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data. The DTC should not set.

- **If the DTC sets**

Replace the Continuously Variable Transmission (CVT). Refer to **Transmission Replacement**.

- **If the DTC does not set**

6. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for K71 Transmission Control Module replacement, programming and setup.

DTC P2714 OR P2715: PRESSURE CONTROL SOLENOID VALVE 4

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P2714

Pressure Control Solenoid Valve 4 - Stuck Off - Transmission Hydraulic/Mechanical Performance

DTC P2715

Pressure Control Solenoid Valve 4 - Stuck On - Transmission Hydraulic/Mechanical Performance

Circuit/System Description

The pressure control solenoid 4 is part of the control solenoid valve assembly, which has no serviceable parts.

The transmission control module controls the control solenoid valve 4 pressure by regulating the current flow through the pressure control solenoid valve 4 windings. The transmission control module determines the appropriate pressure for a given load by monitoring the throttle position sensor voltage, the engine speed and other inputs. The transmission control module then varies the duty cycle on the high side of the pressure control solenoid valve 4 to control current flow to the solenoid. The magnetic field produced by the coil moves the solenoid's internal valve which varies pressure to the pressure regulator valve. The transmission control module

controls the pressure control solenoid valve 4 by applying a varying amount of amperage to the solenoid. Current is controlled from about 20 mA for maximum line pressure to 1200 mA for minimum pressure. The transmission control module monitors the actual current to the solenoid as compared to the requested current.

Conditions for Running the DTC

P2714

- TCM DTC P0705, P0706, P0721, P0792, P0796, P0797, P2714, P2715 or U0100 is not set.
- System voltage 10-16 V.
- Engine Speed greater than 550 rpm.
- Transmission Output Shaft Speed greater than 300 rpm.
- Secondary Pulley Speed greater than 300 rpm.
- Transmission Range D or L.
- Vehicle Speed greater than 10 km/h (7 mph).
- Auxiliary gear box in 1st gear.
- Vehicle decelerating for - Condition 1.
- Throttle position sensor greater than 7.8% - Condition 2.
- DTC P2714 runs continuously.

P2715

- TCM DTC P0705, P0706, P0721, P0792, P0796, P0797, P2714, P2715 or U0100 is not set.
- System voltage 10-16 V.
- Engine Speed greater than 550 rpm.
- Transmission Output Shaft Speed greater than 300 rpm.
- Secondary Pulley Speed greater than 300 rpm.
- Transmission Range D or L.
- Vehicle Speed greater than 10 km/h (7 mph).
- Auxiliary gear box in 2nd gear.
- Throttle position sensor greater than 7.8%.
- DTC P2715 runs continuously.

Conditions for Setting the DTC

P2714 - Condition 1

The auxiliary gearbox ratio is greater than 50% of the 1st gear design ratio for 200 ms.

P2714 - Condition 2

The auxiliary gearbox ratio is less than 10% of the 2nd gear design ratio for 500 ms.

P2715

The auxiliary gearbox ratio is greater than 2.231 for 2 s.

Action Taken When the DTC Sets

P2714

- P2714 is a Type B DTC.
- The transmission control module commands the auxiliary gearbox into 2nd gear.

P2715

- P2715 is a Type B DTC.
- The transmission control module commands the auxiliary gearbox into Neutral until vehicle speed is less than 40 km/h (25 mph). Then the TCM commands the auxiliary gearbox into 1st gear.

Conditions for Clearing the DTC

P2714 and P2715 are Type B DTCs.

Diagnostic Aids

- DTC P2714 or P2715 set due to non-electrical transmission hydraulic/mechanical performance issues.
- If the pressure control solenoid valve 4 has no electrical faults but the transmission control module detects greater than acceptable pressure or to less than acceptable pressure DTC P2714 or P2715 is set.

Reference Information

Connector End View Reference

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- **Inline Harness Connector End Views**

Electrical Information Reference

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- **Wiring Repairs**

Description and Operation

- **Electronic Component Description**
- **Transmission General Description**

- **Transmission Component and System Description**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the transmission fluid level and condition are correct. Refer to **Transmission Fluid Level and Condition Check**.
2. Verify DTC P2720 or P2721 is not set.
 - **If DTC P2720 or P2721 is set**

Refer to **DTC P2720 or P2721**.

- **If DTC P2720 or P2721 is not set**

NOTE: After inspection, apply Nyogel lubricant 760G to each connector terminal. Ensure each connector and CPA is correctly seated.

3. Visually inspect each connector terminal of the K71 transmission control module X2 connector and the Q8 Control Solenoid Valve Assembly connector for damage or corrosion. Repair as necessary.
4. Clear DTC P2714 or P2715 from history.
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observe from the Freeze Frame/Failure Records data. The DTC should not set.
 - **If any of the DTCs are set**

Replace the T12 Automatic Transmission Assembly. Refer to **Transmission Replacement**.

- **If none of the DTCs set**

6. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Control Module References** for control solenoid valve assembly replacement, programming and setup.
- Refer to **Transmission Replacement** for transmission replacement.
- Refer to **Transmission Fluid Level and Condition Check**.

DTC P2720 OR P2721: PRESSURE CONTROL SOLENOID 4

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P2720

Pressure Control Solenoid 4 Control Circuit Low Voltage

DTC P2721

Pressure Control Solenoid 4 Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	P2720	P2721	P2721	-

Typical Scan Tool Data

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Operating Conditions: Engine running, normal operating temperature Parameter Normal Range: OK				
Pressure Control Solenoid Valve 4 Control Circuit Low Voltage Test Status	Malfunction	OK	OK	OK
Pressure Control Solenoid Valve 4 Control Circuit High Voltage Test Status	OK	Malfunction	Malfunction	OK

Circuit/System Description

The pressure control solenoid valve 4 is part of the control solenoid valve assembly which has no serviceable parts.

The transmission control module controls pressure solenoid 4 pressure by regulating the current flow through the pressure control solenoid valve 4 windings. The transmission control module determines the appropriate pressure for a given load by monitoring the throttle position sensor voltage, the engine speed and other inputs. The transmission control module then varies the duty cycle on the high side of the pressure control solenoid

valve 4 to control current flow to the solenoid. The magnetic field produced by the coil moves the solenoid's internal valve which varies pressure to the pressure regulator valve. The transmission control module controls the pressure control solenoid valve 4 by applying a varying amount of amperage to the solenoid. Current is controlled from about 20 mA for maximum line pressure to 1200 mA for minimum pressure. The transmission control module monitors the actual current to the solenoid as compared to the requested current.

Conditions for Running the DTC

P2720

- System voltage 10-16 V.
- Pressure control solenoid valve 4 output current 750 mA or more.
- This DTC runs continuously within the enabling conditions.

P2721

- System voltage 10-16 V.
- Pressure control solenoid valve 4 output current 750 mA or more.
- DTC P0970 not set.
- This DTC runs continuously within the enabling conditions.

Conditions for Setting the DTC

P2720

- The transmission control module has determined that there is a short to ground in the circuit.
- The pressure control solenoid valve 4 current is 200 mA or less for 200 ms when 750 mA is commanded.

P2721

- The transmission control module has determined that there is an open or short to voltage in the circuit.
- The pressure control solenoid valve 4 current is 200 mA or less for 200 ms when 750 mA is commanded.

Action Taken When the DTC Sets

P2720

- P2720 is a Type B DTC.
- If not in 2nd gear, current gear forced to 2nd gear.
- If in 2nd gear, 2nd held until wheel speed equals 0 km/h (0 mph).

P2721

- P2721 is a Type B DTC.
- When the transmission control module has determined that there is an open in the circuit, the auxiliary

gearbox will be held in 2nd gear.

- When the transmission control module has determined that there is a short to voltage in the circuit, if commanding 2nd gear the auxiliary gearbox will be in a neutral state until wheel speed equals 40 km/h (25 mph).

Conditions for Clearing the DTC

DTC P2720 and P2721 are Type B DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

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- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that all of the following scan tool parameters display OK.
 - Pressure Control Solenoid Valve 4 Control Circuit Low Voltage Test Status

- Pressure Control Solenoid Valve 4 Control Circuit High Voltage Test Status
- **If any of the parameters do NOT display OK**

Refer to Circuit/System Testing.

- **If all of the parameters display OK**
2. Verify DTC P2720 or P2721 is only set as a history DTC.
 - **If any of the DTCs are set as current**

Refer to Circuit/System Testing.

- **If any of the DTCs are only set as history**

NOTE: **After inspection, apply Nyogel lubricant 760G to each connector terminal. Ensure each connector and CPA is correctly seated.**

3. Visually inspect each connector terminal of the K71 transmission control module X2 connector and the Q8 Control Solenoid Valve Assembly connector for damage or corrosion. Repair as necessary.
4. Clear DTC P2720 or P2721 from history.
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data. The DTC should not set.
 - **If any of the DTCs are set**

Refer to Circuit/System Testing.

- **If none of the DTCs set**
6. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the Q8 Control Solenoid Valve Assembly connector.

- NOTE:**
- **When test probing harness terminals, it is imperative to use the proper test probe from the most current version of the J-35616 GM-Approved Terminal Test Kit. Use of an improper test probe may deform the terminal, resulting in intermittent open conditions.**
 - **Testing for step 3 is performed on the Q8 Control Solenoid Valve Assembly harness connector using the GY probe J-35616-2A.**
 - **Chassis ground to battery ground 25-35 ohms.**

2. Ignition ON, engine OFF.
3. Test for 2.4-2.8 V between the control circuit terminal 7 and chassis ground.
 - **If less than the specified range**

1. Ignition OFF, disconnect the X2 harness connector at the K71 Transmission Control Module.
2. Test for less than 10 ohms in the control circuit end to end.
 - If 10 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 10 ohms.
3. Test for infinite resistance between the control circuit terminal 7 and chassis ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance.
4. Test for infinite resistance between the control circuit terminal 7 and all other terminals of Q8 Control Solenoid Valve Assembly harness connector.
 - If less than infinite resistance, repair the shorted together condition in the affected circuits.
 - If infinite resistance, replace the K71 Transmission Control Module. Refer to **Transmission Control Module Replacement**.
 - **If greater than the specified range**
 1. Ignition OFF, disconnect the X2 harness connector at the K71 Transmission Control Module.
 2. Test for infinite resistance between the control circuit terminal 7 and all other terminals of Q8 Control Solenoid Valve Assembly harness connector.
 - If less than infinite resistance, repair the shorted together condition in the affected circuits.
 - If infinite resistance, replace the K71 Transmission Control Module. Refer to **Transmission Control Module Replacement**.
 - **If within the specified range**
4. Sensor signal circuit, low reference circuit and K71 Transmission Control Module OK.

Component Testing

Pressure Control Solenoid Valve 4

1. Disconnect the Q8 Control Solenoid Valve Assembly harness connector.

NOTE:

- **When test probing harness terminals, it is imperative to use the proper test probe from the most current version of the J-35616 GM-Approved Terminal Test Kit. Use of an improper test probe may deform the terminal, resulting in intermittent open conditions.**
- **Testing for Step 2 is performed on the Q8 Control Solenoid Valve Assembly connector using the GY probe J-35616-3.**

2. Measure the resistance between the control circuit, terminal 7 and chassis ground. Refer to **Temperature Versus Resistance (ECT)** for resistance values.
 - **If the resistance is not within the specified range for the given temperature**

Replace the T12 Automatic Transmission Assembly. Refer to **Transmission Replacement**.
 - **If the resistance IS within the specified range for the given temperature**

3. Pressure control solenoid 4 OK.

Temperature Versus Resistance

Temp (°C/°F)	Normal Range ohms	Nominal ohms
20/68	5.1-5.5	5.3
30/86	5.3-5.7	5.5
40/104	5.6-6.0	5.8
50/122	5.8-6.2	6.0
60/140	6.0-6.4	6.2
70/158	6.3-6.7	6.5
80/176	6.5-6.9	6.7

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Control Module References** for K71 Transmission Control Module replacement, programming and setup.
- Refer to **Transmission Replacement** for transmission replacement.

DTC P2763 OR P2764: TORQUE CONVERTER CLUTCH (TCC) PRESSURE CONTROL SOLENOID

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P2763

Torque Converter Clutch (TCC) Pressure Control Solenoid Valve Control Circuit High Voltage

DTC P2764

Torque Converter Clutch (TCC) Pressure Control Solenoid Valve Control Circuit Low Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	P2764	P2763	P2763	-

Circuit/System Description

The torque converter clutch pressure control solenoid valve is part of the control solenoid valve assembly which has no serviceable parts.

The transmission control module torque converter clutch pressure control solenoid pressure by regulating the current flow through the torque converter clutch pressure control solenoid valve windings. The transmission control module determines the appropriate pressure for a given load by monitoring the throttle position sensor voltage, the engine speed and other inputs. The transmission control module then varies the duty cycle on the high side of the torque converter clutch pressure control solenoid valve to control current flow to the solenoid. The magnetic field produced by the coil moves the solenoids internal valve which varies pressure to the pressure regulator valve. The transmission control module controls the torque converter clutch pressure control solenoid valve by applying a varying amount of amperage to the solenoid. Current is controlled from about 20 mA for maximum line pressure to 1200 mA for minimum pressure. The transmission control module monitors the actual current to the solenoid as compared to the requested current.

Conditions for Running the DTC

P2763

- System voltage 10-16 V.
- Torque converter clutch pressure control solenoid valve output current 750 mA or more.
- This DTCs runs continuously within the enabling conditions.

P2764

- System voltage 10-16 V.
- Torque converter clutch pressure control solenoid valve output current 750 mA or more.
- This DTCs runs continuously within the enabling conditions.

Conditions for Setting the DTC

P2763

- The transmission control module has determined that there is an open or short to voltage in the circuit.
- The torque converter clutch pressure control solenoid valve current is 200 mA or less for 5 s when 750 mA is commanded.

P2764

- The transmission control module has determined that there is a short to ground in the circuit.
- The torque converter clutch pressure control solenoid valve current is 200 mA or less for 480 ms when 750 mA is commanded.

Action Taken When the DTC Sets

- DTC P2763 and P2764 are Type B DTCs.
- Lock-up is prohibited.
- Engine torque is controlled until sufficient clutch operation is obtained.

Conditions for Clearing the DTC

DTC P2763 and P02764 are Type B DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **Inline Harness Connector End Views**

Description and Operation

- **Electronic Component Description**
- **Transmission Component and System Description**
- **Transmission General Description**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that the following scan tool parameters track each other as engine RPM changes.
 - Actual TCC Pressure Control Solenoid Valve Current
 - Desired TCC Pressure Control Solenoid Valve Current

- **If the parameters do not track each other as engine speed RPM changes**

Refer to Circuit/System Testing.

- **If the parameters do track each other as engine speed RPM changes**

2. Verify DTC P2763 or P2764 is only set as a history DTC.

- **If any of the DTCs are set as current**

Refer to Circuit/System Testing.

- **If any of the DTCs are only set as history**

NOTE: After inspection, apply Nyogel lubricant 760G to each connector terminal. Ensure each connector and CPA is correctly seated.

3. Visually inspect each connector terminal of the K71 transmission control module X2 connector and the Q8 Control Solenoid Valve Assembly connector for damage or corrosion. Repair as necessary.
4. Clear DTC P2763 or P2764 from history.
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data. The DTC should not set.

- **If any of the DTCs are set**

Refer to Circuit/System Testing.

- **If none of the DTCs set**

6. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the Q8 Control Solenoid Valve Assembly connector.

- NOTE:**
- When test probing harness terminals, it is imperative to use the proper test probe from the most current version of the J-35616 GM-Approved Terminal Test Kit. Use of an improper test probe may deform the terminal, resulting in intermittent open conditions.
 - Testing for step 3 is performed on the Q8 Control Solenoid Valve Assembly harness connector using the GY probe J-35616-2A.
 - Chassis ground to battery ground 25-35 ohms.

2. Ignition ON, engine OFF.
3. Test for 2.4-2.8 V between the control circuit terminal 8 and chassis ground.

- **If less than the specified range**

1. Ignition OFF, disconnect the X2 harness connector at the K71 Transmission Control Module.

2. Test for less than 10 ohms in the control circuit end to end.
 - If 10 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 10 ohms.
3. Test for infinite resistance between the control circuit terminal 8 and chassis ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance.
4. Test for infinite resistance between the control circuit terminal 8 and all other terminals of Q8 Control Solenoid Valve Assembly harness connector.
 - If less than infinite resistance, repair the shorted together condition in the affected circuits.
 - If infinite resistance, replace the K71 Transmission Control Module. Refer to **Transmission Control Module Replacement**.
 - **If greater than the specified range**
 1. Ignition OFF, disconnect the X2 harness connector at the K71 Transmission Control Module.
 2. Test for infinite resistance between the control circuit terminal 8 and all other terminals of Q8 Control Solenoid Valve Assembly harness connector.
 - If less than infinite resistance, repair the shorted together condition in the affected circuits.
 - If infinite resistance, replace the K71 Transmission Control Module. Refer to **Transmission Control Module Replacement**.
 - **If within the specified range**
4. Sensor signal circuit, low reference circuit and K71 Transmission Control Module OK.

Component Testing

Torque Converter Clutch Pressure Control Solenoid

1. Disconnect the Q8 Control Solenoid Valve Assembly harness connector.

NOTE:

- **When test probing harness terminals, it is imperative to use the proper test probe from the most current version of the J-35616 GM-Approved Terminal Test Kit. Use of an improper test probe may deform the terminal, resulting in intermittent open conditions.**
- **Testing for Step 2 is performed on the Q8 Control Solenoid Valve Assembly connector using the GY probe J-35616-3.**

2. Measure the resistance between the control circuit, terminal 8 and chassis ground. Refer to **Temperature Versus Resistance (ECT)** for resistance values.
 - **If the resistance is not within the specified range for the given temperature**

Replace the T12 Automatic Transmission Assembly. Refer to **Transmission Replacement**.
 - **If the resistance IS within the specified range for the given temperature**
3. Torque converter clutch pressure control solenoid OK.

Temperature Versus Resistance

Temp (°C/°F)	Normal Range ohms	Nominal ohms
20/68	5.1-5.5	5.3
30/86	5.3-5.7	5.5
40/104	5.6-6.0	5.8
50/122	5.8-6.2	6.0
60/140	6.0-6.4	6.2
70/158	6.3-6.7	6.5
80/176	6.5-6.9	6.7

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Control Module References** for K71 Transmission Control Module replacement, programming and setup.
- Refer to **Transmission Replacement** for transmission replacement.

SYMPTOMS - AUTOMATIC TRANSMISSION

On-Vehicle Repair Matrix

Symptom	Possible Cause
Increasing Engine Speed in Drive, Low or Reverse but No Vehicle Start	• Engine System • Incorrect ATF Level Adjustment • Improper Line Pressure Value • Shift Control Cable • TCM • Transmission Range (TR) Switch • Primary Speed Sensor • Secondary Speed Sensor • Secondary Pressure Sensor • Line Pressure Solenoid Valve • High Clutch and Reverse Brake Solenoid Valve • Low Brake Solenoid Valve • CVT Fluid Temperature Sensor • Control Valve Body • Oil Pump • Pulley, Steel Belt • Low Brake • Reverse Brake

	• Counter Gear • Planetary Gear • Reduction Gear • Final Gear, Differential Gear
Engine Stall in Drive, Low or Reverse and No Vehicle Start	• Shift Control Cable • TCM • Transmission Range (TR) Switch • Primary Speed Sensor • Secondary Speed Sensor • Secondary Pressure Sensor • Primary Pressure Solenoid Valve • Line Pressure Solenoid Valve • High Clutch and Reverse Brake Solenoid Valve • Low Brake Solenoid Valve • CVT Fluid Temperature Sensor • Control Valve Body • Bearings • Counter Gear • Planetary Gear • Reduction Gear • Final Gear, Differential Gear • Parking Mechanism
Insufficient Acceleration at Start in Drive, Low or Reverse during Driving	• Engine System • Improper Line Pressure Value • TCM • Transmission Range (TR) Switch • Primary Speed Sensor • Secondary Speed Sensor • Output Speed Sensor • Secondary Pressure Sensor • Primary Pressure Solenoid Valve • Line Pressure Solenoid Valve • Torque Converter Clutch Solenoid Valve • High Clutch and Reverse Brake Solenoid Valve • Low Brake Solenoid Valve • CVT Fluid Temperature Sensor • Control Valve Body

	• Torque Converter • Low Brake • Reverse Brake
Suddenly Increasing Engine Speed in Drive, Low or Reverse during Driving	• Incorrect ATF Level Adjustment • Improper Line Pressure Value • Secondary Pressure Sensor • Primary Pressure Solenoid Valve • Line Pressure Solenoid Valve • High Clutch and Reverse Brake Solenoid Valve • Low Brake Solenoid Valve • Control Valve Body • Oil Pump • Pulley, Steel Belt • Low Brake • High Clutch • Reverse Brake
Suddenly Applied Engine Brake in Drive or Reverse during Driving	• Engine System • Improper Line Pressure Value • Primary Pressure Solenoid Valve • Line Pressure Solenoid Valve • High Clutch and Reverse Brake Solenoid Valve • Low Brake Solenoid Valve • Control Valve Body • Low Brake • High Clutch • Reverse Brake
Engine Racing from 1st to 2nd Gear or 2nd to 1st Gear	• Engine System • Improper Line Pressure Value • Line Pressure Solenoid Valve • High Clutch and Reverse Brake Solenoid Valve • Low Brake Solenoid Valve • Control Valve Body • Oil Pump • Pulley, Steel Belt • Low Brake • High Clutch
	• Improper Line Pressure Value

Ineffective Engine Braking in Low	• Shift Control Cable • TCM • Transmission Range (TR) Switch • Primary Speed Sensor • Secondary Speed Sensor • Primary Pressure Solenoid Valve • Line Pressure Solenoid Valve • Torque Converter Clutch Solenoid Valve • Low Brake Solenoid Valve • Control Valve Body • Oil Pump • Torque Converter • Pulley, Steel Belt • Low Brake • High Clutch
Immediate Engine Stall before Stop at Deceleration in Drive or Low	• Output Speed Sensor • Torque Converter Clutch Solenoid Valve • Control Valve Body • Torque Converter
Slippage in Lock Up or Impossible Lock Up during Driving in Drive	• TCM • Transmission Range (TR) Switch • Primary Speed Sensor • Secondary Speed Sensor • Output Speed Sensor • Secondary Pressure Sensor • Primary Pressure Solenoid Valve • Line Pressure Solenoid Valve • Torque Converter Clutch Solenoid Valve • CVT Fluid Temperature Sensor • Control Valve Body • Torque Converter
Large Shock at Start in Drive,	• Improper Line Pressure Valve • Secondary Pressure Sensor • Line Pressure Solenoid Valve • Torque Converter Clutch Solenoid Valve • Control Valve Body • Pulley, Steel Belt

Low or Reverse	• Low Brake • Reverse Brake • Counter Gear • Planetary Gear • Reduction Gear • Final Gear, Differential Gear
Large Shock from 1st to 2nd Gear	• Engine System • Improper Line Pressure Value • TCM • Primary Pressure Solenoid Valve • Line Pressure Solenoid Valve • High Clutch and Reverse Brake Solenoid Valve • Low Brake Solenoid Valve • Control Valve Body • Low Brake • High Clutch
Large Shock in Lock Up during Driving in Drive or Low	• TCM • Torque Converter Clutch Solenoid Valve • Control Valve Body • Torque Converter
Large Shock when the Selector Lever Is Shifted from Neutral to Drive and from Neutral to Reverse	• Engine System • Improper Line Pressure Value • TCM • Transmission Range (TR) Switch • Primary Speed Sensor • Secondary Speed Sensor • Line Pressure Solenoid Valve • Torque Converter Clutch Solenoid Valve • High Clutch and Reverse Brake Solenoid Valve • Low Brake Solenoid Valve • CVT Fluid Temperature Sensor • Control Valve Body • Low Brake • Reverse Brake
	• Engine System • Incorrect ATF Level Adjustment • Improper Line Pressure Value

Vibration in Drive, Low or Reverse during Driving	• TCM • Output Speed Sensor • Secondary Pressure Sensor • Torque Converter Clutch Solenoid Valve • High Clutch and Reverse Brake Solenoid Valve • Low Brake Solenoid Valve • Control Valve Body • Oil Pump • Torque Converter • Pulley, Steel Belt • Low Brake • High Clutch • Reverse Brake • Bearings • Counter Gear • Planetary Gear • Reduction Gear • Final Gear, Differential Gear
Noise during Driving	• Incorrect ATF Level Adjustment • Control Valve Body • Oil Pump • Pulley, Steel Belt • Bearings • Counter Gear • Planetary Gear • Reduction Gear • Final Gear, Differential Gear
Noise in Idling	• Engine System • Incorrect ATF Level Adjustment • Control Valve Body • Oil Pump • Pulley, Steel Belt • Bearings • Counter Gear • Planetary Gear
Operative Starter in Drive, Low or Reverse	• Shift Control Cable • TCM

	• Transmission Range (TR) Switch
Inoperative Starter in Park or Neutral	• Shift Control Cable • TCM • Transmission Range (TR) Switch
Engine Stall in Drive, Low or Reverse during Stop	• Engine System • TCM • Output Speed Sensor • Torque Converter Clutch Solenoid Valve • Control Valve Body • Oil Pump • Torque Converter
Engine Stall in Park or Neutral during Stop	• Engine System • TCM • Output Speed Sensor • Torque Converter Clutch Solenoid Valve
Inoperative Parking Lock in Park	• TCM • Transmission Range (TR) Switch • Parking Mechanism
No Cancelled Parking Lock when Selector Lever Is Shifted from Park to Other	• TCM • Transmission Range (TR) Switch • Parking Mechanism

TRANSMISSION ADAPTIVE PRESSURE RESET

The Transmission Adaptive Pressure Reset procedure is used to synchronize the transmission control module with the ROM assembly in the transmission.

The Transmission Adaptive Pressure Reset procedure must be performed whenever one of the following repairs have been made to the vehicle. Failure to perform the procedure after one of the following repairs may result in poor transmission performance, as well as transmission DTCs being set:

- Transmission Control Module replacement
- Transmission Control Module software/calibration update
- Transmission replacement

NOTE: **Ensure the following conditions are met before performing the Transmission Adaptive Pressure Reset procedure:**

- Drive wheels are blocked
- Parking brake is applied

- Transmission Adaptive Pressure Reset may abort if the transmission fluid temperature increases above 110°C (230°F).

1. Use the scan tool to navigate to Transmission Adaptive Pressure Reset by selecting the following:
 1. Module Diagnostics
 2. Transmission Control Module
 3. Configurations/Reset Functions
 4. Transmission Adaptive Pressure Reset

NOTE: **If at any time during the procedure, the required conditions are not met, Transmission Adaptive Pressure Reset may abort and the process may need to be started again from the beginning.**

2. Use the scan tool to perform the Transmission Adaptive Pressure Reset procedure. This takes about 10 seconds. Scan tool confirmation of procedure completion may not happen.
3. Once the procedure is complete, shut OFF the engine and power down the transmission control module. You will lose communication to the scan tool.
4. Restart the engine. This will complete the Transmission Adaptive Pressure Reset procedure.

Procedure Verification

Proper execution of the Transmission Adaptive Pressure Reset procedure can be confirmed by the driver by verifying acceptable garage shifts into and out of Park, Reverse and Drive.

REPAIR INSTRUCTIONS - ON VEHICLE

AUTOMATIC TRANSMISSION RANGE SELECTOR LEVER REPLACEMENT

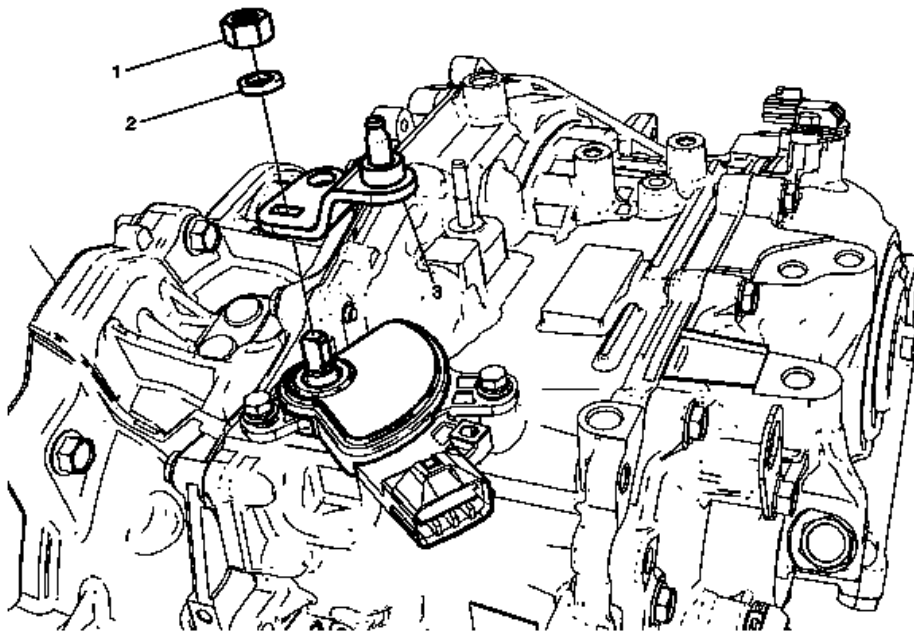


Fig. 6: NO CONTENT
 Courtesy of GENERAL MOTORS COMPANY

Automatic Transmission Range Selector Lever Replacement

Callout	Component Name
Preliminary Procedures 1. Ensure that the shift control range select lever is in the park (P) position. 2. Remove the air cleaner assembly. Refer to <u>Air Cleaner Assembly Replacement</u> . 3. Disconnect the shift control cable from the transmission range selector lever. 4. Depress the shift control cable retainer clip tabs and remove the shift control cable from the shift control cable bracket.	
1	Automatic Transmission Range Selector Lever Fastener CAUTION: Refer to <u>Fastener Caution</u> . Tighten 17 (13 lb ft)
2	Automatic Transmission Range Selector Lever Washer
3	Automatic Transmission Range Selector Lever

RANGE SELECTOR LEVER CABLE REPLACEMENT

Removal Procedure

1. Set the park brake and chock the wheels.
2. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .

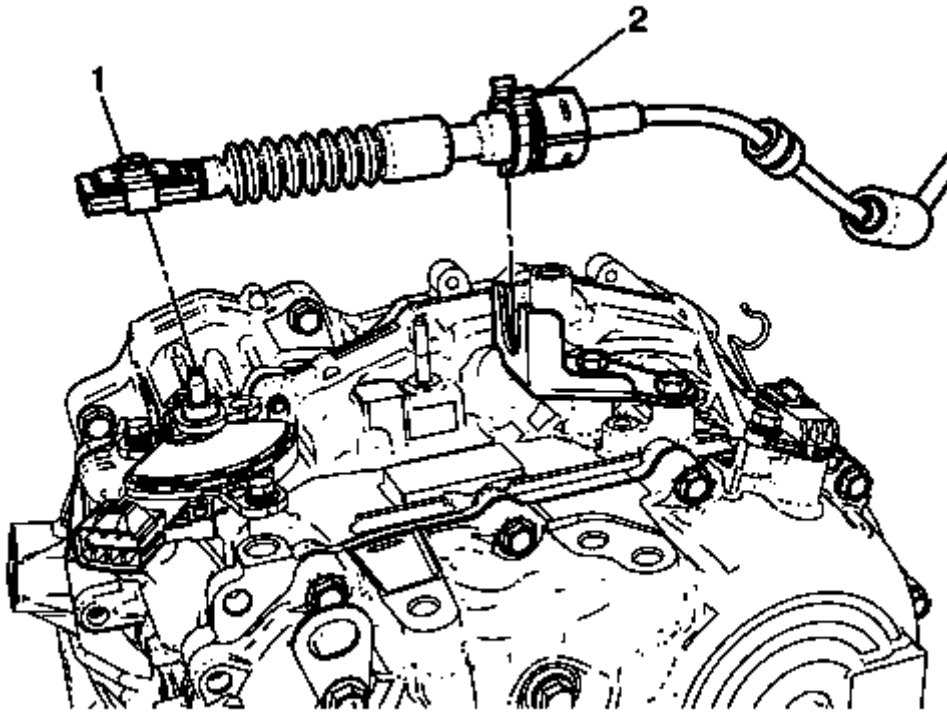


Fig. 7: Transmission Range Selector Lever Cable Terminal
Courtesy of GENERAL MOTORS COMPANY

3. Position the transmission manual shift lever into the park position.
4. Disconnect the transmission range selector lever cable terminal (1) from the transmission range selector lever.
5. Press the retainer clip tabs inward in order to release the transmission range selector lever cable (2) from the cable bracket.

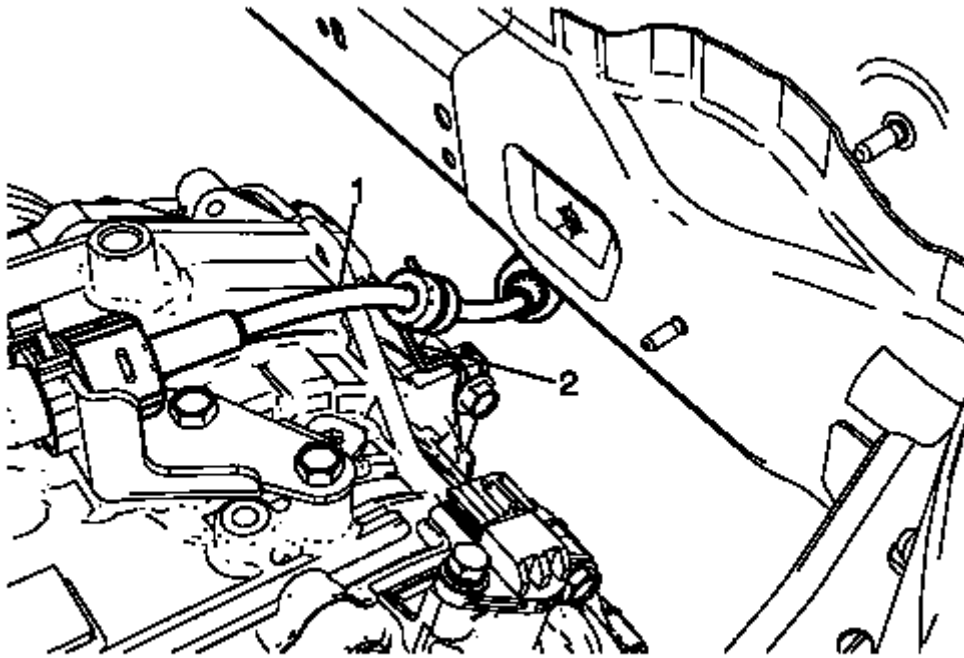


Fig. 8: Cable And Cable Clamp

Courtesy of GENERAL MOTORS COMPANY

6. Disconnect the cable (1) from the cable clamp (2).
7. Remove the console. Refer to **Front Floor Console Replacement** .

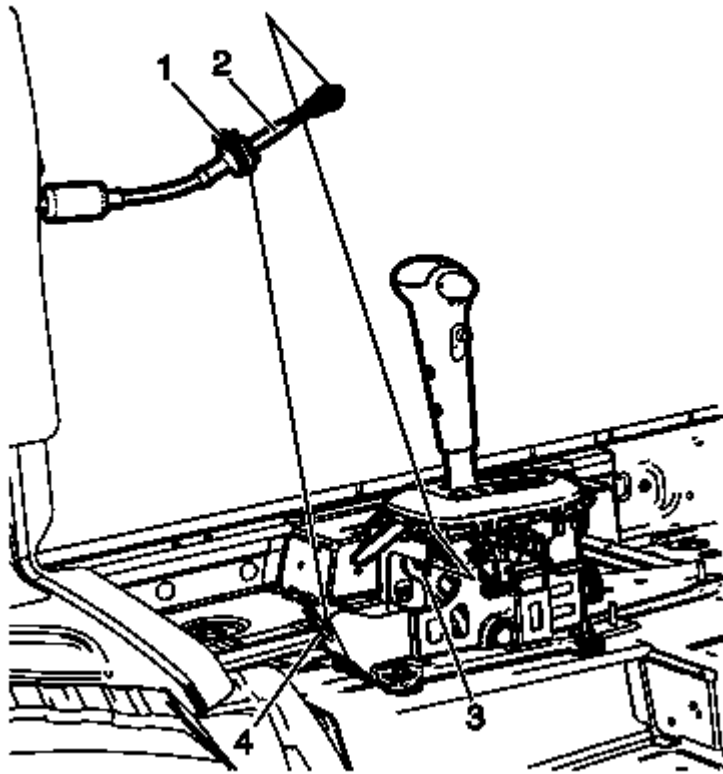


Fig. 9: Transmission Range Selector Lever Cable Terminal And Shift Lever Pin
Courtesy of GENERAL MOTORS COMPANY

8. Disconnect the transmission range selector lever cable terminal (2) from the shift lever pin (3).
9. Release the transmission range selector lever cable retainer (1) and remove the transmission range selector cable from the transmission control lever base (4).

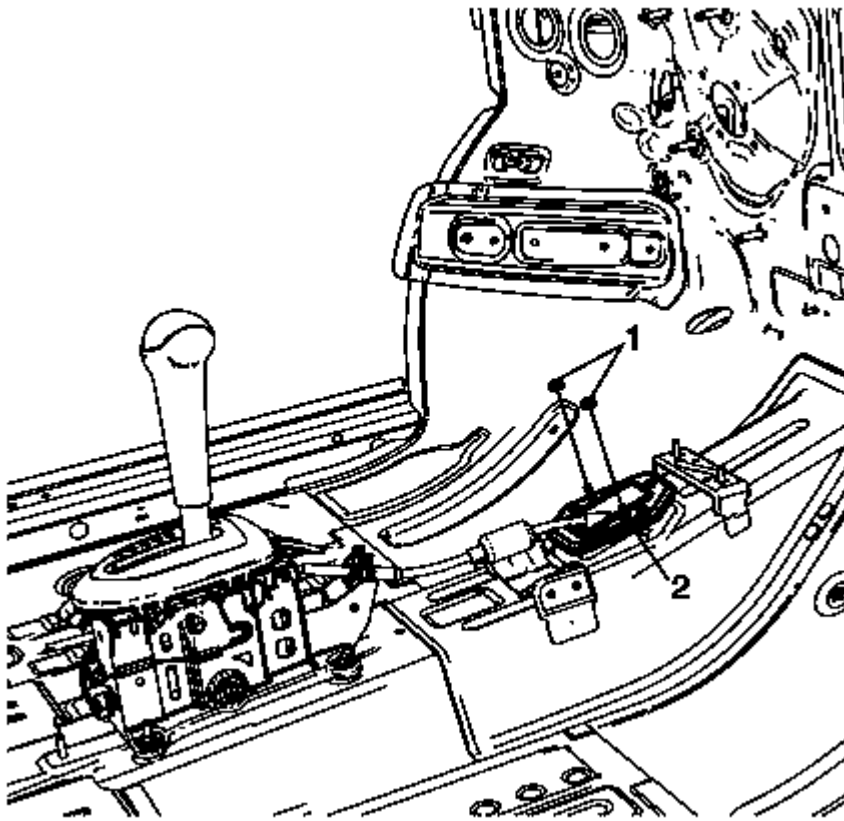


Fig. 10: Transmission Range Selector Lever Cable Grommet Nuts
Courtesy of GENERAL MOTORS COMPANY

10. Remove the transmission range selector lever cable grommet nuts (1).
11. Remove the transmission range selector lever cable grommet (2).
12. Remove the transmission range selector lever cable from the vehicle.

Installation Procedure

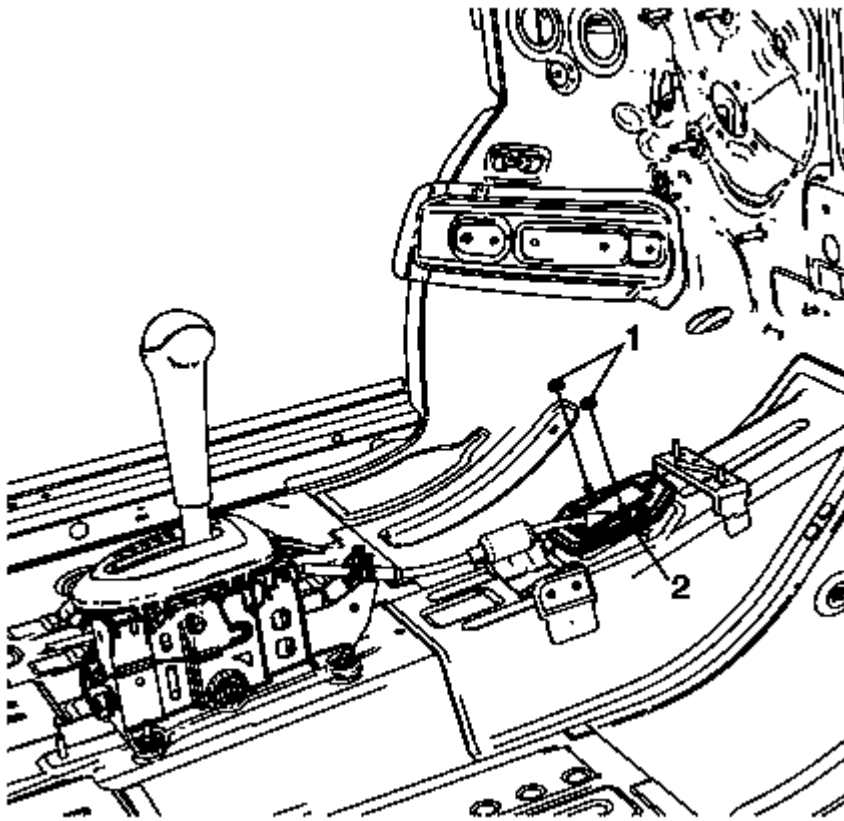


Fig. 11: Transmission Range Selector Lever Cable Grommet Nuts
Courtesy of GENERAL MOTORS COMPANY

1. Verify that the transmission manual shift lever is in the park position.
2. Install the transmission range selector lever cable to the vehicle.
3. Install the transmission range selector lever cable grommet (2).

CAUTION: Refer to Fastener Caution .

4. Install the transmission range selector lever cable grommet nuts (1) and tighten to 9 (80 lb in).

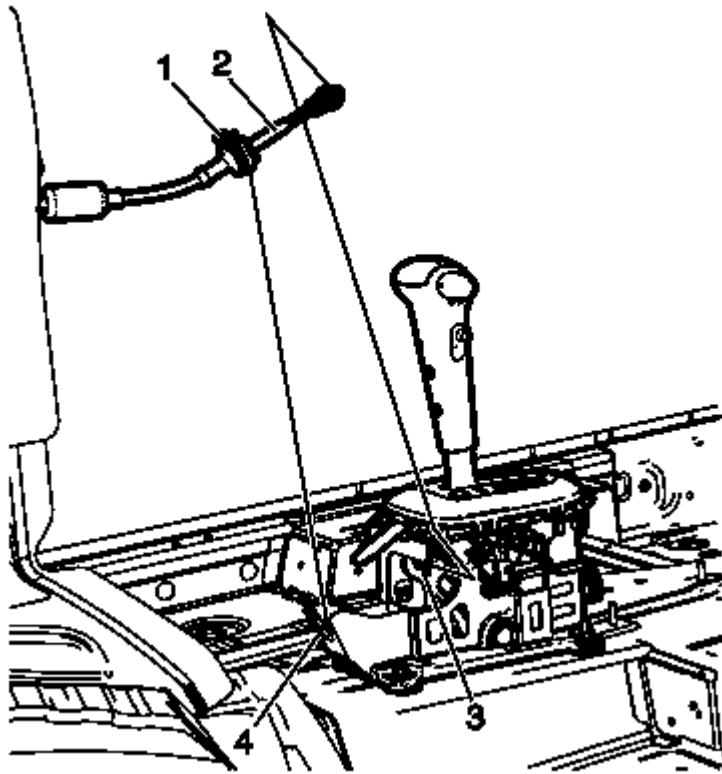


Fig. 12: Transmission Range Selector Lever Cable Terminal And Shift Lever Pin
Courtesy of GENERAL MOTORS COMPANY

5. Install the transmission range selector lever cable to the transmission control lever base. Insure the cable retainer (1) is fully secured to the transmission control lever base (4).
6. Connect the transmission range selector lever cable terminal (2) to the shift lever pin (3).
7. Install the console. Refer to **Front Floor Console Replacement** .

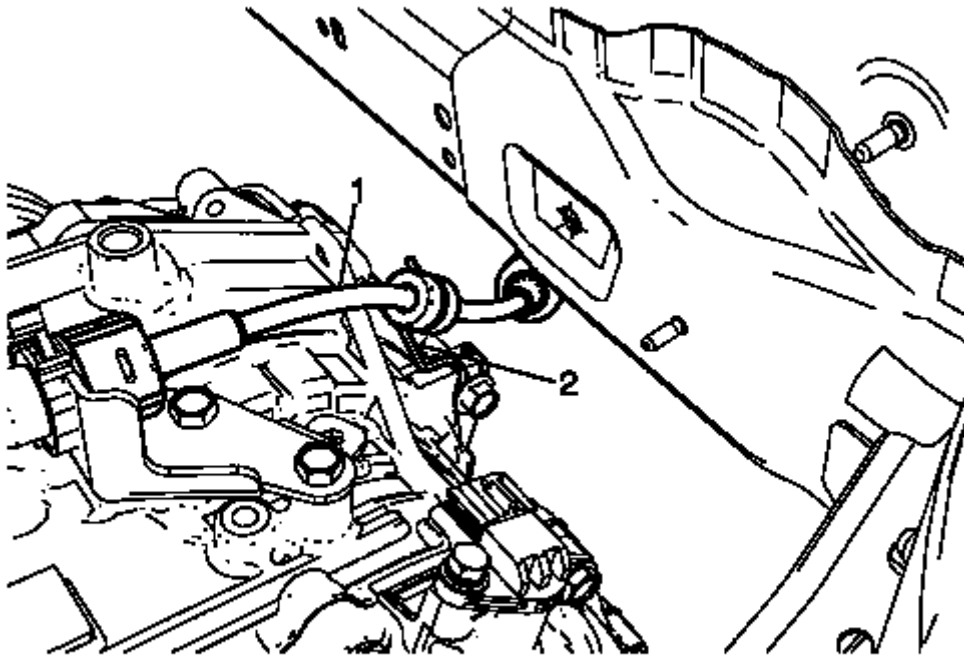


Fig. 13: Cable And Cable Clamp

Courtesy of GENERAL MOTORS COMPANY

8. Connect the cable (1) from the cable clamp (2).

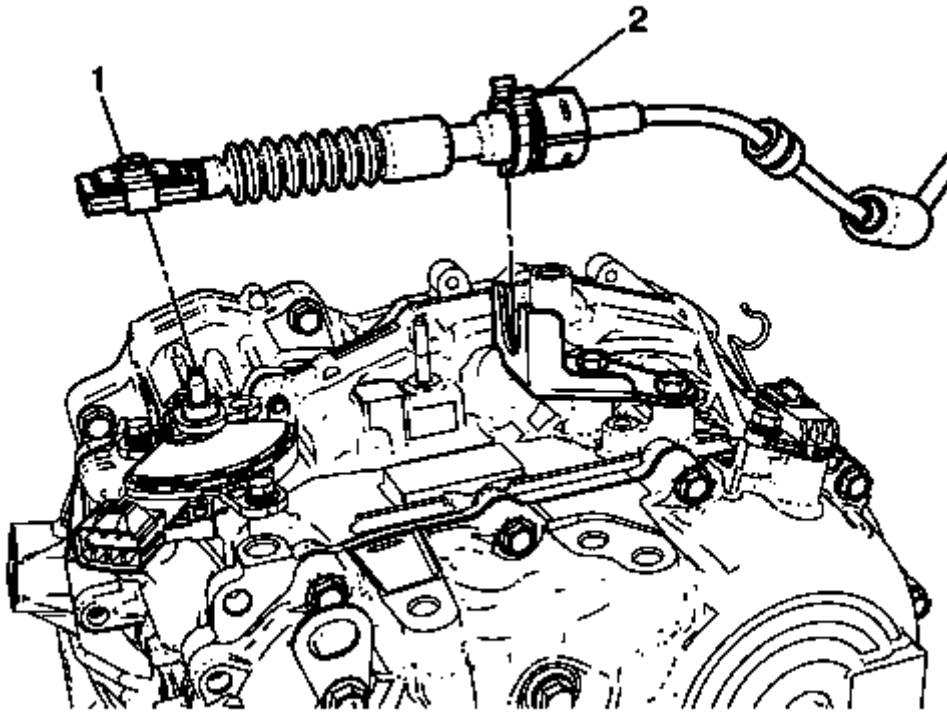


Fig. 14: Transmission Range Selector Lever Cable Terminal
Courtesy of GENERAL MOTORS COMPANY

9. Install the transmission range selector lever cable (2) to the cable bracket.
10. Connect the transmission range selector lever cable terminal (1) to the transmission range selector lever.
11. Adjust the automatic transmission range selector lever cable. Refer to **Range Selector Lever Cable Adjustment**.
12. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .

RANGE SELECTOR LEVER CABLE ADJUSTMENT

Adjustment Procedure

NOTE: **Adjust the automatic transmission range selector cable while the transmission and the gear selector are in the Park position only. Failure to do so may cause miss-adjustment.**

1. Set the park brake and chock the wheels.
2. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
3. Verify the transmission range select lever is in the park (P) position.
4. Verify the transmission manual shift lever is in the P position.

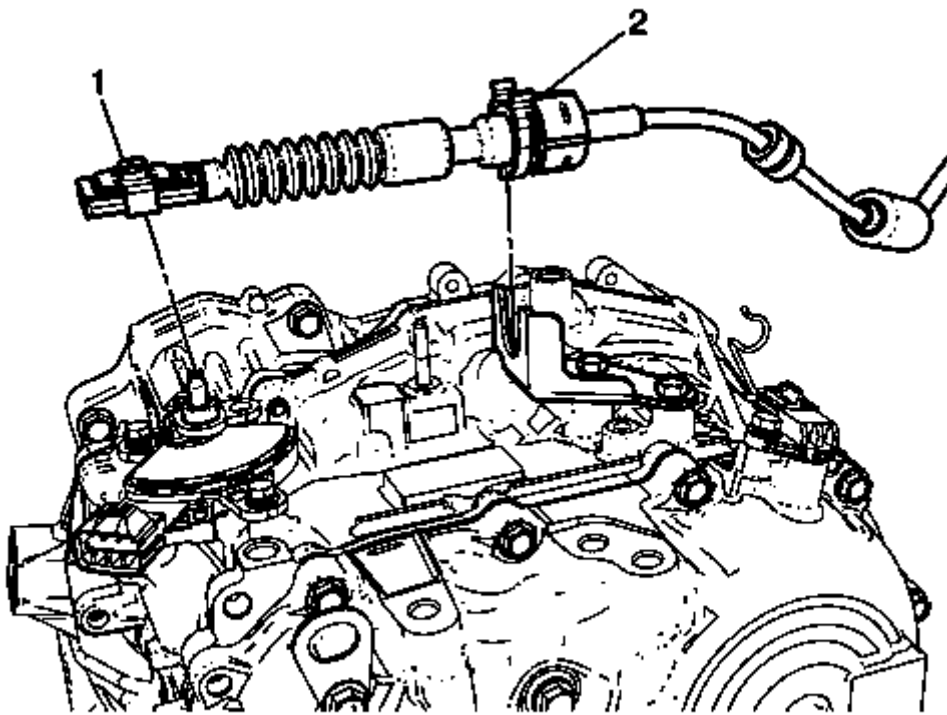


Fig. 15: Transmission Range Selector Lever Cable Terminal
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect the transmission range selector lever cable terminal (1) from the transmission range selector lever.
6. Press the retainer clip tabs inward in order to release the transmission range selector lever cable (2) from the cable bracket.

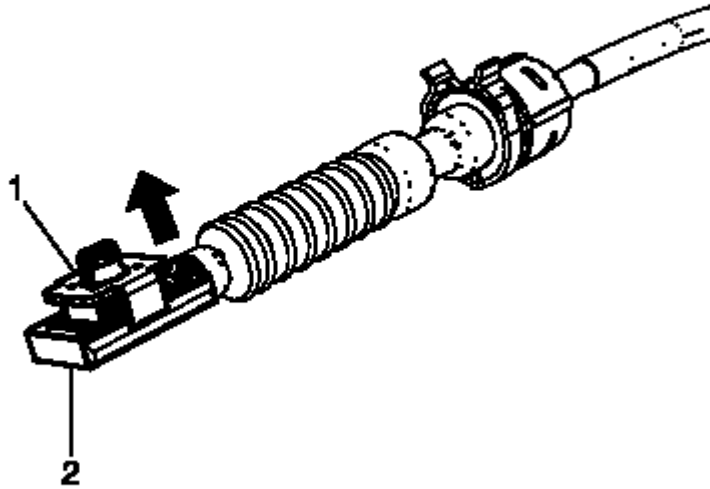


Fig. 16: Cable Adjuster And Cable Adjuster Guide
Courtesy of GENERAL MOTORS COMPANY

7. Pull up on the cable adjuster (1) from the cable adjuster guide (2).

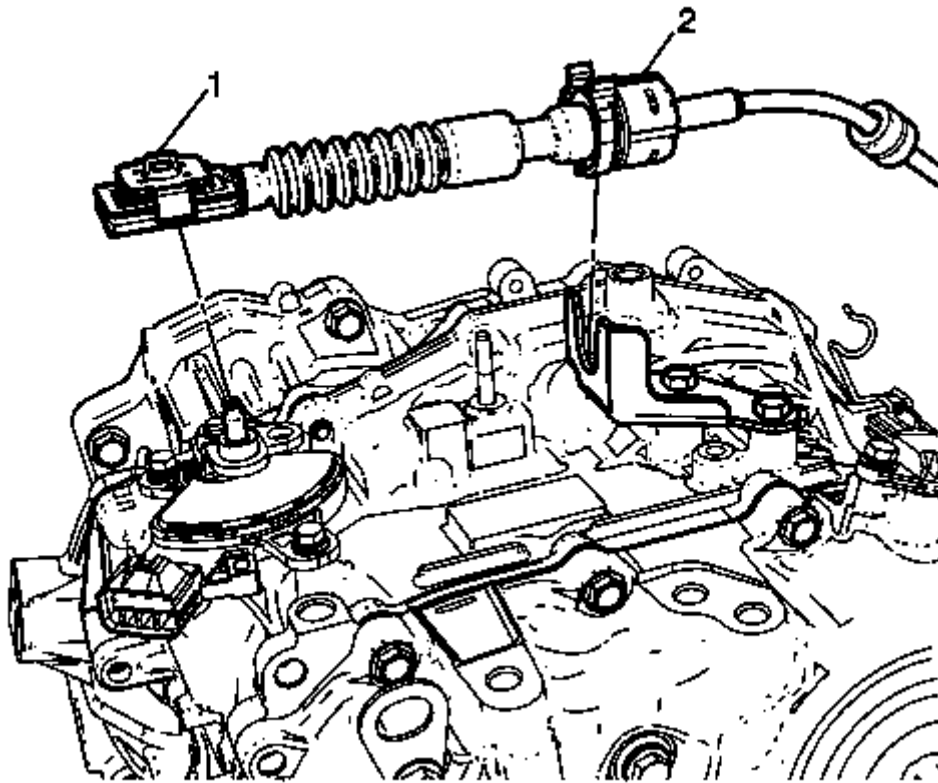


Fig. 17: Transmission Range Selector Lever Cable
Courtesy of GENERAL MOTORS COMPANY

8. Install the transmission range selector lever cable (2) to the cable bracket.
9. Connect the range selector lever cable adjuster (1) to the transmission range selector lever pin.

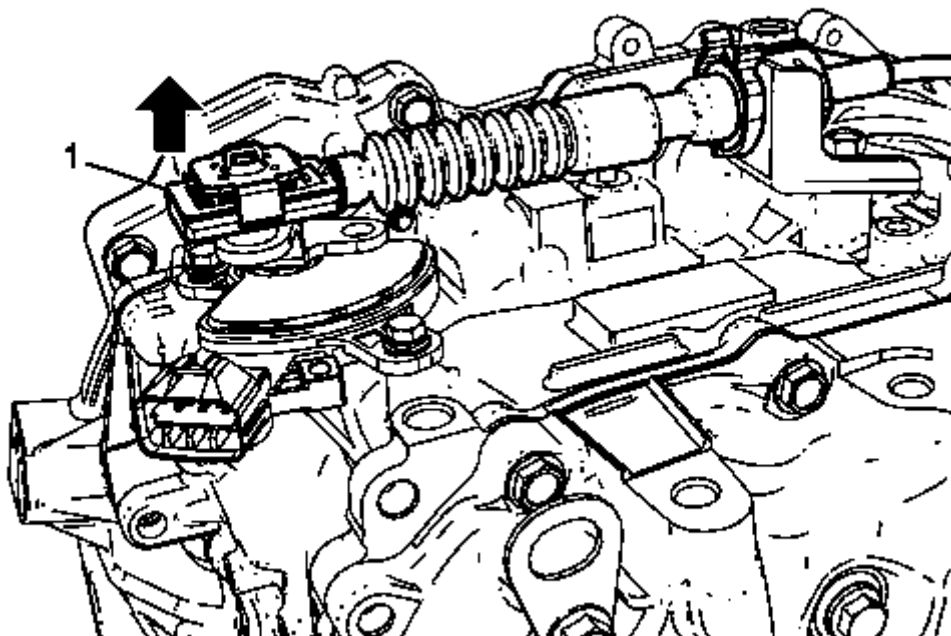


Fig. 18: Cable Adjuster Guide

Courtesy of GENERAL MOTORS COMPANY

10. Pull up on the cable adjuster guide (1) to secure in place.
11. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
12. Check the transmission range select lever in all gear selections for proper operation.

RANGE SELECTOR LEVER CABLE BRACKET REPLACEMENT

Removal Procedure

1. Set the park brake and chock the wheels.
2. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .

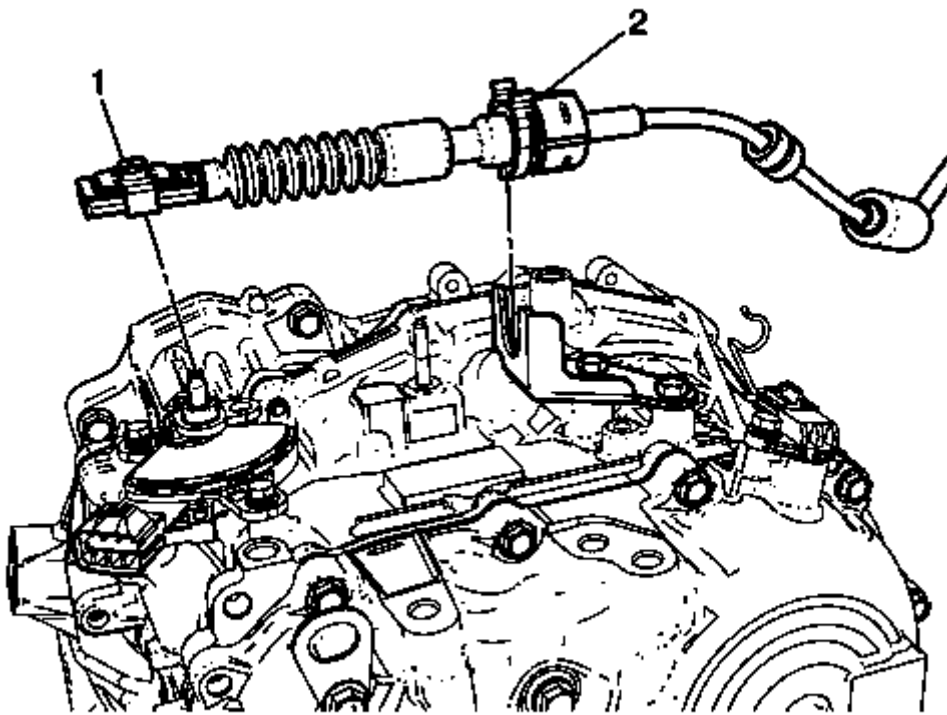


Fig. 19: Transmission Range Selector Lever Cable Terminal
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the transmission range selector lever cable terminal (1) from the range selector lever.
4. Disconnect the range selector lever cable (2) from the range selector lever cable bracket.

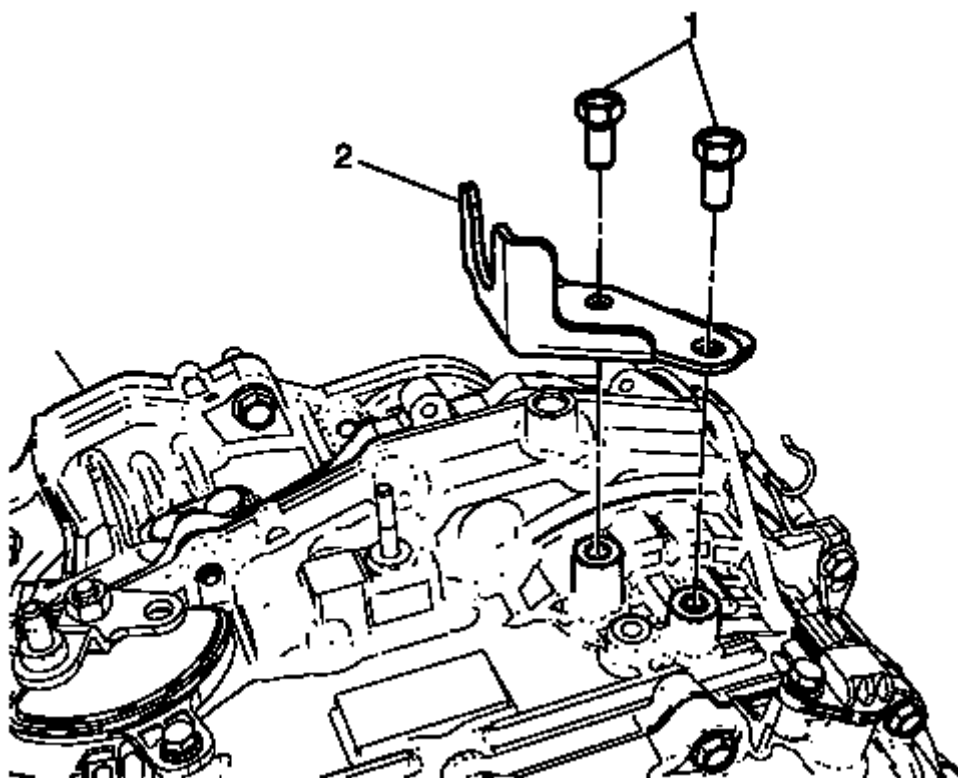


Fig. 20: Transmission Range Selector Cable Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the transmission range selector cable bracket bolts (1).
6. Remove the transmission range selector cable bracket (2).

Installation Procedure

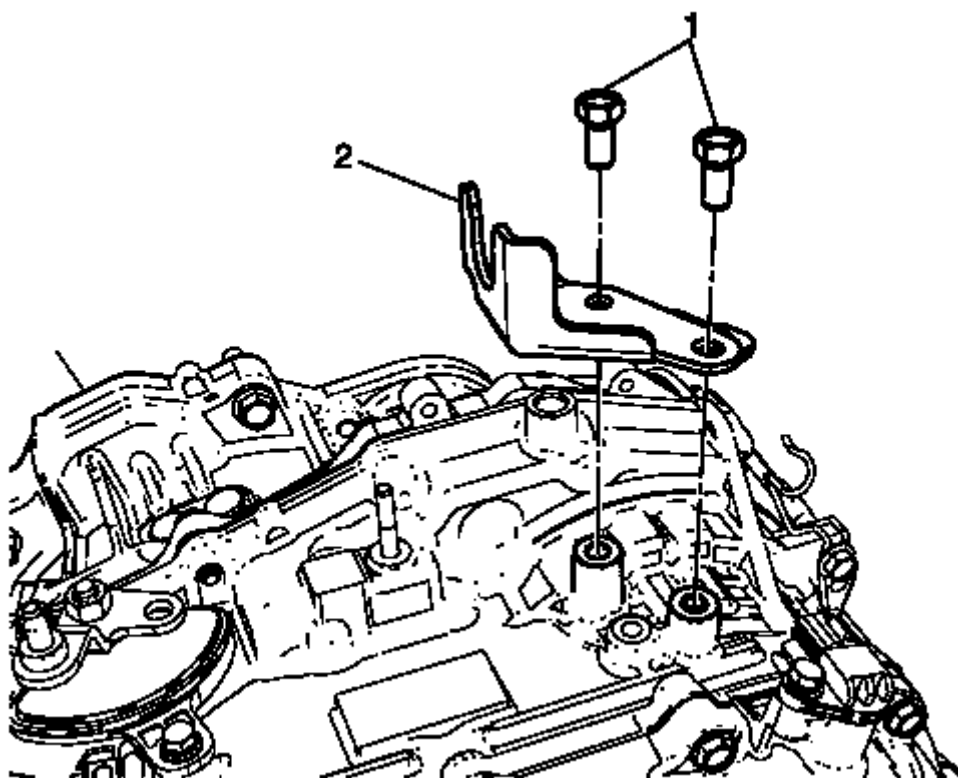


Fig. 21: Transmission Range Selector Cable Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the transmission range selector cable bracket (2).

CAUTION: Refer to Fastener Caution .

2. Install the transmission range selector lever cable bracket bolts (1) and tighten to 22 (16 lb ft).

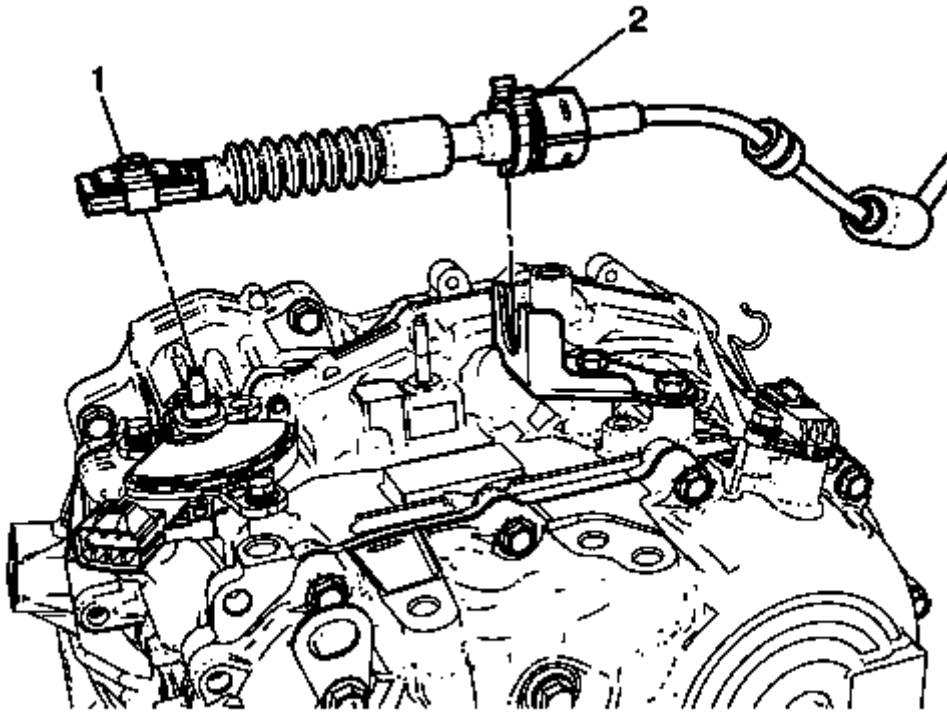


Fig. 22: Transmission Range Selector Lever Cable Terminal
Courtesy of GENERAL MOTORS COMPANY

3. Connect the range selector lever cable (2) to the range selector lever cable bracket.
4. Connect the transmission range selector lever cable terminal (1) to the range selector lever.
5. Check the range selector lever cable adjustment. Refer to **Range Selector Lever Cable Adjustment**.
6. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .

TRANSMISSION CONTROL LEVER KNOB REPLACEMENT

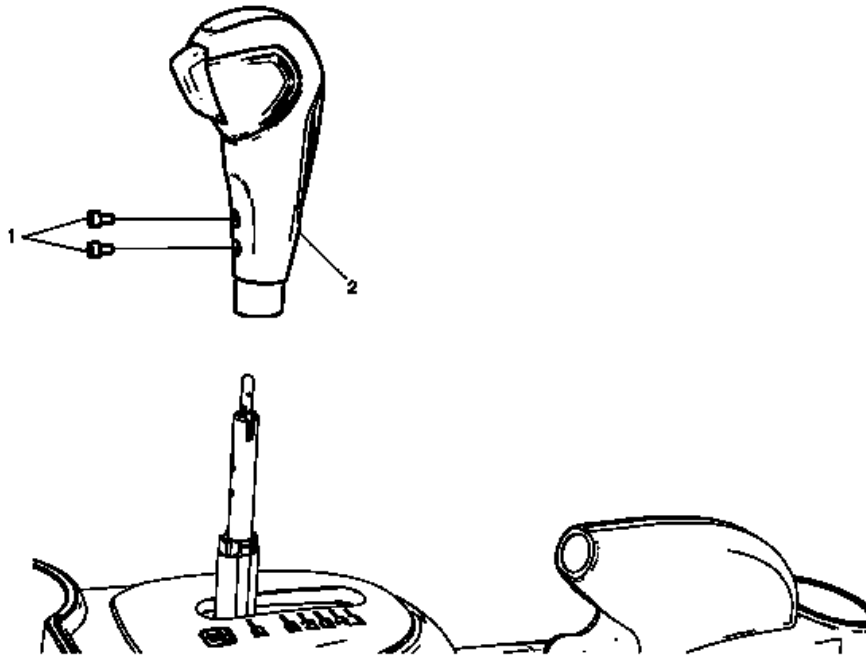


Fig. 23: Transmission Control Lever Knob
 Courtesy of GENERAL MOTORS COMPANY

Transmission Control Lever Knob Replacement

Callout	Component Name
1	Transmission Control Lever Knob Fastener (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 3 (27 lb in)
2	Transmission Control Lever Knob Procedure Remove the transmission control lever knob from the transmission control.

TRANSMISSION CONTROL REPLACEMENT

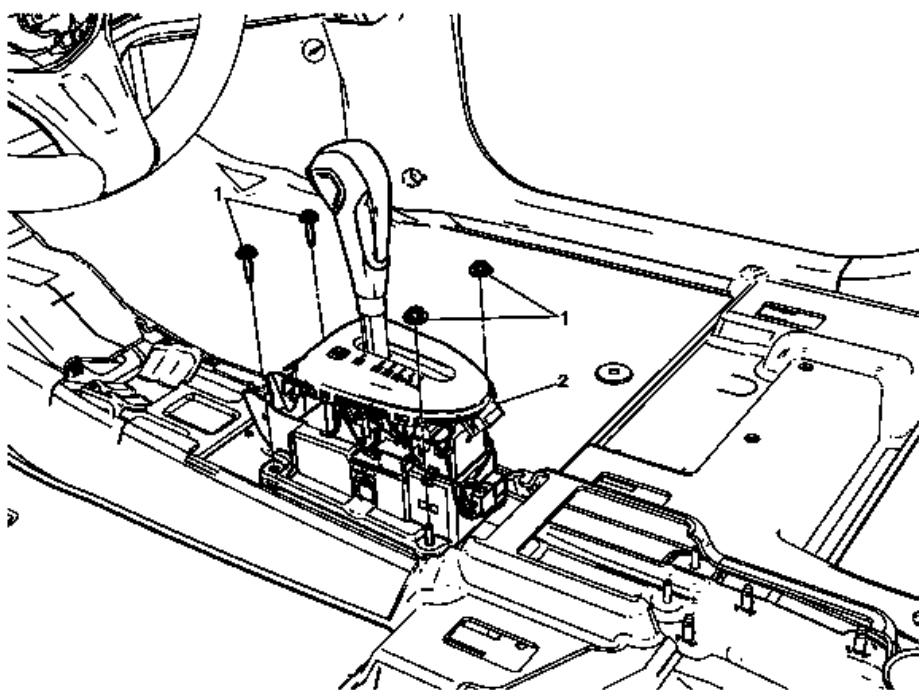


Fig. 24: Transmission Control
 Courtesy of GENERAL MOTORS COMPANY

Transmission Control Replacement

Callout	Component Name
Preliminary Procedure Remove floor console. Refer to Front Floor Console Replacement .	
1	Transmission Control Fastener (Qty: 4) CAUTION: Refer to Fastener Caution . Procedure 1. Remove the clips on the wiring harness and disconnect the shift control electrical connector. 2. Disconnect the shift control cable. Tighten 9 (80 lb in)
2	Transmission Control

PARK/NEUTRAL POSITION SWITCH REPLACEMENT

Special Tools

DT-51175 Range Switch Alignment Checker

Removal Procedure

1. Remove the automatic transmission range select lever. Refer to [Automatic Transmission Range Selector Lever Replacement](#).

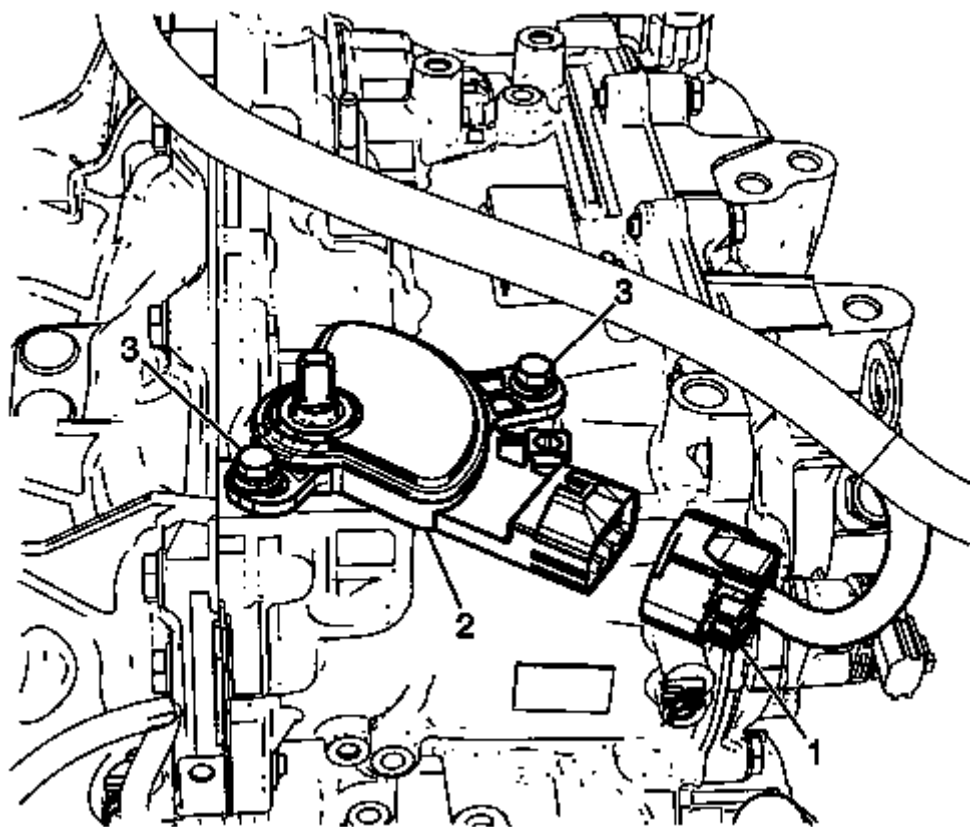


Fig. 25: PNP Switch Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the PNP switch electrical connector (1) from the PNP switch (2).
3. Remove the PNP switch bolts (3).
4. Remove the PNP switch (2) from the transaxle.

Installation Procedure

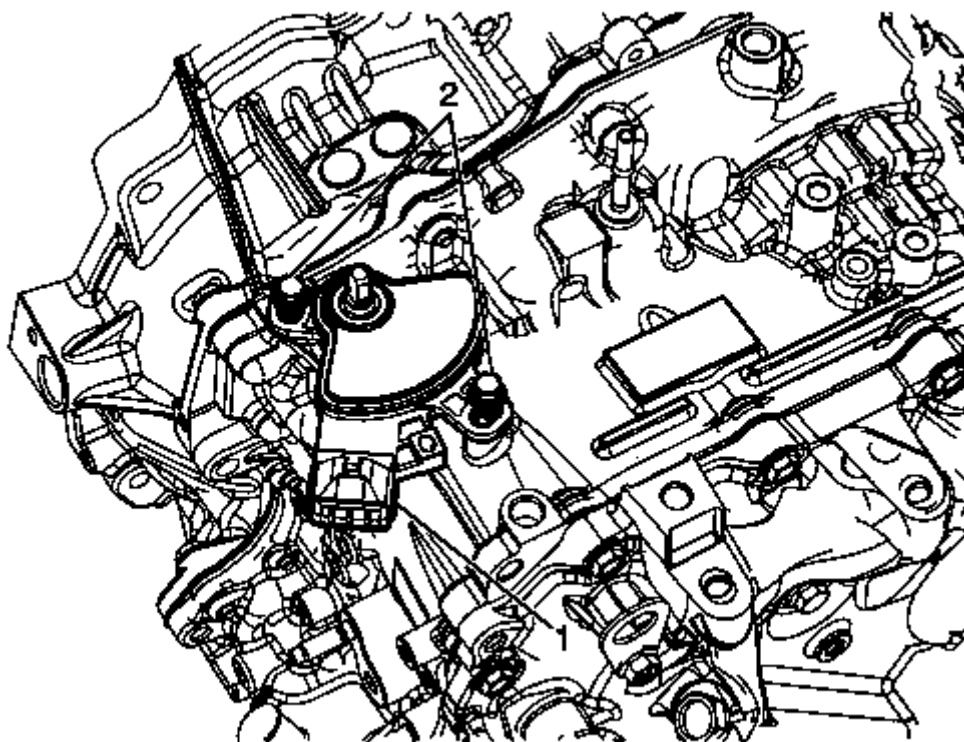


Fig. 26: NEW PNP Switch

Courtesy of GENERAL MOTORS COMPANY

1. Install the NEW PNP switch (1) to the transmission and temporarily tighten the PNP switch bolts (2).

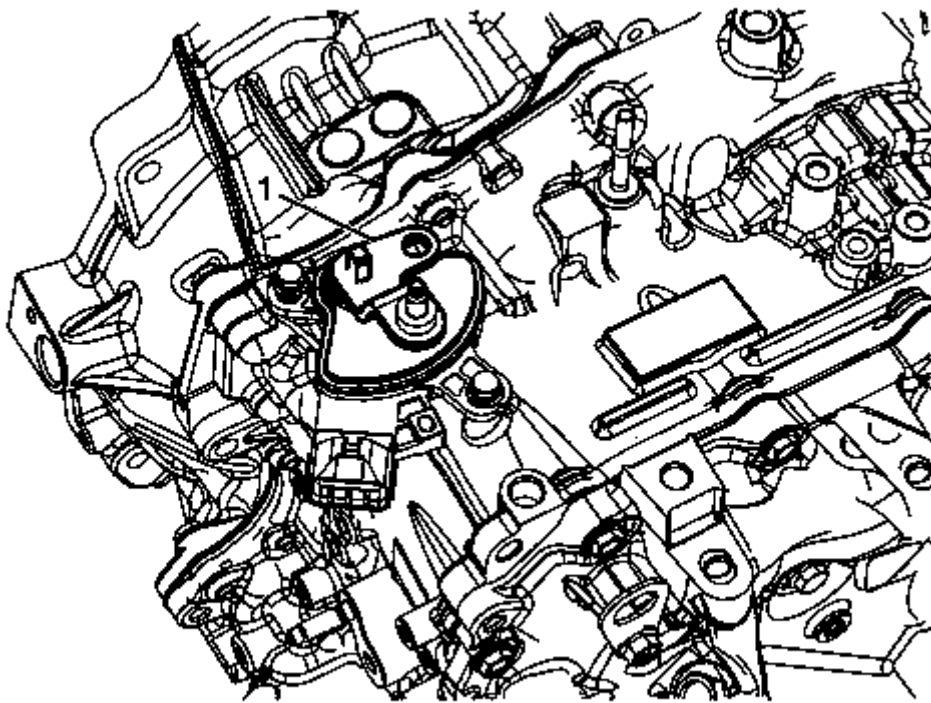


Fig. 27: Selector Lever

Courtesy of GENERAL MOTORS COMPANY

2. Install the selector lever (1) to the manual shaft.
3. Move the selector lever to neutral (N) position.
4. Remove the selector lever from the manual shaft.

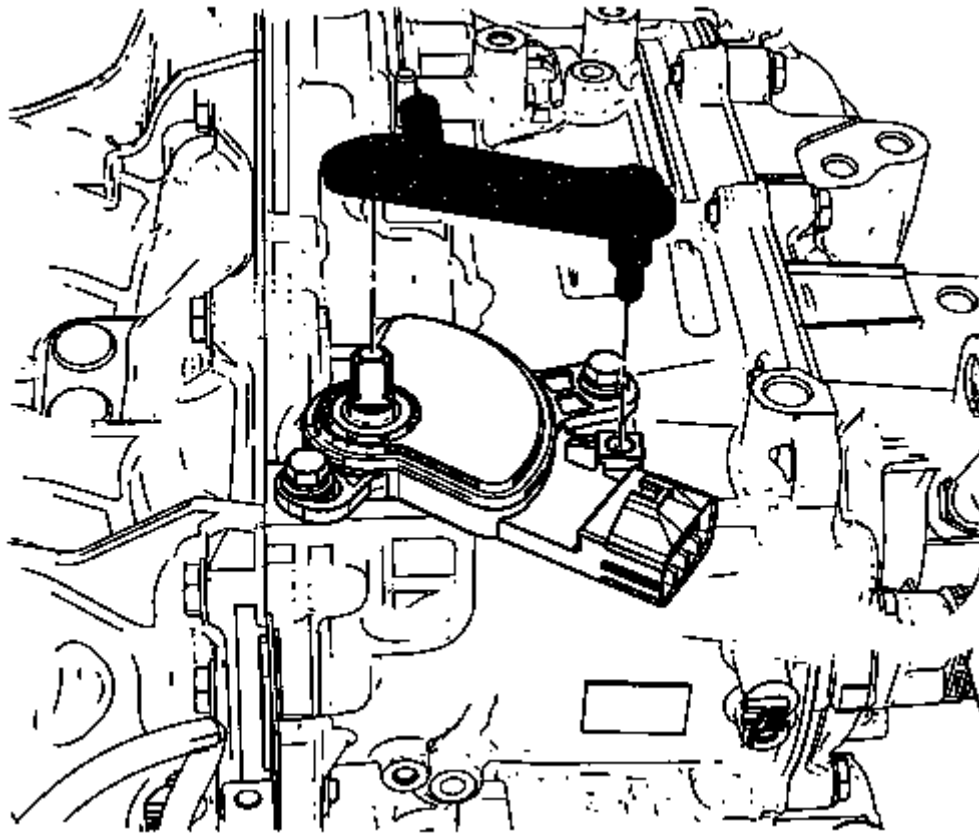


Fig. 28: Range Switch Alignment Checker
Courtesy of GENERAL MOTORS COMPANY

5. Set **DT-51175** range switch alignment checker to the PNP switch and adjust neutral (N) position of PNP switch.

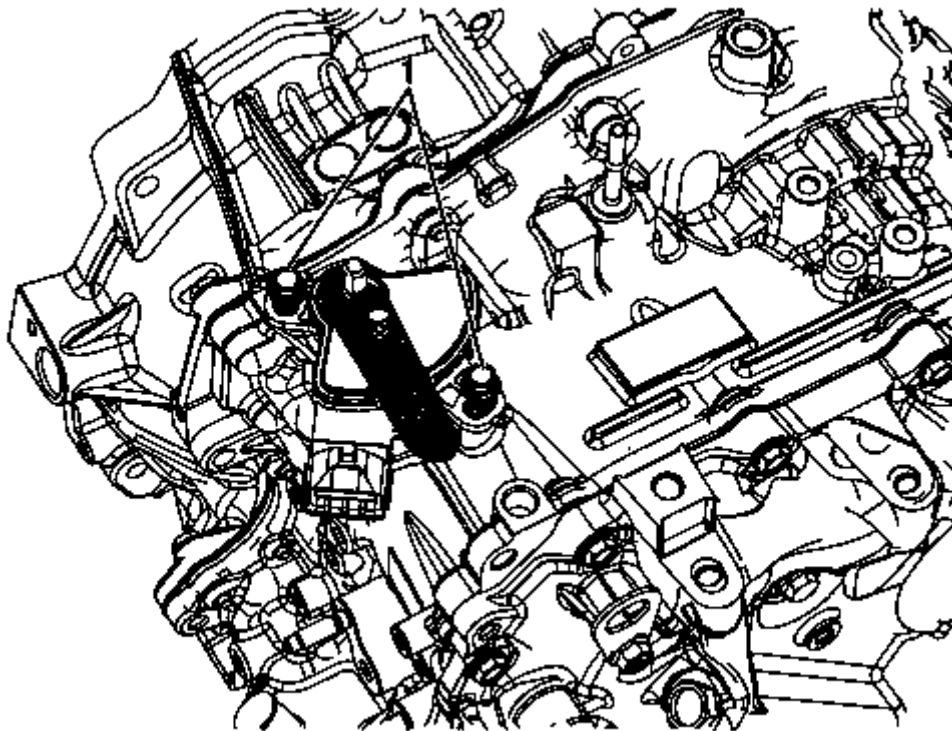


Fig. 29: PNP Switch Bolts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

NOTE: After adjusting the switch, verify the engine only starts in Park or Neutral. If the engine starts in any other position, adjust the switch.

6. Install the PNP switch bolts (1) and tighten to 6 (53 lb in).
7. Remove **DT-51175** range switch alignment checker from the PNP switch.

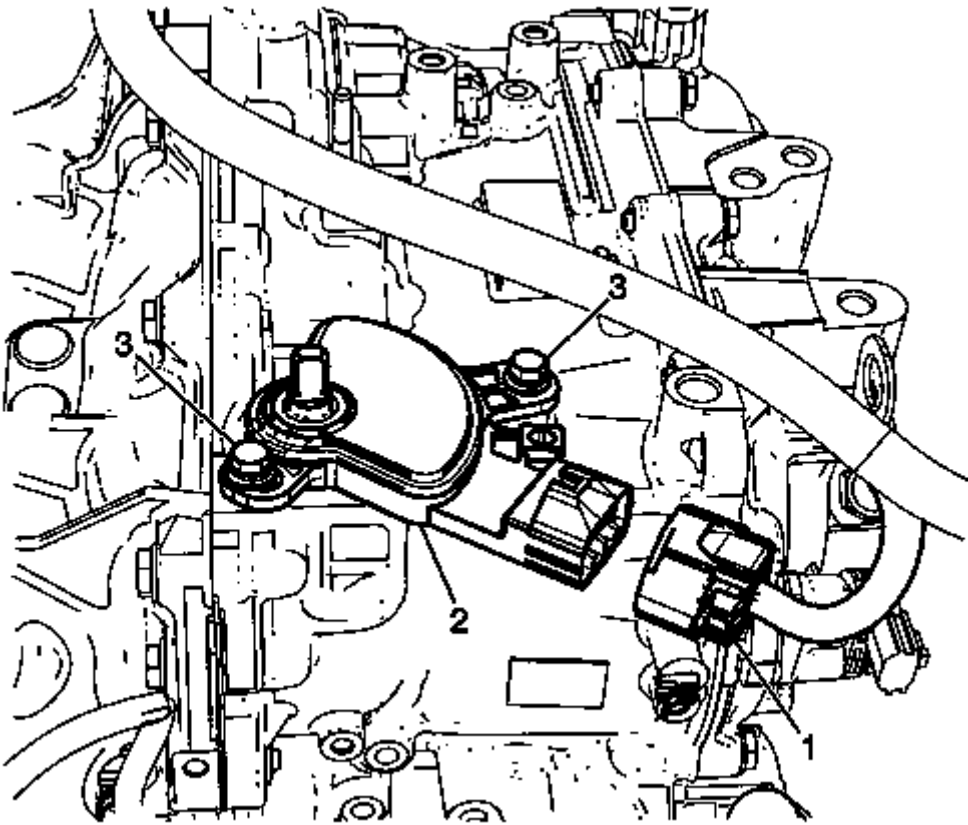


Fig. 30: PNP Switch Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

8. Connect the PNP switch electrical connector (1) to the PNP switch.
9. Install the automatic transmission range selector lever. Refer to **Automatic Transmission Range Selector Lever Replacement**.

PARK/NEUTRAL POSITION SWITCH ADJUSTMENT

Special Tools

DT-51175 Range Switch Alignment Checker

Adjustment Procedure

1. Remove the automatic transmission range select lever. Refer to **Automatic Transmission Range Selector Lever Replacement**.

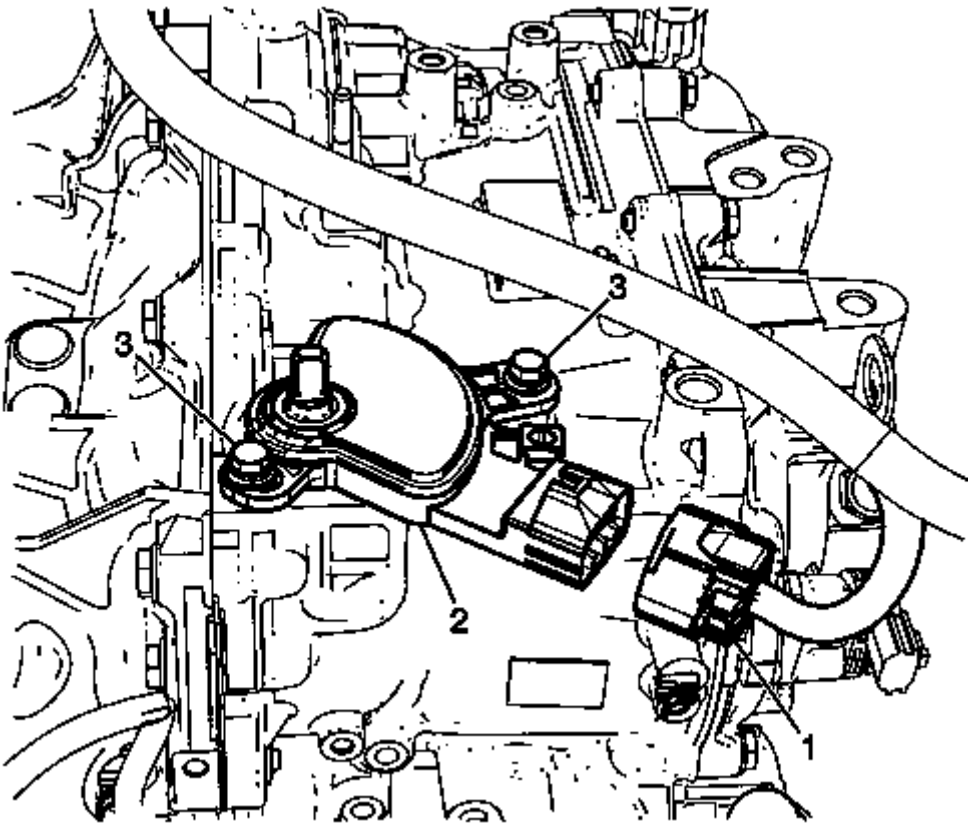


Fig. 31: PNP Switch Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the PNP switch electrical connector (1) from the PNP switch (2).
3. Make sure the transmission manual shaft is in the neutral (N) position.
4. Loosen, DO NOT REMOVE the PNP switch bolts (3).

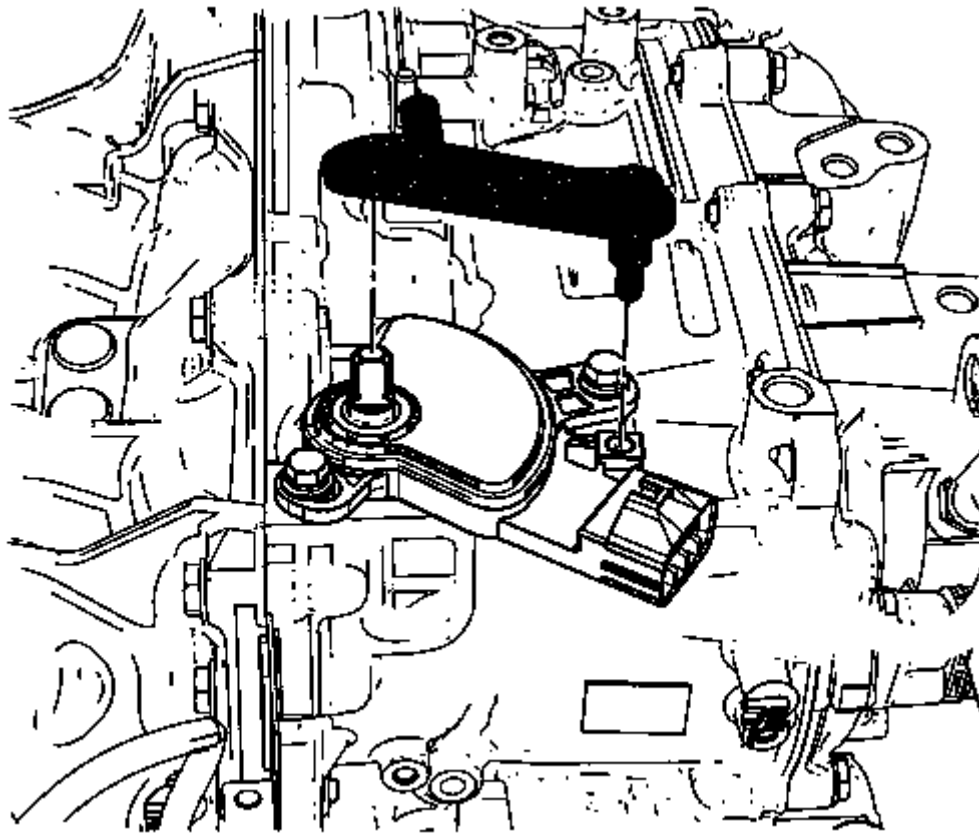


Fig. 32: Range Switch Alignment Checker
Courtesy of GENERAL MOTORS COMPANY

5. Set **DT-51175** range switch alignment checker to the PNP switch and adjust neutral (N) position of PNP switch.

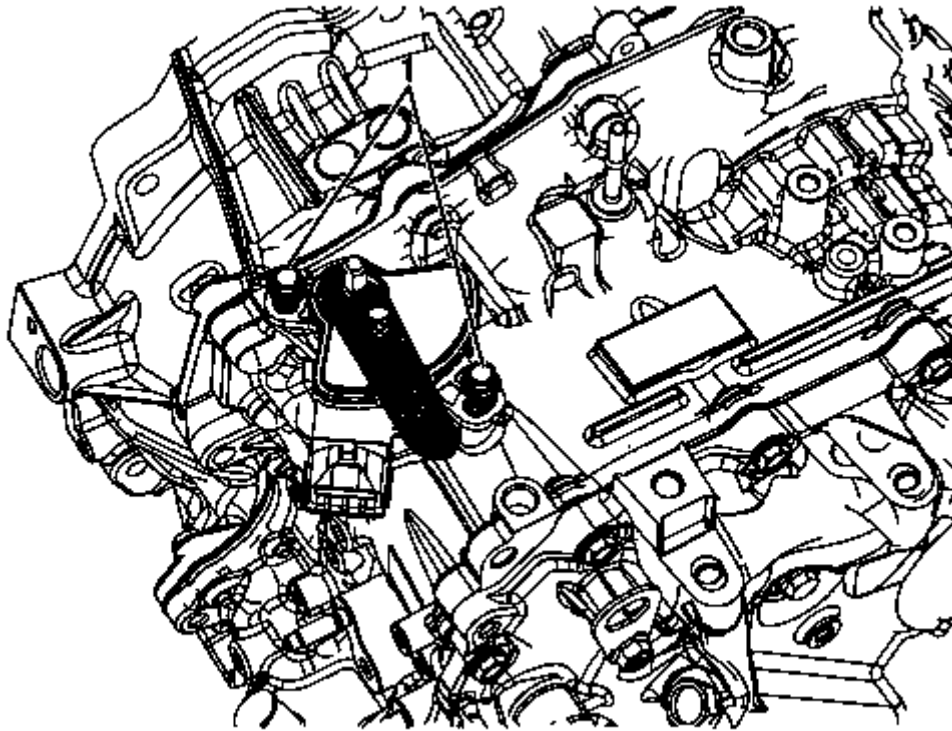


Fig. 33: PNP Switch Bolts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

NOTE: After adjusting the switch, verify the engine only starts in Park or Neutral. If the engine starts in any other position, adjust the switch.

6. Tighten the PNP switch bolts (1) 6 (53 lb in).
7. Remove **DT-51175** range switch alignment checker from the PNP switch.

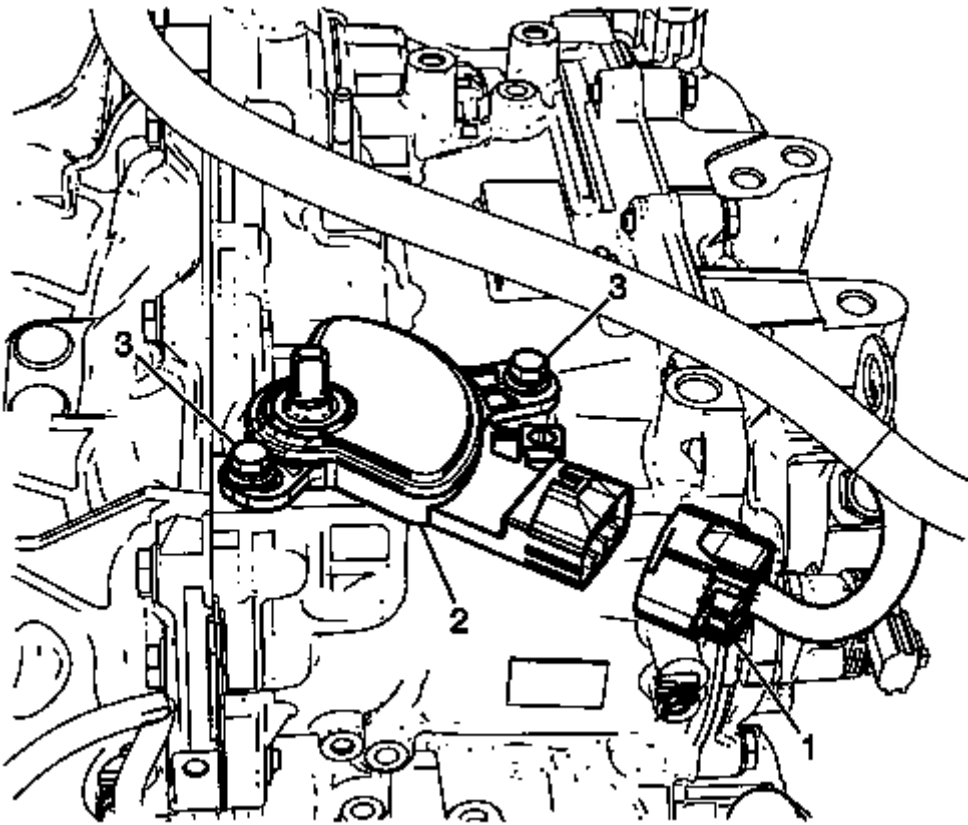


Fig. 34: PNP Switch Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

8. Connect the PNP switch electrical connector (1) to the PNP switch.
9. Install the automatic transmission range selector lever. Refer to **Automatic Transmission Range Selector Lever Replacement**.

TRANSMISSION FLUID DRAIN AND FILL (MAINTENANCE)

CAUTION: Use correct transmission fluid only. Failure to use the proper fluid may result in transmission internal damage.

1. The vehicle must level.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

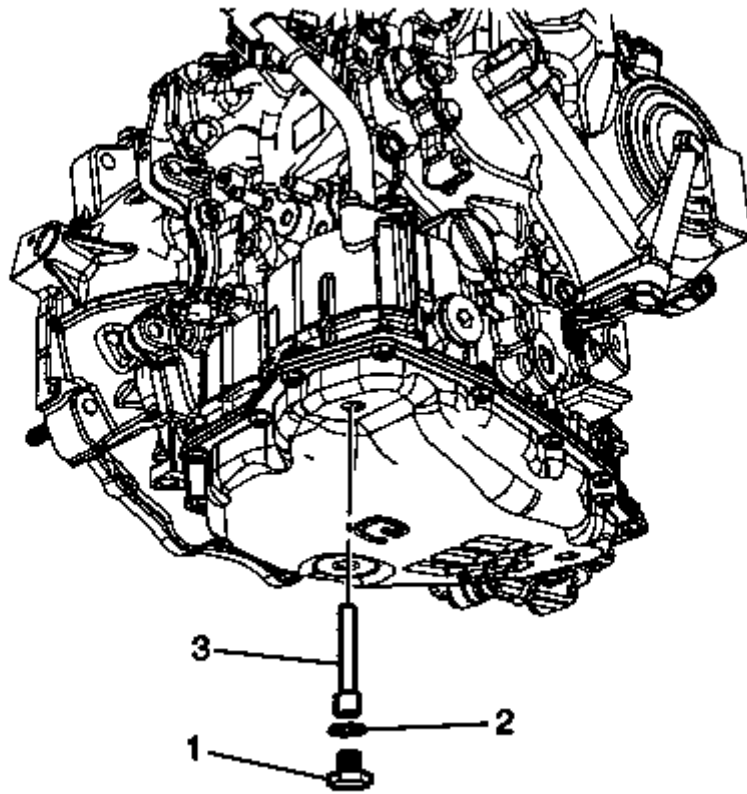


Fig. 35: Drain Plug And Overflow Tube
Courtesy of GENERAL MOTORS COMPANY

3. Remove the drain plug (1) and overflow tube (3) and drain transmission fluid into a suitable container.
4. Install the drain plug (1) with the OLD drain plug gasket (2).

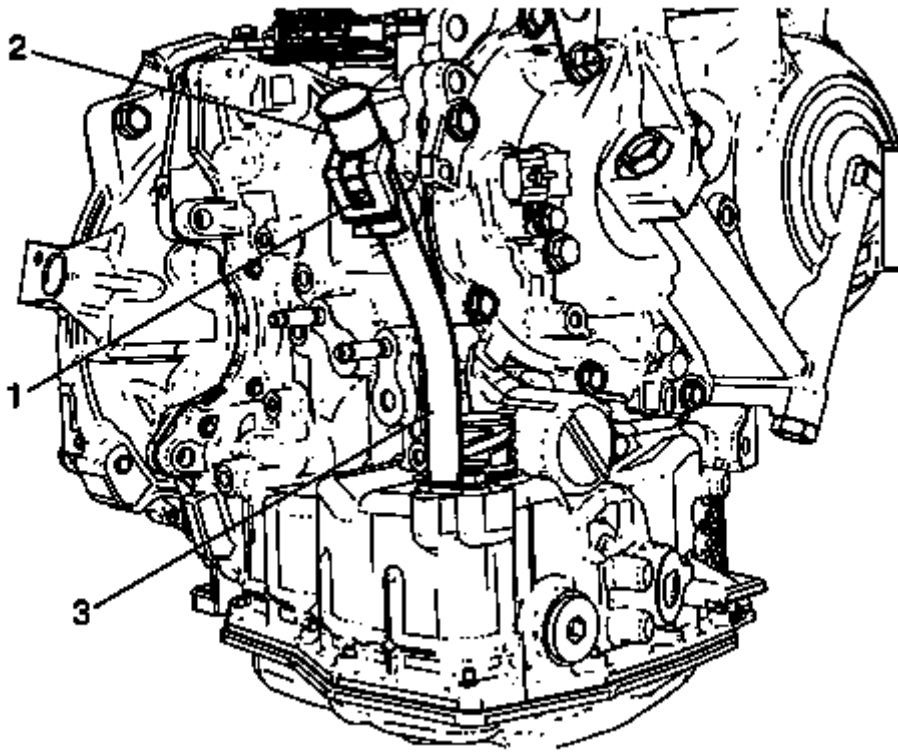


Fig. 36: Air Cleaner Assembly

Courtesy of GENERAL MOTORS COMPANY

5. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
6. Press the tab (1) using a small flat-bladed screwdriver and then remove the fill cap (2).
7. Pour approximately 3.0L (3.17 qt) of the transmission fluid into the charging pipe (3).
8. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
9. Start the engine.
10. Move through the selector lever positions with the foot brake depressed. Switch the selector lever from position P to L and back to P. Hold each position for at least 5 seconds.
11. Stop the engine.
12. Remove the drain plug and then drain transmission fluid from the oil pan.
13. Repeat the above steps 4-12 (one time).

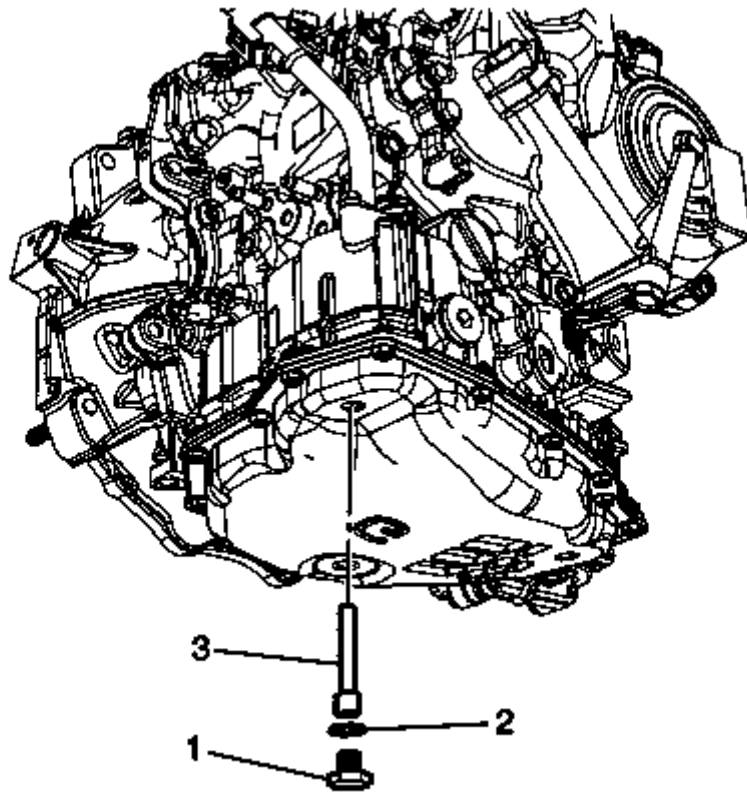


Fig. 37: Drain Plug And Overflow Tube
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

14. Install the overflow tube (3) and tighten to 15 (11 lb ft).
15. Install the drain plug (1) with a NEW plug gasket (2) and tighten to 34 (25 lb ft).
16. Remove the air cleaner assembly. Refer to Air Cleaner Assembly Replacement .
17. Pour approximately 3.0L (3.17 qt) of the transmission fluid into the charging pipe.
18. Install the fill cap.
19. Install the air cleaner assembly. Refer to Air Cleaner Assembly Replacement .
20. Check the ATF level. Refer to Transmission Fluid Level and Condition Check.

TRANSMISSION FLUID DRAIN AND FILL (REPAIR)

CAUTION: Use correct transmission fluid only. Failure to use the proper fluid may result in transmission internal damage.

Transmission Fluid Drain

1. The vehicle must be level.
2. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .

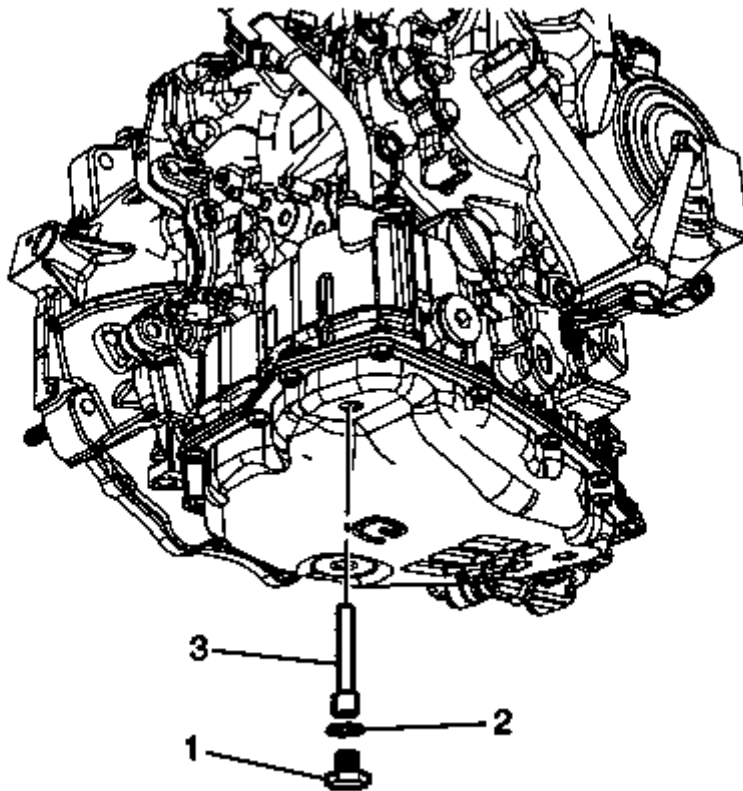


Fig. 38: Drain Plug And Overflow Tube
Courtesy of GENERAL MOTORS COMPANY

3. Remove the drain plug (1) and overflow tube (3) and drain transmission fluid into a suitable container.

CAUTION: Refer to Fastener Caution .

4. Install the overflow tube (3) and tighten to 15 (11 lb ft).
5. Install the drain plug (1) with the OLD plug gasket (2).

Transmission Fluid Fill

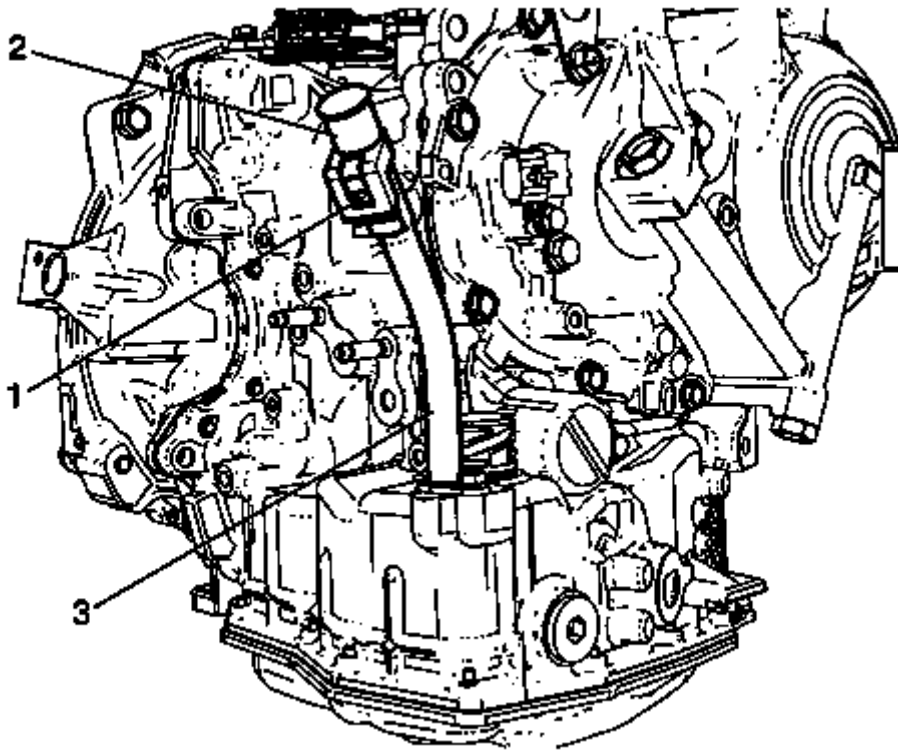


Fig. 39: Air Cleaner Assembly

Courtesy of GENERAL MOTORS COMPANY

1. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
2. Press the tab (1) using a small flat-bladed screwdriver and then remove the fill cap (2).
3. Pour approximately 3.0L (3.17 qt) (6.0L/6.3 qt dry transmission) of the transmission fluid into the transmission fill tube (3).
4. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
5. Start the engine.
6. Move through the selector lever positions with the foot brake depressed. Switch the selector lever from position P to L and back to P. Hold each position for at least 5 seconds.

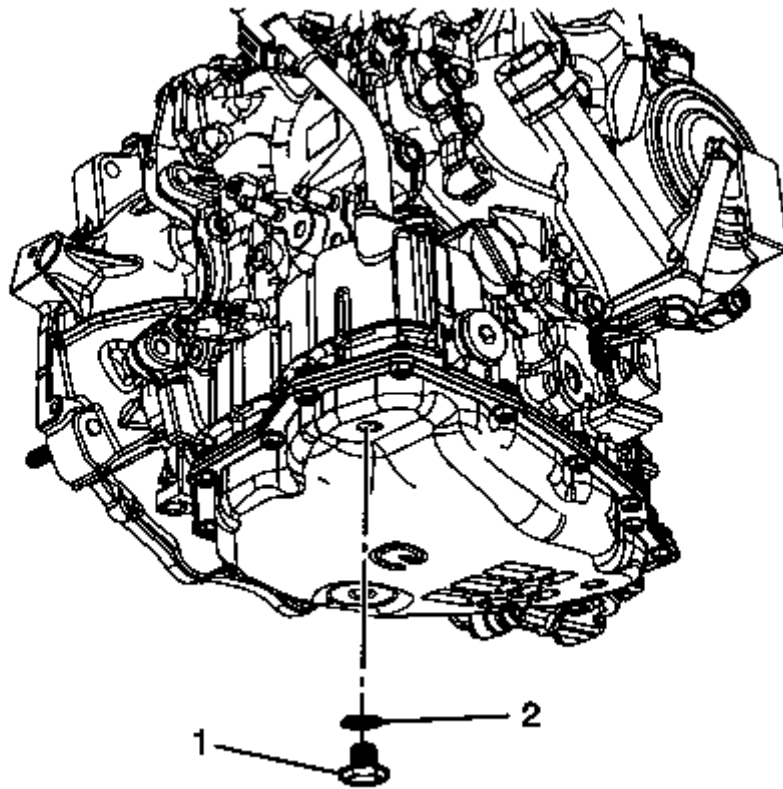


Fig. 40: Drain Plug

Courtesy of GENERAL MOTORS COMPANY

NOTE:

- Perform this work with the engine idling.
- Do not re-use drain plug gasket, replace with a NEW gasket.

7. Check the transmission fluid temperature with the diagnostic tool.
 1. Run the engine until the transmission fluid temperature has reached 50-80°C (122-176°F).
 2. Remove the drain plug (1). Remove and DISCARD the drain plug gasket (2).
 3. If the fluid is flowing as a steady stream, wait until the fluid begins to drip. If no fluid comes out, add the fluid until it drips out.
 4. When the fluid drips out from overflow tube, install the drain plug (1) with a NEW gasket (2) and tighten to 34 (25 lb ft).
8. Turn off the engine.

TRANSMISSION FLUID COOLER PIPE CONNECTOR REPLACEMENT - RADIATOR

Removal Procedure

1. Drain the cooling system. Refer to Cooling System Draining and Filling .
2. Remove the transaxle oil cooler hoses from the oil cooler fittings on the radiator. Refer to Transmission

Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection.

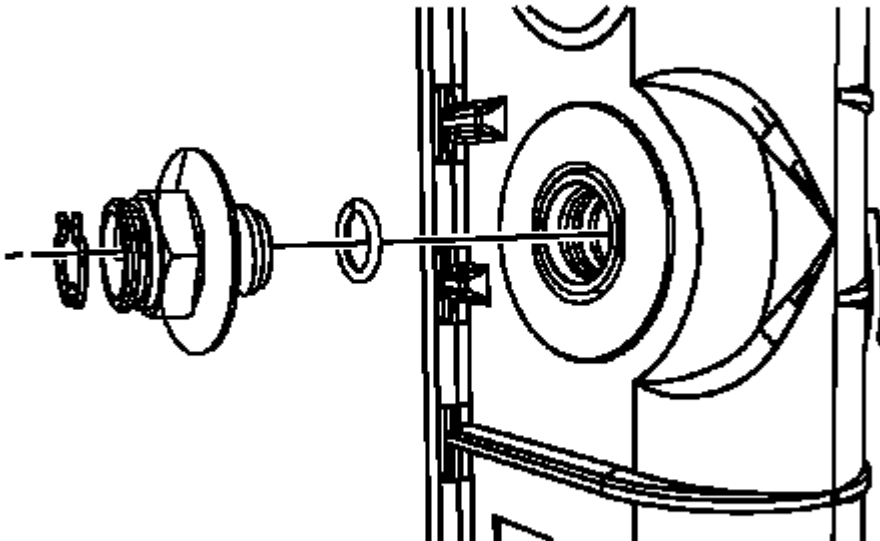


Fig. 41: View Of Oil Cooler Fitting At Radiator
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not remove the upper and lower transaxle oil cooler fittings from the radiator at the same time; otherwise the transaxle oil cooler will fall inside the radiator end tank.

3. Remove the oil cooler fitting from the radiator.

Installation Procedure

1. Inspect the new O-ring seals for cracks, cuts or damage. Replace if necessary.

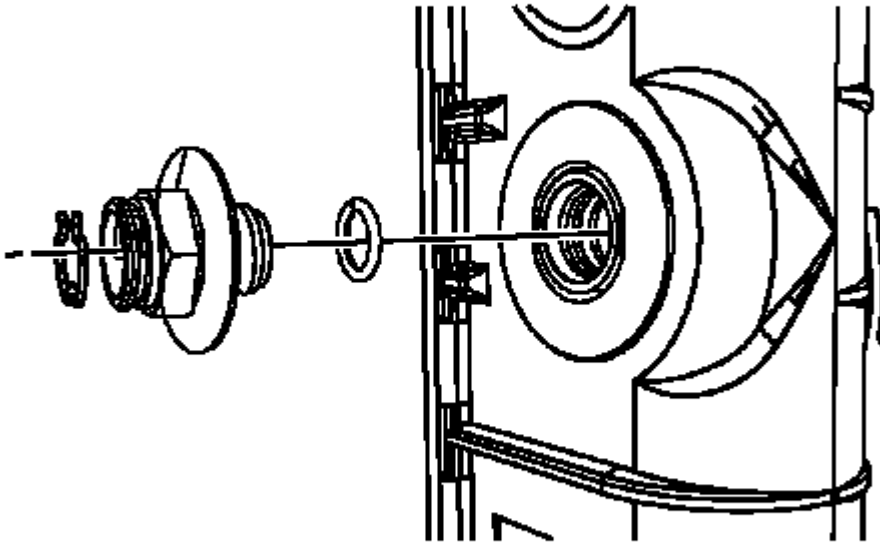


Fig. 42: View Of Oil Cooler Fitting At Radiator
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

NOTE: The correct thread engagement is critical. Cross-threaded fittings can achieve proper tightness and still leak.

2. Install the oil cooler fitting to the radiator and tighten to 20 (15 lb ft).
3. Install the transaxle oil cooler hoses to the oil cooler fittings on the radiator. Refer to Transmission Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection.
4. Fill the cooling system. Refer to Cooling System Draining and Filling .
5. Adjust the transmission fluid level. Refer to Transmission Fluid Level and Condition Check.
6. Inspect for fluid leaks.

TRANSMISSION FLUID COOLER HOSE/PIPE QUICK-CONNECT FITTING DISCONNECTION AND CONNECTION

Removal Procedure

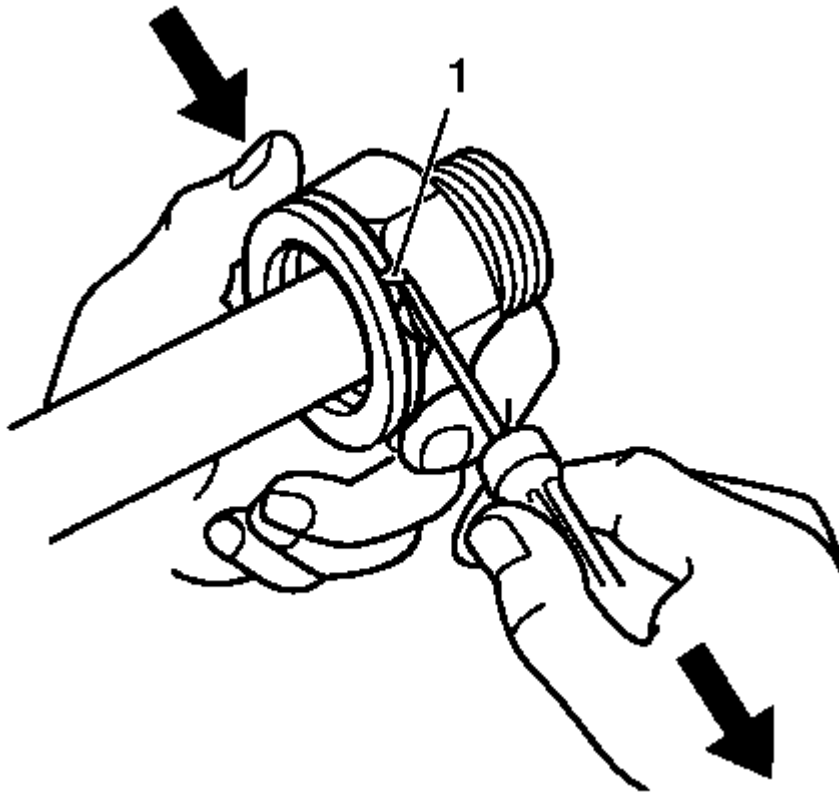


Fig. 43: Automatic Transmission Oil Cooler Fitting Retaining Ring
Courtesy of GENERAL MOTORS COMPANY

NOTE: Perform the following procedure when removing the retaining rings and cooler lines from the quick connect fittings located on the radiator and/or the transmission.

1. Pull the plastic cap back from the quick connect fitting and down along the cooler line about 5 cm (2 in).
2. Using a bent-tip screwdriver, pull on one of the open ends of the retaining ring (1) in order to rotate the retaining ring around the quick connect fitting until the retaining ring is out of position and can be completely removed.
3. Remove the retaining ring from the quick connect fitting.
4. Discard the retaining ring.

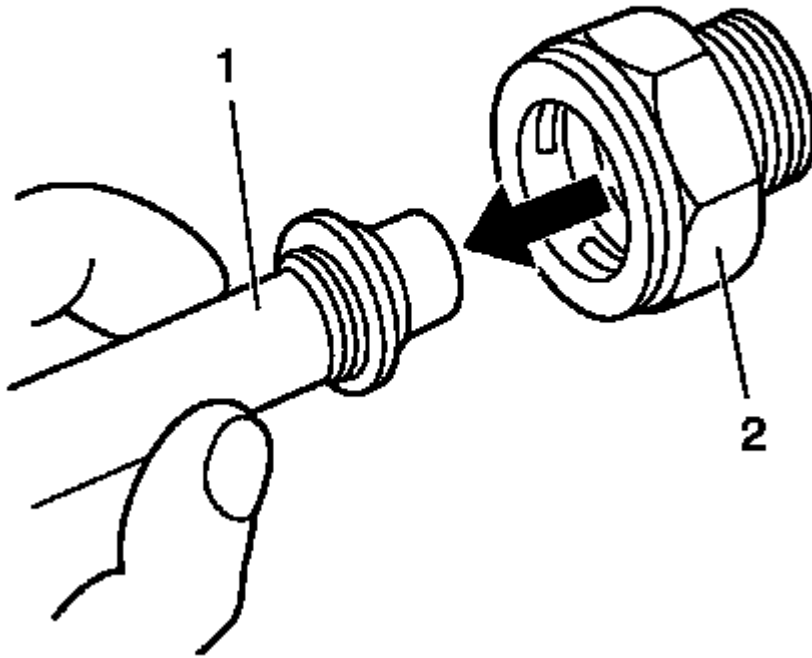


Fig. 44: Automatic Transmission Cooler Line
Courtesy of GENERAL MOTORS COMPANY

5. Pull the cooler line (1) straight out from the quick connect fitting (2).

Installation Procedure

NOTE:

- Do not reuse any of the existing oil lines or oil line fittings if there is excessive corrosion.
- Do not reuse any of the existing retaining rings that were removed from the existing quick connect fittings. Install new retaining rings.
- Ensure the following procedures are performed when installing the new retaining rings onto the fittings.

1. Install a new retaining ring into the quick connect fitting using the following procedure:

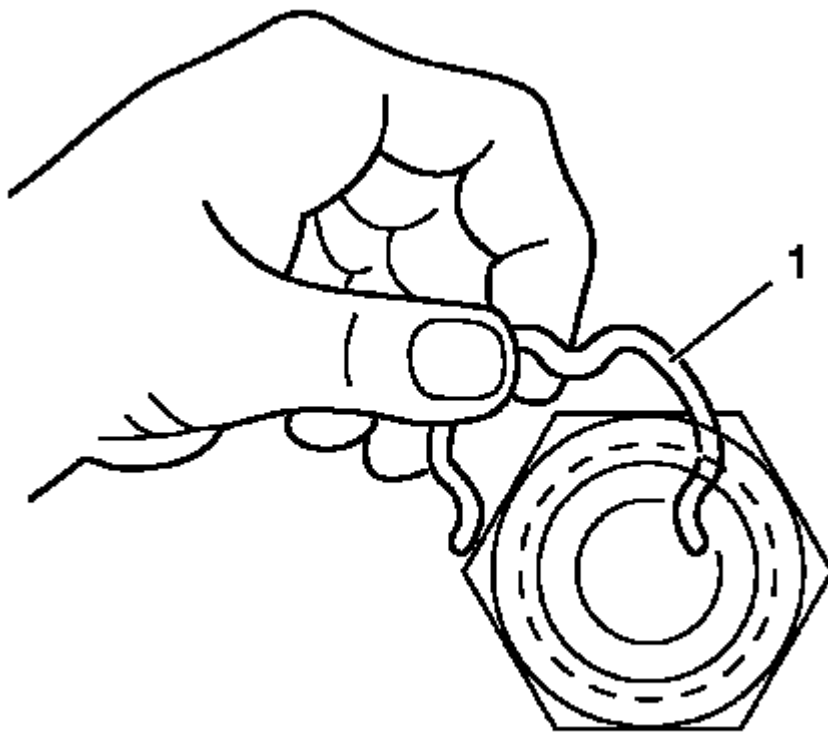


Fig. 45: Automatic Transmission Oil Cooler Fitting Retaining Ring
Courtesy of GENERAL MOTORS COMPANY

2. Hook one of the open ends of the retaining ring (1) in one of the slots in the quick connect fitting.

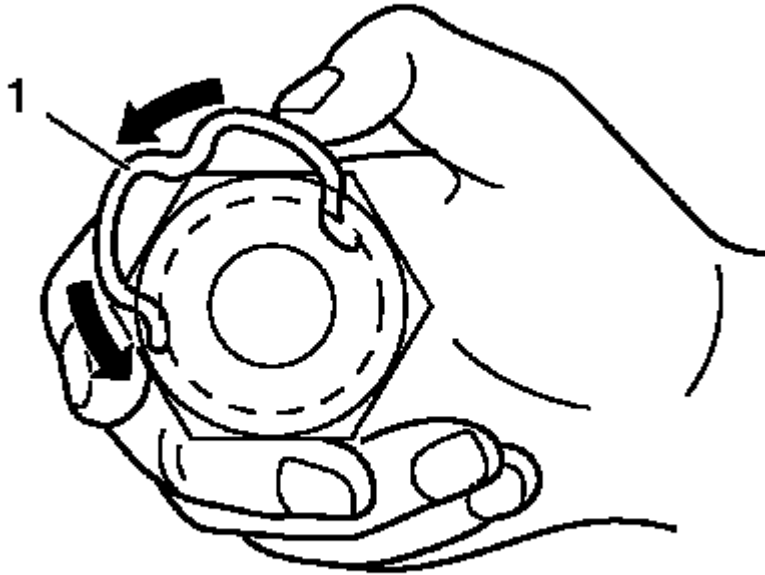


Fig. 46: Rotating Automatic Transmission Oil Cooler Fitting Retaining Ring
Courtesy of GENERAL MOTORS COMPANY

3. Rotate the retaining ring (1) around the fitting until the retaining ring is positioned with all three ears through the three slots on the fitting.

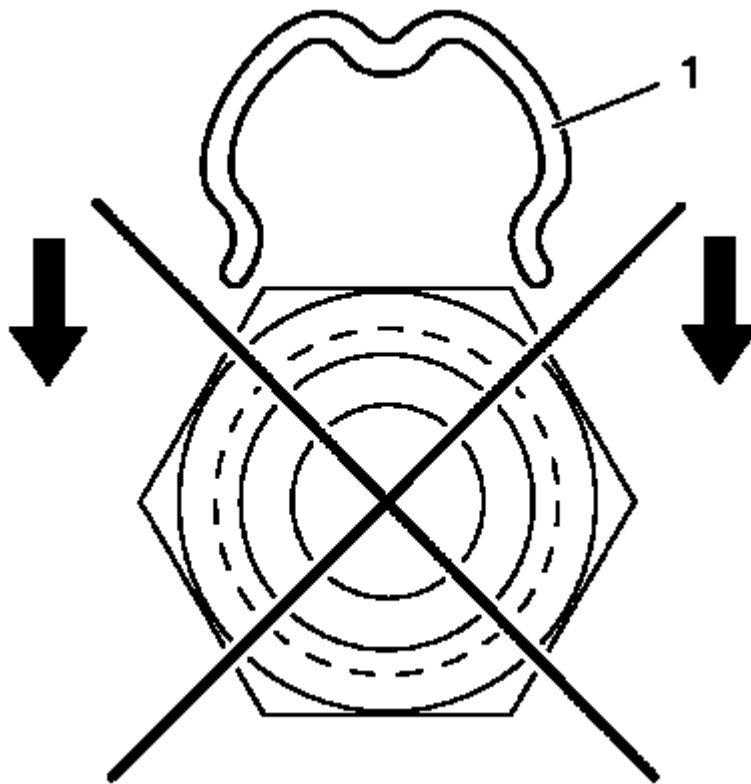


Fig. 47: Automatic Transmission Oil Cooler Fitting Retaining Ring Caution
Courtesy of GENERAL MOTORS COMPANY

4. Do not install the new retaining ring (1) onto the fitting by pushing the retaining ring.

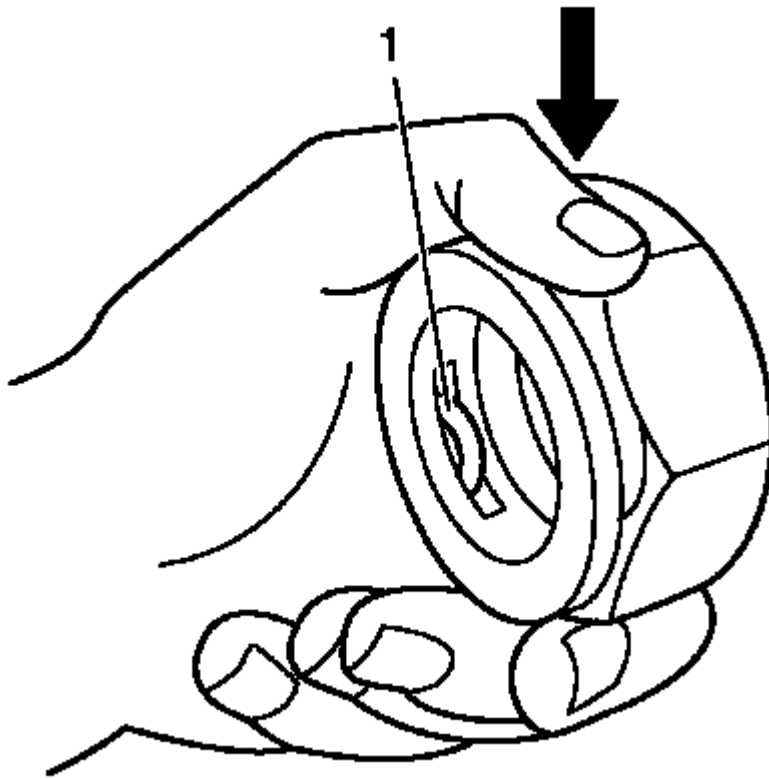


Fig. 48: Retaining Ring Ears

Courtesy of GENERAL MOTORS COMPANY

5. Ensure that the three retaining ring ears are seen from inside the fitting (1) and that the retaining ring moves freely in the fitting slots.

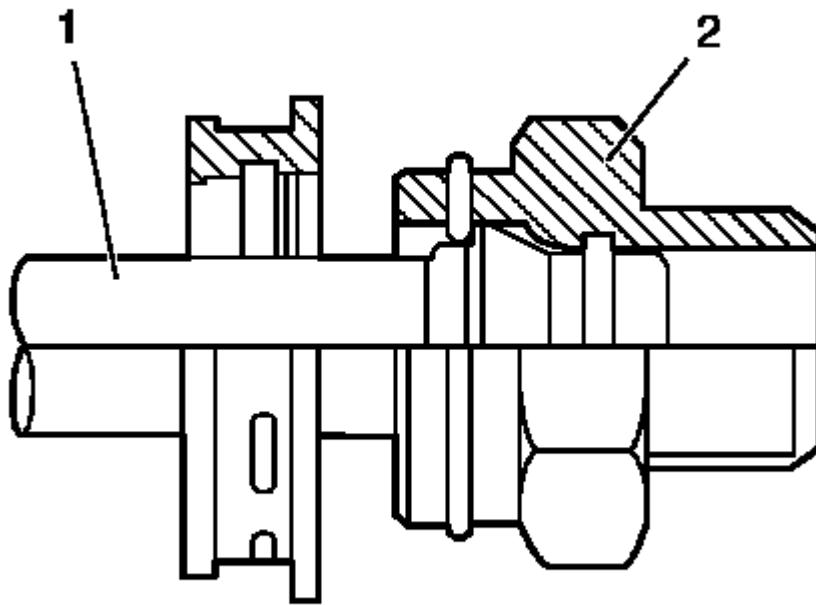


Fig. 49: Cutaway View Of Automatic Transmission Oil Cooler Fitting
Courtesy of GENERAL MOTORS COMPANY

6. Install the cooler line (1) into the quick connect fitting (2).
7. Insert the cooler line end into the quick connect fitting until a click is either heard or felt.

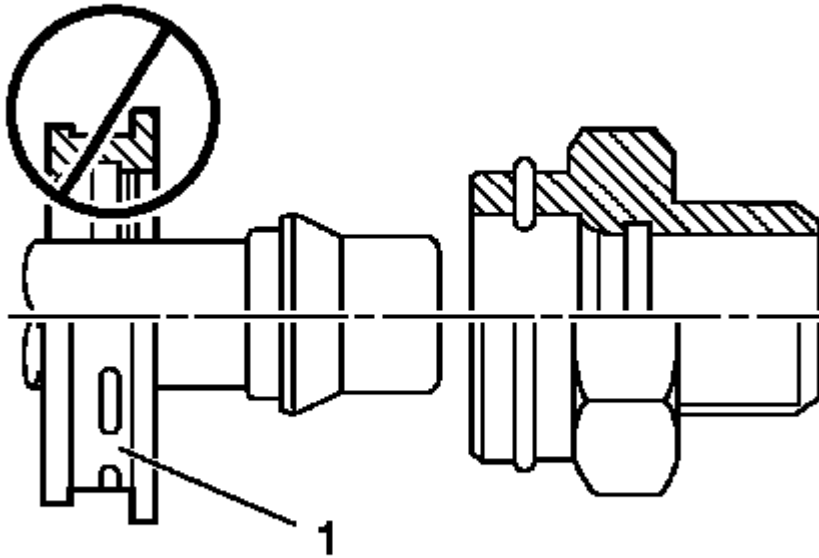


Fig. 50: Automatic Transmission Oil Cooler Line And Fitting Caution
Courtesy of GENERAL MOTORS COMPANY

8. Do not use the plastic cap (1) on the cooler line in order to install the cooler line into the fitting.
9. Pull back sharply on the cooler line in order to ensure that the cooler line is fastened into the quick connect fitting.

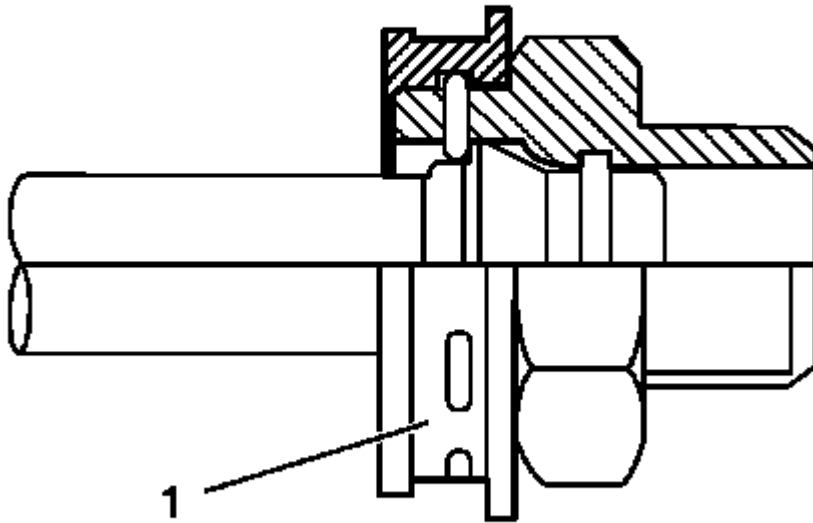


Fig. 51: Automatic Transmission Oil Cooler Fitting Plastic Cap
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not manually depress the retaining clip when installing the plastic cap.

10. Position (snap) the plastic cap (1) onto the fitting. Do not manually depress the retaining ring when installing the plastic cap onto the quick connect fitting.
11. Ensure that the plastic cap is fully seated against the fitting.

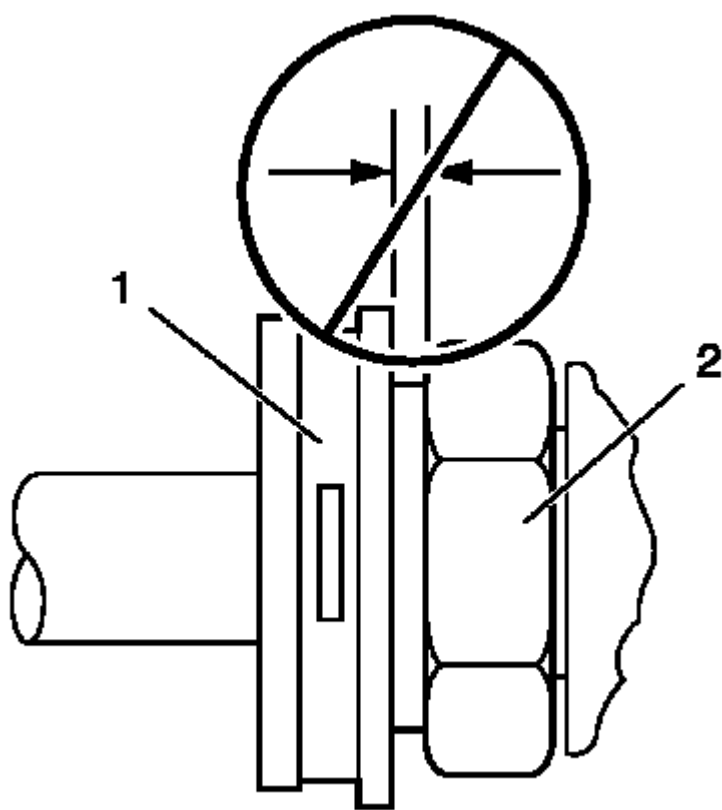


Fig. 52: Automatic Transmission Oil Cooler Fitting Plastic Cap Caution
Courtesy of GENERAL MOTORS COMPANY

12. Ensure that no gap is present between the plastic cap (1) and the fitting (2).

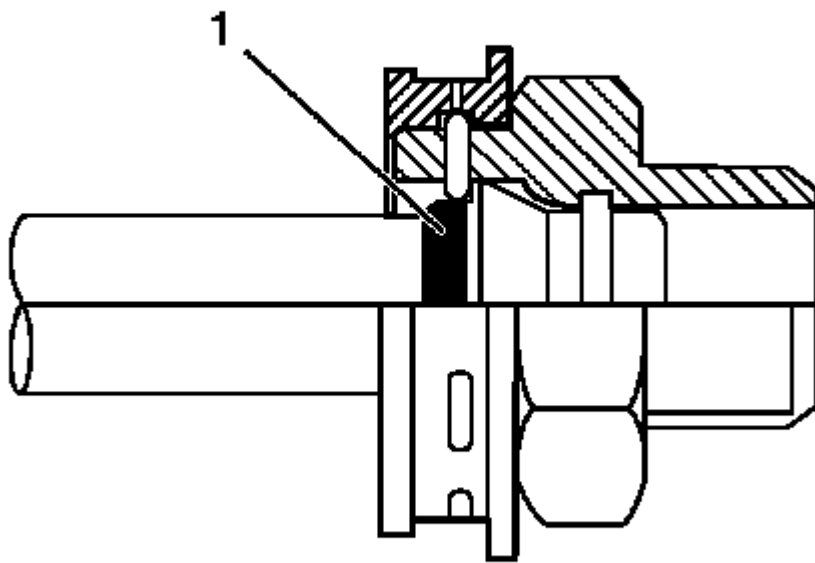


Fig. 53: Yellow Identification Band
Courtesy of GENERAL MOTORS COMPANY

13. Ensure that the yellow identification band (1) on the tube is hidden within the quick connect fitting.

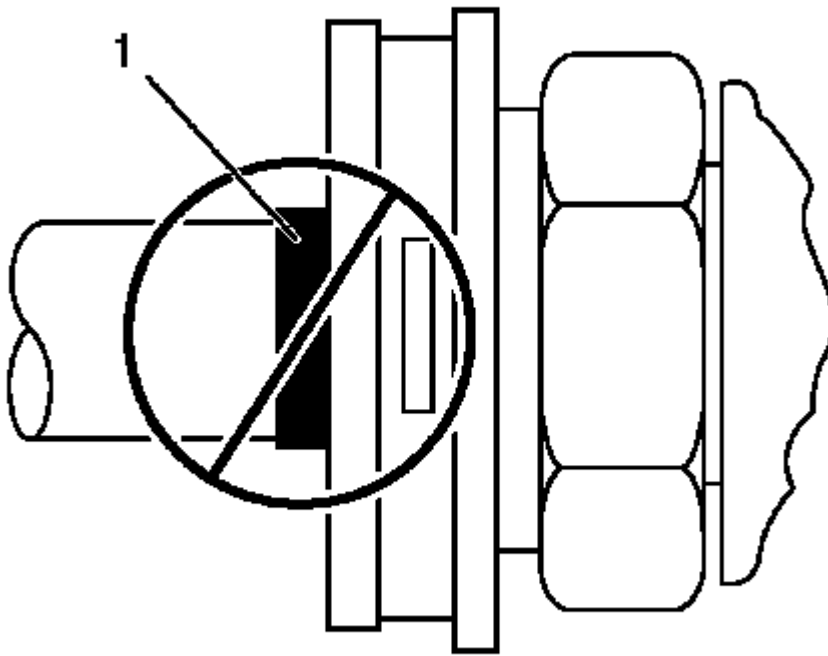


Fig. 54: Yellow Identification Band Caution
Courtesy of GENERAL MOTORS COMPANY

14. A hidden yellow identification band (1) indicates proper joint seating.
15. Fill the transmission to the proper level. Refer to **Transmission Fluid Level and Condition Check.**

OUTPUT SPEED SENSOR REPLACEMENT

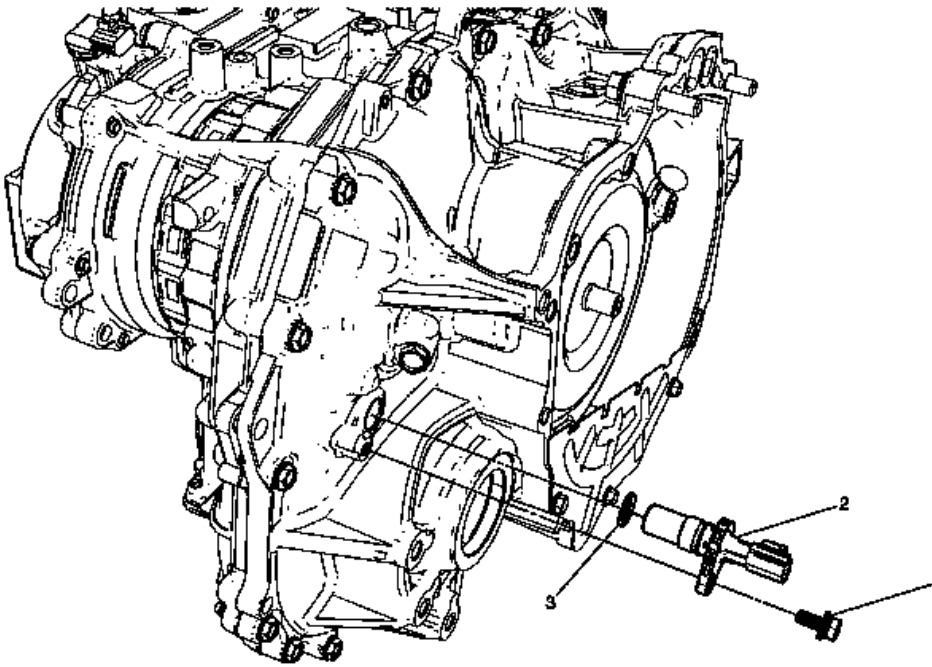


Fig. 55: Output Speed Sensor
 Courtesy of GENERAL MOTORS COMPANY

Output Speed Sensor Replacement

Callout	Component Name
Preliminary Procedure Disconnect the battery negative cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> .	
1	Output Speed Sensor Bolt (Qty: 1) CAUTION: Refer to <u>Fastener Caution</u> . Procedure Disconnect the output speed sensor electrical connector. Tighten 6 (53 lb in)
2	Output Speed Sensor
3	Output Speed Sensor O-Ring Seal NOTE: Do not reuse the output speed sensor O-ring seal.

PRIMARY INPUT SPEED SENSOR REPLACEMENT

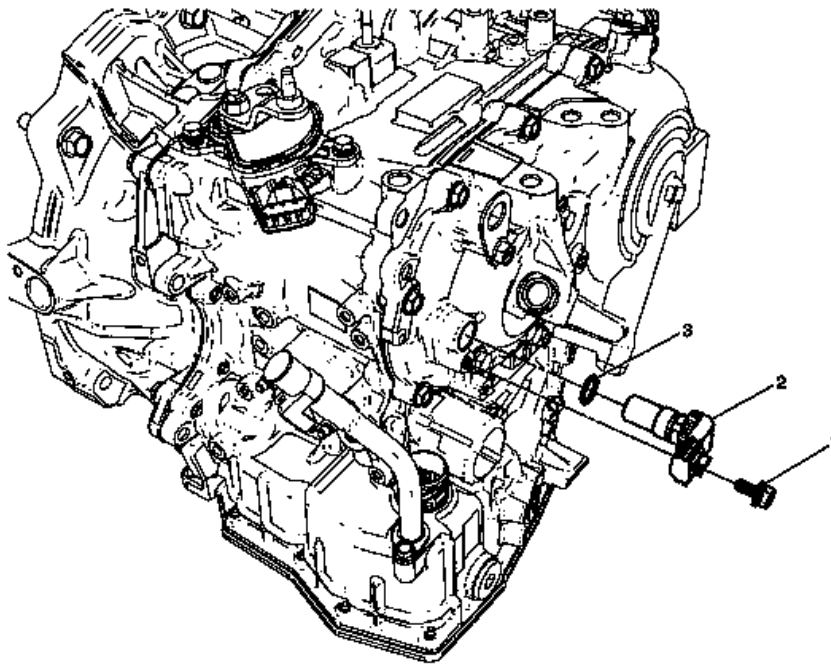


Fig. 56: Primary Input Speed Sensor
 Courtesy of GENERAL MOTORS COMPANY

Primary Input Speed Sensor Replacement

Callout	Component Name
Preliminary Procedures 1. Disconnect the battery negative cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Remove the left front compartment splash shield. Refer to <u>Front Compartment Splash Shield Replacement</u> .	
1	Primary Input Speed Sensor Bolt (Qty: 1) CAUTION: Refer to <u>Fastener Caution</u> . Procedure Disconnect the primary input speed sensor electrical connector. Tighten 6 (53 lb in)
2	Primary Input Speed Sensor
3	Primary Input Speed Sensor O-Ring Seal NOTE: Do not reuse the primary input speed sensor O-ring seal.

SECONDARY INPUT SPEED SENSOR REPLACEMENT

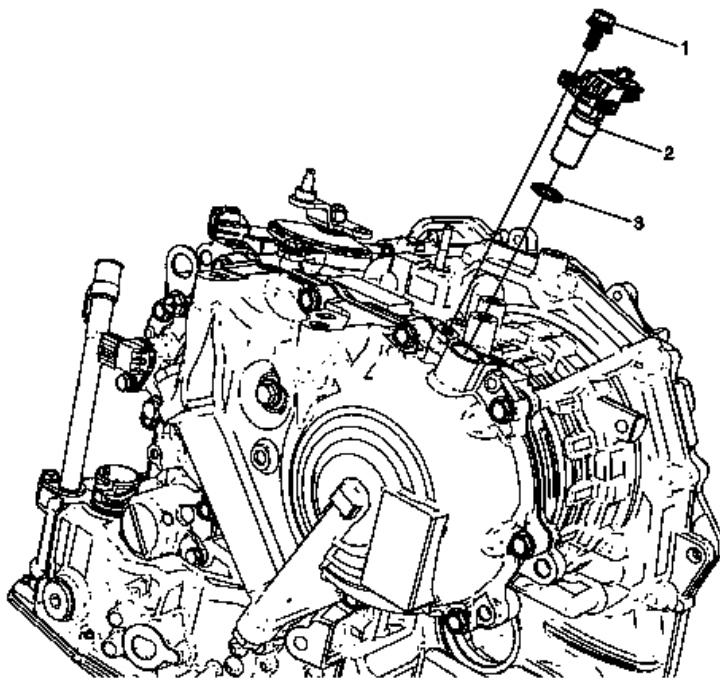


Fig. 57: Secondary Input Speed Sensor
Courtesy of GENERAL MOTORS COMPANY

Secondary Input Speed Sensor Replacement

Callout	Component Name
Preliminary Procedures	
1. Disconnect the battery negative cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Remove the air cleaner assembly. Refer to <u>Air Cleaner Assembly Replacement</u> . 3. Remove the battery tray. Refer to <u>Battery Tray Replacement</u> .	
1	Secondary Input Speed Sensor Bolt (Qty: 1) CAUTION: Refer to <u>Fastener Caution</u> . Procedure Disconnect the secondary input speed sensor electrical connector. Tighten 6 (53 lb in)
2	Secondary Input Speed Sensor
	Secondary Input Speed Sensor O-Ring Seal

3

NOTE:

Do not reuse the secondary input speed sensor O-ring seal.

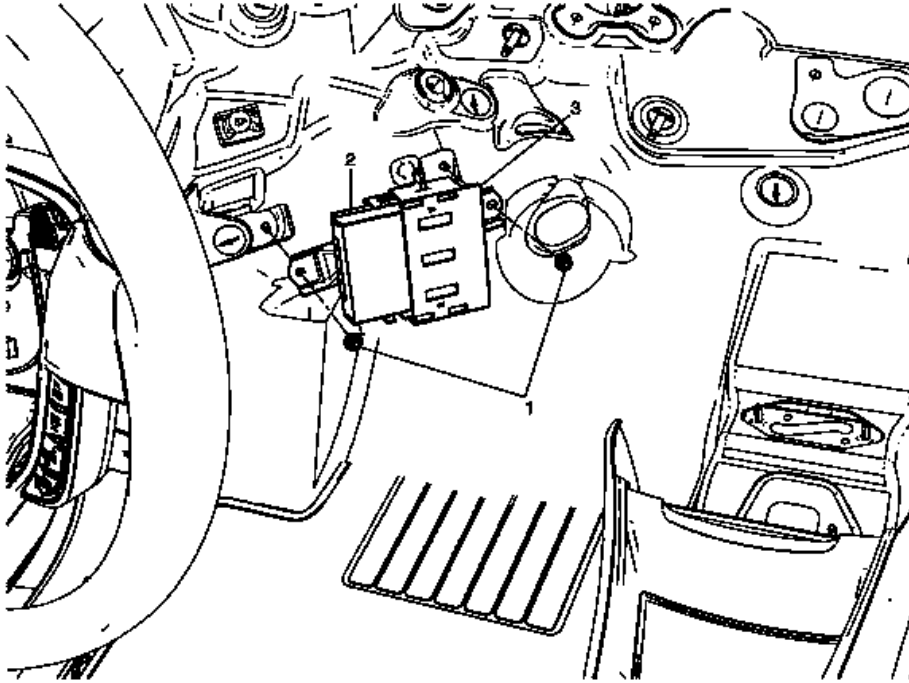
TRANSMISSION CONTROL MODULE REPLACEMENT

Fig. 58: Transmission Control Module
Courtesy of GENERAL MOTORS COMPANY

Transmission Control Module Replacement

Callout	Component Name
1	TCM Fastener CAUTION: Refer to <u>Fastener Caution</u> . Tighten 7 (62 lb in)
2	Transmission Control Module (TCM) Procedure 1. Disconnect the TCM electrical connector. 2. The TCM must be programmed when replaced. Refer to <u>Control Module References</u> for programming and setup information.

FRONT WHEEL DRIVE SHAFT SEAL REPLACEMENT - LEFT SIDE

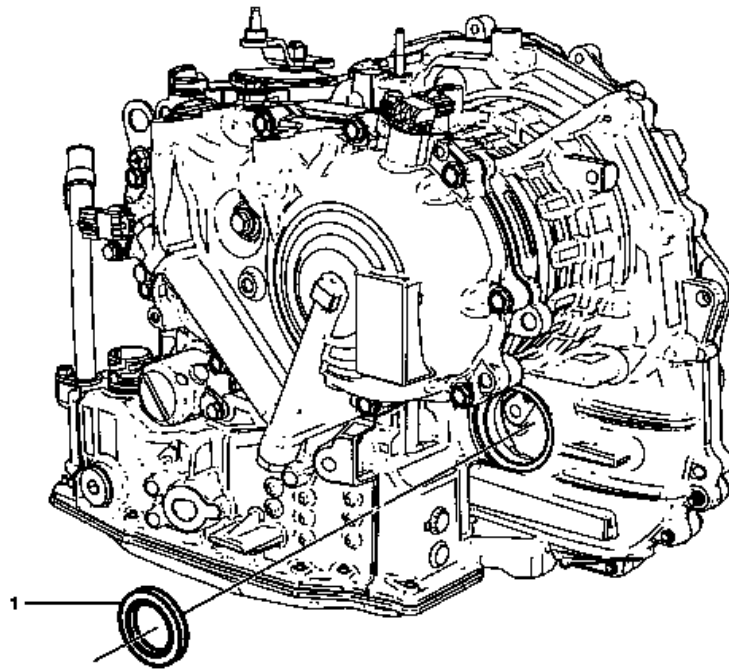


Fig. 59: Front Wheel Drive Shaft Seal - Left Side
 Courtesy of GENERAL MOTORS COMPANY

Front Wheel Drive Shaft Seal Replacement - Left Side

Callout	Component Name
Preliminary Procedures	
1. Raise the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Remove the left wheel drive shaft. Refer to <u>Front Wheel Drive Shaft Replacement</u> .	
1	Left Front Wheel Drive Shaft Oil Seal Procedure 1. For seal removal, use DT-7004 slide hammer with DT-586 seal remover. 2. For seal installation, use DT-51323 seal installer. NOTE: The new seal should be pressed to the correct depth from transmission case end surface. Specification

Approx. 0.9 mm (0.035 in)

Special Tools

- **DT-51323** Seal Installer
- **DT-586** Seal Remover
- **DT-7004** Slide Hammer

For equivalent regional tools, refer to **Special Tools** .

FRONT WHEEL DRIVE SHAFT SEAL REPLACEMENT - RIGHT SIDE

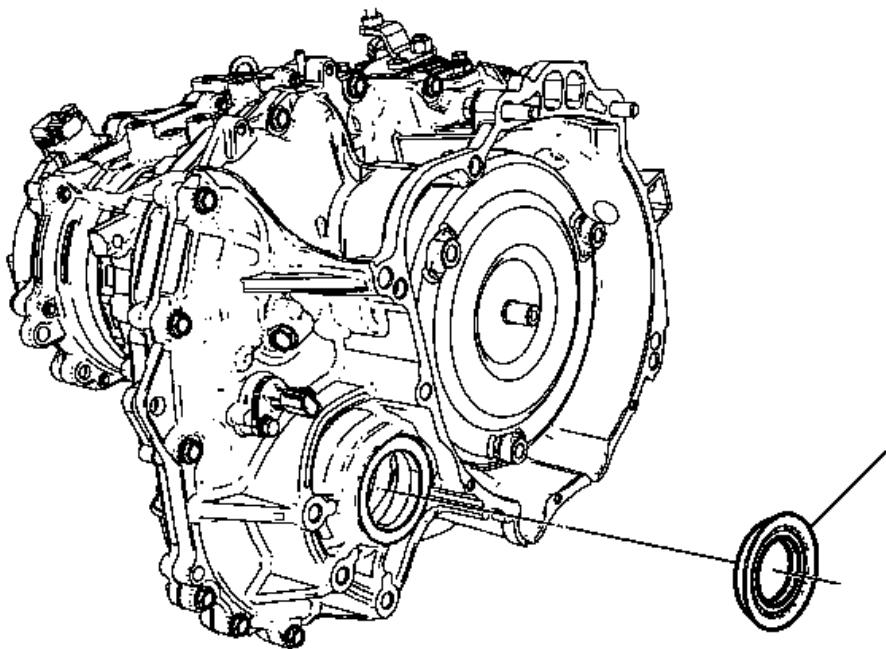


Fig. 60: Front Wheel Drive Shaft Seal - Right Side
Courtesy of GENERAL MOTORS COMPANY

Front Wheel Drive Shaft Seal Replacement - Right Side

Callout	Component Name
Preliminary Procedures	
1. Raise the vehicle. Refer to Lifting and Jacking the Vehicle .	
2. Remove the right wheel drive shaft. Refer to Front Wheel Drive Shaft Replacement .	
	Right Front Wheel Drive Shaft Oil Seal
Procedure	

1. For seal removal, use **DT-7004** slide hammer with **DT-586** seal remover.
2. For seal installation, use **DT-446** seal installer.

Special Tools

1

- **DT-446** Seal Installer
- **DT-586** Seal Remover
- **DT-7004** Slide Hammer

For equivalent regional tools, refer to **Special Tools** .

CONTROL VALVE BODY COVER REPLACEMENT

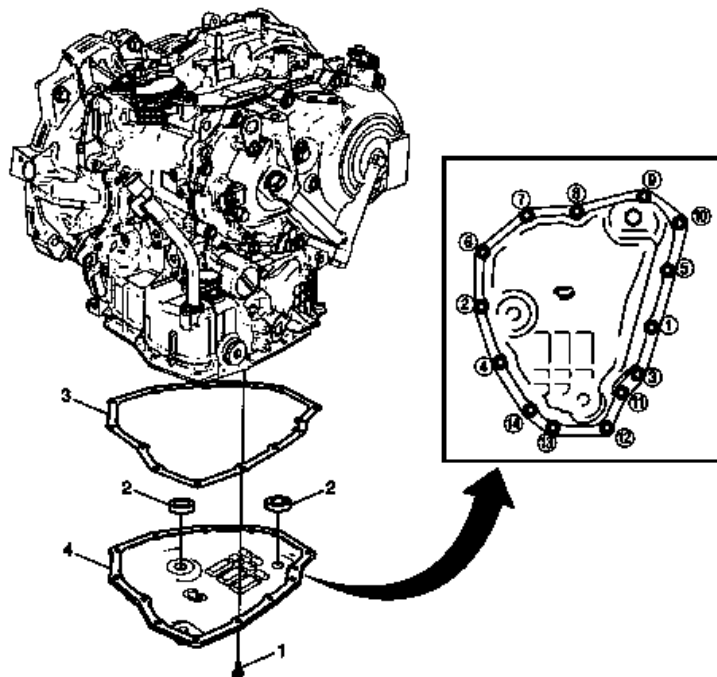


Fig. 61: Control Valve Body Cover

Courtesy of GENERAL MOTORS COMPANY

Control Valve Body Cover Replacement

Callout	Component Name
Preliminary Procedure	
Drain the transmission. Refer to repair Transmission Fluid Drain and Fill (Maintenance) , Transmission Fluid Drain and Fill (Repair) .	
	Control Valve Body Cover Bolt (Qty: 14)
	CAUTION:

1	Refer to <u>Fastener Caution</u> . NOTE: Install all control valve body cover bolts by hand then tighten all bolts in specified sequence. Tighten 6 (53 lb in)
2	Magnet (Qty: 2)
3	Gasket NOTE: Do not reuse the gasket.
4	Control Valve Body Cover

CONTROL VALVE BODY REPLACEMENT

The control valve body is not serviceable separately. Refer to **Transmission Replacement**.

TRANSMISSION REAR MOUNT BRACKET REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Using a suitable jack stand, support the rear of the powertrain.

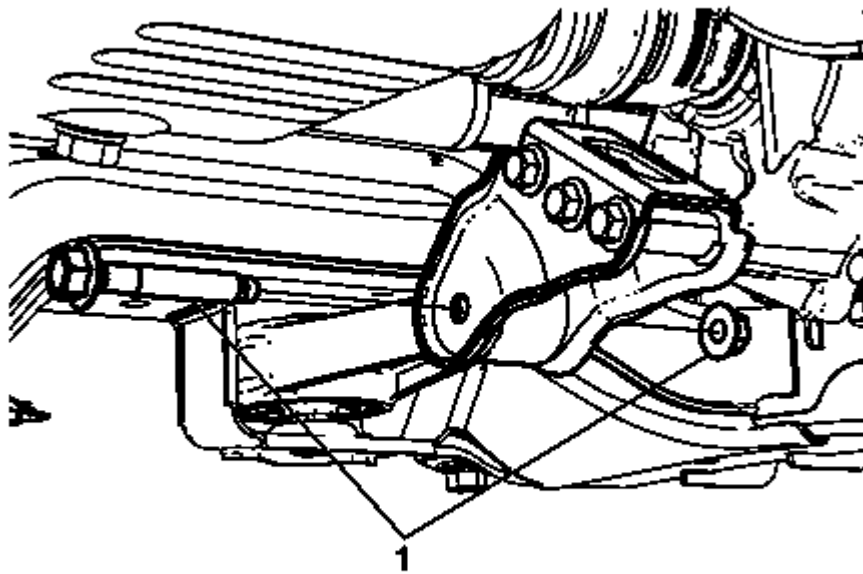


Fig. 62: Transmission Bracket Mount

Courtesy of GENERAL MOTORS COMPANY

3. Remove the transmission bracket mount to mount through bolt and nut (1).

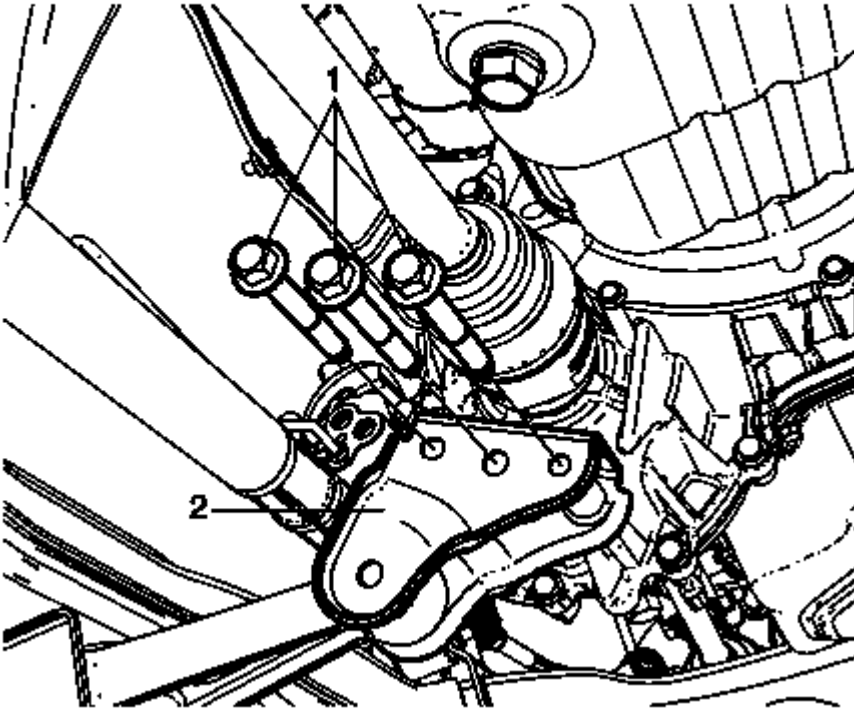


Fig. 63: Transmission Mount To Transmission Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove the transmission mount to transmission bolts (1).
5. Remove the transmission mount bracket (2).

Installation Procedure

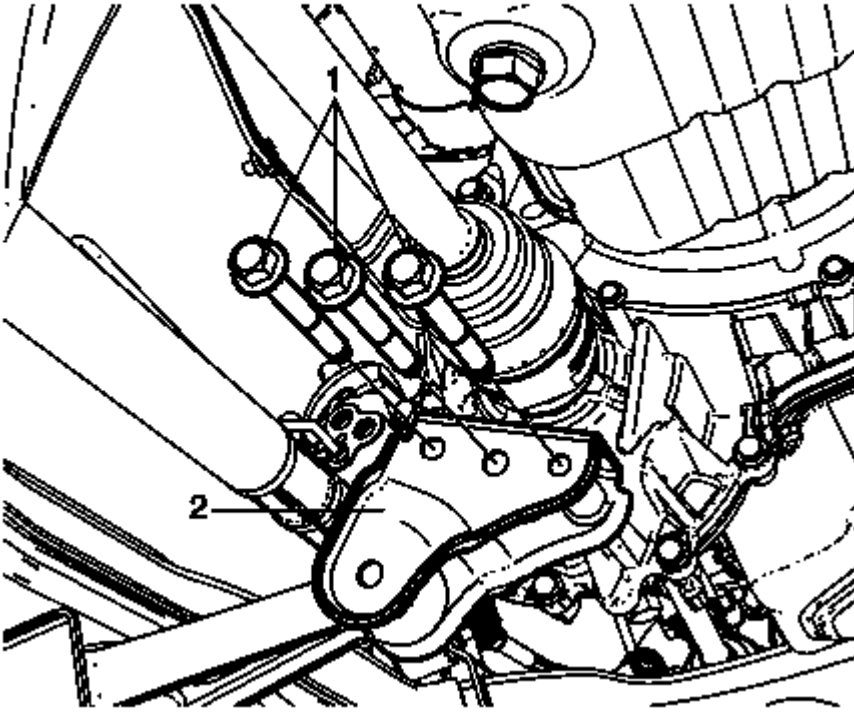


Fig. 64: Transmission Mount To Transmission Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the transmission mount bracket (2).

CAUTION: Refer to Fastener Caution .

2. Install the transmission mount to transmission bolts (1) and tighten to 60 (44 lb ft).

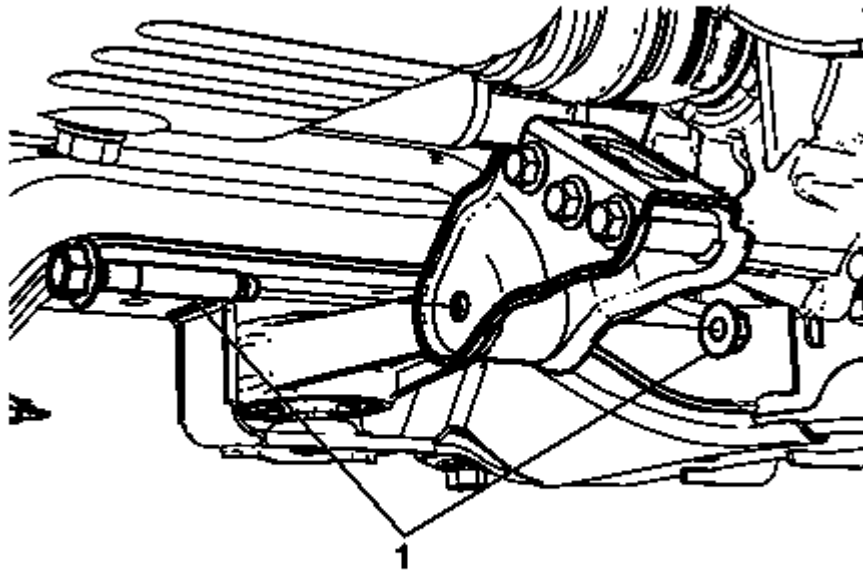


Fig. 65: Transmission Bracket Mount
Courtesy of GENERAL MOTORS COMPANY

3. Install the transmission bracket mount to mount through bolt and nut (1) and tighten to 80 (59 lb ft).
4. Remove the jack stand.
5. Lower the vehicle.

TRANSMISSION REAR MOUNT REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Using a suitable jack stand, support the rear of the powertrain.

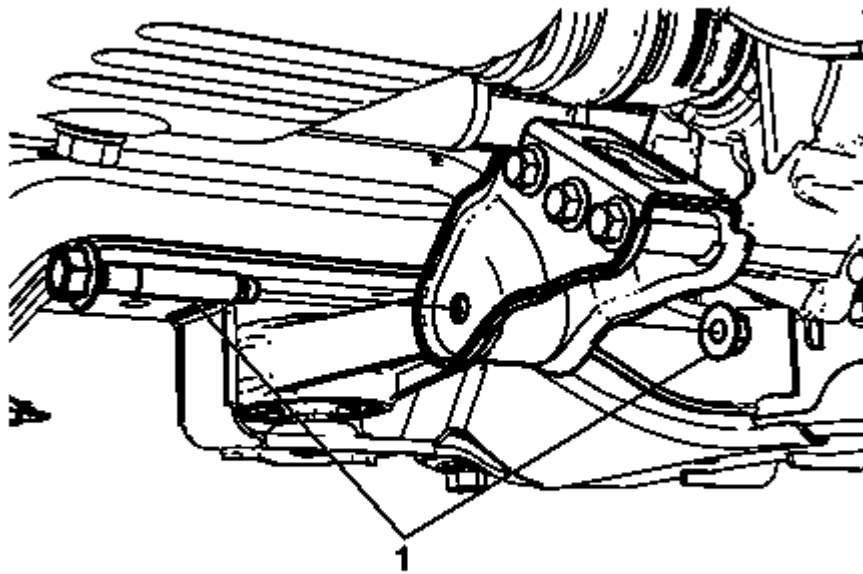


Fig. 66: Transmission Bracket Mount

Courtesy of GENERAL MOTORS COMPANY

3. Remove the transmission bracket mount to mount through bolt and nut (1).

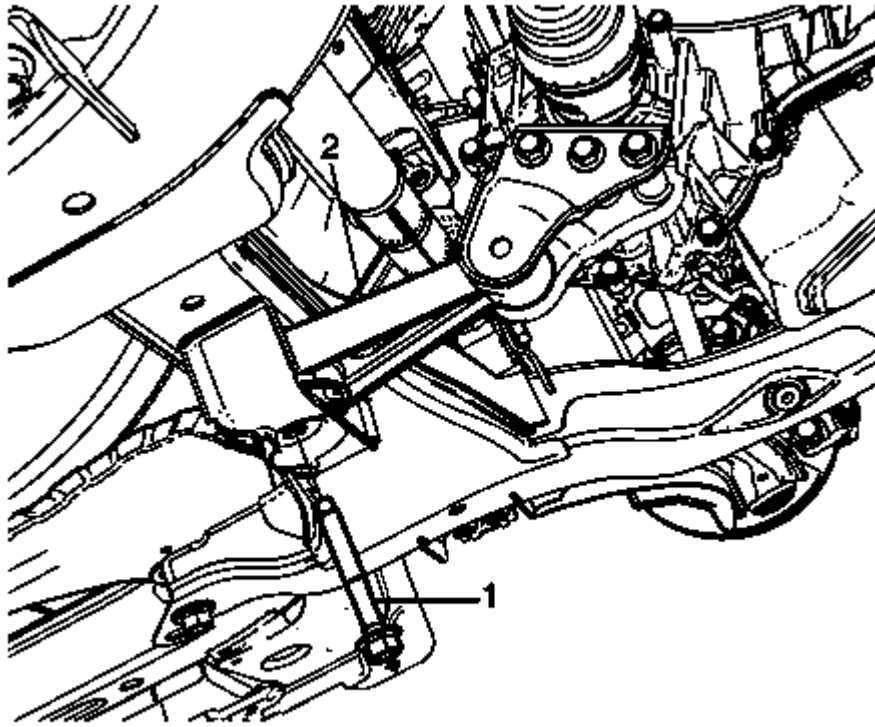


Fig. 67: Transmission Mount To Frame Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Remove the transmission mount to frame bolt (1).
5. Remove the transmission mount (2).

Installation Procedure

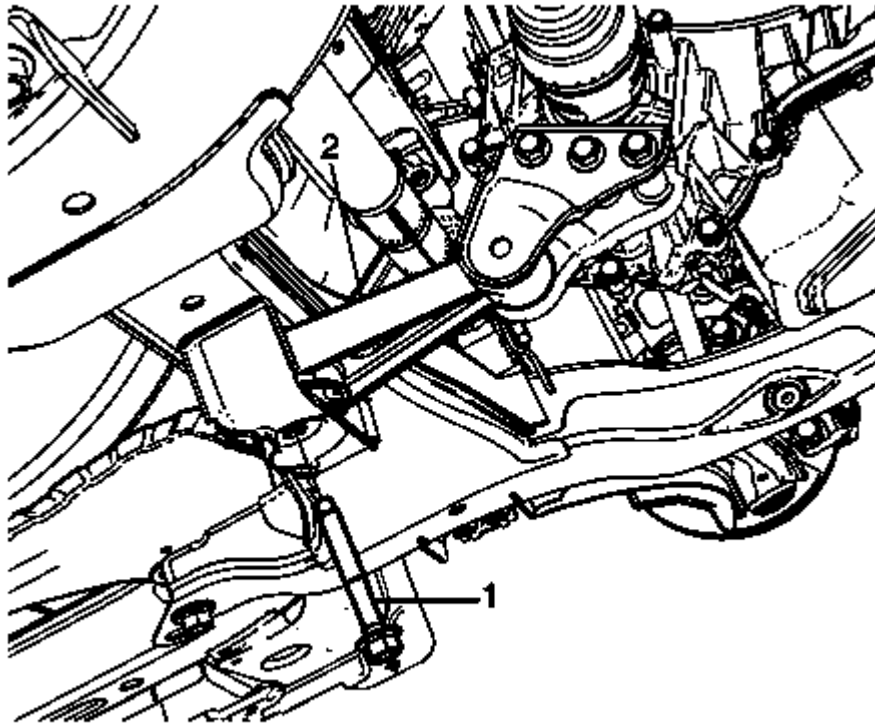


Fig. 68: Transmission Mount To Frame Bolt
Courtesy of GENERAL MOTORS COMPANY

1. Install the transmission mount (2).

CAUTION: Refer to Fastener Caution .

2. Install the transmission mount to frame bolt (1) and tighten to 100 (74 lb ft).

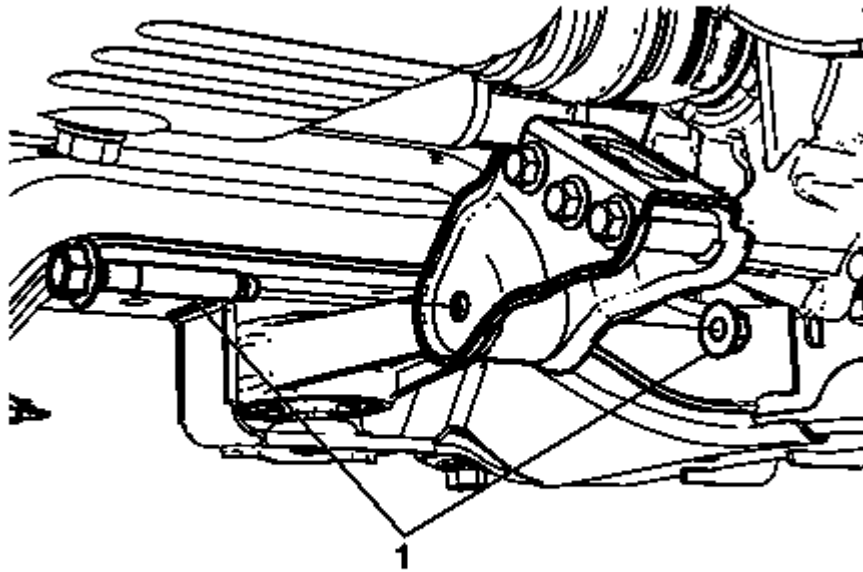


Fig. 69: Transmission Bracket Mount
Courtesy of GENERAL MOTORS COMPANY

3. Install the transmission bracket mount to mount through bolt and nut (1) and tighten to 80 (59 lb ft).
4. Remove the jack stand.
5. Lower the vehicle.

TRANSMISSION MOUNT BRACKET REPLACEMENT - LEFT SIDE

Special Tools

EN-28467 Engine Fixture

For equivalent regional tools, refer to **Special Tools** .

Removal Procedures

1. Remove the battery tray. Refer to **Battery Tray Replacement** .
2. Install the **EN-28467** engine fixture. Refer to **Engine Support Fixture** .
3. Remove the left transmission mount. Refer to **Transmission Mount Replacement - Left Side**.

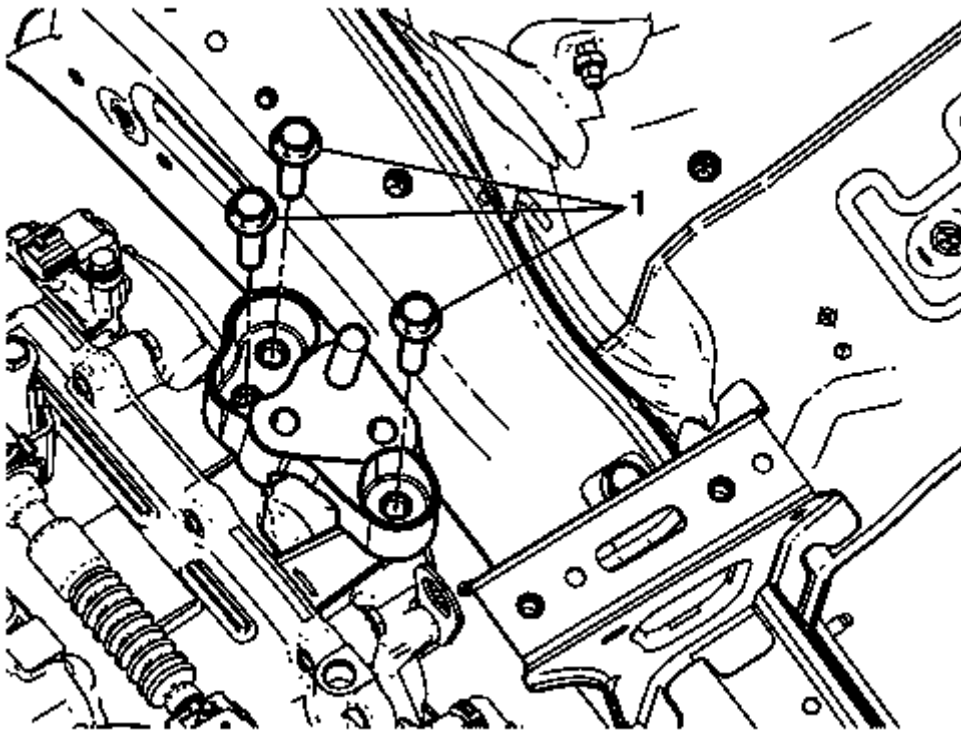


Fig. 70: Left Transmission Mount Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove the left transmission mount bracket bolts (1).
5. Remove the left transmission mount bracket from the vehicle.

Installation Procedure

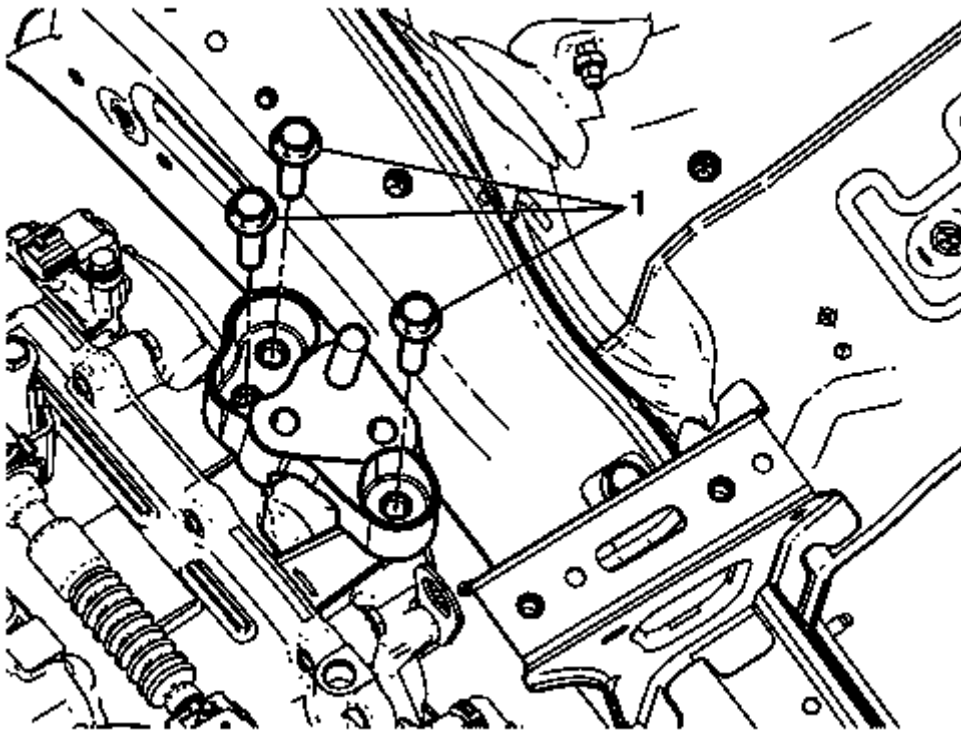


Fig. 71: Left Transmission Mount Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the left transmission mount bracket to the vehicle.

CAUTION: Refer to Fastener Caution .

2. Install the left transmission mount bracket bolts (1) and tighten to 60 (44 lb ft).
3. Install the left transmission mount. Refer to Transmission Mount Replacement - Left Side.
4. Remove the **EN-28476** engine fixture. Refer to Engine Support Fixture .
5. Install the battery tray. Refer to Battery Tray Replacement .

TRANSMISSION MOUNT REPLACEMENT - LEFT SIDE

Special Tools

EN-28467 Engine Fixture

For equivalent regional tools, refer to Special Tools .

Removal Procedure

1. Remove the battery tray. Refer to Battery Tray Replacement .
2. Install the engine support fixture. Refer to Engine Support Fixture .

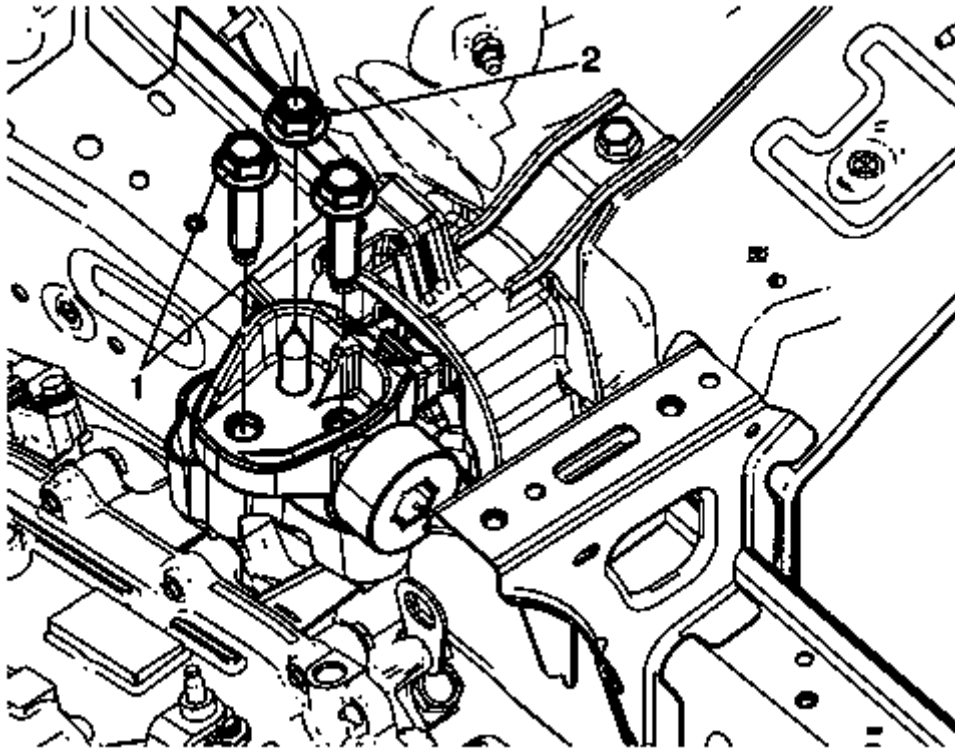


Fig. 72: Location Of Bolts And Nut
Courtesy of GENERAL MOTORS COMPANY

3. Remove the left transmission mount bolts (1) and nut (2) from the transmission mount bracket.

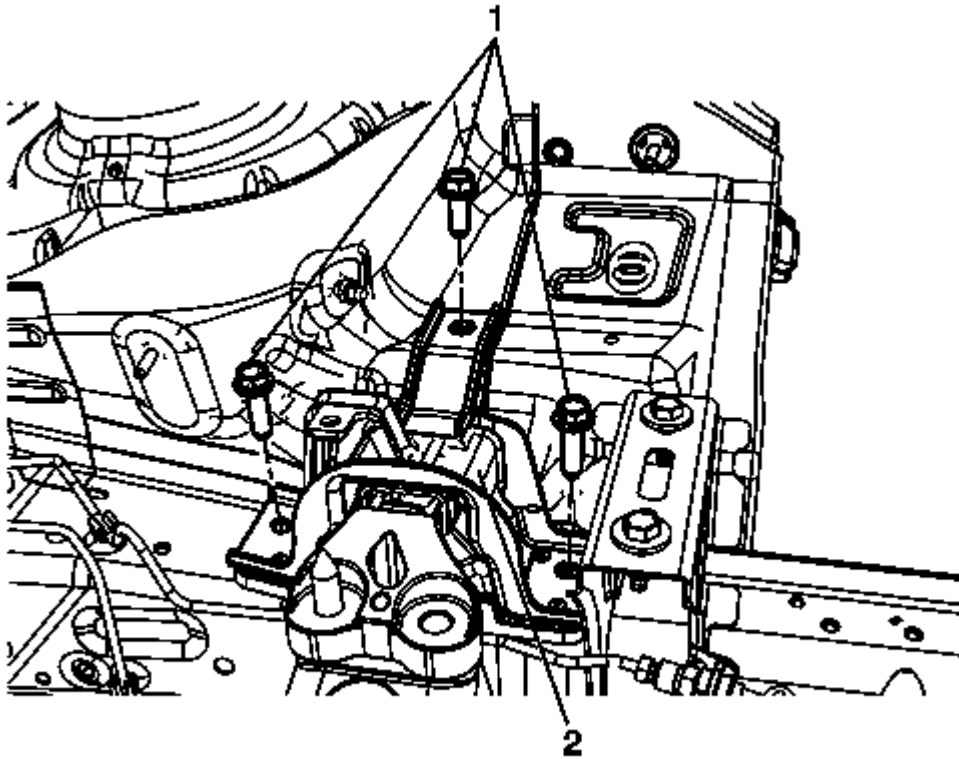


Fig. 73: Left Transmission Mount And Body Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove the left transmission mount to body bolts (1).
5. Remove the transmission mount (2) from the vehicle.

Installation Procedure

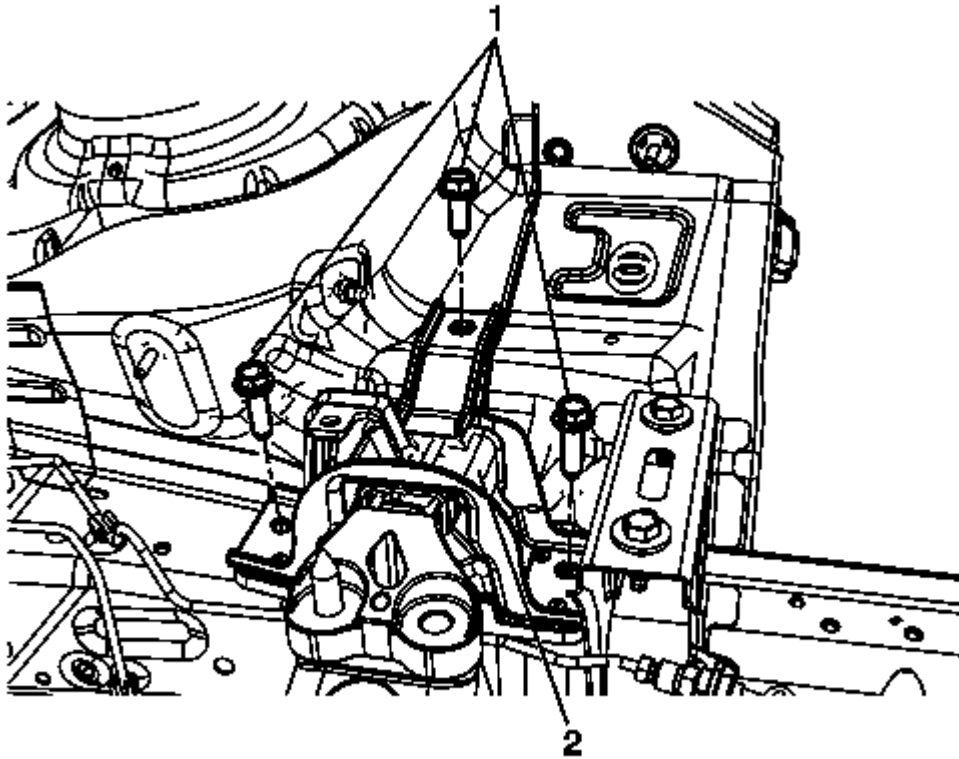


Fig. 74: Left Transmission Mount And Body Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the transmission mount (2) to the vehicle.

CAUTION: Refer to Fastener Caution .

2. Install the transmission mount to body bolts (1) and tighten to 50 (37 lb ft).

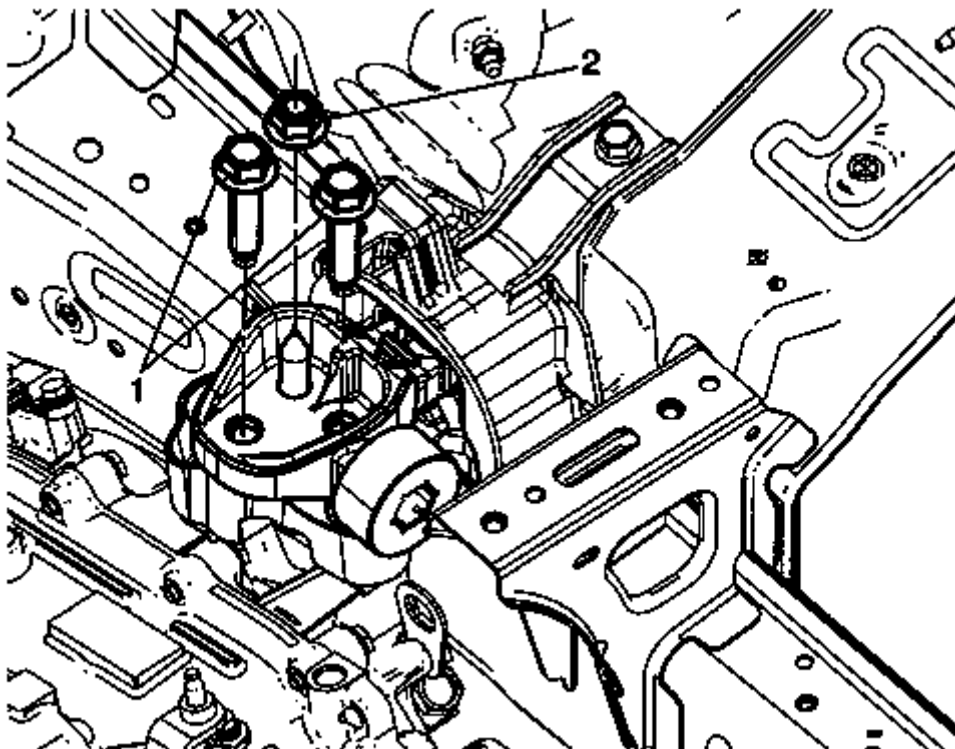


Fig. 75: Location Of Bolts And Nut
Courtesy of GENERAL MOTORS COMPANY

3. Install the left transmission mount bolts (1) and nut (2) to transmission mount bracket and tighten to 95 (70 lb ft).
4. Remove the EN-28467 engine fixture. Refer to Engine Support Fixture .
5. Install the battery tray. Refer to Battery Tray Replacement .

TRANSMISSION REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
2. Drain the transmission fluid. Refer to repair Transmission Fluid Drain and Fill (Maintenance), Transmission Fluid Drain and Fill (Repair).
3. After removing the related parts for the powertrain assembly removal, remove the powertrain assembly from the vehicle. Refer to Engine Replacement (LFM) , Engine Replacement (LL0) .
4. Remove the starter. Refer to Starter Replacement .

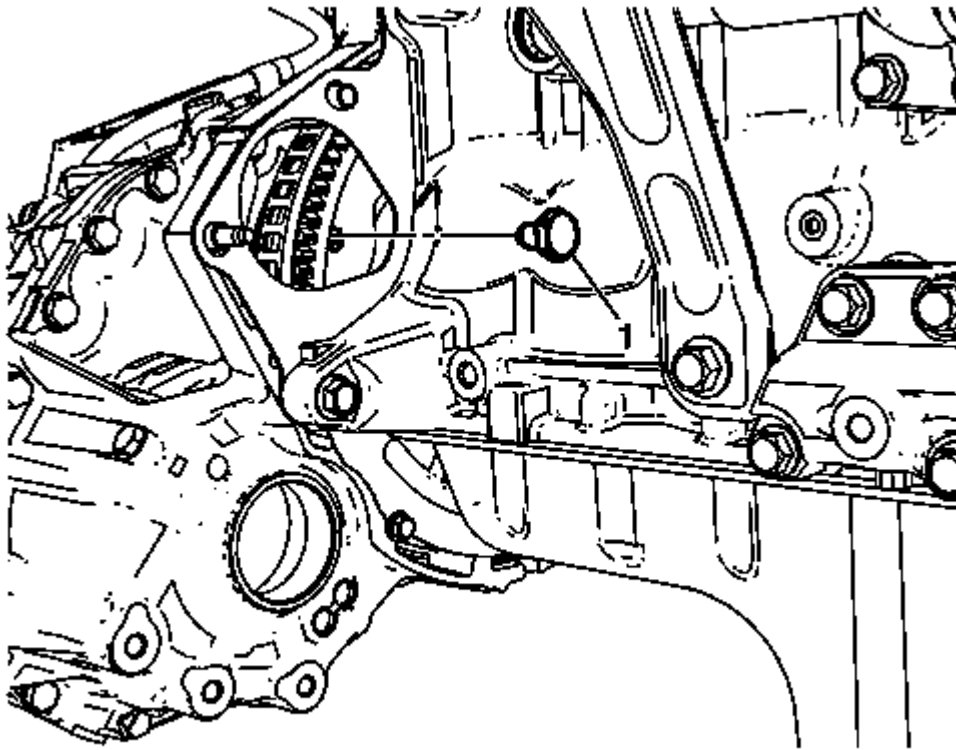


Fig. 76: Torque Converter Bolts

Courtesy of GENERAL MOTORS COMPANY

5. Remove and discard the torque converter bolts (1).

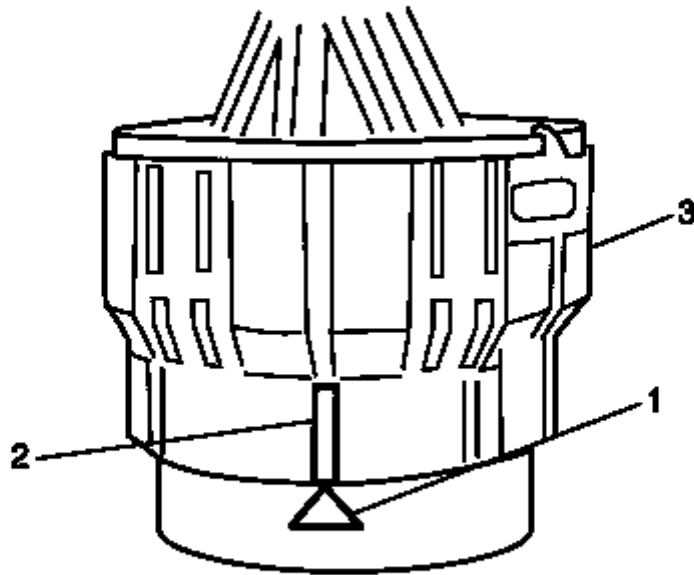


Fig. 77: Bayonet Ring

Courtesy of GENERAL MOTORS COMPANY

6. Rotate bayonet ring (3) counterclockwise to pull out the transmission wiring harness electrical connector upward and disconnect it.
7. Disconnect the output speed sensor electrical connector.
8. Disconnect the primary speed sensor electrical connector.
9. Disconnect the secondary speed sensor electrical connector.
10. Disconnect the park/neutral position (PNP) switch electrical connector.
11. Remove the crankshaft position sensor. Refer to **Crankshaft Position Sensor Replacement** .

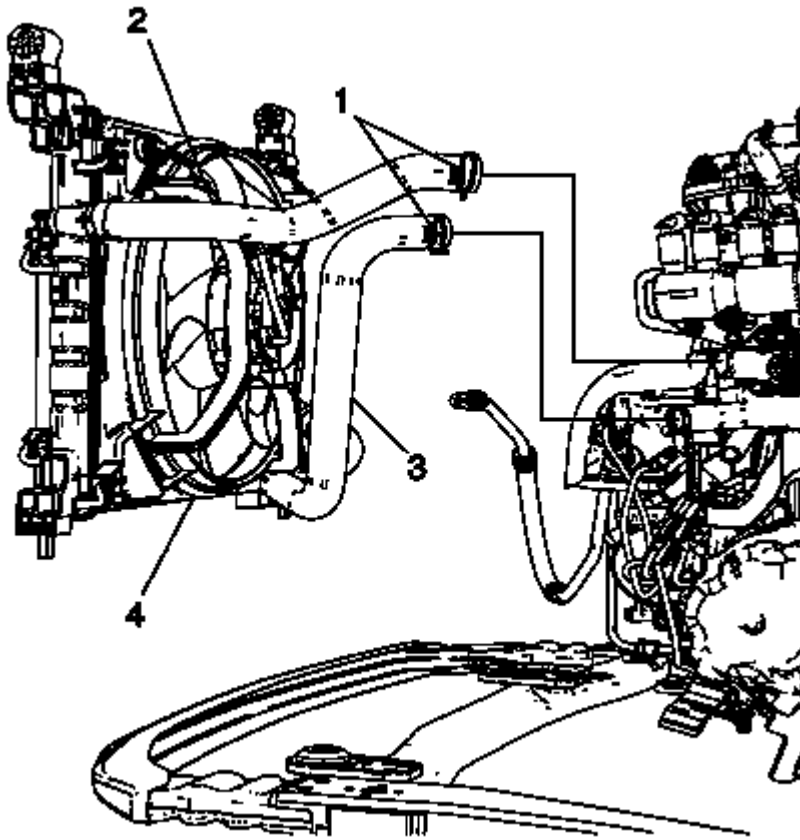


Fig. 78: Radiator Inlet And Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

12. Remove the radiator inlet and outlet hose clamp (1).
13. Disconnect the radiator inlet and outlet hoses (2, 3) and remove the radiator and condenser assembly (4).
14. Disconnect the oil cooler pipes from the transmission. Refer to **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (Aisin 80-40LE)** , **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (Jatco CVT)** .

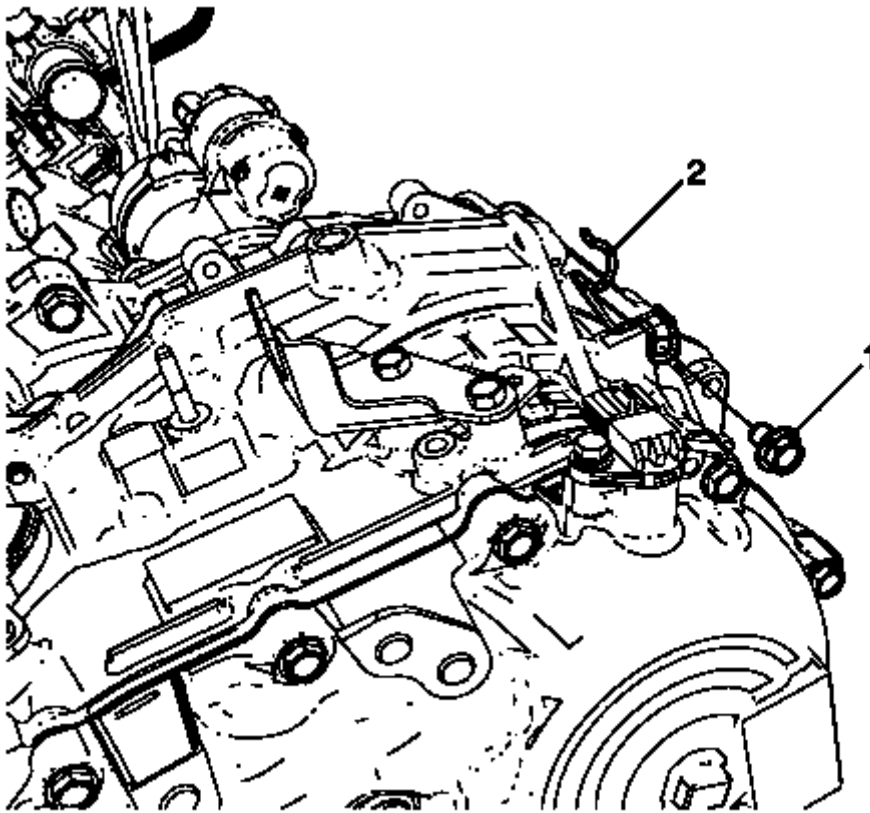


Fig. 79: Selector Control Cable Clamp Bolt
Courtesy of GENERAL MOTORS COMPANY

15. Remove the selector control cable clamp bolt (1) and clamp (2).
16. Separate the related wiring harness from the transmission.
17. Remove the front wheel drive shaft from the transmission. Refer to **Front Wheel Drive Shaft Replacement** .
18. Remove the transmission rear mount bracket. Refer to **Transmission Rear Mount Bracket Replacement**.
19. Remove the transmission rear mount. Refer to **Transmission Rear Mount Replacement**.
20. Remove the left transmission mount bracket. Refer to **Transmission Mount Bracket Replacement - Left Side**.

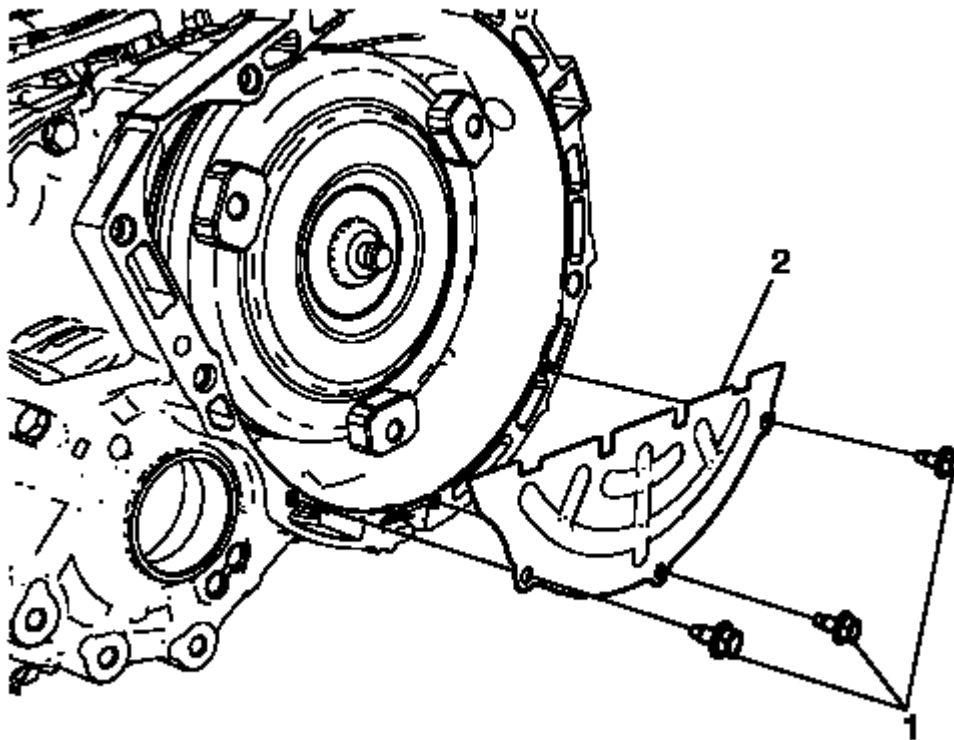


Fig. 80: Torque Converter Cover Plate Bolts
Courtesy of GENERAL MOTORS COMPANY

21. Remove the torque converter cover plate bolts (1).
22. Remove the torque converter cover plate (2).

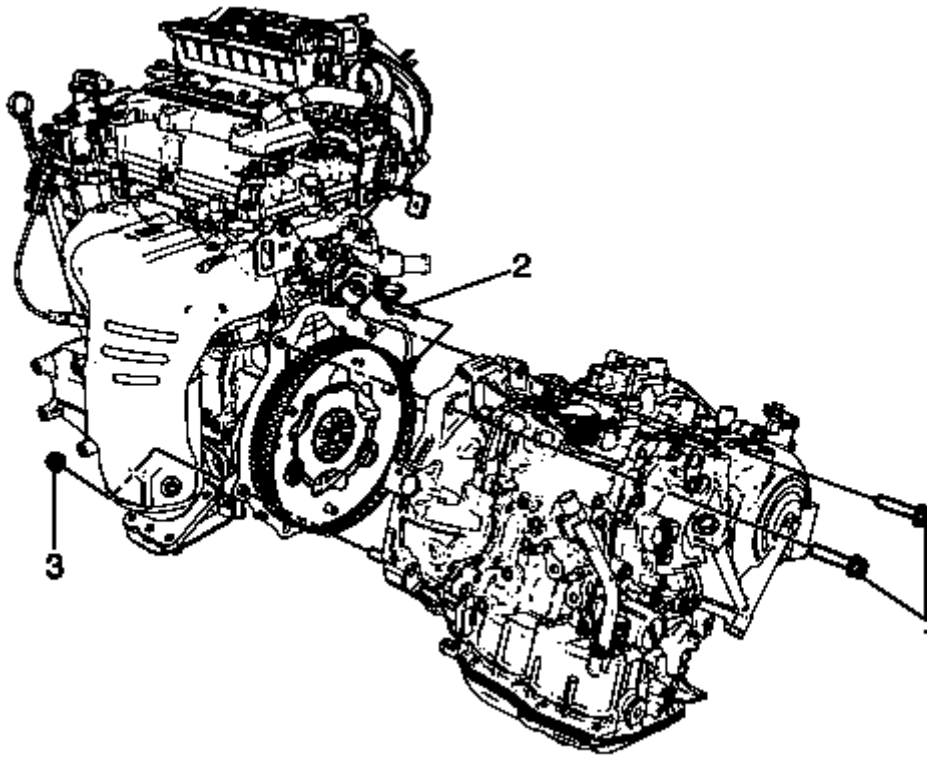


Fig. 81: Transmission Upper Bolts
Courtesy of GENERAL MOTORS COMPANY

23. Remove the transmission upper bolts (1).
24. Remove the transmission lower bolt (2).
25. Remove the transmission lower nut (3).
26. Separate the transmission from the engine.

Installation Procedure

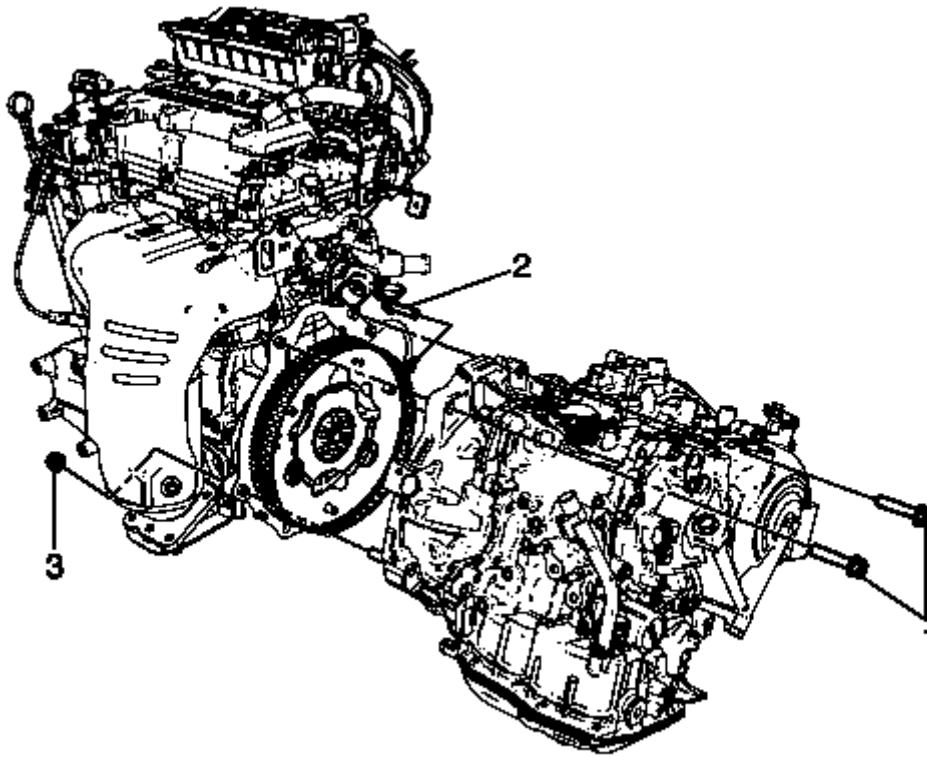


Fig. 82: Transmission Upper Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the transmission to the engine.

CAUTION: Refer to Fastener Caution .

2. Install the transmission lower nut (3) and tighten to 61 (44 lb ft).
3. Install the transmission lower bolt (2) and tighten to 61 (44 lb ft).
4. Install the transmission upper bolts (1) and tighten to 61 (44 lb ft).

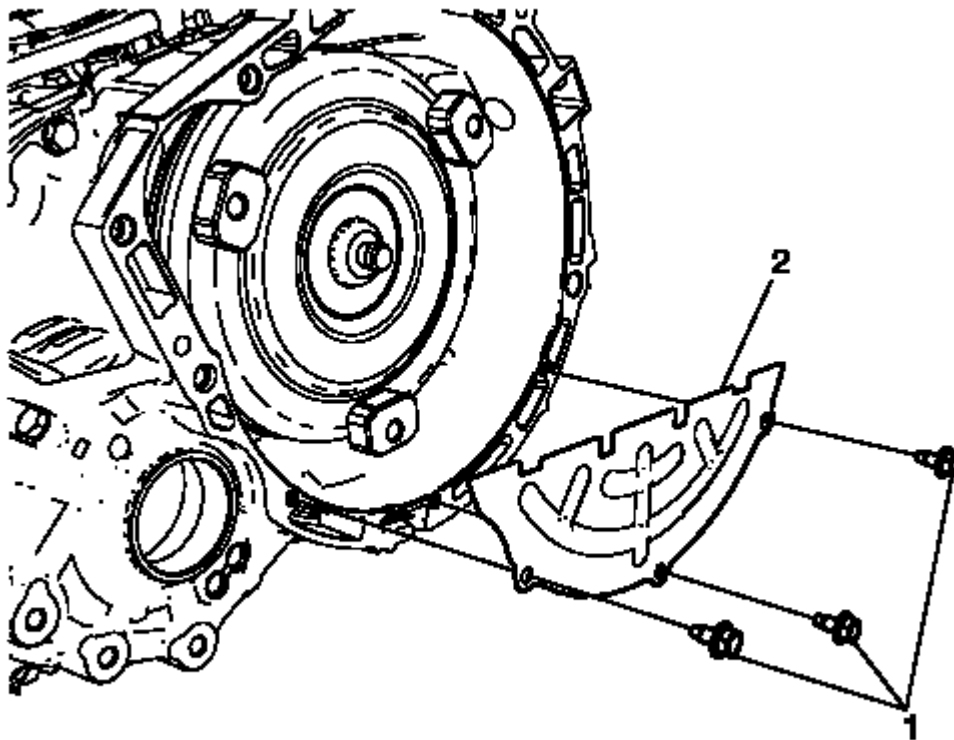


Fig. 83: Torque Converter Cover Plate Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Install the torque converter cover plate (2).
6. Install the torque converter cover plate bolts (1) and tighten to 10 (89 lb in).
7. Install the left transmission mount bracket. Refer to **Transmission Mount Bracket Replacement - Left Side**.
8. Install the transmission rear mount. Refer to **Transmission Rear Mount Replacement**.
9. Install the transmission rear mount bracket. Refer to **Transmission Rear Mount Bracket Replacement**.
10. Install the front wheel drive shaft to the transmission. Refer to **Front Wheel Drive Shaft Replacement**.
11. Position the wiring harness into the transmission.

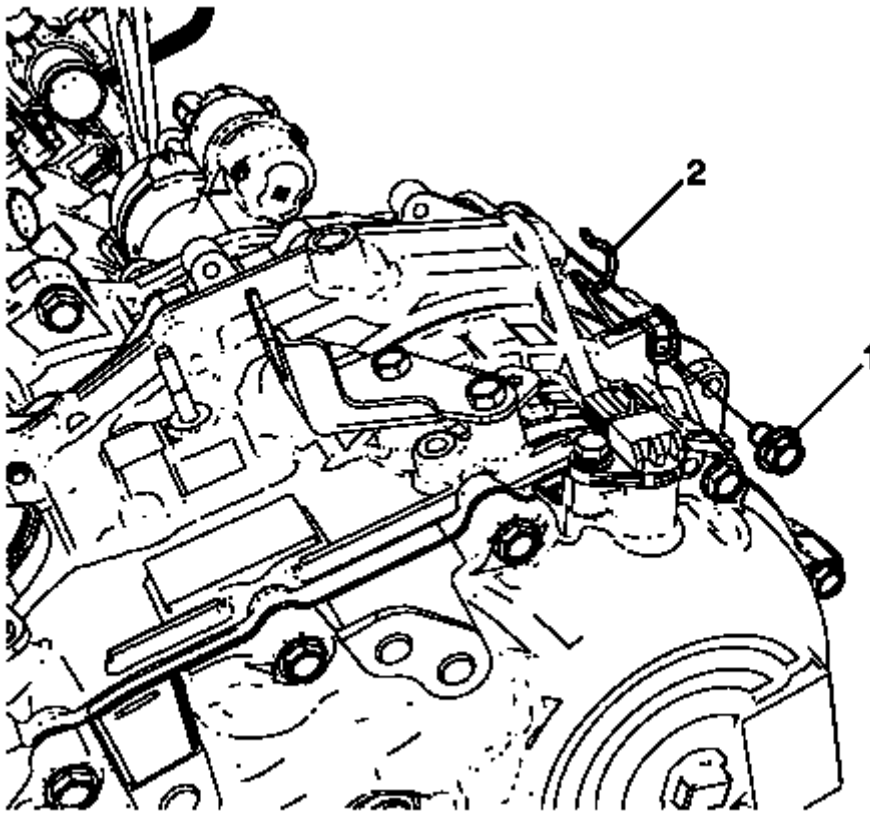


Fig. 84: Selector Control Cable Clamp Bolt
Courtesy of GENERAL MOTORS COMPANY

12. Install clamp (2) and the selector control cable clamp bolt (1) tighten to 22 (16 lb ft).

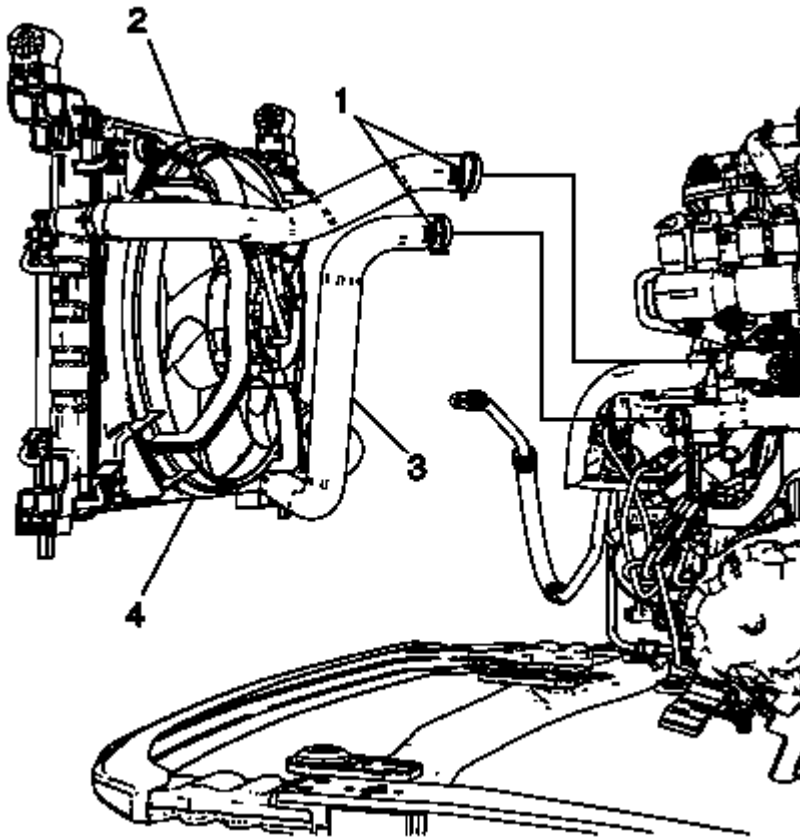


Fig. 85: Radiator Inlet And Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

13. Connect the oil cooler pipes to the transmission. Refer to, **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (Jatco CVT)** .
14. Install the radiator and condenser assembly (4) and connect the radiator inlet and outlet hoses (2, 3).
15. Install the radiator inlet and outlet hose clamp (1).
16. Install the crankshaft position sensor. Refer to **Crankshaft Position Sensor Replacement** .
17. Connect the park/neutral position (PNP) switch electrical connector.
18. Connect the secondary speed sensor electrical connector.
19. Connect the primary speed sensor electrical connector.
20. Connect the output speed sensor electrical connector.

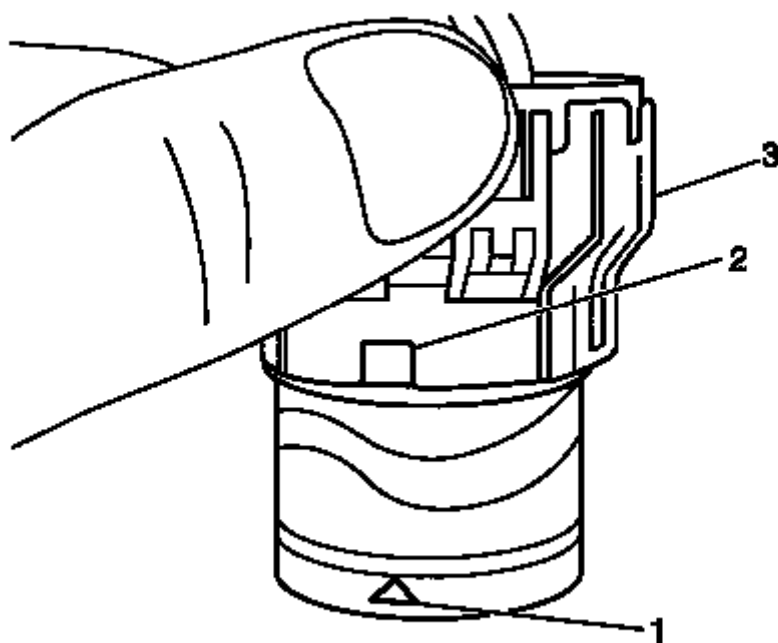


Fig. 86: Bayonet Ring

Courtesy of GENERAL MOTORS COMPANY

21. Align the marking (1) on the transmission harness connector terminal with the marking (2) on bayonet ring (3) to insert the connector.

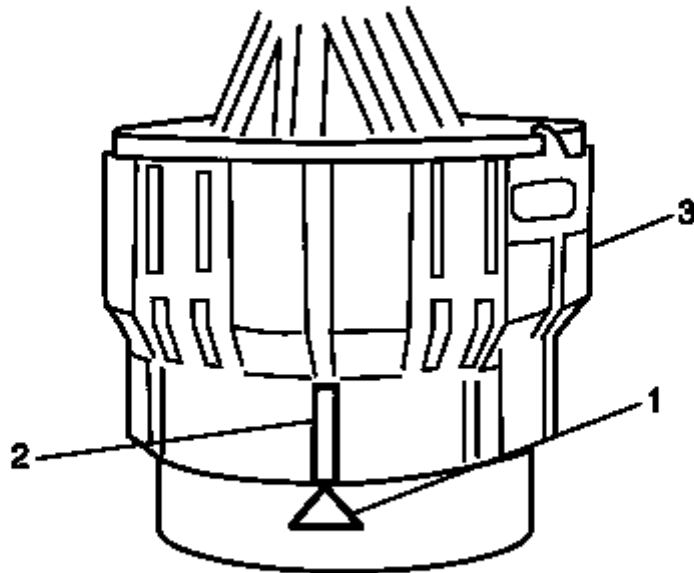


Fig. 87: Bayonet Ring

Courtesy of GENERAL MOTORS COMPANY

NOTE:

- Securely align the marking on the harness connector terminal body with the bayonet ring slit. Then, be careful not to make a half fit condition.
- Never mistake the slit of the bayonet ring for other dent portion.

22. Rotate the bayonet ring (3) clockwise until the marking (1) on the transmission harness connector terminal body is aligned with the slit (2) on bayonet ring.

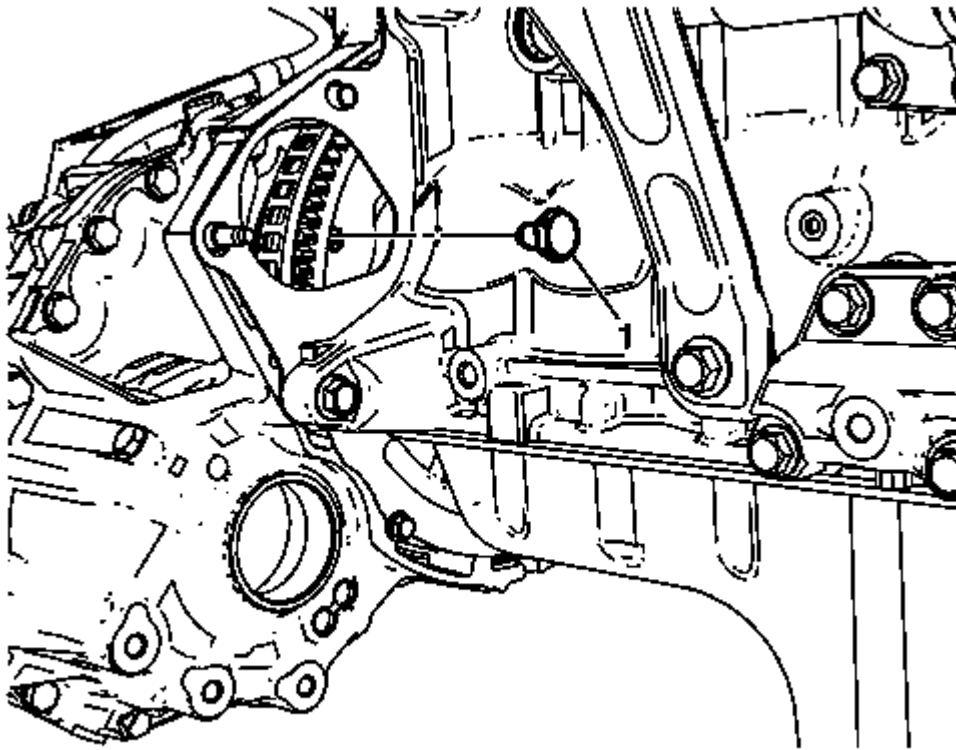


Fig. 88: Torque Converter Bolts

Courtesy of GENERAL MOTORS COMPANY

23. Install NEW torque converter bolts (1) and tighten to 60 (44 lb ft).
24. Install the starter. Refer to **Starter Replacement** .
25. Install the powertrain assembly to the vehicle and then install the related parts. Refer to **Engine Replacement (LFM)** , **Engine Replacement (LL0)** .
26. Perform the transmission fluid cooler flushing and flow test. Refer to **Transmission Fluid Cooler Flushing and Flow Test (JATCO CVT)** , **Transmission Fluid Cooler Flushing and Flow Test (Aisin 80-40LE)** .
27. Check the transmission fluid for proper level. Refer to **Transmission Fluid Level and Condition Check**.
28. Reset the TCM to erase the learned data and calibration data using the scan tool.
29. Perform the transmission adaptive pressure reset when replaced. Refer to **Transmission Adaptive Pressure Reset**.

DESCRIPTION AND OPERATION

TRANSMISSION IDENTIFICATION INFORMATION

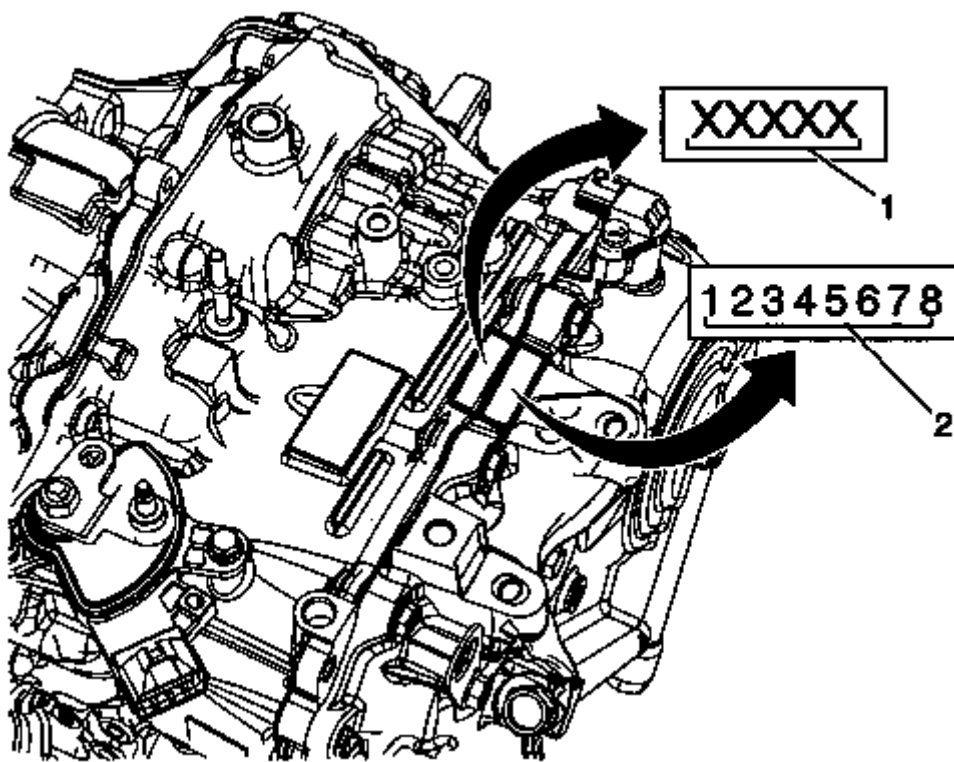


Fig. 89: Transmission Identification
 Courtesy of GENERAL MOTORS COMPANY

Transmission Identification Information

Position	Data
1	Last Five Digits of CVT Assembly Part Number
2	GM 8 Digit Part Number 1 = Last one digit of production year 2 = Production month (1-9 = Jan.-Sep., X = Oct., Y = Nov., Z = Dec.) 3 = Indication of production line 45678 = Production number (Indication of serial number)

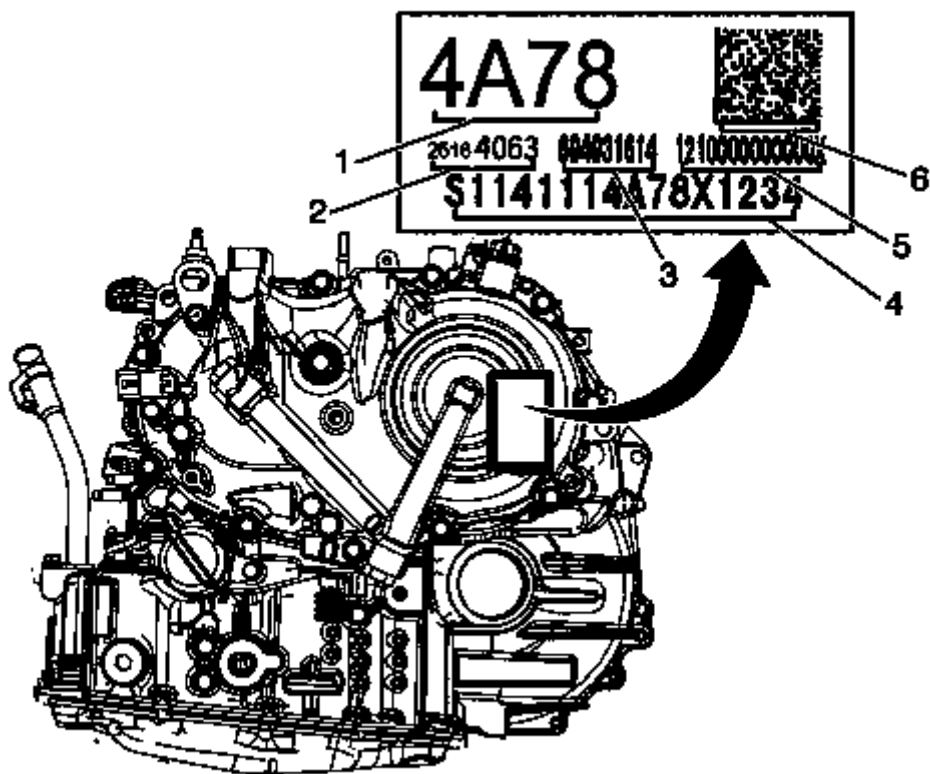


Fig. 90: Transmission Identification
 Courtesy of GENERAL MOTORS COMPANY

Transmission Identification Information

Position	Data
1	Broadcast Code
2	GM Part Number
3	Manufacturing/Assembly DUNS ID
4	GM Defined Trace Code
5	GM Vehicle Partitioning Production Structure Code
6	Data Encoded in 2D

TRANSMISSION GENERAL DESCRIPTION

The model has a new CVT transmission with the following features.

Feature

Item	Contents
Improvement of transmission performance	• Direct-driven hydraulic control by a linear solenoid • Upgrade in cooperative control with the engine (CAN communication)

Improvement of driveability	The addition of an auxiliary gearbox allows top level gear ratios in the automobile industry
Improvement of fuel economy	• Compact and lightweight pulley • The addition of an auxiliary gearbox allows top level gear ratios in the automobile industry • Wide lock-up range • Friction reduction (Placement of powertrain in the upper position allows reduction in fluid agitation resistance and optimization of the oil pump discharge) • Adoption of a ultra-flat torque converter

TRANSMISSION COMPONENT AND SYSTEM DESCRIPTION

Cross-Sectional View

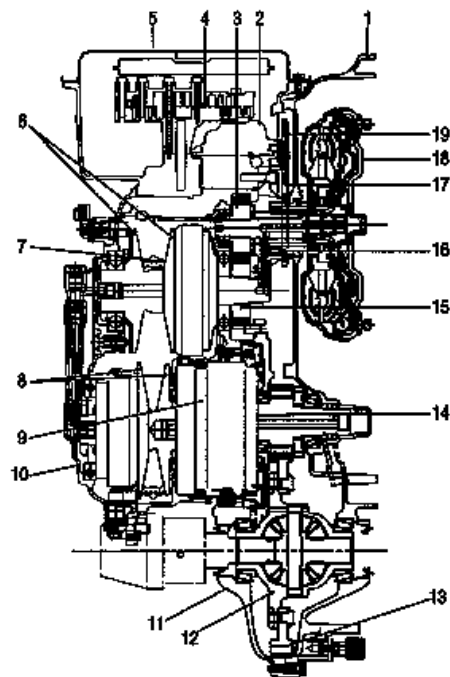


Fig. 91: Cross-Sectional View
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Converter Housing
2	Oil Pump
3	Counter Drive Gear
4	Control Valve
5	Oil Pan
6	Primary Pulley

7	Steel Belt
8	Secondary Pulley
9	Planetary Gear (Auxiliary Gearbox)
10	Side Cover
11	Transmission Case
12	Differential Case
13	Final Gear
14	Reduction Gear
15	Counter Driven Gear
16	Drive Sprocket
17	Oil Pump Chain
18	Torque Converter
19	Driven Sprocket

Operation Status

Range	Parking Mechanism	Counter Gear Set	Low Brake	High clutch	Reverse Brake	Primary Pulley	Secondary Pulley	Steel Belt	Reduction Gear Set
P	X	X	-	-	-	X	X	X	-
R	-	X	-	-	X	X	X	X	X
N	-	X	-	-	-	X	X	X	-
D	-	X	X (1GR)	X (2GR)	-	X	X	X	X
M	-	X	X (1GR)	X (2GR)	-	X	X	X	X

X: Engaged or Applied

Transmission Mechanism

Belt and Pulley Mechanism

It is composed of a pair of pulleys (the groove width is changed freely in the axial direction) and the steel belt (the steel plates are placed continuously and the belt is guided with the multilayer steel rings on both sides). The groove width changes according to wrapping radius of steel belt and pulley from low status to overdrive status continuously with non-step. It is controlled with the oil pressures of primary pulley and secondary pulley.

Steel Belt

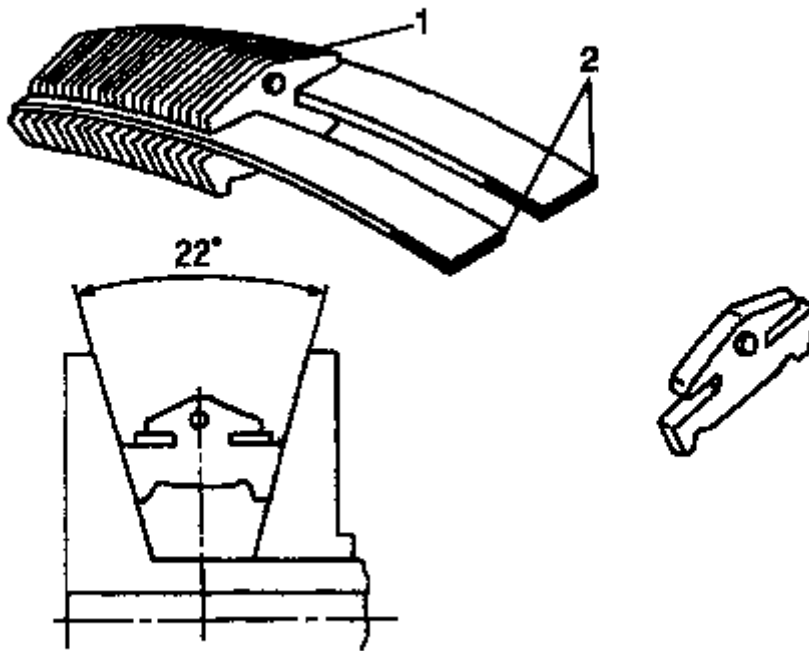


Fig. 92: Composed Of Multiple Steel Plates
Courtesy of GENERAL MOTORS COMPANY

It is composed of multiple steel plates (1) and two steel rings (2) stacked to a several number. The feature of this steel belt transmits power with compression of the steel plate in contrast with transmission of power in pulling with a rubber belt. Friction force is required with the pulley slope to transmit power from the steel plate.

The force is generated with the following mechanism:

1. Oil pressure applies to the secondary pulley to nip the plate.
2. The plate is pushed and extended outward.
3. The steel ring shows withstands.
4. Pulling force is generated on the steel ring.
5. The plate of the primary pulley is nipped between the pulley.
6. Friction force is generated between the steel belt and the pulley.

Therefore, responsibilities are divided by the steel plate that transmits the power with compression and the steel ring that maintains necessary friction force. In this way, the tension of the steel ring is distributed on the entire surface and stress variation is limited, resulting in good durability.

Pulley

The primary pulley (input shaft side) and the secondary pulley (output shaft side) have the shaft with slope (fixed cone surface), movable sheave (movable cone surface that can move in the axial direction) and oil pressure chamber at the back of the movable sheave.

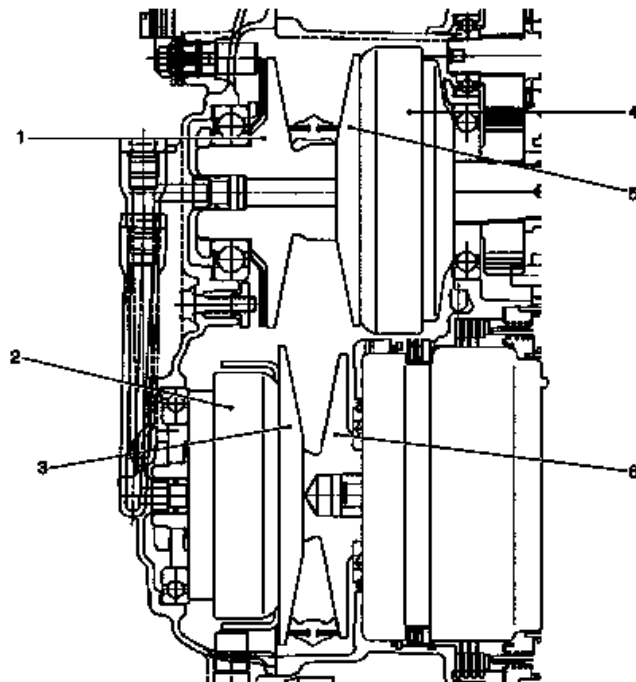


Fig. 93: Primary Pulley (Fixation Side), Secondary Side Oil Pressure Chamber And Primary Side Oil Pressure Chamber

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Primary Pulley (Fixation Side)
2	Secondary Side Oil Pressure Chamber
3	Secondary Pulley (Mobile Side)
4	Primary Side Oil Pressure Chamber
5	Primary Pulley (Mobile Side)
6	Secondary Pulley (Fixation Side)

Pulley Gear Shifting Operation

The movable sheave slides on the shaft to change the groove width of the pulley. Input signals of engine load (accelerator pedal opening), engine revolution and gear ratio (vehicle speed) change the operation pressures of the primary pulley and the secondary pulley and controls the pulley groove width. Along with change of the pulley groove width, the belt contact radius is changed. This allows continuous and stepless gear shifting from low to overdrive. "The contact radius ratio of each pulley in contact with the belt x auxiliary gearbox gear ratio" is the gear ratio.

Low Condition (Pulley Ratio = r_2/r_1)

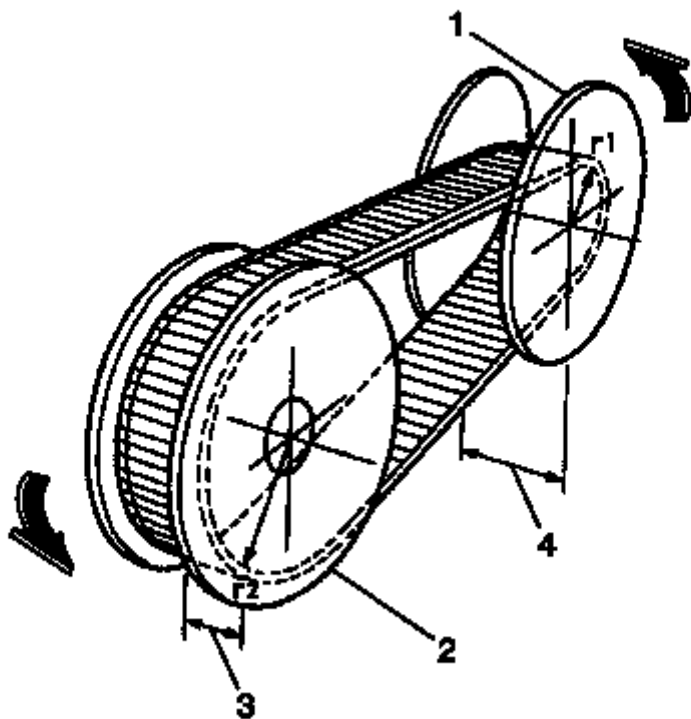


Fig. 94: Low Condition (Pulley Ratio = r_2/r_1)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Primary Pulley
2	Secondary Pulley
3	Narrow
4	Wide

Overdrive Condition (Pulley Ratio = r_2/r_1)

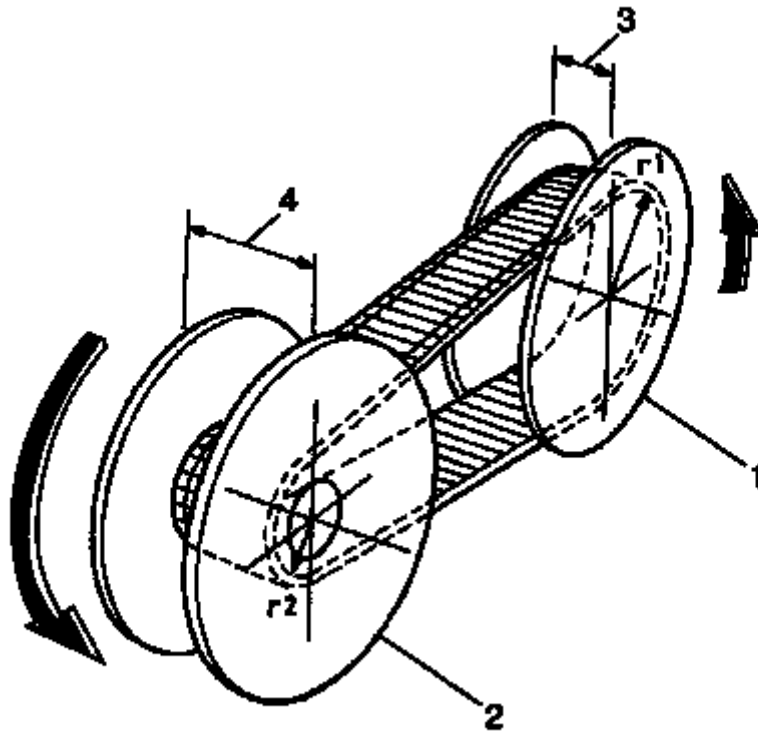


Fig. 95: Overdrive Condition (Pulley Ratio = r_2/r_1)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Primary Pulley
2	Secondary Pulley
3	Narrow
4	Wide

Auxiliary Gearbox

1st, 2nd and reverse gears are changed with the planetary gear mechanism.

Oil Pressure System

Oil pressure required for operation of the transmission mechanism is generated by oil pump, oil pressure control valve, solenoid valve, etc.

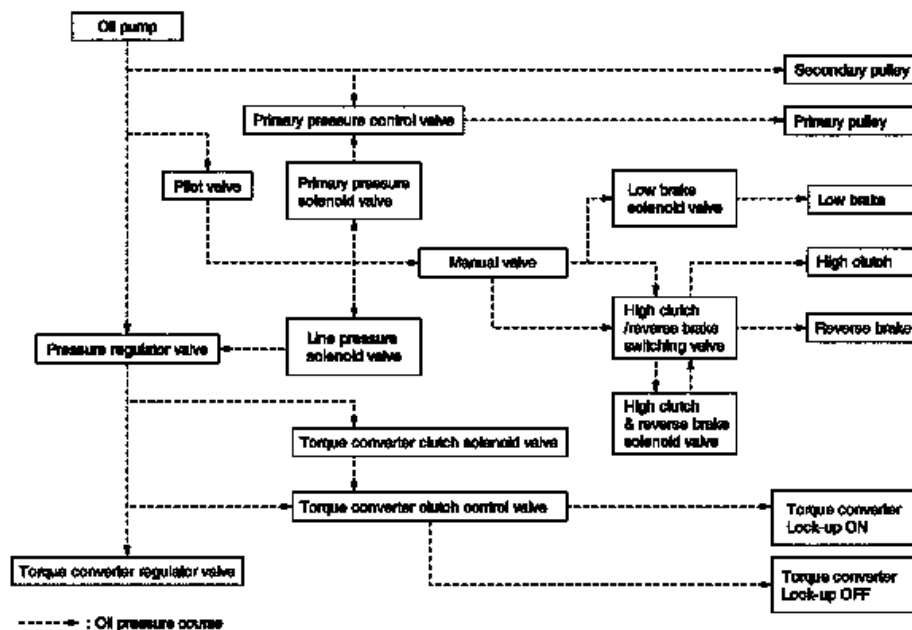


Fig. 96: Oil Pressure System
Courtesy of GENERAL MOTORS COMPANY

The components are as follows:

- **Torque Converter** - It is composed of the cover converter, turbine assembly, stator, pump impeller assembly and etc. It increases the engine torque and transmits the power to the transmission.
- **Oil Pump** - Through the oil pump drive chain, it uses the vane oil pump driven by the engine. It generates necessary oil pressure to circulate fluid and to operate the clutch and brake.
- **Counter Gear Set** - The power from the torque converter is transmitted to the primary pulley through the counter drive gear and the counter driven gear.
- **Belt and Pulley (Continuously Variable Transmission)** - It is composed of the primary pulley, secondary pulley, steel belt, etc. and the mechanism performs shifting, changes the gear ratio and transmits the power with oil pressure from the control valve.
- **Auxiliary Gearbox (Stepped Transmission)** - It is composed of the planetary gear, multi-disc clutch, multi-disc brake, etc. and the mechanism performs shifting (1-2 gear shifting and reverse) with oil pressure from the control valve.
- **Reduction Gear Set** - Conveys power from the transmission mechanism to the reduction gear and the final gear.
- **Parking Mechanism** - When the shift lever is changed to P position, the mechanism fixes the parking gear (integrated with the reduction gear) and fixes the output shaft.
- **Valves**
 - **Control Valve**: Controls oil pressure from the oil pump to the pressure suitable for the line pressure control system, shift control system, lock-up control system and lubrication system.
 - **Pressure Regulator Valve**: Adjusts the discharge pressure from the oil pump to the optimum

pressure (line pressure) corresponding to the driving condition.

- Torque Converter Regulator Valve: Adjusts the feed pressure to the torque converter to the optimum pressure corresponding to the driving condition.
- Pilot Valve: Adjusts line pressure and produces a constant pressure (pilot pressure) necessary for activating each solenoid valve.
- Manual Valve: Distributes the clutch and brake operation pressures (pilot pressure) corresponding to each shift position.
- High Clutch/Reverse Brake Switching Valve: Switches the circuit for the high clutch and the reverse brake.
- Torque Converter Clutch Control Valve: It is operated with the torque converter clutch solenoid valve and it adjusts the tightening pressure and non-tightening pressure of the torque converter clutch piston of the torque converter.
- Primary Pressure Control Valve: It is operated with the primary pressure solenoid valve and adjusts the feed pressure to the primary pulley.
- Primary Pressure Solenoid Valve: Controls the primary pressure control valve.
- Low Brake Solenoid Valve: Adjusts the tightening pressure of the low brake.
- High Clutch and Reverse Brake Solenoid Valve: Adjusts the tightening pressure of the high clutch and reverse brake.
- Torque Converter Clutch Solenoid Valve: Controls the torque converter clutch control valve.
- Line Pressure Solenoid Valve: Controls the pressure regulator valve.

Control System

System Description

- CVT detects the vehicle driving status from switches, sensors and signals and controls the vehicle so that the optimum shift position and shift timing may always be achieved. It also controls the vehicle to reduce shift and lockup shock, etc.
- Receives input signals from switches and sensors.
- Sends the output signal necessary for operation of solenoid valves and evaluates the line pressure, shift timing lockup operation, engine brake performance, etc.
- If a malfunction occurs on the electric system, activate the fail-safe mode only to drive the vehicle.

Input/Output Signal of TCM

Control Item		Shift Control	Line Pressure Control	Select Control	Lock-up Control	Fail-Safe Function*
	Engine Torque Signal (CAN Communication)	X	X	X	X	X
	Engine Speed Signal (CAN Communication)	X	X	X	X	X
	Accelerator Pedal Position Signal (CAN	X	X	X	X	X

Input	Communication)					
	Throttle Position Signal (CAN Communication)	X	X	-	X	X
	Brake Pedal Position Signal (CAN Communication)	X	X	X	X	-
	Secondary Pressure Sensor	X	X	X	-	X
	CVT Fluid Temperature sensor	X	X	X	X	X
	Primary Speed Sensor	X	X	X	X	X
	Secondary Speed Sensor	X	X	X	X	X
	Output Speed Sensor	X	X	X	X	X
	Transmission Range Switch	X	X	X	X	X
Output	Line Pressure Solenoid valve	X	X	X	-	X
	Primary Pressure Solenoid valve	X	X	-	-	X
	Torque Converter Clutch Solenoid Valve	-	-	-	X	X
	High Clutch and Reverse Brake Solenoid Valve	X	-	X	-	X
	Low Brake Solenoid Valve	X	-	X	-	X
	Shift Position Indicator (CAN Communication)	-	-	X	-	-
* If these input/output signals show errors, TCM activates the fail-safe function.						

Fail-Safe

TCM has a fail-safe mode. The mode functions so that operation can be continued even if the signal circuit of the main electronically controlled input/output parts is damaged.

If the vehicle shows following behaviors including "poor acceleration", a malfunction of the applicable system is detected by TCM and the vehicle may be in a fail-safe mode. At this time, check the DTC code and perform inspection and repair according to the malfunction diagnosis procedures.

Protection Control

The TCM becomes the protection control status temporarily to protect the safety when the safety of TCM and transmission is lost. It automatically returns to the normal status if the safety is secured. The TCM has the following protection control.

CVT Control for Wheel Spin

Control	When a wheel spin is detected, the engine output and gear ratio are limited and the line pressure is increased. At 1st gear, the clutch
---------	---

	pressure is increased.
Vehicle Behavior in Control	If the accelerator is kept depressing during wheel spin, the engine revolution and vehicle speed are limited to a certain degree. From the 1st gear, up-shift to a certain gear ratio is only allowed.
Normal Return Condition	Wheel spin convergence returns the control to the normal control.

Control when Fluid Temperature is High

Control	When the CVT fluid temperature is high, the gear shift permission maximum revolution and the maximum torque are reduced than usual to prevent increase of the oil temperature.
Vehicle Behavior in Control	Power performance may be lowered, compared to normal control.
Normal Return Condition	The control returns to the normal control when CVT fluid temperature is lowered.

Torque is Reduced when Driving with the Reverse Gear

Control	Engine output is controlled according to a vehicle speed while reversing the vehicle.
Vehicle Behavior in Control	Power performance may be lowered while reversing the vehicle.
Normal Return Condition	Torque returns to normal by positioning the selector lever in a range other than "R" position.

Reverse Prohibit Control

Control	The reverse brake is controlled to avoid becoming engaged when the selector lever is set in "R" position while driving in forward direction at more than the specified speed.
Vehicle Behavior in Control	If the selector lever is put at "R" position when driving with the forward gear, the gear becomes neutral, not reverse.
Normal Return Condition	The control returns to normal control when the vehicle is driven at low speeds. (The reverse brake becomes engaged.)

Line Pressure Control

Highly accurate line pressure control (secondary pressure control) reduces friction for improvement of fuel economy.

- Normal Oil Pressure Control

Appropriate line pressure and secondary pressure suitable for driving condition are determined based on the accelerator pedal position, engine speed, primary pulley (input) speed, secondary pulley (output) speed, vehicle speed, input torque, stop lamp switch signal, transmission range switch signal, lock-up signal, power voltage, target shift ratio, oil temperature and oil pressure.

- Secondary Pressure Feedback Control

In normal oil pressure control and oil pressure control in shifting, highly accurate secondary pressure is

determined by detecting the secondary pressure using an oil pressure sensor and by feedback control.

Shift Control

In order to select the gear ratio which can obtain the driving force in accordance with driver's intention and the vehicle condition, the TCM monitors the driving conditions such as the vehicle speed and the throttle position and select the optimum gear ratio and determines the gear change steps to the gear ratio.

The information is output to the primary pressure solenoid valve to control the line pressure input/output to the primary pulley, to determine the primary pulley (movable pulley) position and to control the gear position.

- **Drive (D) Position**

Shifting over all the ranges of gear ratios from the lowest to the highest.

- **Low (L) Position**

By limiting the shifting range only to the lowest of the gear ratio, a large driving force and engine brake are obtained.

- **Hill Climbing and Descending Control**

When downhill is detected with the accelerator pedal released, the engine brake will be strengthened up by downshifting so as not to accelerate the vehicle more than necessary.

- **Control in Acceleration**

According to the vehicle speed and a change of accelerator pedal angle, driver's request for acceleration and driving scene are judged. This function assists improvement in acceleration feeling by making the engine speed proportionate to the vehicle speed.

Select Control

Based on accelerator pedal angle, engine speed, primary pulley speed and the secondary pulley speed, the optimum operating pressure is set to reduce impact of a selector lever operation while shifting from "N" ("P") to "D" ("R") position.

Lock-up Control

The torque converter clutch piston located in the converter is engaged to eliminate slip to increase power transmission efficiency. The control valve operation is performed by the torque converter clutch solenoid valve, which is controlled by a signal sent by the TCM. This control valve engages or releases the torque converter clutch piston directly using the pressure provided by the oil pump.

In lock-up released state, the torque converter clutch control valve is set into the unlocked state by the solenoid and the lock-up pressure apply is drained. In this way, the clutch piston is not coupled.

In the lock-up applied state, the torque converter clutch control valve is set into the locked state by the solenoid and lock-up apply pressure is generated. In this way, the clutch piston is pressed and coupled.

ELECTRONIC COMPONENT DESCRIPTION

Transmission Control Module (TCM)

The vehicle driving status is judged based on the signals from the sensors, switches and other control units and the optimal transmission control is performed.

ROM Assembly

The ROM assembly is installed to the control valve body.

The ROM assembly stores the calibration data (characteristic value).

Transmission Range Switch

The transmission range switch is installed to the upper part of transmission case and detects the selector lever position.

Primary Speed Sensor

The primary speed sensor is installed to the transmission side cover.

The primary speed sensor detects the primary pulley speed and generates an ON-OFF pulse signal according to the rotor speed.

TCM judges the rotor speed from the pulse signal.

Secondary Speed Sensor

The secondary speed sensor is installed to the transmission side cover.

The secondary speed sensor detects secondary pulley speed generates an ON-OFF pulse signal according to the rotor speed.

TCM judges the rotor speed from the pulse signal.

Output Speed Sensor

The output speed sensor is installed to the back side of transmission case.

The output speed sensor detects the final gear speed. TCM evaluates the vehicle speed from the final gear revolution.

The output speed sensor generates an ON-OFF pulse signal according to the rotor speed. TCM judges the rotor speed from the pulse signal.

CVT Fluid Temperature Sensor

The CVT fluid temperature sensor is installed to the control valve body and detects CVT fluid temperature in the oil pan.

The fluid temperature sensor uses a thermistor and changes the signal voltage by converting changes in the CVT fluid temperature to a resistance value. TCM evaluates the CVT fluid temperature from the signal voltage value.

Secondary Pressure Sensor

The secondary pressure sensor is installed to the control valve body and detects the pressure applied to the secondary pulley.

When the pressure is applied to the ceramic device in the secondary pressure sensor, the ceramic device is deformed, resulting in voltage change.

TCM evaluates the secondary pressure from its voltage change. The voltage is increased along with the pressure increase.

Primary Pressure Solenoid Valve

The primary pressure solenoid valve is installed to the control valve body and controls the primary pressure control valve.

The primary pressure solenoid valve uses the linear solenoid valve [N/H (normal high) type].

NOTE:

- The principle of the linear solenoid valve utilizes the fact that the force pressing on the valve spool installed inside the coil increases nearly in proportion to the current. This allows it to produce the fluid pressure that is proportional to this pressing force.
- The N/H (normal high) produces hydraulic control when the coil is not energized.

Low Brake Solenoid Valve

The low brake solenoid valve is installed to the control valve body and adjusts the tightening pressure of the low brake.

The low brake solenoid valve uses the linear solenoid valve [N/L (normal low) type].

NOTE:

- The principle of the linear solenoid valve utilizes the fact that the force pressing on the valve spool installed inside the coil increases nearly in proportion to the current. This allows it to produce the fluid pressure that is proportional to this pressing force.
- The N/L (normal low) does not produce hydraulic control when the coil is

not energized.

High Clutch and Reverse Brake Solenoid Valve

The high clutch & reverse brake solenoid valve is installed to the control valve body and adjusts the tightening pressure of the high clutch and reverse brake.

The high clutch & reverse brake solenoid valve uses the linear solenoid valve [N/H (normal high) type].

NOTE:

- **The principle of the linear solenoid valve utilizes the fact that the force pressing on the valve spool installed inside the coil increases nearly in proportion to the current. This allows it to produce the fluid pressure that is proportional to this pressing force.**
- **The N/H (normal high) produces hydraulic control when the coil is not energized.**

Torque Converter Clutch Solenoid Valve

The torque converter clutch solenoid valve is installed to the control valve body and controls the torque converter clutch control valve.

The torque converter clutch solenoid valve utilizes the linear solenoid valve [N/L (normal low) type].

NOTE:

- **The principle of the linear solenoid valve utilizes the fact that the force pressing on the valve spool installed inside the coil increases nearly in proportion to the current. This allows it to produce the fluid pressure that is proportional to this pressing force.**
- **The N/L (normal low) does not produce hydraulic control when the coil is not energized.**

Line Pressure Solenoid Valve

The line pressure solenoid valve is installed to the control valve body and controls the pressure regulator valve.

The line pressure solenoid valve uses the linear solenoid valve [N/H (normal high) type].

NOTE:

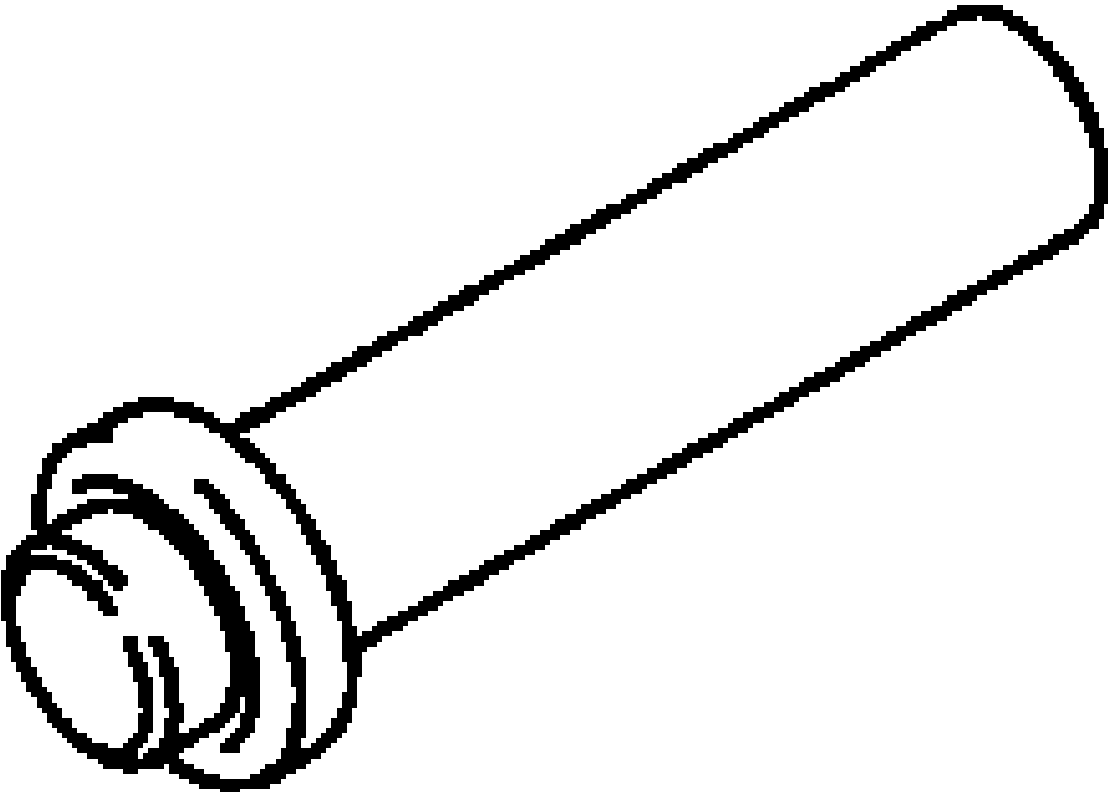
- **The principle of the linear solenoid valve utilizes the fact that the force pressing on the valve spool installed inside the coil increases nearly in proportion to the current. This allows it to produce the fluid pressure that is proportional to this pressing force.**
- **The N/H (normal high) produces hydraulic control when the coil is not energized.**

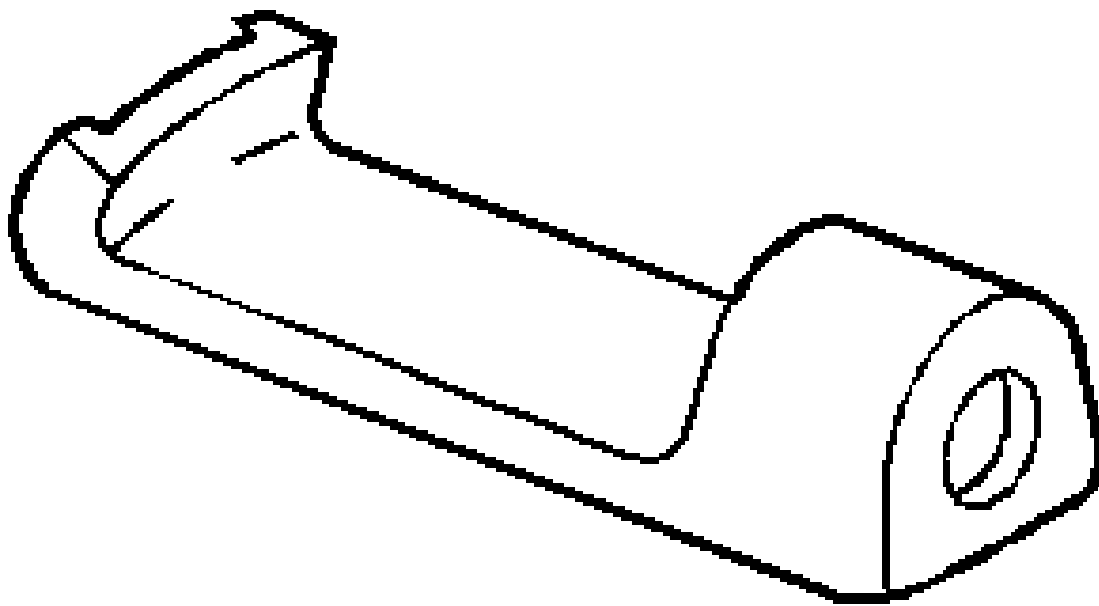
Oil Pressure Switch

The oil pressure switch is installed to control valve body and detects the pressure applied to the high clutch.

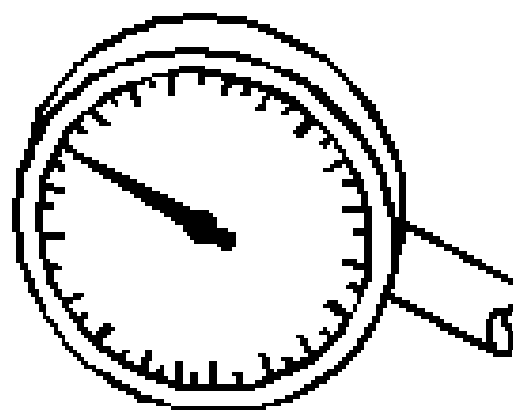
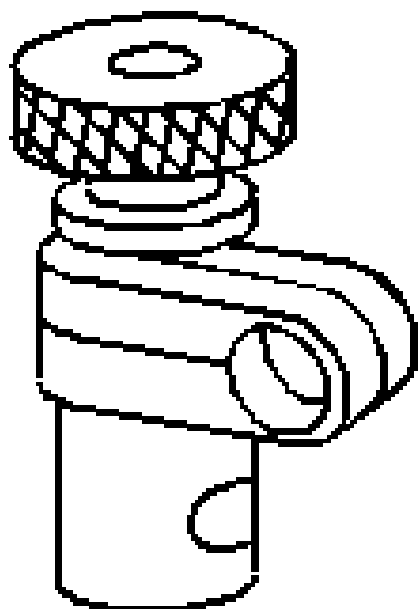
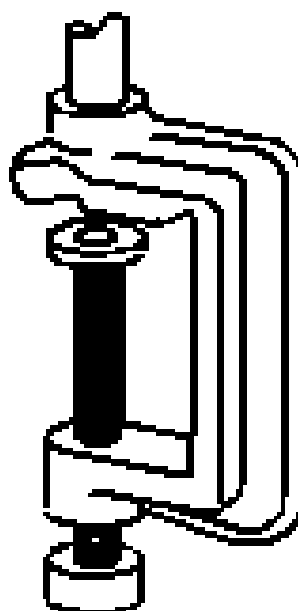
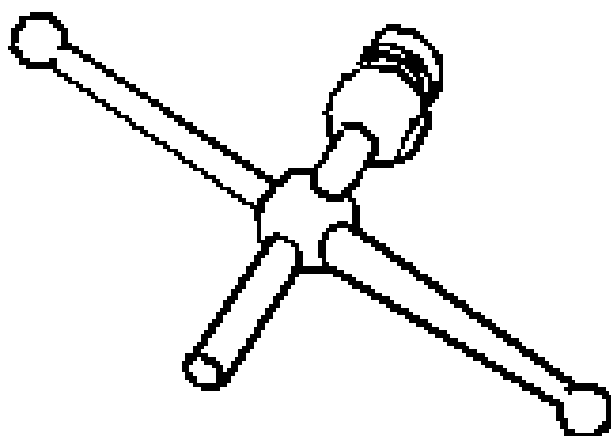
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

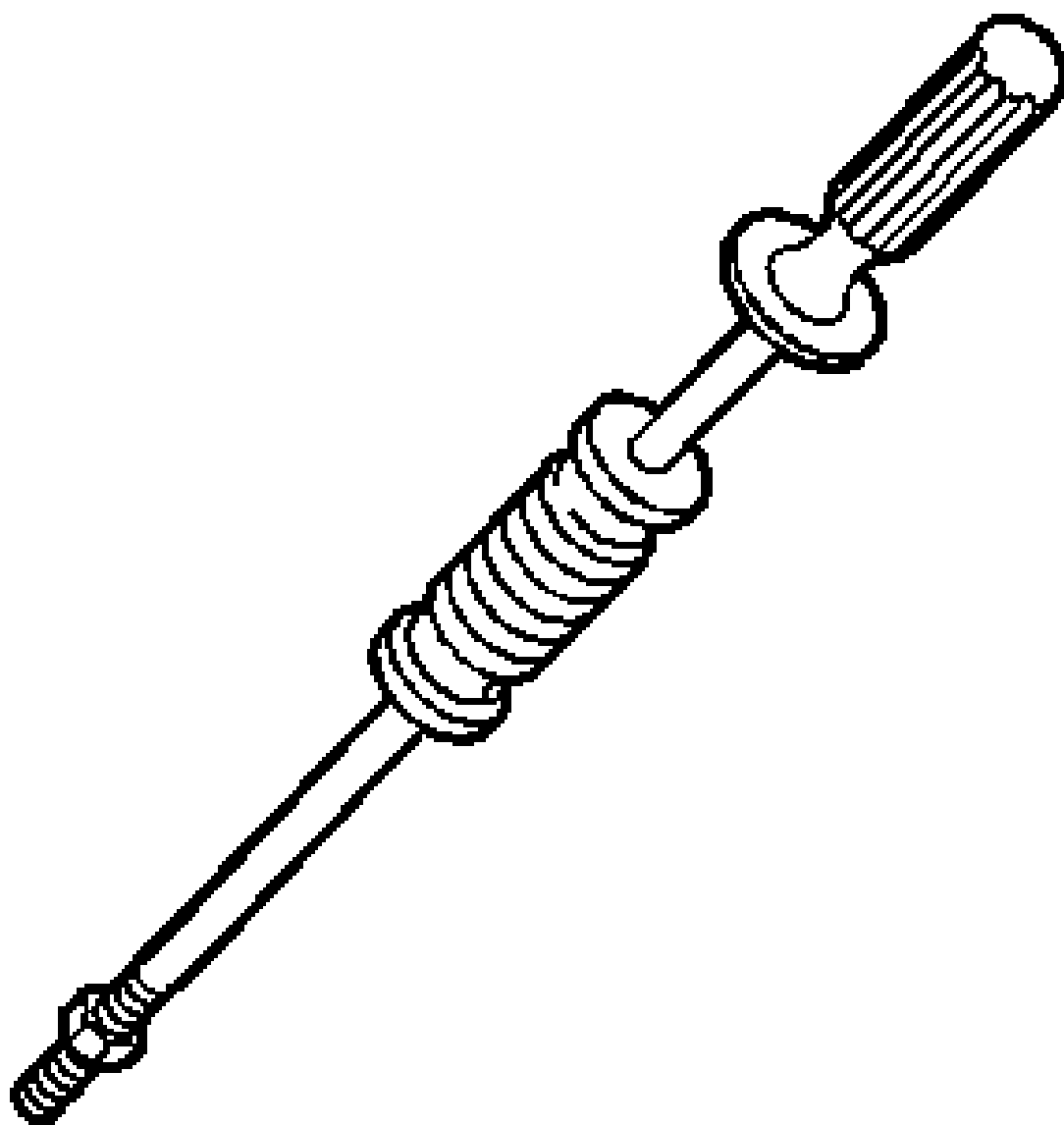
Illustration	Tool Number/Descrip
	DT-446 KM-446 Seal Installer



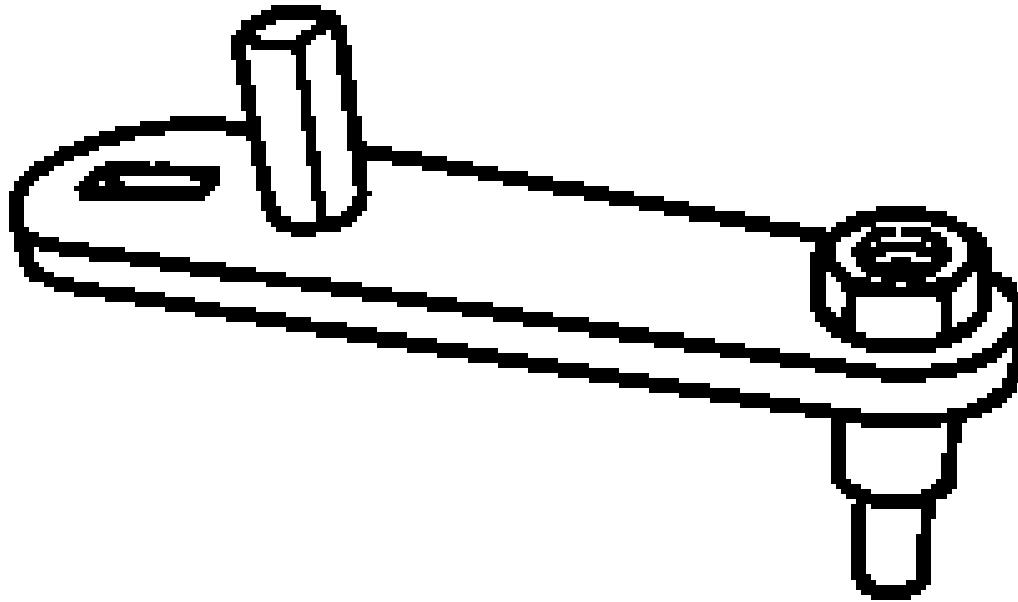
DT-586
J-23129
Universal Sea
Remover



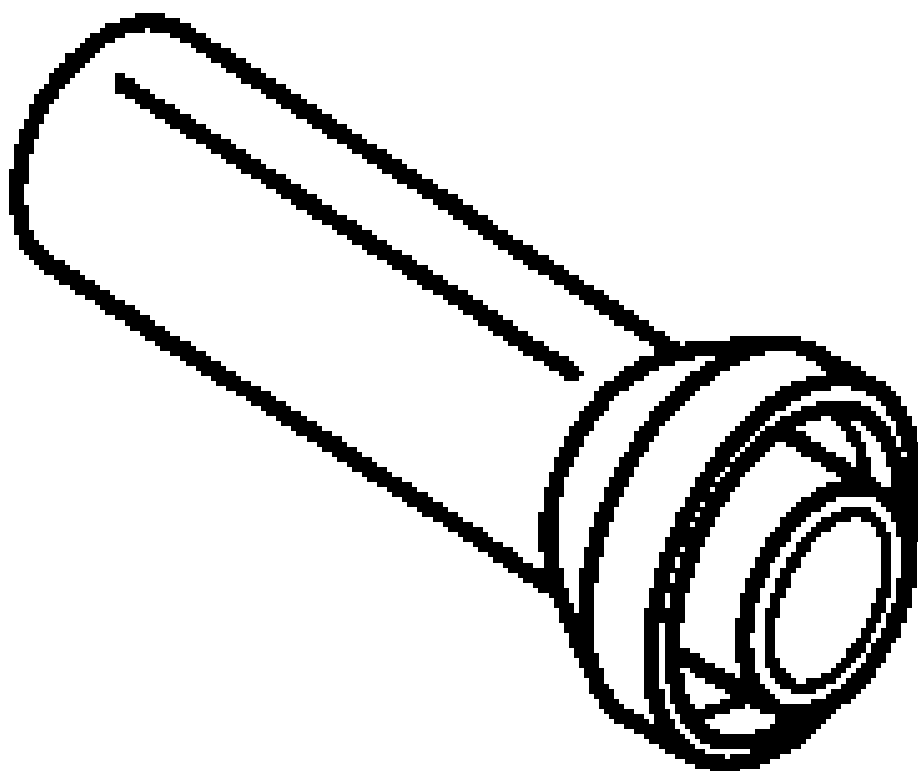
DT-45096
J-45096
Transmission C
Cooling Syster
Flush and Flow T
Tool



DT-7004
J-6125-1B
Slide Hammer w
Adapter



DT-51175
Range Switch
Alignment Chec



DT-51323
Seal Installer

GENERAL INFORMATION

Trouble Shooting - Basic Procedures

* PLEASE READ THIS FIRST *

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT**, **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing.

ACCESSORIES & ELECTRICAL

CHARGING SYSTEM TROUBLE SHOOTING

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BASIC CHARGING SYSTEM TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Vehicle Will Not Start	
Dead battery	Check battery cells, alternator belt tension and alternator output
Loose or corroded battery connections	Check all charging system connections
Ignition circuit or switch malfunction	Check and replace as necessary
Alternator Light Stays On With Engine Running	
Loose or worn alternator drive belt	Check alternator drive tension and condition, See Belt Adjustment in TUNE-UP article in the TUNE-UP section
Loose alternator wiring connections	Check all charging system connections

Short in alternator light wiring	See Indicator Warning Lights in STANDARD INSTRUMENTS in the ACCESSORIES & EQUIPMENT section
Defective alternator stator or diodes	See Bench Tests in ALTERNATOR article
Defective regulator	See Regulator Check in ALTERNATOR article
Alternator Light Stays Off With Ignition Switch ON	
Blown fuse	See WIRING DIAGRAMS
Defective alternator	See Testing in ALTERNATOR article
Defective indicator light bulb or socket	See Indicator Warning Lights in STANDARD INSTRUMENTS in the ACCESSORIES & EQUIPMENT section
Alternator Light Stays OFF With Ignition Switch ON	
Short in alternator wiring	See On-Vehicle Tests in ALTERNATOR article
Defective rectifier bridge	See Bench Tests in ALTERNATOR article
Lights or Fuses Burn Out Frequently	
Defective alternator wiring	See On-Vehicle Tests in ALTERNATOR article
Defective regulator	See Regulator Check in ALTERNATOR article
Defective battery	Check and replace as necessary
Ammeter Gauge Shows Discharge	
Loose or worn drive belt	Check alternator drive belt tension and condition. See Belt Adjustment in TUNE-UP article in the TUNE-UP section
Defective wiring	Check all wires and wire connections
Defective alternator or regulator	See Bench Tests and On- Vehicle Tests in ALTERNATOR article
Defective ammeter, or improper ammeter wiring connection	See Testing in STANDARD INSTRUMENTS in the ACCESSORIES & EQUIPMENT section
Noisy Alternator	
Loose drive pulley	Tighten drive pulley attaching nut

Loose mounting bolts	Tighten all alternator mounting bolts
Worn or dirty bearings	See Bearing Replacement ALTERNATOR article
Defective diodes or stator	See Bench Test in ALTERNATOR article
Battery Does Stay Charged	
Loose or worn drive belt	Check alternator drive belt tension and condition. See Belt Adjustment in appropriate TUNE-UP article in the TUNE-UP section
Loose or corroded battery connections	Check all charging system connections
Loose alternator connections	Check all charging system connections
Defective alternator or battery	See On-Vehicle Tests and Bench Tests in ALTERNATOR article
Add-on electrical accessories exceeding alternator capacity	Install larger alternator
Battery Overcharged-Uses Too Much Water	
Defective battery	Check alternator output and repair as necessary
Defective alternator	See On-Vehicle Test and Bench Tests in ALTERNATOR article
Excessive alternator voltage	Check alternator output and repair as necessary

IGNITION SYSTEM TROUBLE SHOOTING

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Ignition Secondary Trouble shooting Chart

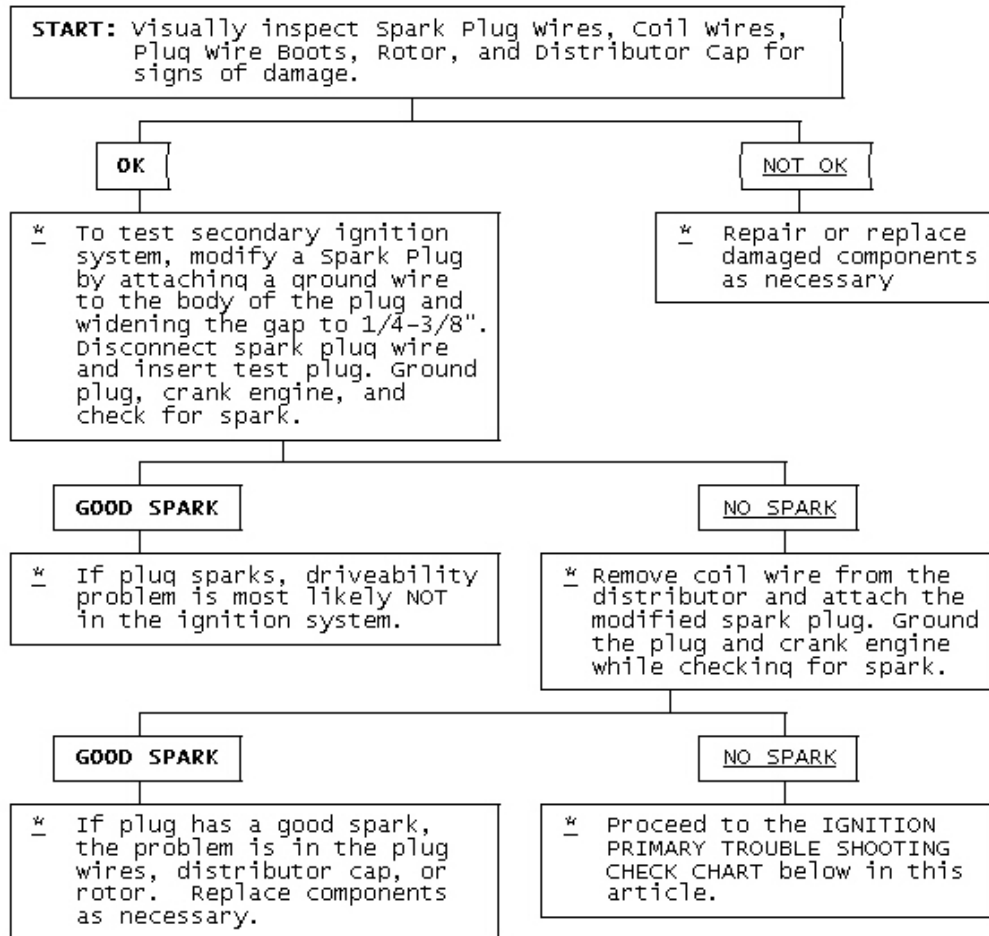


Fig. 1: Ignition Secondary Trouble Shooting Chart

Ignition Primary Trouble Shooting Chart

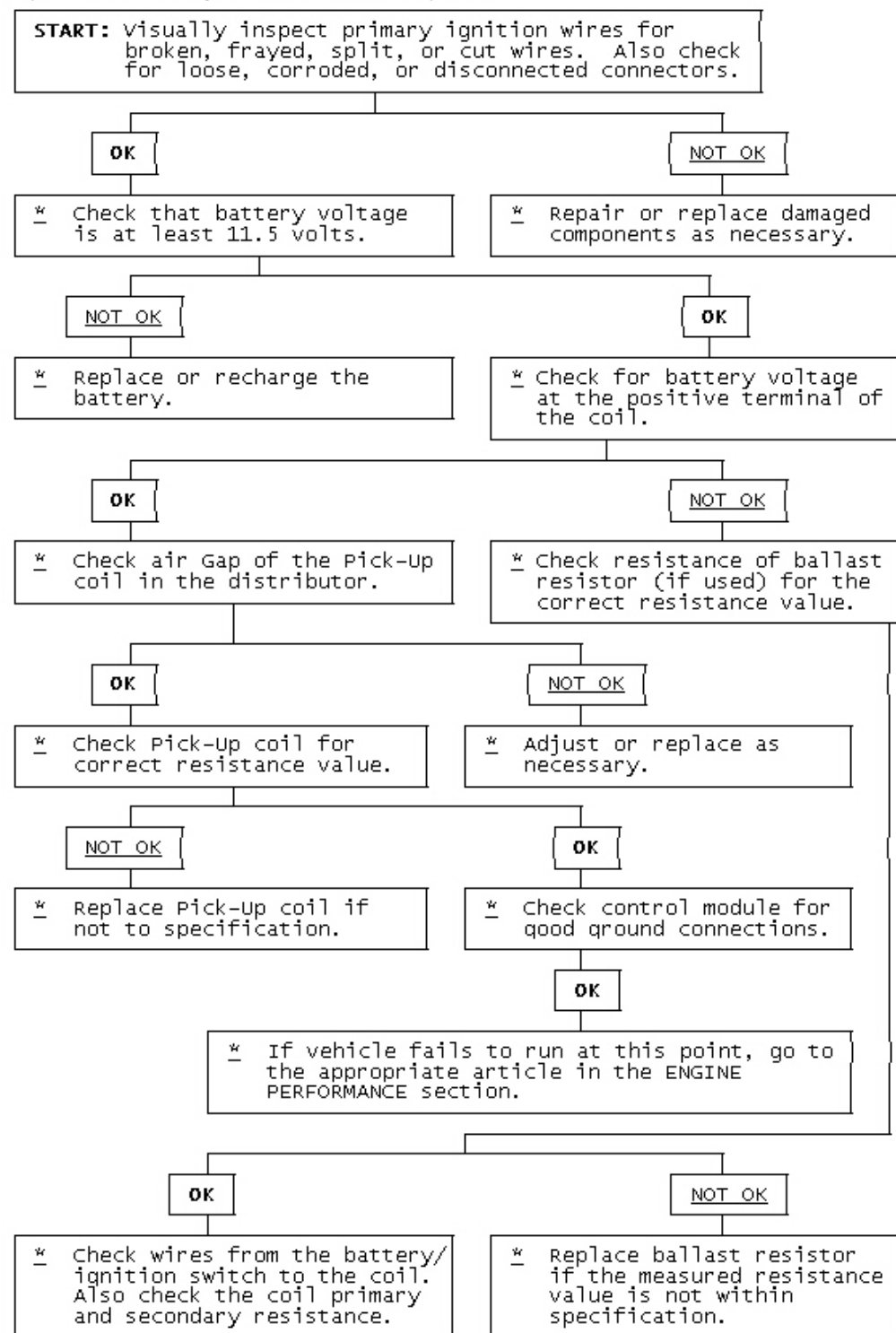


Fig. 2: Ignition Primary Trouble Shooting Chart

STARTER TROUBLE SHOOTING

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BASIC STARTER TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Starter Fails to Operate	
Dead battery or bad connections between starter and battery	Check battery charge and all wires and connections to starter
Ignition switch faulty or misadjusted	Adjust or replace ignition switch
Open circuit between starter switch ignition terminal on starter relay	Check and repair wires and connections as necessary
Starter relay or starter defective	See Testing in STARTER article
Open solenoid pull-in wire	Testing in STARTER article
Starter Does Not Operate and Headlights Dim	
Weak battery or dead cell	Charge or replace battery as necessary
Loose or corroded battery connections	Check that battery connections are clean and tight
Internal ground in starter windings	See Testing in STARTER article
Grounded starter fields	See Testing in STARTERS
Armature rubbing on pole	See STARTER article shoes
Starter Turns but Engine Does Not Rotate	
Starter clutch slipping	See STARTER article
Broken clutch housing	See STARTER article
Pinion shaft rusted or dry	See STARTER article
Engine basic timing incorrect	See Ignition Timing in TUNE-UP article
Broken teeth on engine flywheel	Replace flywheel and check for starter pinion gear damage
Starter Will Not Crank Engine	
Faulty overrunning clutch	See STARTER article
Broken clutch housing	See STARTER article
Broken flywheel teeth	Replace flywheel and check

	for starter pinion gear damage
Armature shaft sheared or reduction gear teeth stripped	See STARTER article
Weak battery	Charge or replace battery as necessary
Faulty solenoid	See On-Vehicle Tests in STARTER article
Poor grounds	Check all ground connections for tight and clean connections
Ignition switch faulty or misadjusted	Adjust or replace ignition switch as necessary
Starter Cranks Engine Slowly	
Battery weak or defective	Charge or replace battery as necessary
Engine overheated	See ENGINE COOLING SYSTEM article
Engine oil too heavy	Check that proper viscosity oil is used
Poor battery-to-starter connections	Check that all between battery and starter are clean and tight
Current draw too low or too high	See Bench Tests in STARTER article
Bent armature, loose pole shoes screws or worn bearing	See STARTER article
Burned solenoid contacts	Replace solenoid
Faulty starter	Replace starter
Starter Engages Engine Only Momentarily	
Engine timing too far advanced	See Ignition Timing in TUNE-UP article
Overrunning clutch not engaging properly	Replace overrunning clutch. See STARTER article
Broken starter clutch	See STARTER article
Broken teeth on engine flywheel	Replace flywheel and check starter pinion gear for damage
Weak drive assembly thrust spring	See STARTER article
Weak hold-in coil	See Bench Tests in STARTER article
Starter Drive Will Not Engage	
Defective point assembly	See Testing in STARTER article
Poor point assembly ground	See Testing in STARTER article
Defective pull-in coil	Replace starter solenoid
Starter Relay Does Not Close	
Dead battery	Charge or replace battery as

	necessary
Faulty wiring	Check all wiring and connections leading to relay
Neutral safety switch faulty	Replace neutral safety switch
Starter relay faulty	Replace starter relay
Starter Drive Will Not Disengage	
Starter motor loose on mountings	Tighten starter attach bolts
Worn drive end bushing	See STARTER article
Damaged engine flywheel teeth	Replace flywheel and starter pinion gear for damage
Drive yolk return spring broken or missing	Replace return spring
Faulty ignition switch	Replace ignition switch
Insufficient clearance between winding leads to solenoid terminal and main contact in solenoid	Replace starter solenoid
Starter clutch not disengaging	Replace starter clutch
Ignition starter switch	Replace ignition switch contacts sticking
Starter Relay Operates but Solenoid Does Not	
Faulty solenoid switch, switch connections or relay	Check all wiring between relay and solenoid or replace relay or solenoid as necessary
Broken lead or loose soldered connections	Repair wire or wire connections as necessary
Solenoid Plunger Vibrates When Switch is Engaged	
Weak battery	Charge or replace battery as necessary
Solenoid contacts corroded	Clean contacts or replace solenoid
Faulty wiring	Check all wiring leading to solenoid
Broken connections inside switch cover	Repair connections or replace solenoid
Open hold-in wire	solenoid
Low Current Draw	
Worn brushes or weak brush springs	Replace brushes or brush springs as necessary
High Pitched Whine During Cranking Before Engine Fires but Engine Fires and Cranks Normally	
Distance too great between starter pinion and flywheel	Align starter or check that correct starter and flywheel are being used
High Pitched Whine After Engine Fires With Key released. Engine Fires and Cranks Normally	
Distance too small between starter pinion and flywheel	Flywheel runout contributes to the intermittent nature

AIR CONDITIONING & HEAT

AIR CONDITIONING TROUBLE SHOOTING

WARNING: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT**, **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing.

BASIC AIR CONDITIONING TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE
Compressor Not Working	Compressor clutch circuit open.
.....	Compressor clutch coil inoperative.
.....	Poor clutch ground connection.
.....	Fan belts loose.
.....	Thermostatic switch inoperative.
.....	Thermostatic switch not adjusted.
.....	Ambient temperature switch open.
.....	Superheat fuse blown.
Excessive Noise or Vibration	Missing or loose mounting bolts.
.....	Bad idler pulley bearings.
.....	Fan belts not tightened correctly.
.....	Compressor clutch contacting body.
.....	Excessive system pressure.
.....	Compressor oil level low.
.....	Damaged clutch bearings.
.....	Damaged reed valves.
.....	Damaged compressor.
Insufficient or No Cooling; Compressor Working	Expansion valve inoperative.
.....	Heater control valve stuck open.
.....	Low system pressure.
.....	Blocked condenser fins.
.....	Blocked evaporator fins.
.....	Vacuum system leak.
.....	Vacuum motors inoperative.
.....	Control cables improperly adjusted.
.....	Restricted air inlet.
.....	Mode doors binding.
.....	Blower motor inoperative.

.....	Temperature above system capacity.
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HEATER SYSTEM TROUBLE SHOOTING

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BASIC HEATER SYSTEM TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE
Insufficient, Erratic, or No Heat	Low Coolant Level
.....	Incorrect thermostat.
.....	Restricted coolant flow through core.
.....	Heater hoses plugged.
.....	Misadjusted control cable.
.....	Sticking heater control valve.
.....	Vacuum hose leaking.
.....	Vacuum hose blocked.
.....	Vacuum motors inoperative.
.....	Blocked air inlet.
.....	Inoperative heater blower motor.
.....	Oil residue on heater core fins.
.....	Dirt on heater core fins.
Too Much Heat	Improperly adjusted cables.
.....	Sticking heater control valve.
.....	No vacuum to heater control valve.
.....	Temperature door stuck open.
Air Flow Changes During Acceleration	Vacuum system leak.
.....	Bad check valve or reservoir.
Air From Defroster At All Times	Vacuum system leak.
.....	Improperly adjusted control cables.
.....	Inoperative vacuum motor.
Blower Does Not Operate Correctly	Blown fuse.
.....	Blower motor windings open.
.....	Resistors burned out.
.....	Motor ground connection loose.
.....	Wiring harness connections loose.
.....	Blower motor switch inoperative.
.....	Blower relay inoperative.

.....	Fan binding or foreign object in housing.
.....	Fan blades broken or bent.

BRAKES

BRAKE SYSTEM TROUBLE SHOOTING

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT**, **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing.

BRAKE SYSTEM TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Brakes Pull Left or Right	
Incorrect tire pressure	Inflate tires to proper pressure
Front end out of alignment	See WHEEL ALIGNMENT
Mismatched tires	Check tires sizes
Restricted brake lines or hoses	Check hose routing
Loose or malfunctioning caliper	See DISC BRAKES or BRAKE SYSTEM
Bent shoe or oily linings	See DRUM BRAKES or BRAKE SYSTEM
Malfunctioning rear brakes	See DRUM, DISC BRAKES or BRAKE SYSTEM
Loose suspension parts	See SUSPENSION
Noises Without Brakes Applied	
Front linings worn out	Replace linings
Dust or oil on drums or rotors	See DRUM, DISC BRAKES or BRAKE SYSTEM
Noises With Brakes Applied	
Insulator on outboard shoe damaged	See DISC BRAKES or BRAKE SYSTEM
Incorrect pads or linings	Replace pads or linings
Brake Rough, Chatters or Pulsates	
Excessive lateral runout	Check rotor runout
Parallelism not to specifications	Reface or replace rotor
Wheel bearings not adjusted	See SUSPENSION
Rear drums out-of-round	Reface or replace drums
Disc pad reversed, steel against rotor	Remove and reinstall pad
Excessive Pedal Effort	
Malfunctioning power unit	See POWER BRAKES or

	BRAKE SYSTEM
Partial system failure	Check fluid and pipes
Worn disc pad or lining	Replace pad or lining
Caliper piston stuck or sluggish	See DISC BRAKES or BRAKE SYSTEM
Master cylinder piston stuck	See MASTER CYLINDERS or BRAKE SYSTEM
Brake fade due to incorrect pads for linings	Replace pads or linings
Linings or pads glazed	Replace pads or linings
Worn drums	Reface or replace drums
Excessive Pedal Travel	
Partial brake system failure	Check fluid and pipes
Insufficient fluid in master cylinder	See MASTER CYLINDERS or BRAKE SYSTEM
Air trapped in system	See BRAKE BLEEDING or BRAKE SYSTEM
Rear brakes not adjusted	See Adjustments in DRUM BRAKES or BRAKE SYSTEM
Bent shoe or lining	See DRUM BRAKES or BRAKE SYSTEM
Plugged master cylinder cap	See MASTER CYLINDERS or BRAKE SYSTEM
Improper brake fluid	Replace brake fluid
Pedal Travel Decreasing	
Compensating port plugged	See MASTER CYLINDERS or BRAKE SYSTEM
Swollen cup in master cylinder	See MASTER CYLINDERS or BRAKE SYSTEM
Master cylinder piston not returning	See MASTER CYLINDERS or BRAKE SYSTEM
Weak shoe retracting springs	See DRUM BRAKES BRAKE SYSTEM
Wheel cylinder piston sticking	See DRUM BRAKES or BRAKE SYSTEM
Dragging Brakes	
Master cylinder pistons not returning	See MASTER CYLINDERS BRAKE SYSTEM
Restricted brake lines or hoses	Check line routing
Incorrect parking brake adjustment	See DRUM BRAKES BRAKE SYSTEM
Parking Brake cables frozen	See DRUM BRAKES BRAKE SYSTEM

Incorrect installation of inboard disc pad	Remove and replace correctly
Power booster output rod too long	See POWER BRAKE UNITS BRAKE SYSTEM
Brake pedal not returning freely	See DISC, DRUM BRAKES BRAKE SYSTEM
Brakes Grab or Uneven Braking Action	
Malfunction of combination valve	See CONTROL VALVE or BRAKE SYSTEM
Malfunction of power brake unit	See POWER BRAKE UNITS or BRAKE SYSTEM
Binding brake pedal	See DISC, DRUM BRAKES or BRAKE SYSTEM
Pulsation or Roughness	
Uneven pad wear caused by caliper	See DISC BRAKES or BRAKE SYSTEM
Uneven rotor wear	See DISC BRAKES or BRAKE SYSTEM
Drums out-of-round	Reface or replace drums

ENGINE MECHANICAL

COOLING SYSTEM TROUBLE SHOOTING

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COOLING SYSTEM TROUBLE SHOOTING

CONDITION & POSSIBLE CAUSE	CORRECTION
Overheating	
Coolant Leak	Fill/Pressure Test System
A/C Condenser Fins Clogged	Remove/Clean Condenser
Radiator Fins Clogged	Remove/Clean Radiator
Thermostat Stuck Closed	Replace Thermostat
Clogged Cooling System Passages	Clean/Flush Cooling System
Water Pump Malfunction	Replace Water Pump
Fan Clutch Malfunction	Replace Fan Clutch
Retarded Ignition Timing	Reset Ignition Timing
Cooling Fan Malfunction	Test Cooling Fan/Circuit
Cooling Fan Motor Malfunction	Test Fan Motor
Cooling Fan Relay Malfunction	Test Fan Relay

Faulty Radiator Cap	Replace Radiator Cap
Broken/Slipping Fan Belt	Replace Fan Belt
Restricted Exhaust	Repair Exhaust System
Corrosion	
Impurities In Coolant	Clean/Flush System
Coolant Leakage	
Damaged hose	Replace Hose
Leaky Water Pump	Replace Water Pump
Damaged Radiator Seam	Replace/Repair Radiator
Leaky Thermostat Cover	Replace Thermostat Cover
Cylinder Head Problem	Check Head/Head Gasket
Leaky Freeze Plugs	Replace Freeze Plugs
Recovery System Inoperative	
Loose and/or Defective Radiator Cap	Replace Radiator Cap
Overflow Tube Clogged and/or Leaking	Repair Tube
Recovery Bottle Vent Restricted	Clean Vent
No Heater Core Flow	
Collapsed Heater Hose	Replace Heater Hose
Plugged Heater Core	Clean/Replace Heater Core
Faulty Heater Valve	Replace Heater Valve

GASOLINE ENGINE - MECHANICAL TROUBLE SHOOTING

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BASIC GASOLINE ENGINE - MECHANICAL TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Lopes At Idle	
Intake manifold-to-head leaks	Replace manifold gasket, See ENGINES
Blown head gasket	Replace head gasket, See ENGINES
Worn timing gears, chain or sprocket	Replace gears, chain or sprocket
Worn camshaft lobes	Replace camshaft, See ENGINES
Overheated engine	Check cooling system, See COOLING
Blocked crankcase vent valve	Remove restriction

Leaking EGR valve	Repair leak and/or replace valve
Faulty fuel pump	Replace fuel pump
Engine Has Low Power	
Leaking fuel pump	Repair leak and/or replace fuel pump
Excessive piston-to-bore clearance	Install larger pistons, See ENGINES
Sticking valves or weak valve springs	Check valve train components, See ENGINES
Incorrect valve timing	Reset valve timing, See ENGINES
Worn camshaft lobes	Replace camshaft, See ENGINES
Blown head gasket	Replace head gasket. See ENGINES.
Clutch slipping	Adjust pedal and/or replace components, See ENGINES
Engine overheating	Check cooling system, See COOLING
Auto. Trans. pressure regulator valve faulty	Replace pressure regulator valve
Auto. Trans. fluid level too low	Add fluid as necessary
Improper vacuum diverter valve operation	Replace vacuum diverter valve
Vacuum leaks	Inspect vacuum system and repair as required
Leaking piston rings	Replace piston rings, See ENGINES
Faulty High Speed Operation	
Low fuel pump volume	Replace fuel pump
Leaking valves or worn	Replace valves and/or springs, See ENGINES
Incorrect valve timing	Reset valve timing, See ENGINES
Intake manifold restricted	Remove restriction
Worn distributor shaft	Replace distributor
Faulty Acceleration	
Improper fuel pump stroke	Remove pump and reset pump stroke
Incorrect ignition timing	Reset ignition timing, See TUNE-UP
Leaking valves	Replace valves, See ENGINES

Worn fuel pump diaphragm or piston	Replace diaphragm or piston
Intake Backfire	
Improper ignition timing	Reset ignition timing, See TUNE-UP
Faulty accelerator pump discharge	Replace accelerator pump
Improper choke operation	Check choke and adjust as required
Defective EGR valve	Replace EGR valve
Fuel mixture too lean	Reset air/fuel mixture, See TUNE-UP
Choke valve initial clearance too large	Reset choke valve initial clearance
Exhaust Backfire	
Vacuum leak	Inspect and repair vacuum system
Faulty vacuum diverter valve	Replace vacuum diverter valve
Faulty choke operation	Check choke and adjust as required
Exhaust system leak	repair exhaust system leak
Engine Detonation	
Ignition timing too far advanced	Reset ignition timing, See TUNE-UP
Faulty ignition system	Check ignition timing, See TUNE-UP
Spark plugs loose or faulty	Retighten or replace plugs
Fuel delivery system clogged	Inspect lines, pump and filter for clog
EGR valve inoperative	Replace EGR valve
PCV system inoperative	Inspect and/or replace hoses or valve
Vacuum leaks	Check vacuum system and repair leaks
Excessive combustion chamber deposits	Remove built-up deposits
Leaking, sticking or broken valves	Inspect and/or replace valves
External Oil Leakage	
Fuel pump improperly seated or worn gasket	Remove pump, replace gasket and seat properly
Oil pan gasket broken or pan bent	Straighten pan and replace gasket
Timing chain cover gasket broken	Replace timing chain cover gasket
Rear main oil seal worn	Replace rear main oil seal

Oil pan drain plug not seated properly	Remove and reinstall drain plug
Camshaft bearing drain hole blocked	Remove restriction
Oil pressure sending switch leaking	Remove and reinstall sending switch
Excessive Oil Consumption	
Worn valve stems or guides	Replace stems or guides, See ENGINES
Valve "O" ring seals damaged	Replace "O" ring seals, See ENGINES
Plugged oil drain back holes	Remove restrictions
Improper PCV valve operation	Replace PCV valve
Engine oil level too high	Remove excess oil
Engine oil too thin	Replace thicker oil
Valve stem oil deflectors damaged	Replace oil deflectors
Incorrect piston rings	Replace piston rings, See ENGINES
Piston ring gaps not staggered	Reinstall piston rings, See ENGINES
Insufficient piston ring tension	Replace rings, See ENGINES
Piston ring grooves or oil return	slots clogged Replace piston rings, See ENGINES
Piston rings sticking in grooves	Replace piston rings, See ENGINES
Piston ring grooves excessively worn	Replace piston and rings, See ENGINES
Compression rings installed upside down	Replace compression rings correctly, See ENGINES
Worn or scored cylinder walls	Rebore cylinders or replace block
Mismatched oil ring expander and rail	Replace oil ring expander and rail, See ENGINES
Intake gasket dowels too long	Replace intake gasket dowels
Excessive main or connecting rod bearing clearance	Replace main or connecting rod bearings, See ENGINES
No Oil Pressure	
Low oil level	Add oil to proper level
Oil pressure sender or gauge broken	Replace sender or gauge
Oil pump malfunction	Remove and overhaul oil pump, See ENGINES
Oil pressure relief valve sticking	Remove and reinstall valve
Oil pump passages blocked	Overhaul oil pump, See ENGINES

Oil pickup screen or tube blocked	Remove restriction
Loose oil inlet tube	Tighten oil inlet tube
Loose camshaft bearings	Replace camshaft bearings, See ENGINES
Internal leakage at oil passages	Replace block or cylinder head
Low Oil Pressure	
Low engine oil level	Add oil to proper level
Engine oil too thin	Remove and replace with thicker oil
Excessive oil pump clearance	Reduce oil pump clearance, See ENGINES
Oil pickup tube or screen blocked	Remove restrictions
Main, rod or cam bearing clearance excessive	Replace bearing to reduce clearance, See ENGINES
High Oil Pressure	
Improper grade of oil	Replace with proper oil
Oil pressure relief valve stuck closed	Eliminate binding
Oil pressure sender or gauge faulty	Replace sender or gauge
Noisy Main Bearings	
Inadequate oil supply	Check oil delivery to main bearings
Excessive main bearing clearance	Replace main bearings, See ENGINES
Excessive crankshaft end play	Replace crankshaft, See ENGINES
Loose flywheel or torque converter	Tighten attaching bolts
Loose or damaged vibration damper	Tighten or replace vibration damper
Crankshaft journals out-of-round	Re-grind crankshaft journals
Excessive belt tension	Loosen belt tension
Noisy Connecting Rods	
Excessive bearing clearance or missing bearing	Replace bearing, See ENGINES
Crankshaft rod journal out-of-round	Re-grind crankshaft journal
Misaligned connecting rod or cap	Remove rod or cap and realign
Incorrectly tightened rod bolts	Remove and re-tighten rod bolts
Noisy Pistons and Rings	
Excessive piston-to-bore clearance	Install larger pistons, See ENGINES
Bore tapered or out-of-round	Rebore block

Piston ring broken	Replace piston rings, See ENGINES
Piston pin loose or seized	Replace piston pin, See ENGINES
Connecting rods misaligned	Realign connecting rods
Ring side clearance too loose or tight	Replace with larger or smaller rings
Carbon build-up on piston	Remove carbon
Noisy Valve Train	
Worn or bent push rods	Replace push rods, See ENGINES
Worn rocker arms or bridged pivots	Replace push rods, See ENGINES
Dirt or chips in valve lifters	Remove lifters and remove dirt/chips
Excessive valve lifter leak-down	Replace valve lifters, See ENGINES
Valve lifter face worn	Replace valve lifters, See ENGINES
Broken or cocked valve springs	Replace or reposition springs
Too much valve stem-to-guide clearance	Replace valve guides, See ENGINES
Valve bent	Replace valve, See ENGINES
Loose rocker arms	Retighten rocker arms, See ENGINES
Excessive valve seat run-out	Reface valve seats, See ENGINES
Missing valve lock	Install new valve lock
Excessively worn camshaft lobes	Replace camshaft, See ENGINES
Plugged valve lifter oil holes	Eliminate restriction or replace lifter
Faulty valve lifter check ball	Replace lifter check ball, See ENGINES
Rocker arm nut installed upside down	Remove and reinstall correctly
Valve lifter incorrect for engine	Remove and replace valve lifters
Faulty push rod seat or lifter plunger	Replace plunger or push rod
Noisy Valves	
Improper valve lash	Re-adjust valve lash, See ENGINES
Worn or dirty valve lifters	Clean and/or replace lifters
Worn valve guides	Replace valve guides, See ENGINES

Excessive valve seat or face run-out	Reface seats or valve face
Worn camshaft lobes	Replace camshaft, See ENGINES
Loose rocker arm studs	Re-tighten rocker arm studs, See ENGINES
Bent push rods	Replace push rods, See ENGINES
Broken valve springs	Replace valve springs, See ENGINES
Burned, Sticking or Broken Valves	
Weak valve springs or warped valves	Replace valves and/or springs, See ENGINES
Improper lifter clearance	Re-adjust clearance or replace lifters
Worn guides or improper guide clearance	Replace valve guides, See ENGINES
Out-of-round valve seats or improper seat width	Re-grind valve seats
Gum deposits on valve stems, seats or guide	Remove deposits
Improper spark timing	Re-adjust spark timing
Broken Pistons/Rings	
Undersize pistons	Replace with larger pistons, See ENGINES
Wrong piston rings	Replace with correct rings, See ENGINES
Out-of-round cylinder bore	Re-bore cylinder bore
Improper connecting rod alignment	Remove and realign connecting rods
Excessively worn ring grooves	Replace pistons, See ENGINES
Improperly assembled piston pins	Re-assemble pin-to-piston, See ENGINES
Insufficient ring gap clearance	Install new rings, See ENGINES
Engine overheating	Check cooling system
Incorrect ignition timing	Re-adjust ignition timing, See TUNE-UP
Excessive Exhaust Noise	
Leaks at manifold to head, or to pipe	Replace manifold or pipe gasket
Exhaust manifold cracked or broken	Replace exhaust manifold, See ENGINES

ENGINE PERFORMANCE

CARBURETOR TROUBLE SHOOTING:

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BASIC COLD START SYMPTOMS TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Won't Start	
Choke not closing	Check choke operation, see FUEL SYSTEMS
Choke linkage bent	Check linkage, see FUEL SYSTEM
Engine Starts, Then Dies	
Choke vacuum kick setting too wide	Check setting and adjust see, FUEL SYSTEMS
Fast idle RPM too low	Reset RPM to specification, see TUNE-UP
Fast idle cam index incorrect	Reset fast idle cam index, see FUEL SYSTEMS
Vacuum leak	Inspect vacuum system for leaks
Low fuel pump outlet	Repair or replace pump, see FUEL SYSTEMS
Low carburetor fuel level	Check float setting see FUEL SYSTEM
Engine Quits Under Load	
Choke vacuum kick setting incorrect	Reset vacuum kick setting, see FUEL SYSTEMS
Fast idle cam index incorrect	Reset fast idle cam index, see FUEL SYSTEM
Incorrect hot fast idle speed RPM	Reset fast idle RPM, see TUNE-UP
Engine Starts, Runs Up, Then Idles, Slowly With Black Smoke	
Choke vacuum kick set too narrow	Reset vacuum kick, see FUEL SYSTEMS
Fast idle cam index incorrect	Reset fast idle cam index, see FUEL SYSTEMS
Hot fast idle RPM too low	Reset fast idle RPM, see TUNE-UP

BASIC HOT START SYMPTOMS TROUBLE SHOOTING CHART

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CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Won't Start	
Engine flooded	Allow fuel to evaporate

BASIC COLD ENGINE DRIVEABILITY SYMPTOMS TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Stalls in Gear	
Choke vacuum kick setting incorrect	Reset choke vacuum kick, see FUEL SYSTEMS
Fast idle RPM incorrect	Reset fast idle RPM, see TUNE-UP
Fast idle cam index incorrect	Reset fast idle cam see FUEL SYSTEMS
Acceleration Sag or Stall	
Defective choke control switch	Replace choke control switch
Choke vacuum kick setting incorrect	Reset choke vacuum kick see, FUEL SYSTEMS
Float level incorrect (too low)	Adjust float level, FUEL SYSTEMS
Accelerator pump defective	Repair or replace pump see FUEL SYSTEMS
Secondary throttles not closed	Inspect lockout adjustment, see FUEL SYSTEMS
Sag or Stall After Warmup	
Defective choke control switch	Replace choke control switch, see FUEL SYSTEMS
Defective accelerator pump	Replace pump, see FUEL SYSTEMS
Float level incorrect (too low)	Adjust float level, see FUEL SYSTEMS
Backfiring & Black Smoke	
Plugged heat crossover system	Remove restriction

BASIC WARM ENGINE DRIVEABILITY SYMPTOMS TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Hesitation With Small Amount of Gas Pedal Movement	
Vacuum leak	Inspect vacuum lines
Accelerator pump weak or inoperable	Replace pump, see FUEL SYSTEMS
Float level setting too low	Reset float level, see, FUEL SYSTEMS
Metering rods sticking or binding	Inspect and/or replace rods, see FUEL SYSTEMS

Carburetor idle or transfer system plugged	Inspect system and remove restriction
Frozen or binding heated air inlet	Inspect heated air door for binding
Hesitation With Heavy Gas Pedal Movement	
Defective accelerator pump	Replace pump, see FUEL SYSTEMS
Metering rod carrier sticking or binding	Remove restriction
Large vacuum leak	Inspect vacuum system and repair leak
Float level setting too low	Reset float level, see FUEL SYSTEMS
Defective fuel pump, lines or filter	Inspect pump, lines and filter
Air door setting incorrect	Adjust air door setting, see FUEL

DIESEL ENGINE TROUBLE SHOOTING

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NOTE: Diesel engines mechanical diagnosis is the same as gasoline engines for items such as noisy valves, bearings, pistons, etc. The following trouble shooting covers only items pertaining to diesel engines.

BASIC DIESEL ENGINE TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Won't Crank	
Bad battery connections or dead batteries	Check connections and/or replace batteries
Bad starter connections or bad starter	Check connections and/or replace starter
Engine Cranks Slowly, Won't Start	
Bad battery connections or dead batteries	Check connections and/or replace batteries
Engine oil too heavy	Replace engine oil
Engine Cranks Normally, But Will Not Start	
Glow plugs not functioning	Check glow plug system, see FUEL SYSTEMS
Glow plug control not functioning	Check controller, see FUEL SYSTEMS

Fuel not injected into cylinders	Check fuel injectors, see FUEL SYSTEMS
No fuel to injection pump	Check fuel delivery system
Fuel filter blocked	Replace fuel filter
Fuel tank filter blocked	Replace fuel tank filter
Fuel pump not operating	Check pump operation and/or replace pump
Fuel return system blocked	Inspect system and remove restriction
No voltage to fuel solenoid	Check solenoid and connections
Incorrect or contaminated fuel	Replace fuel
Incorrect injection pump timing	Re-adjust pump timing, see FUEL SYSTEMS
Low compression	Check valves, pistons, rings, see ENGINES
Injection pump malfunction	Inspect and/or replace injection pump
Engine Starts, Won't Idle	
Incorrect slow idle adjustment	Reset idle adjustment, see TUNE-UP
Fast idle solenoid malfunctioning	Check solenoid and connections
Fuel return system blocked	Check system and remove restrictions
Glow plugs go off too soon	See glow plug diagnosis in FUEL SYSTEMS
Injection pump timing incorrect	Reset pump timing, see FUEL SYSTEMS
No fuel to injection pump	Check fuel delivery system
Incorrect or contaminated fuel	Replace fuel
Low compression	Check valves, piston, rings, see ENGINES
Injection pump malfunction	Replace injection pump, see FUEL SYSTEMS
Fuel solenoid closes in RUN position	Check solenoid and connections
Engines Starts/Idles Rough W/out Smoke or Noise	
Incorrect slow idle adjustment	Reset slow idle, see TUNE-UP
Injection line fuel leaks	Check lines and connections
Fuel return system blocked	Check lines and connections
Air in fuel system	Bleed air from system
Incorrect or contaminated fuel	Replace fuel

Injector nozzle malfunction	Check nozzles, see FUEL SYSTEMS
Engines Starts and Idles Rough W/out Smoke or Noise, But Clears After Warm-Up	
Injection pump timing incorrect	Reset pump timing, see FUEL SYSTEMS
Engine not fully broken in	Put more miles on engine
Air in system	Bleed air from system
Injector nozzle malfunction	Check nozzles, see FUEL SYSTEMS
Engine Idles Correctly, Misfires Above Idle	
Blocked fuel filter	Replace fuel filter
Injection pump timing incorrect	Reset pump timing, see FUEL SYSTEMS
Incorrect or contaminated fuel	Replace fuel
Engine Won't Return To Idle	
Fast idle adjustment incorrect	Reset fast idle, see TUNE-UP
Internal injection pump malfunction	Replace injection pump, see FUEL SYSTEMS
External linkage binding	Check linkage and remove binding
Fuel Leaks On Ground	
Loose or broken fuel line	Check lines and connections
Internal injection pump seal leak	Replace injection pump, see FUEL SYSTEMS
Cylinder Knocking Noise	
Injector nozzles sticking open	Test injectors, see FUEL SYSTEMS
Very low nozzle opening pressure	Test injectors and/or replace
Loss of Engine Power	
Restricted air intake	Remove restriction
EGR valve malfunction	Replace EGR valve
Blocked or damaged exhaust system	Remove restriction and/or replace components
Blocked fuel tank filter	Replace filter
Restricted fuel filter	Remove restriction and/or replace filter
Block vent in gas cap	Remove restriction and/or replace cap
Tank-to-injection pump fuel supply blocked	Check fuel lines and connections
Blocked fuel return system	Remove restriction
Incorrect or contaminated fuel	Replace fuel
Blocked injector nozzles	Check nozzle for blockage, see

	FUEL SYSTEMS
Low compression	Check valves, rings, pistons, see ENGINES
Loud Engine Noise With Black Smoke	
Basic timing incorrect	Reset timing, see FUEL SYSTEMS
EGR valve malfunction	Replace EGR valve
Internal injection pump malfunction	Replace injection pump, see FUEL SYSTEMS
Incorrect injector pump housing pressure	Check pressure, see FUEL SYSTEMS
Engine Overheating	
Cooling system leaks	Check cooling system and repair leaks
Belt slipping or damaged	Check tension and/or replace belt
Thermostat stuck closed	Remove and replace thermostat, see ENGINE COOLING
Head gasket leaking	Replace head gasket
Oil Light on at Idle	
Low oil pump pressure	Check oil pump operation, see ENGINES
Oil cooler or line restricted	Remove restriction and/or replace cooler
Engine Won't Shut Off	
Injector pump fuel solenoid does not return fuel valve to OFF position	Remove and check solenoid and replace if needed

VACUUM PUMP DIAGNOSIS

CONDITION & POSSIBLE CAUSE	CORRECTION
Excessive Noise	
Loose pump-to-drive assembly screws	Tighten screws
Loose tube on pump assembly	Tighten tube
Valves not functioning properly	Replace valves
Oil Leakage	
Loose end plug	Tighten end plug
Bad seal crimp	Remove and re-crimp seal

FUEL INJECTION TROUBLE SHOOTING

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Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC FUEL INJECTION TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Won't Start (Crankes Normally)	
Cold start valve inoperative	Test valve and circuit
Poor connection;vacuum or wiring	Check vacuum and electrical connections
Contaminated fuel	Test fuel for water or alcohol
Defective fuel pump relay or circuit	Test relay and wiring
Battery too low	Charge and test battery
Low fuel pressure	Test pressure regulator and fuel pump, check for restricted lines and filters
No distributor reference pulses	Repair ignition system as necessary
Open coolant temperature sensor circuit	Test sensor and wiring
Shorted W.O.T. switch in T.P.S.	Disconnect W.O.T. switch, engine should start
Defective ECM	Replace ECM
Fuel tank residual pressure valve leaks	Test for fuel pressure drop after shut down
Hard Starting	
Disconnected hot air tube to air cleaner	Reconnect tube and test control valve
Defective Idle Air Control (IAC) valve	Test valve operation and circuit
Shorted, open or misadjusted T.P.S.	Test and adjust or replace T.P.S.
EGR valve open	Test EGR valve and control circuit
Poor Oxygen sensor signal	Test for shorted or circuit
Incorrect mixture from PCV system	Test PCV for flow, check sealing of oil filter cap
Poor High Speed Operation	
Low fuel pump volume	Faulty pump or restricted fuel lines or filters
Poor MAP sensor signal	Test MAP sensor, vacuum hose and wiring
Poor Oxygen sensor signal	Test for shorted or open sensor or circuit

Open coolant temperature sensor circuit	Test sensor and wiring
Faulty ignition operation	Check wires for cracks or poor connections, test secondary voltage with oscilloscope
Contaminated fuel	Test fuel for water or alcohol
Intermittent ECM ground	Test ECM ground connection for resistance
Restricted air cleaner	Replace air cleaner
Restricted exhaust system	Test for exhaust manifold back pressure
Poor MAF sensor signal	Check leakage between sensor and manifold
Poor VSS signal	If tester for ALCL hook-up is available check that VSS reading matches speedometer
Ping or Knock on Acceleration	
Poor Knock sensor signal	Test for shorted or open sensor or circuit
Poor Baro sensor signal	Test for shorted or open sensor or circuit
Improper ignition timing	See VEHICLE EMISSION CONTROL LABEL (where applicable)
Check for engine overheating problems	Low coolant, loose belts or electric cooling fan inoperative

NOTE: For additional electronic fuel injection trouble shooting information, see the appropriate article in the ENGINE PERFORMANCE section (not all vehicles have Computer Engine Control articles). Information is provided there for diagnosing fuel system problems on vehicles with electronic fuel injection.

IGNITION SYSTEM TROUBLE SHOOTING

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Ignition Secondary Trouble shooting Chart

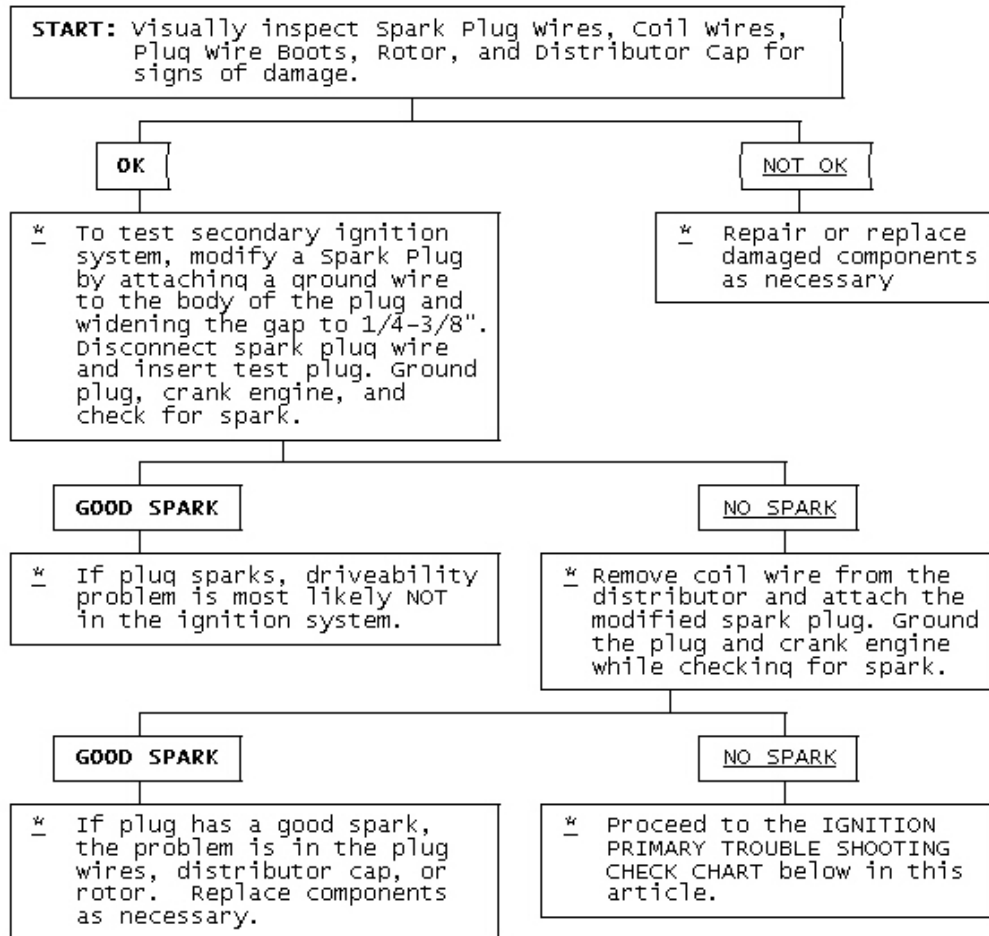


Fig. 3: Ignition Secondary Trouble Shooting Chart

Ignition Primary Trouble Shooting Chart

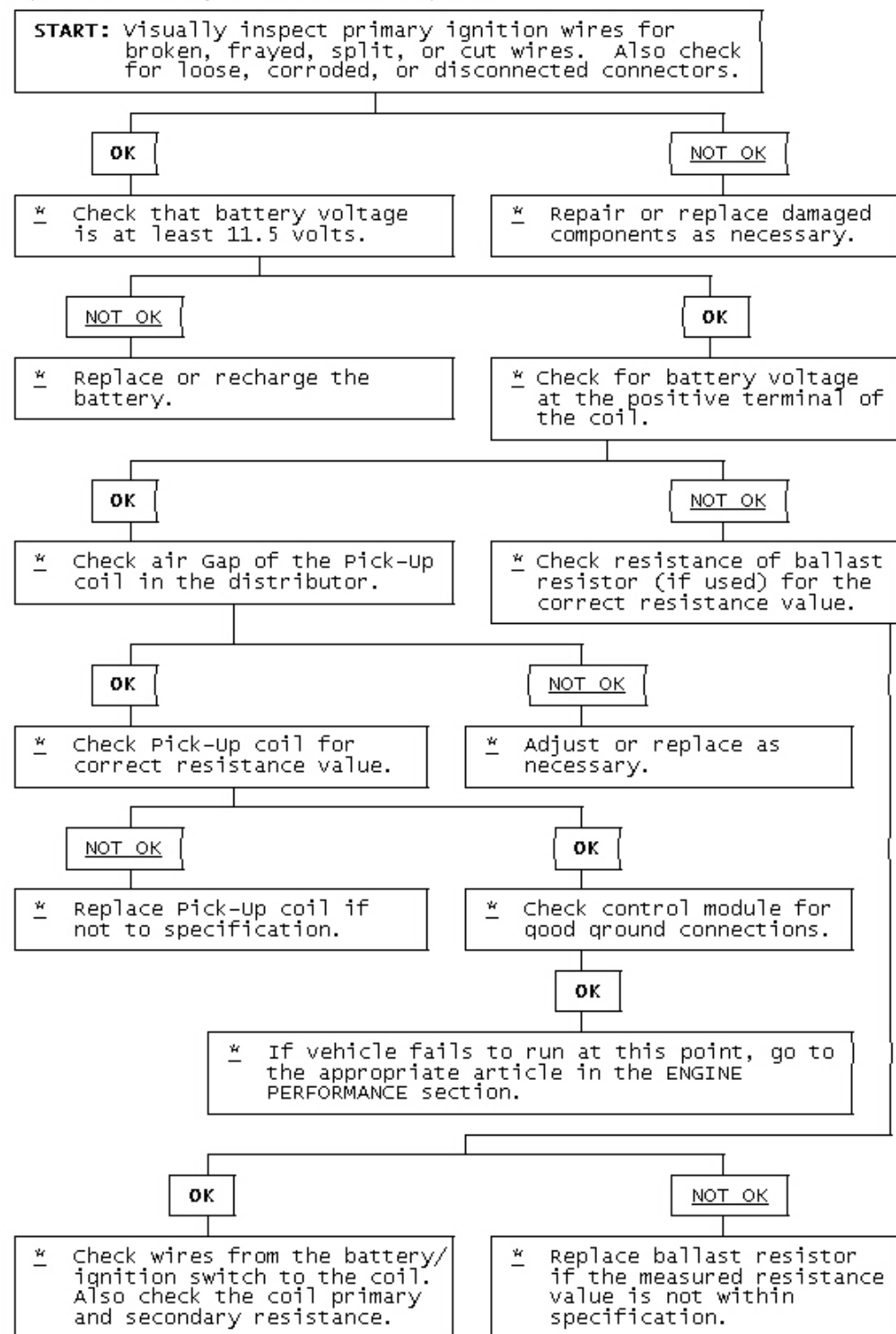


Fig. 4: Ignition Primary Trouble Shooting Chart

STARTER TROUBLE SHOOTING

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BASIC STARTER TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Starter Fails to Operate	
Dead battery or bad connections between starter and battery	Check battery charge and all wires and connections to starter
Ignition switch faulty or misadjusted	Adjust or replace ignition switch
Open circuit between starter switch ignition terminal on starter relay	Check and repair wires and connections as necessary
Starter relay or starter defective	See Testing in STARTER article
Open solenoid pull-in wire	See Testing in STARTER article
Starter Does Not Operate and Headlights Dim	
Weak battery or dead cell	Charge or replace battery as necessary
Loose or corroded battery connections	Check that battery connections are clean and tight
Internal ground in starter windings	See Testing in STARTER article
Grounded starter fields	See Testing in STARTERS
Armature rubbing on pole shoes	See STARTER article
Starter Turns but Engine Does Not Rotate	
Starter clutch slipping	See STARTER article
Broken clutch housing	See STARTER article
Pinion shaft rusted or dry	See STARTER article
Engine basic timing incorrect	See Ignition Timing in TUNE-UP article
Broken teeth on engine flywheel	Replace flywheel and check for starter pinion gear damage
Starter Will Not Crank Engine	

Faulty overrunning clutch	See STARTER article
Broken clutch housing	See STARTER article
Broken flywheel teeth	Replace flywheel and check for starter pinion gear damage
Armature shaft sheared or reduction gear teeth stripped	See STARTER article
Weak battery	Charge or replace battery as necessary
Faulty solenoid	See On-Vehicle Tests in STARTER article
Poor grounds	Check all ground connections for tight and clean connections
Ignition switch faulty or misadjusted	Adjust or replace ignition switch as necessary
Starter Cranks Engine Slowly	
Battery weak or defective	Charge or replace battery as necessary
Engine overheated	See ENGINE COOLING SYSTEM article
Engine oil too heavy	Check that proper viscosity oil is used
Poor battery-to-starter connections	Check that all between battery and starter are clean and tight
Current draw too low or too high	See Bench Tests in STARTER article
Bent armature, loose pole shoes screws or worn bearings	See STARTER article
Burned solenoid contacts	Replace solenoid
Faulty starter	Replace starter
Starter Engages Engine Only Momentarily	
Engine timing too far advanced	See Ignition Timing in TUNE-UP article
Overrunning clutch not engaging properly	Replace overrunning clutch. See STARTER article
Broken starter clutch	See STARTER article
Broken teeth on engine flywheel	Replace flywheel and check starter pinion gear for damage
Weak drive assembly thrust spring	See STARTER article
Weak hold-in coil	See Bench Tests in STARTER article
Starter Drive Will Not Engage	
Defective point assembly	See Testing in STARTER

	article
Poor point assembly ground	See Testing in STARTER article
Defective pull-in coil	Replace starter solenoid
Starter Relay Does Not Close	
Dead battery	Charge or replace battery as necessary
Faulty wiring	Check all wiring and connections leading to relay
Neutral safety switch faulty	Replace neutral safety switch
Starter relay faulty	Replace starter relay
Starter Drive Will Not Disengage	
Starter motor loose on mountings	Tighten starter attach bolts
Worn drive end bushing	See STARTER article
Damaged engine flywheel teeth	Replace flywheel and starter pinion gear for damage
Drive yolk return spring broken or missing	Replace return spring
Faulty ignition switch	Replace ignition switch
Insufficient clearance between winding leads to solenoid terminal and main contact in solenoid	Replace starter solenoid
Starter clutch not disengaging	Replace starter clutch
Ignition starter switch contacts sticking	Replace ignition switch
Starter Relay Operates but Solenoid Does Not	
Faulty solenoid switch, switch connections or relay	Check all wiring between relay and solenoid or replace relay or solenoid as necessary
Broken lead or loose soldered connections	Repair wire or wire connections as necessary
Solenoid Plunger Vibrates When Switch is Engaged	
Weak battery	Charge or replace battery as necessary
Solenoid contacts corroded	Clean contacts or replace solenoid
Faulty wiring	Check all wiring leading to solenoid
Broken connections inside switch cover	Repair connections or replace solenoid
Open hold-in wire	Replace solenoid
Low Current Draw	
Worn brushes or weak	Replace brushes or brush springs as necessary
High Pitched Whine During Cranking Before Engine Fires but Engine Fires and Cranks Normally	
Distance too great between starter pinion and flywheel	Align starter or check that

	correct starter and flywheel are being used
High Pitched Whine After Engine Fires With Key released. Engine Fires and Cranks Normally	
Distance too small between starter pinion and flywheel	Flywheel runout contributes to the intermittent nature

TUNE-UP TROUBLE SHOOTING - GAS ENGINE VEHICLES

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BASIC SPARK PLUG TROUBLE SHOOTING CHARTS

CONDITION & POSSIBLE CAUSE	CORRECTION
Normal Spark Plug Condition	
Light Tan or Gray deposits	No Action
Electrode not burned or fouled	No Action
Gap tolerance not changed	No Action
Cold Fouling or Carbon Deposits	
Overrich air/fuel mixture	Adjust air/fuel mixture, see ENGINE PERFORMANCE section
Faulty choke	Replace choke assembly, see ENGINE PERFORMANCE section
Clogged air filter	Clean and/or replace air filter
Incorrect idle speed or dirty carburetor	Reset idle speed and/ or clean carburetor
Faulty ignition wires	Replace ignition wiring
Prolonged operation at idle	Shut engine off during long idle
Sticking valves or worn valve guide seals	Check valve train
Wet Fouling or Oil Deposits	
Worn rings and pistons	Install new rings and pistons
Excessive cylinder wear	Rebore or replace block
Excessive valve guide clearance	Worn or loose bearing
Gap Bridged	
Deposits in combustion chamber becoming fused to electrode	Clean combustion chamber of deposits
Blistered Electrode	
Engine overheating	Check cooling system

Wrong type of fuel	Replace with correct fuel
Loose spark plugs	Retighten spark plugs
Over-advanced ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Pre-Ignition or Melted Electrodes	
Incorrect type of fuel	Replace with correct fuel
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Burned valves	Replace valves
Engine Overheating	Check cooling system
Wrong type of spark plug, too hot	Replace with correct spark plug, see ENGINE PERFORMANCE
Chipped Insulators	
Severe detonation	Check for over-advanced timing or combustion
Improper gapping procedure	Re-gap spark plugs
Rust Colored Deposits	
Additives in unleaded fuel	Try different fuel brand
Water In Combustion Chamber	
Blown head gasket or cracked head	Repair or replace head or head gasket

NOTE: Before diagnosing an electronic ignition system, ensure that all wiring is connected properly between distributor, wiring connector and spark plugs. Ignition problem will show up either as: Engine Will Not Start or Engine Runs Rough.

BASIC ELECTRONIC IGNITION TROUBLE SHOOTING CHARTS

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Won't Start	
Open circuit between distributor and bulkhead connector	Repair circuit
Open circuit between bulkhead connector and ignition switch	Repair circuit
Open circuit between ignition switch and starter solenoid	Repair circuit
Engine Runs Rough	
Fuel lines leaking or clogged	Tighten fitting, remove restriction
Initial timing incorrect	Reset ignition timing see ENGINE PERFORMANCE
Centrifugal advance malfunction	Repair distributor advance
Defective spark plugs or wiring	Replace plugs or plug wiring
Component Failure	
Spark arc-over on cap, rotor or coil	Replace cap, rotor or or coil

Defective pick-up coil	Replace pick-up coil
Defective ignition coil	Replace ignition coil
Defective vacuum unit	Replace vacuum unit
Defective control module	Replace control module

BASIC ELECTRONIC IGNITION TROUBLE SHOOTING CHARTS - USING OSCILLOSCOPE PATTERNS

CONDITION & POSSIBLE CAUSE	CORRECTION
Firing Voltage Lines are the Same, but Abnormally High	
Retarded ignition timing	Reset ignition timing, see ENGINE PERFORMANCE section
Fuel mixture too lean	Readjust carburetor, see ENGINE PERFORMANCE
High resistance in coil wire	Replace coil wire
Corrosion in coil tower terminal	Clean and/or replace coil
Corrosion in distributor coil terminal	Clean and/or replace distributor cap
Firing Voltage Lines are the Same but Abnormally Low	
Fuel mixture too rich	Readjust carburetor, see ENGINE PERFORMANCE
Breaks in coil wire causing arcing	Replace coil wire
Cracked coil tower causing arcing	Replace coil
Low coil output	Replace coil
Low engine compression	Determine cause and repair
One or More, But Not All Firing Voltage Lines are Higher Than Others	
Carburetor idle mixture not balanced	Readjust carburetor, see ENGINE PERFORMANCE
EGR valve stuck open	Clean and/or replace valve
High resistance in spark plug wires	Replace spark plug wires
Cracked or broken spark plug insulator	Replace spark plugs
Intake vacuum leak	Repair leak
Defective spark plugs	Replace spark plugs
Corroded spark plug terminals	Replace spark plugs
One or More, But Not All Firing Voltage Lines Are Lower Than Others	
Curb idle mixture not balanced	Readjust carburetor, see ENGINE PERFORMANCE
Breaks in plug wires	Replace plug wires causing arcing
Cracked coil tower causing arcing	Replace coil
Low compression	Determine cause and repair
Defective spark plugs	Replace spark plugs

Corroded spark plugs	Replace spark plugs
Cylinders Not Firing	
Cracked distributor cap terminals	Replace distributor cap
Shorted spark plug wire	Determine cause and repair
Mechanical problem in engine	Determine cause and repair
Defective spark plugs	Replace spark plugs
Spark plugs fouled	Replace spark plugs

BASIC DRIVEABILITY PROBLEMS TROUBLE SHOOTING

CONDITION & POSSIBLE CAUSE	CORRECTION
Hard Starting	
Binding carburetor linkage	Eliminate binding
Binding choke linkage	Eliminate binding
Binding choke piston	Eliminate binding
Restricted choke vacuum	Check vacuum lines for blockage
Worn or dirty needle valve and seat	Clean carburetor, see ENGINE PERFORMANCE
Float sticking	Readjust or replace float see the ENGINE PERFORMANCE section
Incorrect choke adjustment	Reset choke adjustment see ENGINE PERFORMANCE
Defective coil	Replace coil
Improper spark plug gap	Regap spark plugs
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Detonation	
Over-advanced ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Defective spark plugs	Replace spark plugs
Fuel lines clogged	Clean fuel lines
EGR system malfunction	Check and repair EGR system
PCV system malfunction	Repair PCV system
Vacuum leaks	Check and repair vacuum system
Loose fan belts	Tighten or replace fan belts, see ENGINE PERFORMANCE
Restricted airflow	Remove restriction
Vacuum advance malfunction	Check distributor operation
Dieseling	
Binding carburetor linkage	Eliminate binding

Binding throttle linkage	Eliminate blinding
Binding choke linkage or fast idle cam	Eliminate binding
Defective idle solenoid	Replace idle solenoid see ENGINE PERFORMANCE
Improper base idle speed	Reset idle speed, see see ENGINE PERFORMANCE
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Incorrect idle mixture setting	Reset idle mixture, see ENGINE PERFORMANCE
Faulty Acceleration	
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Engine cold and choke too lean	Adjust choke and allow engine to warm-up
Defective spark plugs	Replace spark plugs
Defective coil	Replace coil
Faulty Low Speed Operation	
Clogged idle transfer slots	Clean idle transfer slots, see FUEL
Restricted idle air bleeds and passages	Disassemble and clean carburetor, see FUEL
Clogged air cleaner	Replace air filter
Defective spark plugs	Replace spark plugs
Defective ignition wires	Replace ignition wire see ENGINE PERFORMANCE
Defective distributor cap	Replace distributor cap
Faulty High Speed Operation	
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Defective distributor centrifugal advance	Replace advance mechanism
Defective distributor vacuum advance	Replace advance unit
Incorrect spark plugs or plug gap	Check gap and/or replace spark plugs
Faulty choke operation	Check choke and repair as required
Clogged vacuum passages	Remove restrictions
Improper size or clogged main jet	Check jet size and clean, see FUEL
Restricted air cleaner	Check filter and replace as necessary
Defective distributor cap, rotor or coil	Replace cap, rotor or coil
Misfire at All Speeds	

Defective spark plugs	Replace spark plugs
Defective spark plug wires	Replace spark plug wires
Defective distributor cap, rotor, or coil	Replace cap, rotor, or coil
Cracked or broken vacuum hoses	Replace vacuum hoses
Vacuum leaks	Repair vacuum leaks
Fuel lines clogged	Remove restriction
Hesitation	
Cracked or broken vacuum	Replace vacuum hoses hoses
Vacuum leaks	Repair Vacuum leaks
Binding carburetor linkage	Eliminate binding
Binding throttle linkage	Eliminate binding
Binding choke linkage or fast idle cam	Eliminate binding
Improper float setting	Readjust float setting, see FUEL
Cracked or broken ignition wires	Replace ignition wires
Rough Idle, Missing or Stalling	
Incorrect curb idle or fast idle speed	Reset idle speed, see see ENGINE PERFORMANCE
Incorrect basic timing	Reset ignition timing see ENGINE PERFORMANCE
Improper idle mixture adjustment	Reset idle mixture, see ENGINE PERFORMANCE
Improper feedback system operation	Check feedback system see ENGINE PERFORMANCE
Incorrect spark plug gap	Reset spark plug gap, see ENGINE PERFORMANCE
Moisture in ignition components	Dry components
Loose or broken ignition wires	Replace ignition wires
Damaged distributor cap or or rotor	Replace distributor cap or rotor
Faulty ignition coil	Replace ignition coil
Fuel filter clogged or worn	Replace fuel filter
Damaged idle mixture screw	Replace idle mixture screw, see FUEL
Improper fast idle cam adjustment	Reset fast idle cam adjustment, see TUNE- see ENGINE PERFORMANCE
Improper EGR valve operation	Replace EGR valve
Faulty PCV valve air flow	Replace PCV valve
Choke binding or improper choke setting	Reset choke or eliminate binding
Vacuum leak	Repair vacuum leak
Improper float bowl fuel level	Reset float adjustment, see

	FUEL
Clogged air bleed or idle passages	Clean carburetor passages, see FUEL
Clogged or worn air cleaner filter	Replace air filter
Faulty choke vacuum diaphragm	Replace diaphragm, see ENGINE PERFORMANCE
Exhaust manifold heat valve inoperative	Replace heat valve
Improper distributor spark advance	Check distributor operation
Leaking valves or valve components	Check and repair valvetrain
Improper carburetor mounting	Remove and remount carburetor
Excessive play in distributor shaft	Replace distributor
Loose or corroded wiring connections	Repair or replace as required
Engine Surges	
Improper PCV valve airflow	Replace PCV valve
Vacuum leaks	Repair vacuum leaks
Clogged air bleeds	Remove restriction
EGR valve malfunction	Replace EGR valve
Restricted air cleaner filter	Replace air filter
Cracked or broken vacuum hoses	Replace vacuum hoses
Cracked or broken ignition wires	Replace ignition wires
Vacuum advance malfunction	Check unit and replace as necessary
Defective or fouled spark plugs	Replace spark plugs
Ping or Spark Knock	
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Distributor centrifugal or vacuum advance malfunction	Check operation and replace as necessary
Carburetor setting too lean	Readjust mixture setting, see ENGINE PERFORMANCE
Vacuum leak	Eliminate vacuum leak
EGR valve malfunction	Replace EGR valve
Poor Gasoline Mileage	
Cracked or broken vacuum	Replace vacuum hoses hoses
Vacuum leaks	Repair vacuum leaks
Defective ignition wires	Replace wires
Incorrect choke setting	Readjust setting, see ENGINE PERFORMANCE
Defective vacuum advance	Replace vacuum advance
Defective spark plugs	Replace spark plugs
Binding carburetor power piston	Eliminate binding

Dirt in carburetor jets	Clean and/or replace jets
Incorrect float adjustment	Readjust float setting, see FUEL
Defective power valve	Replace power valve, see ENGINE PERFORMANCE
Incorrect idle speed	Readjust idle speed
Engine Stalls	
Improper float level	Readjust float level
Leaking needle valve and seat	Replace needle valve and seat
Vacuum leaks	Eliminate vacuum leaks

VACUUM PUMP - DIESEL TROUBLE SHOOTING

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NOTE: Diesel engines mechanical diagnosis is the same as gasoline engines for items such as noisy valves, bearings, pistons, etc. The following trouble shooting covers only items pertaining to diesel engines.

VACUUM PUMP (DIESEL) TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Excessive Noise	
Loose pump-to-drive assembly screws	Tighten screws
Loose tube on pump assembly	Tighten tube
Valves not functioning properly	Replace valves
Oil Leakage	
Loose end plug	Tighten end plug
Bad seal crimp	Remove and re-crimp seal

MANUAL TRANSMISSION

MANUAL TRANSMISSION TROUBLE SHOOTING

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MANUAL TRANSMISSION/TRANSAXLE TROUBLE SHOOTING

Condition	Possible Cause
Noisy In Forward Gears	Low gear oil level, Loose bell housing bolts, Worn bearings or gears
Clunk On Deceleration (FWD Only)	Loose engine mounts, Worn inboard CV joints, Worn differential pinion shaft, Side gear hub counterbore in case worn oversize
Gear Clash When Shifting Forward Gears	Clutch Out Of Adjustment, Shift linkage damaged or out of adjustment, Gears or synchronizers damaged, Low gear oil level
Transmission Noisy When Moving (RWD Only) Quiet In Neutral With Clutch Engaged	Worn rear outputshaft bearing
Gear Rattle	Worn bearings, Wrong gear oil, Low gear oil, Worn gears
Steady Ticking At Idle (Increases With RPM)	Broken tooth on gear
Gear Clash When Shifting Forward Gears	Worn or broken synchronizers
Loud Whine In Reverse	Normal condition ⁽¹⁾
Noise When Stepping On Clutch	Bad release bearing, Worn pilot bearing
Ticking Or Screeching As Clutch Is Engaged	Faulty release bearing, Uneven pressure plate fingers
Click Or Snap When Clutch Is Engaged	Worn clutch fork, Worn or broken front bearing retainer
Transmission Shifts Hard	Clutch not releasing, Shift mechanism binding, Clutch installed backwards
Will Not Shift Into One Gear, Shifts Into All Others	Bent shift fork, Worn detent balls
Locked Into Gear, Cannot Shift	Clutch adjustment, Worn detent balls
Transmission Jumps Out Of Gear	Pilot bearing worn, Bent shift fork, Worn gear teeth or face, Excessive gear train end play, Worn synchronizers, Missing detent ball spring, Shift mechanism worn or out of adjustment, Engine or transmission mount bolts loose or out of adjustment, Transmission not aligned
Shift Lever Rattle	Worn shift lever or detents, Worn shift forks, Worn synchronizers sleeve
Shift Lever Hops Under Acceleration	Worn engine or transmission mounts
(1) Most units use spur cut gears in reverse and are noisy	

POWERTRAIN

CLUTCH TROUBLE SHOOTING

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Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT**, **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing.

BASIC CLUTCH TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Chattering or Grabbing	
Incorrect clutch adjustment	Adjust clutch
Oil, grease or glaze on facings	Disassemble and clean or replace
Loose "U" joint flange	See DRIVE AXLES article
Worn input shaft spline	Replace input shaft
Binding pressure plate	Replace pressure plate
Binding release lever	See CLUTCH article
Binding clutch disc hub	Replace clutch disc
Unequal pressure plate contact	Replace worn/misaligned components
Loose/bent clutch disc	Replace clutch disc
Incorrect transmission alignment	Realign transmission
Worn pressure plate, disc or flywheel	Replace damaged components
Broken or weak pressure springs	Replace pressure plate
Sticking clutch pedal	Lubricate clutch pedal & linkage
Incorrect clutch disc facing	Replace clutch disc
Engine loose in chassis	Tighten all mounting bolts
Failure to Release	
Oil or grease on clutch facings	Clean or replace clutch disc
Incorrect release lever or pedal adjustment	See CLUTCH article
Worn or broken clutch facings	Replace clutch disc
Bent clutch disc or pressure plate	Replace damaged components
Clutch disc hub binding on input shaft	Clean or replace clutch disc and/or input shaft
Binding pilot bearing	Replace pilot bearing
Sticking release bearing sleeve	Replace release bearing and/or sleeve
Binding clutch cable	See CLUTCH article
Defective clutch master	Replace master cylinder
Defective clutch slave	Replace slave cylinder
Air in hydraulic system	Bleed hydraulic system
Rattling	
Weak or broken release lever spring	Replace spring and check alignment
Damaged pressure plate	Replace pressure plate

Broken clutch return spring	Replace return spring
Worn splines on clutch disc or input shaft	Replace clutch disc and/or input shaft
Worn clutch release bearing	Replace release bearing
Dry or worn pilot bearing	Lubricate or replace pilot bearing
Unequal release lever contact	Align or replace release lever
Incorrect pedal free play	Adjust free play
Warped or damaged clutch disc	Replace damaged components
Slipping	
Pressure springs worn or	Release pressure plate
Oily, greasy or worn facings	Clean or replace clutch disc
Incorrect clutch alignment	Realign clutch assembly
Warped clutch disc or pressure plate	Replace damaged components
Binding release levers or clutch pedal	Lubricate and/or replace release components
Squeaking	
Worn or damaged release	Replace release bearing
Dry or worn pilot or release bearing	Lubricate or replace assembly
Pilot bearing turning in crankshaft	Replace pilot bearing and/or crankshaft
Worn input shaft bearing	Replace bearing and seal
Incorrect transmission alignment	Realign transmission
Dry release fork between pivot	Lubricate release fork and pivot
Heavy and/or Stiff Pedal	
Sticking release bearing sleeve	Replace release bearing and/or sleeve
Dry or binding clutch pedal hub	Lubricate and align components
Floor mat interference with pedal	Lay mat flat in proper area
Dry or binding ball/fork pivots	Lubricate and align components
Faulty clutch cable	Replace clutch cable
Noisy Clutch Pedal	
Faulty interlock switch	Replace interlock switch
Self-adjuster ratchet noise	Lubricate or replace self-adjuster
Speed control interlock switch	Lubricate or replace interlock switch
Clutch Pedal Sticks Down	
Binding clutch cable	See CLUTCH article
Springs weak in pressure plate	Replace pressure plate
Binding in clutch linkage	Lubricate and free linkage
Noisy	
Dry release bearing	Lubricate or replace release bearing

Dry or worn pilot bearing	Lubricate or replace bearing
Worn input shaft bearing	Replace bearing
Transmission Click	
Weak springs in pressure	Replace pressure plate plate
Release fork loose on ball stud	Replace release fork and/or ball stud
Oil on clutch disc damper	Replace clutch disc
Broken spring in slave cylinder	Replace slave cylinder

DRIVE AXLE - NOISE DIAGNOSIS

Unrelated Noises

Some driveline trouble symptoms are also common to the engine, transmission, wheel bearings, tires, and other parts of the vehicle. Ensure cause of trouble actually is in the drive axle before adjusting, repairing, or replacing any of its parts.

Non-Drive Axle Noises

A few conditions can sound just like drive axle noise and have to be considered in pre-diagnosis. The 4 most common noises are exhaust, tires, CV/universal joints and wheel trim rings.

In certain conditions, the pitch of the exhaust gases may e gear whine. At other times, it may be mistaken for a wheel bearing rumble.

Tires, especially radial and snow, can have a high-pitched tread whine or roar, similar to gear noise. Also, some non-standard tires with an unusual tread construction may emit a roar or whine.

Defective CV/universal joints may cause clicking noises or excessive driveline play that can be improperly diagnosed as drive axle problems.

Trim and moldings also can cause a whistling or whining noise. Ensure none of these components are causing the noise before disassembling the drive axle.

Gear Noise

A "howling" or "whining" noise from the ring and pinion gear can be caused by an improper gear pattern, gear damage, or improper bearing preload. It can occur at various speeds and driving conditions, or it can be continuous.

Before disassembling axle to diagnose and correct gear ke sure that tires, exhaust, and vehicle trim have been checked as possible causes.

Chuckle

This is a particular rattling noise that sounds like a stick against the spokes of a spinning bicycle wheel. It occurs while decelerating from 40 MPH and usually can be heard until vehicle comes to a complete stop. The

frequency varies with the speed of the vehicle.

A chuckle that occurs on the driving phase is usually caused by clearance due to differential gear wear, or by a damaged tooth on the coast side of the pinion or ring gear. Even a very small tooth nick or a ridge on the edge of a gear tooth is enough to cause the noise.

This condition can be corrected simply by cleaning the gear tooth nick or ridge with a small grinding wheel. If either gear is damaged or scored badly, the gear set must be replaced. If metal has broken loose, the carrier and housing must be cleaned to remove particles that could cause damage.

Knock

This is very similar to a chuckle, though it may be louder, and occur on acceleration or deceleration. Knock can be caused by a gear tooth that is damaged on the drive side of the ring and pinion gears. Ring gear bolts that are hitting the carrier casting can cause knock. Knock can also be due to excessive end play in the axle shafts.

Clunk

Clunk is a metallic noise heard when an automatic transmission is engaged in Reverse or Drive, or when throttle is applied or released. It is caused by backlash somewhere in the driveline, but not necessarily in the axle. To determine whether driveline clunk is caused by the axle, check the total axle backlash as follows:

1. Raise vehicle on a frame or twinpost hoist so that drive wheels are free. Clamp a bar between axle companion flange and a part of the frame or body so that flange cannot move.
2. On conventional drive axles, lock the left wheel to keep it from turning. On all models, turn the right wheel slowly until it is felt to be in Drive condition. Hold a chalk marker on side of tire about 12" from center of wheel. Turn wheel in the opposite direction until it is again felt to be in Drive condition.
3. Measure the length of the chalk mark, which is the total axle backlash. If backlash is one inch or less, drive axle is not the source of clunk noise.

Bearing Whine

Bearing whine is a high-pitched sound similar to a whistle. It is usually caused by malfunctioning pinion bearings. Pinion bearings operate at drive shaft speed. Roller wheel bearings may whine in a similar manner if they run completely dry of lubricant. Bearing noise will occur at all driving speeds. This distinguishes it from gear whine, which usually comes and goes as speed changes.

Bearing Rumble

Bearing rumble sounds like marbles being tumbled. It is usually caused by a malfunctioning wheel bearing. The lower pitch is because the wheel bearing turns at only about 1/3 of drive shaft speed.

Chatter On Turns

This is a condition where the entire front or rear of vehicle vibrates when vehicle is moving. The vibration is plainly felt as well as heard. Extra differential thrust washers installed during axle repair can cause a condition of partial lock-up that creates this chatter.

Axle Shaft Noise

Axle shaft noise is similar to gear noise and pinion bearing whine. Axle shaft bearing noise will normally distinguish itself from gear noise by occurring in all driving modes (Drive, cruise, coast and float), and will persist with transmission in Neutral while vehicle is moving at problem speed.

If vehicle displays this noise condition, remove suspect parts, replace wheel seals and install a new set of bearings. Re-evaluate vehicle for noise before removing any internal components.

Vibration

Vibration is a high-frequency trembling, shaking or grinding condition (felt or heard) that may be constant or variable in level and can occur during the total operating speed range of the vehicle.

The types of vibrations that can be felt in the vehicle can be divided into 3 main groups:

- Vibrations of various unbalanced rotating parts of the vehicle.
- Resonance vibrations of the body and frame structures caused by rotating of unbalanced parts.
- Tip-in moans of resonance vibrations from stressed engine or exhaust system mounts or driveline flexing modes.

DRIVE AXLE - RWD TROUBLE SHOOTING

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DRIVE AXLE (RWD) TROUBLE SHOOTING

CONDITION & POSSIBLE CAUSE	CORRECTION
Knocking or Clunking	
Differential Side Gear Clearance	Check Clearance
Worn Pinion Shaft	Replace Pinion Shaft
Axle Shaft End Play	Check End Play
Missing Gear Teeth	Check Differential/Replace Gear
Wrong Axle Backlash	Check Backlash
Misaligned Driveline	Realign Driveline
Clinking During Engagement	
Side Gear Clearance	Check Clearance
Ring and Pinion Backlash	Check Backlash
Worn/Loose Pinion Shaft	Replace Shaft/Bearing

Bad "U" Joint	Replace "U" Joint
Sticking Slip Yoke	Lube Slip Yoke
Broken Rear Axle Mount	Replace Mount
Loose Drive Shaft Flange	Check Flange
Click/Chatter On Turns	
Differential Side Gear Clearance	Check Clearance
Wrong Turn On Plates ⁽¹⁾	Replace Clutch Plates
Wrong Differential Lubricant ⁽¹⁾	Change Lubricant
Knock Or Click	
Flat Spot on Rear Wheel Bearing	Replace Wheel Bearing
Low Vibration At All Speeds	
Faulty Wheel Bearing	Replace Wheel Bearing
Faulty "U" Joint	Replace "U" Joint
Faulty Drive Shaft	Balance Drive Shaft
Faulty Companion Flange	Replace Flange
Faulty Slip Yoke Flange	Replace Flange
(1) Limited slip differential only.	

FWD AXLE SHAFTS & CV JOINTS TROUBLE SHOOTING

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT**, **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing.

BASIC FWD AXLE SHAFTS & CV JOINTS TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE
Grease Leaks	CV boot torn or cracked
Clicking Noise on Cornering	Damaged outer CV
Clunk Noise on Acceleration	Damaged inner CV
Vibration or Shudder on Acceleration	Sticking, damaged or worn CV Misalignment or spring height

STEERING & SUSPENSION

MANUAL STEERING GEAR TROUBLE SHOOTING

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DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC MANUAL STEERING GEAR TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Rattle or Chucking Noise in Rack and Pinion	
Rack and pinion mounting bracket loose	Tighten all mounting bolts
Lack of/or incorrect lubricant	Correct as necessary
Steering gear mounting bolts loose	Tighten all mounting bolts
Excessive Play	
Front wheel bearing improperly adjusted	See FRONT SUSPENSION article
Loose or worn steering linkage	See STEERING LINKAGE article
Loose or worn steering gear shift	See MANUAL STEERING GEAR article
Steering arm loose on gear shaft	See MANUAL STEERING GEAR article
Steering gear housing bolts loose	Tighten all mounting bolts
Steering gear adjustment too loose	See MANUAL STEERING GEAR article
Steering arms loose on knuckles	Tighten and check steering linkage
Rack and pinion mounting loose	Tighten all mounting bolts
Rack and pinion out of adjustment	See adjustment in STEERING article
Tie rod end loose	Tighten and check steering linkage
Excessive Pitman shaft-to-ball nut lash	Repair as necessary
Poor Returnability	
Lack of lubricant in ball joint or linkage	Lubricate and service systems
Binding in linkage or ball joints	See STEERING LINKAGE and SUSPENSION article
Improper front end alignment	See WHEEL ALIGNMENT article
Improper tire pressure	Inflate to proper pressure
Tie rod binding	Inflate to proper pressure
Shaft seal rubbing shaft	See STEERING COLUMN article
Excessive Vertical Motion	
Improper tire pressure	Inflate to proper pressure
Tires, wheels or rotors out of balance	Balance tires then check wheels and rotors
Worn or faulty shock absorbers	Check and replace if necessary

Loose tie rod ends or steering	Tighten or replace if necessary
Loose or worn wheel bearings	See SUSPENSION article
Steering Pulls to One Side	
Improper tire pressure	Inflate to proper pressure
Front tires are different sizes	Rotate or replace if necessary
Wheel bearings not adjusted properly	See FRONT SUSPENSION article
Bent or broken suspension components	See FRONT SUSPENSION article
Improper wheel alignment	See WHEEL ALIGNMENT article
Brakes dragging	See BRAKES article
Instability	
Low or uneven tire pressure	Inflate to proper pressure
Loose or worn wheel bearings	See FRONT SUSPENSION article
Loose or worn idler arm bushing	See FRONT SUSPENSION article
Loose or worn strut bushings	See FRONT SUSPENSION article
Incorrect front wheel alignment	See WHEEL ALIGNMENT article
Steering gear not centered	See MANUAL STEERING GEARS article
Springs or shock	Check and replace if necessary
Improper cross shaft	See MANUAL STEERING GEARS article

POWER STEERING TROUBLE SHOOTING

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BASIC POWER STEERING TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Rattle or Chucking Noise	
Pressure hoses touching engine parts	Adjust to proper clearance
Loose Pitman shaft	Adjust or replace if necessary
Tie rods ends or Pitman arm loose	Tighten and check system
Rack and pinion mounts loose	Tighten all mounting bolts

Free play in worm gear	See POWER STEERING GEAR article
Loose sector shaft or thrust bearing adjustment	See POWER STEERING GEAR
Free play in pot coupling	See STEERING COLUMN article
Worn shaft serrations	See STEERING COLUMN article
Growl in Steering Pump	
Excessive pressure in hoses	Restricted hoses, see POWER STEERING GEAR article
Scored pressure plates	See POWER STEERING GEAR article
Scored thrust plates or rotor	See POWER STEERING GEAR article
Extreme wear of cam ring	See POWER STEERING GEAR article
Rattle in Steering Pump	
Vanes not installed	See POWER STEERING PUMP article
Vanes sticking in rotor	See POWER STEERING PUMP article
Swish noise in Pump	
Defective flow control valve	See POWER STEERING PUMP article
Groan in Steering Pump	
Air in fluid	See POWER STEERING PUMP article
Poor pressure hose connection	Tighten and check, replace if necessary
Squawk When Turning	
Damper "O" ring on valve spool cut	See POWER STEERING PUMP article
Moan or Whine in Pump	
Pump shaft bearing scored	Replace bearing and fluid
Air in fluid or fluid level low	See POWER STEERING PUMP article
Hose or column grounded	Check and replace if necessary
Cover "O" ring missing or damaged	See POWER STEERING PUMP article
Valve cover baffle missing or damaged	See POWER STEERING PUMP article
Interference of components in pump	See POWER STEERING

	PUMP article
Loose or poor bracket alignment	Correct or replace if necessary
Hissing When Parking	
Internal leakage in steering gear	Check valved assembly first
Chirp in Steering Pump	
Loose or worn power steering belt	Adjust or replace if necessary
Buzzing When Not Steering	
Noisy pump	See POWER STEERING PUMP article
Free play in steering shaft bearing	See STEERING COLUMN article
Bearing loose on shaft serrations	See STEERING COLUMN article
Clicking Noise in Pump	
Pump slippers too long	See POWER STEERING PUMP article
Broken slipper springs	See POWER STEERING PUMP article
Excessive wear or nicked rotors	See POWER STEERING PUMP article
Damaged cam contour	See POWER STEERING PUMP article
Poor Return of Wheel	
Wheel rubbing against turn signal	See STEERING COLUMN SWITCHES article
Flange rubbing steering gear adjuster	See STEERING COLUMN article
Tight or frozen steering shaft bearing	See STEERING COLUMN article
Steering gear out of adjustment	See POWER STEERING GEAR article
Sticking or plugged spool valve	See POWER STEERING PUMP article
Improper front end alignment	See WHEEL ALIGNMENT article
Wheel bearings worn or loose	See FRONT SUSPENSION article
Ties rods or ball joints binding	Check and replace if necessary
Intermediate shaft joints binding	See STEERING COLUMN article
Kinked pressure hoses	Correct or replace if necessary
Loose housing head spanner nut	See POWER STEERING GEAR article

Damaged valve lever	See POWER STEERING GEAR article
Sector shaft adjusted too tight	See ADJUSTMENTS in POWER STEERING GEAR article
Worm thrust bearing adjusted too tight	See ADJUSTMENTS in POWER STEERING GEAR article
Reaction ring sticking in cylinder	See POWER STEERING GEAR article
Reaction ring sticking in housing head	See POWER STEERING GEAR article
Steering pump internal leakage	See POWER STEERING PUMP article
Steering gear-to-column misalignment	See STEERING COLUMN article
Lack of lubrication in linkage	Service front suspension
Lack of lubrication in ball joints	Service front suspension
Increased Effort When Turning Wheel Fast Foaming, Milky Power Steering Fluid, Low Fluid Level or Low Pressure	
High internal pump leakage	See POWER STEERING PUMP article
Power steering pump belt slipping	Adjust or replace if necessary
Low fluid level	Check and fill to proper level
Engine idle speed too low	Adjust to correct setting
Air in pump fluid system	See POWER STEERING PUMP article
Pump output low	See POWER STEERING PUMP article
Steering gear malfunctioning	See POWER STEERING GEAR article
Wheel Surges or Jerks	
Low fluid level	Check and fill to proper level
Loose fan belt	Adjust or replace if necessary
Insufficient pump pressure	See POWER STEERING PUMP article
Sticky flow control valve	See POWER STEERING PUMP article
Linkage hitting oil pan at full turn	Replace bent components
Kick Back or Free Play	
Air in pump fluid system	See POWER STEERING PUMP article
Worn poppet valve in steering gear	See POWER STEERING PUMP article

Excessive over center lash	See POWER STEERING GEAR article
Thrust bearing out of adjustment	See POWER STEERING GEAR article
Free play in pot coupling	See POWER STEERING PUMP article
Steering gear coupling loose on shaft	See POWER STEERING PUMP article
Steering disc mounting bolts loose	Tighten or replace if necessary
Coupling loose on worm shaft	Tighten or replace if necessary
Improper sector shaft adjustment	See POWER STEERING GEAR article
Excessive worm piston side play	See POWER STEERING GEAR article
Damaged valve lever	See POWER STEERING GEAR article
Universal joint loose	Tighten or replace if necessary
Defective rotary valve	See POWER STEERING GEAR article
No Power When Parking	
Sticking flow control valve	See POWER STEERING PUMP article
Insufficient pump pressure output	See POWER STEERING PUMP article
Excessive internal pump leakage	See POWER STEERING PUMP article
Excessive internal gear leakage	See POWER STEERING PUMP article
Flange rubs against gear adjust plug	See STEERING COLUMN article
Loose pump belt	Adjust or replace if necessary
Low fluid level	Check and add proper amount of fluid
Engine idle too low	Adjust to correct setting
Steering gear-to-column misaligned	See STEERING COLUMN article
No Power, Left Turn	
Left turn reaction seal "O" ring worn	See POWER STEERING GEAR article
Left turn reaction seal damaged/missing	See POWER STEERING GEAR article

Cylinder head "O" ring damaged	See POWER STEERING PUMP article
No Power, Right Turns	
Column pot coupling bottomed	See STEERING COLUMN article
Right turn reaction seal "O" ring worn	See POWER STEERING GEAR article
Right turn reaction seal damaged	See POWER STEERING GEAR article
Internal leakage through piston end plug	See POWER STEERING GEAR article
Internal leakage through side plugs	See POWER STEERING GEAR article
Lack of Effort in Turning	
Left and/or right reaction seal sticking in cylinder head	Replace, see POWER STEERING GEAR article
Wanders to One Side	
Front end alignment incorrect	See WHEEL ALIGNMENT article
Unbalanced steering gear valve	See POWER STEERING GEAR article
Low Pressure Due to Steering Pump	
Flow control valve stuck or inoperative	See POWER STEERING PUMP article
Pressure plate not flat against cam ring	See POWER STEERING PUMP article
Extreme wear of cam ring	Replace and check adjustments
Scored plate, thrust plate or rotor	See POWER STEERING PUMP article
Vanes not installed properly	See POWER STEERING PUMP article
Vanes sticking in rotor slots	See POWER STEERING PUMP article
Cracked/broken thrust or pressure plate	See POWER STEERING PUMP article

STEERING COLUMN TROUBLE SHOOTING

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BASIC STEERING COLUMN TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Noise in Steering	
Coupling pulled apart	See STEERING COLUMNS article
Column not correctly aligned	See STEERING COLUMNS article
Broken lower joint	Replace joint
Horn contact ring not	See STEERING COLUMN article
Bearing not lubricated	See STEERING COLUMN article
Shaft snap ring not properly seated	Reseat or replace snap ring
Plastic spherical joint not lubricated	See STEERING COLUMN article
Shroud or housing loose	Tighten holding screws
Lock plate retaining ring not seated	See STEERING COLUMN article
Loose sight shield	Tighten holding screws
High Steering Shaft Effort	
Column assembly misaligned	See STEERING COLUMN article
Improperly installed dust shield	Adjust or replace
Tight steering universal joint	See STEERING COLUMN article
High Shift Effort	
Column is out of alignment	See STEERING COLUMN article
Improperly installed dust shield	Adjust or replace
Seals or bearings not lubricated	See STEERING COLUMNS article
Mounting bracket screws too long	Replace with new shorter screws
Burrs on shift tube	Remove burrs or replace tube
Lower bowl bearing assembled wrong	See STEERING COLUMN article
Shift tube bent or broken	Replace as necessary
Improper adjustment of shift levers	See STEERING COLUMN article
Improper Trans. Shifting	
Sheared shift tube joint	Replace as necessary
Sheared lower shaft lever	Replace as necessary
Improper shift lever adjustment	See STEERING COLUMN

	article
Improper gate plate adjustment	See STEERING COLUMN article
Excess Play in Column	
Instrument panel bracket bolts loose	Tighten bolts and check bracket
Broken weld nut on jacket	See STEERING COLUMN article
Instrument bracket capsule sheared	See STEERING COLUMN article
Column bracket/jacket bolts loose	Tighten bolts and check bracket
Steering Locks in Gear	
Release lever mechanism	See STEERING COLUMN article

SUSPENSION TROUBLE SHOOTING

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BASIC SUSPENSION TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Front End Noise	
Loose or worn wheel	See Wheel Bearing Adjustment in SUSPENSION
Worn shocks or shock mountings	Replace struts or strut mountings
Worn struts or strut mountings	Replace struts or strut mountings
Loose or worn lower control arm	See SUSPENSION
Loose steering gear-to-frame bolts	See STEERING
Worn control arm bushings	See SUSPENSION
Ball joints not lubricated	Lubricate ball joints & see Ball Joint Checking in SUSPENSION
Front Wheel Shake, Shimmy, or Vibration	
Tires or wheels out of balance	Check tire balance
Incorrect wheel alignment	See WHEEL ALIGNMENT
Drive shaft unbalanced	Check drive shaft balance
Loose or worn wheel bearings	See WHEEL ALIGNMENT

Loose or worn tie rod ends	See SUSPENSION
Worn upper ball joints	See Ball Joint Checking in SUSPENSION
Worn shock absorbers	Replace shock absorbers
Worn strut bushings	Replace strut bushings
Car Pulls to One Side	
Mismatched or uneven tires	Check tire condition
Broken or sagging springs	See SUSPENSION
Loose or worn strut bushings	See SUSPENSION
Improper wheel alignment	See WHEEL ALIGNMENT
Improper rear axle alignment	Check rear axle alignment
Power steering gear unbalanced	See STEERING
Front brakes dragging	See BRAKES
Abnormal Tire Wear	
Unbalanced tires	Check tire balance & rotation
Sagging or broken springs	See SUSPENSION
Incorrect front end alignment	See WHEEL ALIGNMENT
Faulty shock absorbers	Replace chock absorbers
Scuffed Tires	
Toe-In incorrect	See WHEEL ALIGNMENT
Suspension arm bent or twisted	See appropriate SUSPENSION article
Springs Bottom or Sag	
Bent or broken springs	See SUSPENSION
Leaking or worn shock absorbers	Replace shock absorbers
Frame misalignment	Check frame for damage
Spring Noises	
Loose "U" Bolts	See SUSPENSION
Loose or worn bushings	See SUSPENSION
Worn or missing interliners	See SUSPENSION
Shock Absorber Noise	
Loose shock mountings	Check & tighten mountings
Worn bushings	Replace bushings
Air in system	Bleed air from system
Undercoating on shocks	Remove undercoating
Car Leans or Sways on Corners	
Loose stabilizer bar	See SUSPENSION
Faulty shocks or mountings	Replace shocks or mountings
Broken or sagging springs	See SUSPENSION
Shock Absorbers Leaking	
Worn seals or reservoir tube crimped	See SUSPENSION

Broken Springs	
Loose "U" bolts	See SUSPENSION
Inoperative shock absorbers	Replace shock absorbers

WHEEL ALIGNMENT TROUBLE SHOOTING

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BASIC WHEEL ALIGNMENT TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Premature Tire Wear	
Improper tire inflation	Check tire pressure
Front alignment out of tolerance	See ALIGNMENT SPECS in WHEEL ALIGNMENT section
Suspension components worn	See SUSPENSION section
Steering system components worn	See STEERING section
Improper standing height	See WHEEL ALIGNMENT
Uneven or sagging springs	See SUSPENSION section
Bent wheel	See WHEEL ALIGNMENT
Improper torsion bar adjustment	See SUSPENSION section
Loose or worn wheel bearings	See WHEEL BEARING ADJ. in SUSPENSION section
Worn or defective shock	Replace shock absorbers
Tires out of balance	Check tire balance
Pulls to One Side	
Improper tire inflation	Check tire pressure
Brake dragging	See BRAKE section
Mismatched tires	See WHEEL ALIGNMENT
Broken or sagging spring	See SUSPENSION section
Broken torsion bar	See SUSPENSION section
Power steering valve not centered	See STEERING section
Front alignment out of tolerance	See WHEEL ALIGNMENT section
Defective wheel bearing	See WHEEL BEARINGS in SUSPENSION section
Uneven sway bar links	See SUSPENSION section
Frame bent	Check for frame damage
Steering system bushing worn	See STEERING section

Hard Steering

Idler arm bushing too tight	See STEERING LINKAGE in STEERING section
Ball joint tight or seized	See SUSPENSION section
Steering linkage too tight	See STEERING LINKAGE in STEERING section
Power steering fluid low	Add proper amount of fluid
Power steering drive belt loose	See STEERING section
Power steering pump defective	See STEERING section
Steering gear out of adjustment	See STEERING section
Incorrect wheel alignment	See WHEEL ALIGNMENT
Damaged steering gear	See STEERING section
Damaged suspension	See SUSPENSION section
Bent steering knuckle or supports	See SUSPENSION section

Vehicle "Wanders"

Strut rod or control arm bushing worn	See SUSPENSION section
Loose or worn wheel bearings	See WHEEL BEARINGS in SUSPENSION section
Improper tire inflation	Check tire pressure
Stabilizer bar missing or defective	See SUSPENSION section
Wheel alignment out of tolerance	See Adjustment in WHEEL ALIGNMENT section
Broken spring	See SUSPENSION section
Defective shock absorber	Replace shock absorbers
Worn steering & suspension components	See SUSPENSION section

Front End Shimmy

Tire out of balance/round	Check tire balance
Excessive wheel runout	See WHEEL ALIGNMENT
Insufficient or improper caster	See WHEEL ALIGNMENT section
Worn suspension or steering components	See SUSPENSION section
Defective shock absorbers	Replace shock absorber
Wheel bearings worn or loose	See WHEEL BEARING ADJ. in SUSPENSION section
Power steering reaction Bracket loose	See STEERING section
Steering gear box (rack) mounting loose	See STEERING section
Steering gear adjustment loose	See STEERING section
Worn spherical joints	See SUSPENSION section

Toe-In Not Adjustable

Lower control arm bent	See SUSPENSION section
Frame bent	Check frame for damage

Camber Not Adjustable

Control arm bent	See SUSPENSION section
Frame bent	Check frame for damage
Hub & bearing not seated properly	See SUSPENSION section

ELECTRICAL

12 V Starting and Charging - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Air Cleaner Assembly - Battery Tray Retaining Bolt	6	53 lb in
Battery Holder Retaining Nut	6	53 lb in
Battery Negative Cable Frame Ground Bolt	12	9 lb ft
Battery Tray Mounting Bolt	12	9 lb ft
ECM Bracket Retaining Bolt	10	89 lb in
Generator B (+) Nut	11	8 lb ft
Generator Under Bolt	22	16 lb ft
Generator Upper Bolt	22	16 lb ft
Negative Battery Cable Nut	12	9 lb ft
Positive Battery Cable Nut	12	9 lb ft
Starter Retaining Bolt	22	16 lb ft
Starter Solenoid B (+) Nut	11	8 lb ft
Wiring Harness Clip Retaining Nut	12	9 lb ft

BATTERY USAGE

Battery Usage

Application	Specification
Type	MF (Maintenance Free)
Amp Hours	40 AH (1.0L) / 50 AH (1.2L or 1.19L or Cold Area)
Cold Cranking Amperage (CCA)	50 AH: 375 EN CCA
RC	40 AH: 52 MIN / 50 AH: 70 MIN

STARTER USAGE

Starter Usage

Application	Specification
Model	PG260C
Output	1.2 KW

GENERATOR USAGE

Generator Usage

Application	Specification
Model	NP10
Output (Capacity)	12 (V)/100 (A)

SCHEMATIC WIRING DIAGRAMS

STARTING AND CHARGING WIRING SCHEMATICS

Starting Wiring Schematics

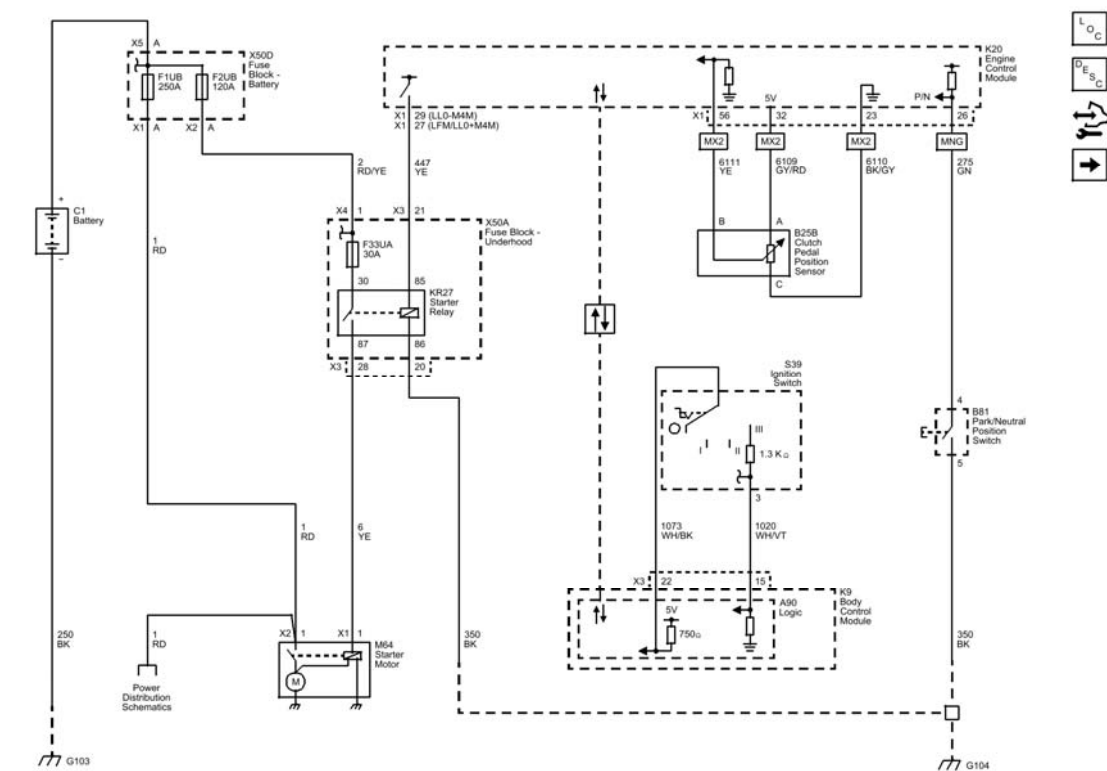


Fig. 1: Starting Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Charging Wiring Schematics

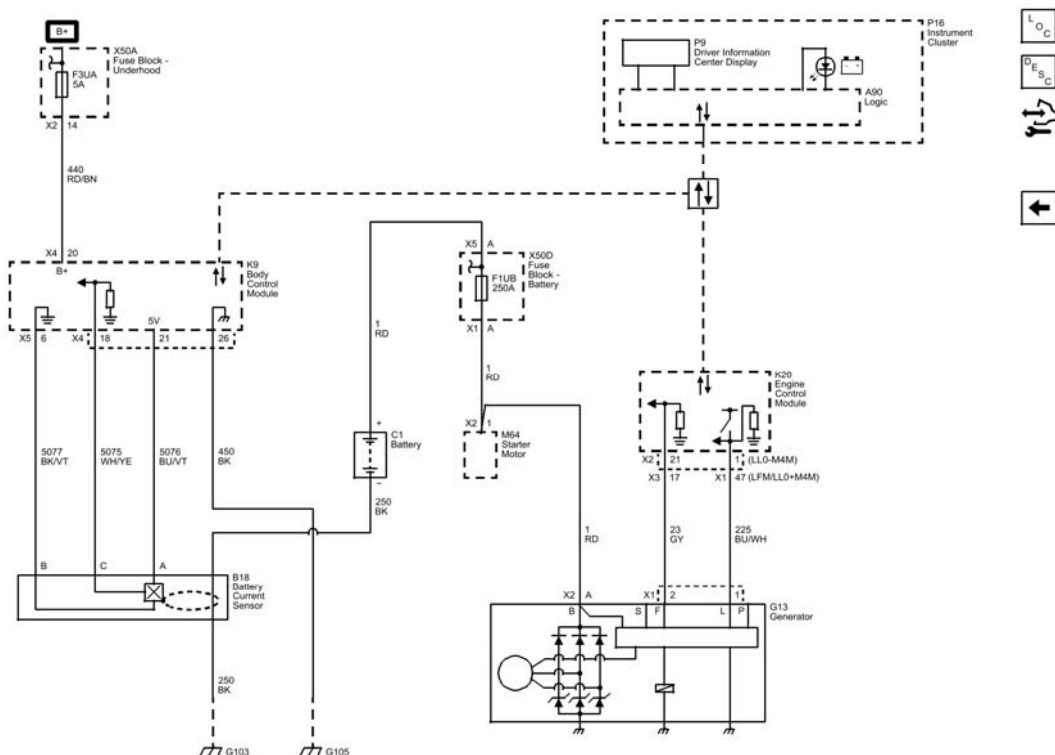


Fig. 2: Charging Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC B1325, B1330, B1517, C0800, P0560, P0562, or P0563</u>	DTC B1325 03 Control Module Power Circuit Low Voltage
	DTC B1325 07 Control Module Power Circuit High Voltage
	DTC B1330 03 Device Power 2 Circuit Low Voltage
	DTC B1517 03 Battery Voltage Low Voltage
	DTC B1517 07 Battery Voltage High Voltage
	DTC B1517 5A Battery Voltage Plausibility Failure
	DTC C0800 03 Control Module Power Circuit Low Voltage
	DTC C0800 07 Control Module Power Circuit High Voltage
	DTC C0800 08 Control Module Power Circuit Voltage Signal Invalid

	DTC C0800 11 Control Module Power Circuit High Input DTC C0800 12 Control Module Power Circuit Low Input DTC C0800 0D Control Module Power Circuit High Resistance DTC P0560 System Voltage DTC P0562 System Voltage Low Voltage DTC P0563 System Voltage High Voltage
<u>DTC B1516</u>	DTC B1516 08 Battery Current Sensor Performance - Signal Invalid DTC B1516 66 Battery Current Sensor Incorrect Mounting
<u>DTC B151A</u>	DTC B151A 58 Battery Capacity Performance
<u>DTC B1527</u>	DTC B1527 00 Parasitic Load
<u>DTC P0615, P0616, or P0617</u>	DTC P0615 Starter Relay Control Circuit DTC P0616 Starter Relay Control Circuit Low Voltage DTC P0617 Starter Relay Control Circuit High Voltage
<u>DTC P0621</u>	DTC P0621 Generator L-Terminal Circuit
<u>DTC P0622</u>	DTC P0622 Generator F-Terminal Circuit

DTC B1325, B1330, B1517, C0800, P0560, P0562, OR P0563: SYSTEM VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B1325 03

Control Module Power Circuit Low Voltage

DTC B1325 07

Control Module Power Circuit High Voltage

DTC B1330 03

Device Power 2 Circuit Low Voltage

DTC B1517 03

Battery Voltage Low Voltage

DTC B1517 07

Battery Voltage High Voltage

DTC B1517 5A

Battery Voltage Plausibility Failure

DTC C0800 03

Control Module Power Circuit Low Voltage

DTC C0800 07

Control Module Power Circuit High Voltage

DTC C0800 08

Control Module Power Circuit Voltage Signal Invalid

DTC C0800 11

Control Module Power Circuit High Input

DTC C0800 12

Control Module Power Circuit Low Input

DTC C0800 0D

Control Module Power Circuit High Resistance

DTC P0560

System Voltage

DTC P0562

System Voltage Low Voltage

DTC P0563

System Voltage High Voltage

Circuit/System Description

The vehicle control modules or sensors monitor the system voltage to verify the system voltage is within the normal operating range.

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

The control module or sensor detects a system voltage of less than approximately 9 V or greater than 18 V for approximately 5 s.

Action Taken When the DTC Sets

- A driver information center message and/or warning indicator may be displayed.
- The control module may be temporarily disabled.

Conditions for Clearing the DTC

The system voltage returns to normal operating range.

Diagnostic Aids

- A high or low voltage DTC set or voltage value in multiple modules/sensors indicates a concern in the charging system.
- A possible cause of this DTC could be overcharging with a battery charger or jump starting.

Reference Information

Schematic Reference

Control Module References

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **Inline Harness Connector End Views**

Description and Operation

Charging System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**

- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition OFF, measure and record the battery voltage at the battery terminals.
2. Verify the battery voltage stabilizes between 12.4 and 12.8 V within a few minutes of turning the ignition OFF.

- **If battery voltage is less than 12.4 V or more than 12.8 V**

Refer to **Battery Inspection/Test**.

- **If battery voltage is between 12.4 and 12.8 V**

3. Engine running, headlights ON, measure and record the battery voltage at the battery terminals.
4. Verify the voltage is at least 1 V greater than the voltage measured in step 1, but less than 15 V.
 - **If the voltage is not at least 1 V greater than the voltage measured in step 1 or is greater than 15 V.**

Refer to **Charging System Test**.

- **If the voltage is at least 1 V greater than the voltage measured in step 1, but less than 15 V.**

5. Verify the appropriate control module scan tool battery voltage and ignition voltage parameters are within 1 V of the battery voltage.

- **If not within 1 V of the battery voltage**

Refer to Circuit/System Testing.

- **If within 1 V of the battery voltage**

6. All OK.

Circuit/System Testing

NOTE: Use the schematic to identify the following:

- Control modules the vehicle is equipped with
- The control module's ground, B+, and Ignition circuit terminal IDs and connectors

NOTE: Some control module ground circuits may require up to 20 min after the ignition is turned off before achieving a resistance reading of less than 5 ohms. In most cases the readings will drop below 20 ohms within 1 min indicating the control module is going to sleep.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connectors at the appropriate control module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 ohms between each ground circuit terminal and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the appropriate control module.
 - **If the test lamp illuminates**
4. Ignition ON.
5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the appropriate control module.
 - **If the test lamp illuminates**

6. Replace the control module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for control module replacement, programming and setup

DTC B1516: BATTERY CURRENT SENSO

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B1516 08

Battery Current Sensor Performance - Signal Invalid

DTC B1516 66

Battery Current Sensor Incorrect Mounting

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	B1516 08	B1516 08	B1516 08	-
Signal	B1516 08	B1516 08	B1516 08	B1516 08, B1516 66
Low Reference	-	B1516 08	-	-

Circuit/System Description

The battery current sensor is a 3-wire hall effect current sensor. The body control module (BCM) supplies 5 V and ground to the battery current sensor. The battery current sensor measures the amount of current flowing to or from the battery, and supplies a pulse width modulation (PWM) signal to the BCM.

Conditions for Running the DTC

B1516 08

The BCM is awake.

B1516 66

- The BCM is awake.
- The engine is OFF.

Conditions for Setting the DTC

B1516 08

The battery current signal is less than 4% or greater than 96 % duty cycle for 2 min.

B1516 66

The battery current polarity is positive for 2 min.

Action Taken When the DTC Sets

The regulated voltage control is disabled.

Conditions for Clearing the DTC

The DTC passes when the battery current returns to the normal range for 15 s.

Diagnostic Aids

DTC B1516 08 could be set by overcharging with a battery charger or jump starting.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

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Description and Operation

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Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

B1516 08

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B18 Battery Current Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 30 ohms between the low reference circuit terminal B and ground.
 - **If 30 ohms or greater**
 1. Ignition OFF, disconnect the X5 harness connector at the K9 Body Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If less than 30 ohms**
3. Ignition ON.
4. Test for 4.8-5.2 V between the 5 V reference circuit terminal A and ground.
 - **If less than 4.8 V**
 1. Ignition OFF, disconnect the X4 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the 5V reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If greater than 5.2 V**
 1. Ignition OFF, disconnect the X4 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If between 4.8-5.2 V**
5. Test for 4.8-5.2 V between the signal circuit terminal C and ground.
 - **If less than 4.8 V**
 1. Ignition OFF, disconnect the X4 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the signal circuit end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.
- If less than 2 ohms, replace the K9 Body Control Module.
- **If greater than 5.2 V**
- 1. Ignition OFF, disconnect the X4 harness connector at the K9 Body Control Module, ignition ON.
- 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
- **If between 4.8-5.2 V**
- 6. Test or replace the B18 Battery Current Sensor.

B1516 66

1. Verify that the B18 Battery Current Sensor is installed securely around the negative battery cable, with the tape tab pointing away from the negative terminal on the C1 Battery.
 - **If the B18 Battery Current Sensor is not installed correctly**
 - Remove and reinstall the B18 Battery Current Sensor properly.
 - **If the B18 Battery Current Sensor is installed correctly**
2. Replace the B18 Battery Current Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Battery Positive and Negative Cable Replacement (LL0), Battery Positive and Negative Cable Replacement (LFM)**
- **Control Module References** for BCM replacement, programming and setup.

DTC B151A: BATTERY CAPACITY PERFORMANCE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B151A 58

Battery Capacity Performance

Circuit/System Description

The body control module (BCM) monitors the battery voltage level during an engine crank event to detect a low battery voltage condition.

Conditions for Running the DTC

The vehicle is ON

Conditions for Setting the DTC

A minimum crank battery voltage is less than the minimum crank battery voltage threshold for 16 consecutive crank events.

Action Taken When the DTC Sets

A driver information center message is displayed.

Conditions for Clearing the DTC

The DTC will clear if the minimum crank voltage is greater than the minimum crank voltage threshold during a crank event.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

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Electrical Information Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC P0621 or P0622 is not set.

- If DTC P0621 or P0622 is set

Refer to DTC P0621, or DTC P0622

- If DTC P0621 or P0622 is not set

2. Perform the Battery Inspection/Test.

DTC B1527: PARASITIC LOAD

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC B1527 00

Parasitic Load

Circuit/System Description

The body control module (BCM) monitors the state of charge of the electrical system.

Conditions for Running the DTC

The ignition is in Accessory or Run mode.

Conditions for Setting the DTC

The state of charge at ignition ON is 30% lower than when the engine was running and battery drain is more than 2 A.

Action Taken When the DTC Sets

There is no battery telltale illuminated or DIC message displayed.

Conditions for Clearing the DTC

- The DTC will clear if the fault does not return after 50 consecutive ignition cycles.
- The DTC will clear when run state of charge is greater than or equal to 80%.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Refer to **Battery Electrical Drain/Parasitic Load Test**.

DTC P0615, P0616, OR P0617: STARTER RELAY

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0615

Starter Relay Control Circuit

DTC P0616

Starter Relay Control Circuit Low Voltage

DTC P0617

Starter Relay Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	P0616	P0615	P0617	-
Ground	-	P0615	-	-

Circuit/System Description

When the ignition switch is placed in the START position, a discrete signal is supplied to the body control module (BCM) notifying it that the ignition is in the START position. The BCM then sends a message to the engine control module (ECM) that crank has been requested. The ECM then verifies that the clutch pedal is depressed or the transmission is in Park/Neutral. If it is, the ECM then supplies 12 V to the control circuit of the starter relay. When this occurs, battery voltage is supplied through the switch of the starter relay to the starter solenoid.

Conditions for Running the DTC

- The ignition is in the START position.
- The system voltage is between 9.5-18 V.

Conditions for Setting the DTC

The ECM detects improper voltage on the control circuit of the starter relay.

Action Taken When the DTC Sets

DTC P0615, P0616, and P0617 are type C DTCs.

Conditions for Clearing the DTC

DTC P0615, P0616, and P0617 are type C DTCs.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

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Starting System Description and Operation

Electrical Information Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the KR27 starter relay. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 86 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Ignition ON.
4. Verify a test lamp illuminates between the B+ circuit terminal 30 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is OK**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance,
 3. Test for infinite resistance between the control circuit terminal 87 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the KR27 starter relay.

- **If the test lamp illuminates**
- 5. Connect a test lamp between the control circuit terminal 85 and the ground circuit terminal 86.
- 6. Verify the test lamp turns ON and OFF when commanding the starter relay ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the harness connector at the K20 engine control module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 engine control module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the harness connector at the K20 engine control module, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 engine control module.
 - **If the test lamp turns ON and OFF**
- 7. Ignition ON, connect a 30 A fused jumper wire between the B+ circuit terminal 30 and the control circuit terminal 87.
- 8. Verify the M64 starter motor is activated.
 - **If the M64 starter motor does not activate**
 1. Ignition OFF, disconnect the harness connector at the M64 starter motor.
 2. Test for infinite resistance between the control circuit terminal X2 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the M64 starter motor.
 - **If the M64 starter motor activates**
- 9. Test or replace the KR27 starter relay.

Component Testing

Relay Test

1. Ignition OFF, disconnect the KR27 starter relay.
2. Test for 60-180 ohms between terminals 85 and 86.
 - **If less than 60 or greater than 180 ohms**

Replace the relay.

- **If between 60-180 ohms**

3. Test for infinite resistance between the terminals listed below:

- 30 and 86
- 30 and 87
- 30 and 85
- 85 and 87
- **If less than infinite resistance**

Replace the relay.

- **If infinite resistance**

4. Install a 20 A fused jumper wire between relay terminal 85 and 12 V. Install a jumper wire between relay terminal 86 and ground.
5. Test for less than 2 ohms between terminals 30 and 87
- **If 2 ohms or greater**

Replace the relay.

- **If less than 2 ohms**

6. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Relay Replacement (Within an Electrical Center)** , **Relay Replacement (Attached to Wire Harness)**
- **Control Module References** for ECM replacement, programming, and setup.

DTC P0621: GENERATOR L-TERMINAL

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0621

Generator L-Terminal Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	-	P0621	-	-
Control - L Terminal	P0621	P0621	P0621	-
Signal - F Terminal	P0622	P0622	P0622	P0622

Circuit/System Description

The engine control module (ECM) uses the generator turn on control circuit to control the load of the generator on the engine. A high side driver in the ECM applies a duty cycled voltage to the voltage regulator. The duty cycle controls the voltage regulator to turn the field circuit on and off. The ECM monitors the state of the generator turn on control circuit. The ECM should detect low voltage on the generator turn on control circuit when the ignition is ON and the engine is off, or when the charging system malfunctions. With the engine running, the ECM should detect on the generator turn on control circuit, a high voltage when the duty cycle voltage is commanded high, and a low voltage when the duty cycle voltage is commanded low.

Conditions for Running the DTC

- Ignition ON, engine OFF (Prior to Ignition ON, the ignition must have been OFF for at least 5 s).
- The engine is running for the run test.

Conditions for Setting the DTC

- Ignition ON, engine OFF - The ECM detects greater than 3.5 V on the generator control circuit for 5 s.
- Engine running - The ECM detects a low voltage for 15 s on the generator control circuit when the duty cycle voltage is commanded high.
- Engine running - The ECM detects a high voltage for 15 s on the generator control circuit when the duty cycle voltage is commanded low.

Action Taken When the DTC Sets

DTC P0621 is a type C DTC.

Conditions for Clearing the DTC

- Ignition ON, engine OFF- Low voltage.
- Engine running - A control signal duty cycle is detected.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
2. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**
3. All OK.

Circuit/System Testing

1. Verify a test lamp illuminates between the G13 Generator B+ circuit terminal A X2, B X2 or 1 X2, and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Remove the test lamp and disconnect the B+ cable at the G13 Generator.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**
- 1. Remove the test lamp, disconnect the battery negative cable, and disconnect the G13 Generator B+ cable.
- 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
- **If the test lamp illuminates**
- 2. Disconnect the X1 harness connector at the G13 Generator, ignition ON.
- 3. Test for 1 V or greater between the control circuit terminal 1 X1 and ground.
 - **If less than 1 V**
 - 1. Ignition OFF, disconnect the harness connectors at the K20 Engine Control Module.
 - 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 - 3. Test for less than 2 ohms in the control circuit end to end.
 - If greater than 2 ohms, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If 1V or greater**
 - 4. Ignition OFF, disconnect the harness connectors at the K20 Engine Control Module, Ignition ON.
 - 5. Test for less than 1 V between the G13 Generator control circuit terminal 1 X1 and ground.
 - **If greater than 1 V**
 - Repair the short to voltage on the circuit.
 - **If 1V or less**
 - 6. Test or replace the G13 Generator.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Generator Replacement**
- **Control Module References** for engine control module replacement, programming, and setup

DTC P0622: GENERATOR F-TERMINAL

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0622

Generator F-Terminal Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	-	P0621	-	-
Control - L Terminal	P0621	P0621	P0621	-
Signal - F Terminal	P0622	P0622	P0622	P0622

Circuit/System Description

The engine control module (ECM) uses the generator field duty cycle signal circuit, or F-terminal circuit, to monitor the duty cycle of the generator. The generator field duty cycle signal circuit connects to high side of the field windings in the generator. A pulse width modulated (PWM) high side driver in the voltage regulator turns the field windings on and off. The ECM uses the PWM signal input to determine the generator load on the engine. This allows the ECM to adjust the idle speed to compensate for high electrical loads. The ECM monitors the status of the generator field duty cycle signal circuit. When the ignition is ON and the engine is off, the ECM should detect a duty cycle near 0%. When the engine is running, the duty cycle should be between 5-99%.

Conditions for Running the DTC

- Ignition ON, engine OFF (Prior to Ignition ON, the ignition must have been OFF for at least 5 s)
- Engine running at less than 3, 000 RPM

Conditions for Setting the DTC

- DTC P0621 is not set
- Ignition ON, engine OFF (Prior to Ignition ON, the ignition must have been OFF for at least 5 s), the ECM detects a PWM signal that is greater than 65% for 5 s
- Engine running at less than 3, 000 RPM-The ECM detects a PWM signal that is less than 5% for 30 s

Action Taken When the DTC Sets

DTC P0622 is a type C DTC

Conditions for Clearing the DTC

- Ignition ON, Engine OFF- Low / no PWM signal detected
- Engine running - A 5-90% duty cycle is detected

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: Do not have a battery charger connected during the generator testing.

1. Engine running.
2. Verify the scan tool Engine Control Module Generator F-Terminal Signal parameter is between 5-90%.
 - **If not between 5-90%**

Refer to Circuit/System Testing.

- **If between 5-90%**
3. Verify the scan tool Generator F-Terminal Signal parameter changes when commanding the headlamps ON and OFF.
 - **If the parameter does not change**

Refer to Circuit/System Testing.

- **If the parameter changes**

4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
5. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

6. All OK.

Circuit/System Testing

1. Verify a test lamp illuminates between the G13 Generator B+ circuit terminal A X2, B X2 or 1 X2, and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Remove the test lamp and disconnect the B+ cable at the G13 Generator.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Remove the test lamp, disconnect the battery negative cable, and disconnect the G13 Generator B+ cable.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - **If the test lamp illuminates**
2. Disconnect the X1 harness connector at the G13 Generator, engine running.
3. Verify the scan tool Engine Control Module Generator F-Terminal Signal parameter is less than 5%.
 - **If 5% or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit terminal 2 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If less than 5%**
4. Install a 3 A fused jumper wire between the signal circuit terminal 2 and B+, engine running.
5. Verify the scan tool Engine Control Module Generator F-Terminal Signal parameter is greater than 95%.
 - **If 95% or less**
 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance
- 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit
 - If less than 2 ohms, replace the K20 Engine Control Module.
- **If greater than 95%**
- 6. Test or replace the G13 Generator.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Generator Replacement**
- **Control Module References** for engine control module replacement, programming, and setup

SYMPTOMS - ENGINE ELECTRICAL

NOTE: The following steps must be completed before using the symptom tables.

- Perform **Diagnostic System Check - Vehicle** before using the Symptom Tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data link.
- Review the system descriptions and operations in order to familiarize yourself with the system functions. Refer to one of the following system operations:
 - **Battery Description and Operation**
 - **Charging System Description and Operation**
 - **Electrical Power Management Description and Operation**
 - **Starting System Description and Operation**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the starting and charging systems. Refer to **Checking Aftermarket Accessories**.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections**.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- Battery Inspection/Test
- Battery Electrical Drain/Parasitic Load Test
- Charging System Test
- Generator Noise Diagnosis
- Starter Solenoid Does Not Click
- Starter Solenoid Clicks, Engine Does Not Crank
- Engine Cranks Slowly
- Starter Noise Diagnosis

BATTERY INSPECTION/TEST

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Diagnostic Aids

NOTE: For Warranty repairs -

You must use regionally required battery test equipment for warranty repairs.

For accurate test results the battery must be disconnected from the vehicle and the equipment connected directly to the battery posts. When setting up the equipment, select "Out of Vehicle" and then the correct battery type (Flooded or AGM) and rated CCA (both from the battery label) must be entered.

- **Failure to obtain the correct connections during the test may result in a failed test on a good battery.**
- **Use the Out of Vehicle test (both batteries disconnected with test equipment connected directly to the post) test for each battery when testing a vehicle with dual batteries.**

Follow these instructions in order to avoid an incorrect diagnosis because of connections:

- If testing the vehicle with the battery cables still connected, wiggle the battery tester clips on the terminal. This may cut through any coating or through any oxidation that may be present on the terminal.
- If correct connections to the battery terminals in the vehicle are in doubt, perform the following steps:
 1. Disconnect the negative battery cable.
 2. Disconnect the positive battery cable.
 3. Follow the instructions for testing a removed battery.
- If the tester displays a REPLACE BATTERY or BAD CELL-REPLACE result for a battery tested in the

vehicle with the battery cables connected, perform the following steps:

1. Disconnect the negative battery cable.
2. Disconnect the positive battery cable.

NOTE: Always write the test code displayed by the tester on the repair order for any warranty purposes. The number is a unique code that describes the test data for a particular battery at a particular time. The test code may occasionally repeat when you retest the same battery. More often, each test will result in a different code. Use the test code from the second, or Out of Vehicle test.

3. Follow the instructions for testing a removed battery.
4. Replace the battery only if the second test shows a REPLACE BATTERY or BAD CELL-REPLACE result.

Use the test code from the second test for any warranty purposes.

Reference Information

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Starting and Charging Schematics

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Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL 50313 Battery Tester

Circuit/System Testing

WARNING: Unless directed otherwise, the ignition and start switch must be in the OFF or LOCK position, and all electrical loads must be OFF before servicing any electrical component. Disconnect the negative battery cable to prevent an electrical spark should a tool or equipment come in contact with an exposed electrical terminal. Failure to follow these precautions may result in personal injury and/or damage to the vehicle or its components.

For Vehicles equipped with OnStar® (UE1) with Back Up Battery:

The Back Up Battery is a redundant power supply to allow limited OnStar® functionality in the event of a main vehicle battery power disruption to the VCIM (OnStar® module). Do not disconnect the main vehicle battery or remove the OnStar® fuse with the ignition key in any position other than OFF. Retained accessory power should be allowed to time out or be disabled (simply opening the driver door should disable retained accessory power) before disconnecting power. Disconnecting power to the OnStar® module in any way while the ignition is On or with retained accessory power activated may cause activation of the OnStar® Back-Up Battery system and will discharge and permanently damage the back-up battery. Once the Back-Up Battery is activated it will stay on until it has completely discharged. The back-up battery is not rechargeable and once activated the back-up battery must be replaced.

1. Verify the C1 or C1B Battery case is not cracked, broken, or damaged, which may be indicated by battery acid leakage.
 - **If there is any apparent damage**

Replace the C1 or C1B Battery.
 - **If there is no damage**
2. Verify the cold cranking amperage and amperage hour rating of the C1 or C1B Battery. Refer to the manufacturer specifications on the battery label.
 - **If the C1 or C1B Battery does not meet specifications**

Replace the C1 or C1B Battery.
 - **If the C1 or C1B Battery meets specifications**
3. Verify that the battery cables are clean and tight. The battery terminal bolts should be torqued as specified in **Fastener Tightening Specifications**.
 - **If the battery cables need to be cleaned or tightened**

Clean as required and tighten as specified.

- **If the battery cables are clean and tight**

4. Install the battery tester and follow directions supplied by the tester.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Battery Replacement

BATTERY CHARGING

Special Tools

EL 50313 Battery Tester

For equivalent regional tools, refer to **Special Tools**.

Diagnostic Aids

- For best results, use an automatic taper-rate battery charger with a voltage capability of 16 V.
- The charging area should be well ventilated.
- Do not charge a battery that appears to be frozen. Allow the battery to warm to room temperature and test it using the EL 50313 before charging.

Battery State of Charge

NOTE: **Using voltage to determine the batteries state of charge is only accurate after the battery has been at rest for 24 hours. This is enough time for the acid in each cell to equalize. If the battery has been charged or discharged in the past 24 hours, the battery state of charge will only be an estimate.**

The maintenance-free batteries state of charge is estimated by reading the voltage of the battery across the battery terminals. Because the voltage is affected by current flow into or out of the battery, the engine must be stopped and all electrical loads turned OFF, including parasitic loads, when checking the voltage. The voltage can also be affected if the battery has just been charged or discharged, so it is important to consider what has happened to the battery in the time just before testing. Use the following procedure to determine the battery's state of charge:

1. Be sure all electrical loads are turned OFF.
2. Determine whether the battery has been used in a vehicle or charged within the past 12 hours.
 - If the answer is no, the terminal voltage will be stabilized and no action is necessary before reading the voltage. Skip to step 3.
 - If the answer is yes, terminal voltage will not be stabilized and you should wait 12 hours since the last time the battery was used.
3. Estimate the battery temperature by determining the average temperature to which the battery has been

exposed for the past 12 hours.

NOTE: The table is accurate to 10 % only after the battery has been at rest for 12 hours.

4. Measure the battery voltage at the battery terminals. Refer to the following table to determine the state of charge according to the estimated battery temperature:

Battery Voltage	% Charge at 0°C (32°F)	% Charge at 25°C (75°F)
12.75 V	100%	100%
12.7 V	100%	90%
12.6 V	90%	75%
12.45 V	75%	65%
12.2 V	65%	45%
12.0 V	40%	20%

Use the state of charge information as follows:

- A battery with a state of charge that is below 65% must always be recharged before returning it to service or continuing storage.
- A battery with a state of charge that is 65% or greater is generally considered to be charged enough in order to be returned to normal service or in order to continue storage. However, if the battery is being used in slow traffic or with short drive times, or if the temperature is very hot or very cold, the battery should be fully charged, to at least 90%, before returning it to service or continuing storage.

Charging Time Required

The time required to charge a battery will vary depending upon the following factors:

- The battery charger capacity-The higher the charger amperage, the less time it will take to charge the battery.
- The state of charge of the battery-A completely discharged battery requires more than twice as much charging time as a half charged battery. In a discharged battery with a voltage below 11 V, the battery has a very high internal resistance and may only accept a very low current at first. Later, as the charging current causes the acid content to increase in the electrolyte, the charging current will increase. Extremely discharged batteries may not activate the reversed voltage protection in some chargers. Refer to the manufacturer's instructions for operating this circuitry.
- The temperature of the battery-The colder the battery is, the more time it takes to recharge the battery. The charging current accepted by a cold battery is very low at first. As the battery warms, the charging current will increase.

Charging Procedure

CAUTION: Turn OFF the ignition when connecting or disconnecting the battery cables, the battery charger or the jumper cables. Failure to do so may

damage the ECM/PCM or other electronic components.

CAUTION: Refer to Fastener Caution .

When charging side-terminal batteries with the battery cables connected, connect the charger to the positive cable bolt and to a ground located away from the battery. When charging side-terminal batteries with the battery cables disconnected, install the battery side terminal adapters and connect the charger to the adapters.

Tighten

Tighten the battery side terminal adapters to 15 (11 lb ft).

Use the following procedure to charge the battery:

1. Turn OFF the charger.
2. Ensure that all of the battery terminal connections are clean and tight.
3. Connect the charger positive lead to the battery positive terminal on the battery or the remote jumper stud underhood.

CAUTION: Do not connect the negative charger lead to the housings of other vehicle electrical accessories or equipment. The action of the battery charger may damage such equipment.

4. Connect the negative charger lead to a solid engine ground or to a ground stud in the engine compartment that is connected directly to the battery negative terminal, but away from the battery. If the negative battery cable is disconnected and a terminal adapter is being used, connect directly to the adapter.
5. Turn ON the charger and set to the highest setting for normal charging.
6. Inspect the battery every half hour after starting the battery charger.
 - Charge the battery until the taper-rate charger indicates that the battery is fully charged.
 - Estimate the battery temperature by feeling the side of the battery. If it feels hot to the touch or its temperature is over 45°C (125°F), discontinue charging and allow the battery to cool before resuming charging.
7. After charging, test the battery. Refer to Battery Inspection/Test.

BATTERY ELECTRICAL DRAIN/PARASITIC LOAD TEST

12 V Battery

The following procedure is for the 12 V battery only.

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

Components most likely to cause a parasitic draw on the vehicles battery are switches, relays, and control modules. After the ignition is turned OFF the control modules will begin to go to sleep (shut OFF). All control modules do not go to sleep at the same time, some may take up to 30 minutes or longer after turning the ignition off before going to sleep. Others such as the ON Star and keyless entry control modules may periodically wake up then go back to sleep. These are all normal conditions.

Diagnostic Aids

- Rule out any possible aftermarket equipment causing an unacceptable parasitic current drain. Aftermarket accessories installed into the courtesy lamp circuit can cause the inadvertent power timer in the body control module (BCM) to keep resetting. This may cause the BCM to remain awake and cause a current drain on the battery.
- Rule out customer driving habits such as regular short trips that do not allow enough time to properly charge the battery. Refer to **Battery Description and Operation**.
- Verify that the battery and charging system are in proper working order. Refer to **Battery Charging**, and **Charging System Test**.
- A battery discharging for no apparent reason while the vehicle is parked can be caused by an intermittent draw, such as a module waking up, or a continuous draw, such as a dome light or stuck relay.
- Some systems and modules such as OnStar®, and regulated voltage control, if equipped, are designed to wake up, perform a task, and go back asleep at regular intervals. Refer to **Body Control System Description and Operation** for the system or modules description and operation.
- An engine off natural vacuum evaporative test can occur if the engine control module (ECM) determines the drive cycle has met the appropriate criteria immediately after key off. The ECM will stay awake and the vent solenoid will stay energized for as long as 45 min. The typical current draw for this is about 1 A.
- Digital OnStar Generation 6 and later vehicle communication interface module do not "wake up" every 10 minutes for the first 48 hours as the Generation 5 and prior. Generation 6 and later vehicle communication interface module current draw is very low, less than 40 mA, so the OnStar system is left in that state for up to the first 48 h. Parasitic draw of up to 40 mA with an occasional spike as high as 80 mA through the vehicle communication interface module for the first 48 hours is normal.
- Some automatic climate control systems can remain in a semi awake state for up to three hours, actual draw amounts vary by vehicle platform but are typically not greater than 50 mA.
- An extremely low mA current level is consumed by the body control module for monitoring purposes, actual system wake up only occurs when the fobs for the vehicle are used. When other devices on the same remote keyless entry operating frequency are activated, such as the 4 tire pressure monitoring sensors and other vehicle Fobs in the vicinity, the body control module will have a 100 mA spike. These spikes are normal and occur too briefly to have a significant effect on battery drain. Competing signals may cause remote keyless entry performance issues such as jamming but should not cause excessive battery draw.
- If an excessive current draw is not present during initial testing, continue periodic testing over a 1-2 hour period to see if the current draw increases and stays above an unacceptable level.

NOTE: The battery specification listed below is a generic specification. Refer to the label on the original battery when testing the battery.

- The battery run down time will vary depending on the batteries reserve capacity. If the reserve capacity is higher, then the battery run down time may be longer. If the reserve capacity is lower, then the battery run down time may be shorter. The graph below indicates roughly how many days a 690 cold cranking amperage battery with a 110 min. reserve capacity starting at 80 percent state of charge will last with a constant current draw until it reaches 50 percent state of charge. Differences in battery reserve capacity and temperature will affect the results.

Current Drain	Days
25 mA	33
50 mA	16.5
75 mA	11
100 mA	8.25
250 mA	3.3
500 mA	1.65
750 mA	1
1 A	0.8
2 A	0.4

Reference Information

Schematic Reference

Control Module References

Connector End View Reference

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- Testing for Intermittent Conditions and Poor Connections
- Connector Repairs
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL 38758 Parasitic Draw Test Switch

For equivalent regional tools, refer to **Special Tools**.

Circuit/System Verification

NOTE:

- Most vehicle systems will go to sleep within 30 min, but it can take up to 2 hours before all systems power down allowing the parasitic draw test to pass. An occasional increase in the parasitic draw is normal as long as it returns within 1 s.
- Closing the door latches/ajar switch while leaving the doors open is recommended, this allows the vehicle systems to perform in a "doors closed" mode while allowing vehicle interior access that may be needed to complete the diagnostic steps.
- Locking doors will arm the vehicle content theft deterrent system if equipped. Failure to arm the system may cause a theft system fault to not be present during testing.
- There are many things that can prevent the vehicle from completely going to sleep and passing the parasitic draw test. Make sure all the conditions listed below are met before performing the parasitic current draw test.
 - Ignition OFF
 - Key out of the ignition switch - when not equipped with keyless access and start
 - Retained Accessory Power OFF - open and close the driver door after ignition OFF
 - Scan tool not communicating with a vehicle control module - in some cases it may need to be disconnected from the DLC
 - All access doors closed
 - Head lamps OFF - auto head lamps disabled
 - Any delay lighting OFF
 - If equipped with an under hood lamp disable it
 - HVAC after blow OFF
 - Any accessory that can work with ignition OFF inactive or OFF
 - Wait up to 2 min or longer, after all other listed conditions are met

Using an Inductive Pickup Probe

1. Connect an inductive pickup probe to the negative battery cable that can read down to 1 mA.
2. Ignition OFF, as the vehicle systems shut down test for less than 30 mA of parasitic current drain.
 - If greater than the specified range, refer to Circuit/System Testing.

Using the EL 38758 Parasitic Draw Test Switch

WARNING: Refer to **Battery Disconnect Warning** .

CAUTION: When a fused jumper wire or digital multimeter is connected to the test switch terminals, always turn the test switch ON before opening any access door, turning the ignition on, or turning any accessory on. This is to prevent damaging the jumper wire or digital multimeter fuse.

NOTE: The switch knob on the EL 38758 switch is marked ON and OFF. When the switch knob is in the ON position, the circuit is closed and electrical current will pass through the switch. When the switch knob is in the OFF position, the circuit is open and electrical current will not pass through the switch.

1. Ignition OFF, disconnect the battery negative cable from the battery. Refer to **Battery Negative Cable Disconnection and Connection**.
2. Turn the **EL 38758** switch knob to the OFF position.
3. Install the male end of the **EL 38758** switch to the battery ground terminal.
4. Install the battery negative cable to the female end of the **EL 38758** switch.
5. Turn the **EL 38758** switch knob to the ON position.
6. Road test the vehicle and activate all of the accessories such as the radio and air conditioning.
7. Ignition OFF, connect a 10 A fused jumper wire to the test switch tool terminals.
8. Turn the **EL 38758** switch knob to the OFF position. The current now flows through the jumper wire.
9. Check the fuse in the jumper wire. The fuse should be OK.
 - Failed: If the jumper wire fuse is blown, refer to Circuit/System Testing.
 - Passed
10. Turn the **EL 38758** switch knob to the ON position. Remove the fused jumper wire.
11. Connect a DMM set to the 10 A DC scale between the test switch tool terminals.
12. Turn the **EL 38758** switch knob to the OFF position. The current now flows through the DMM.
13. As the vehicle systems shut down test for less than 30 mA of parasitic current drain.
 - If greater than the specified range, refer to Circuit/System Testing.

Circuit/System Testing

- NOTE:**
- Removing or installing a fuse, relay, or connector, to determine the area causing high parasitic draw may wake up control modules. You must wait for the control modules to go back to sleep before retesting. It is best to install any removed or disconnected components after the diagnosis is completed.
 - Fuses for power mode master components such as the BCM should be removed last to avoid misdiagnosis.
 - If a scan tool is connected to the DLC, either disconnect it or subtract the

scan tool current draw from the DMM reading to get the actual vehicle parasitic current draw.

If the vehicle has an unacceptable amount of parasitic current draw, remove each fuse one at a time until the current draw falls to an acceptable level. A drop of more than 10-20 mA, when disabling a single system or circuit, is an indication of an overly high current draw that could be causing the battery drain. Refer to **Power Distribution Schematics** to diagnose exactly which circuit of the suspect system is causing the high parasitic drain. The following is a list of common components that could cause a high current draw:

- Stuck switch
- Stuck relay
- Control module

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for control module replacement, programming and setup

CHARGING SYSTEM TEST

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	-	P0621	-	-
Control - L Terminal	P0621	P0621	P0621	-
Signal - F Terminal	P0622	P0622	P0622	P0622

Circuit/System Description

The engine control module (ECM) uses the generator turn ON control circuit to control the load of the generator on the engine. A high side driver in the ECM applies a duty cycled voltage to the voltage regulator. The duty cycle controls the voltage regulator to turn the field circuit ON and OFF. The ECM monitors the state of the generator turn ON control circuit. The ECM should detect low voltage on the generator turn on control circuit when the ignition is ON and the engine is OFF, or when the charging system malfunctions. With the engine running, the ECM should detect high voltage when the duty cycle voltage is commanded high and a low voltage when the duty cycle voltage is commanded low on the generator turn on control circuit.

The engine control module (ECM) uses the generator field duty cycle signal circuit, or F-terminal circuit, to

monitor the duty cycle of the generator. The generator field duty cycle signal circuit connects to high side of the field windings in the generator. A pulse width modulated (PWM) high side driver in the voltage regulator turns the field windings on and off. The ECM uses the PWM signal input to determine the generator load on the engine. This allows the ECM to adjust the idle speed to compensate for high electrical loads. The ECM monitors the status of the generator field duty cycle signal circuit. When the ignition is ON and the engine is off, the ECM should detect a duty cycle near 0%. When the engine is running, the duty cycle should be between 5-99%.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

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Charging System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Circuit/System Verification

NOTE: **Do not have a battery charger connected during the generator testing.**

1. Ignition ON.
2. Verify that no G13 Generator or B18 Battery Current Sensor DTCs are set that would cause a charging system concern.
 - **If DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If no DTCs are set**
3. Verify the scan tool Body Control Module Battery Voltage parameter is 12 V or greater.
 - **If less than 12 V**

Refer to **Battery Inspection/Test**.

- **If 12 V or greater**
- 4. Engine running, all accessories OFF.
- 5. Verify the scan tool Body Control Module Battery Voltage parameter continually increases when controlling the Body Control Module Generator Regulator Setpoint from 10% to 80% with a scan tool. It may take up to 10 s for the battery voltage to stabilize between each setpoint change.
 - **If the battery voltage does not continually increase**

Refer to Circuit/System Testing.

- **If the battery voltage continually increases**
- 6. All OK.

Circuit/System Testing

NOTE: You must perform the Circuit/System Verification before proceeding with Circuit/System Testing.

1. Ignition OFF.
2. Test for less than 2 ohms between the G13 Generator housing and C1 Battery negative terminal.
 - **If 6.5 ohms or greater**

Repair the open/high resistance in the circuit.

- **If less than 6.4 ohms**
- 3. Verify a test lamp illuminates between the G13 Generator B+ circuit terminal A X2, B X2 or 1 X2 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Remove the test lamp and disconnect the B+ cable at the G13 Generator.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Remove the test lamp, disconnect the C1 Battery negative cable, and disconnect the G13 Generator B+ cable.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - **If the test lamp illuminates**
- 4. Test or replace the G13 Generator.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Generator Replacement

GENERATOR NOISE DIAGNOSIS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Aids

Noise from a generator may be due to electrical or mechanical noise. Electrical noise or magnetic whine usually varies with the electrical load placed on the generator and is a normal operating characteristic of all generators. When diagnosing a noisy generator, it is important to remember that loose or misaligned components around the generator may transmit the noise into the passenger compartment and that replacing the generator may not solve the problem.

Circuit/System Testing

1. Start the engine. Verify the noise can be heard. Compare the concern to a similar vehicle.
2. Perform a charging system test. Verify that the generator is charging properly.
3. Inspect the generator, generator mounting, wiring harness, heater hoses, A/C lines, or other accessory equipment that may be misrouted or be the cause of noise being transmitted into the passenger compartment.
4. Ignition OFF, remove the engine drive belt.
5. Verify the generator, A/C compressor, water pump pulley, power steering pump, idler pulley, and tensioner pulley spin freely.

- **If any of the pulleys do not spin freely**

Replace the affected component.

- **If all belt driven components spin freely**

6. Start the engine. Operate the engine for no longer than 30-40 seconds.
 7. Verify that the noise goes away.
- **If the noise is still present**

The generator is not the cause of the noise. Refer to **Symptoms - Engine Mechanical** .

- **If noise is no longer present**

8. Inspect for worn accessory drive components or abnormalities such as severe cracking, bumps, or missing areas in the accessory drive belt and/or misalignment of system components

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

STARTER SOLENOID DOES NOT CLICK

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ (relay terminal 30)	1	1	-	-
Relay Coil Control (relay terminal 85)	P0615	P0615	2	-
Starter Control (relay terminal 87)	1	1	2	-
Ground (relay terminal 86)	-	P0615	-	-
1. Starter Solenoid Does Not Click 2. Cranks All The Time				

Circuit/System Description

When the ignition mode switch is placed in the START position, a discrete signal is supplied to the body control module (BCM) notifying it that the ignition is in the START position. The BCM then sends a serial data message to the engine control module (ECM) that crank has been requested. The ECM then verifies that the clutch is fully depressed or the automatic transmission is in Park/Neutral. If it is, the ECM then supplies 12 V to the control circuit of the starter relay. When this occurs, battery voltage is supplied through the switch of the starter relay to the starter solenoid.

Reference Information

Schematic Reference

- **Starting and Charging Schematics**
- **Automatic Transmission Controls Schematics**
- **Manual Transmission Schematics**

Connector End View Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Automatic Transmission

1. Ignition ON.
2. Verify that no ignition, KR27 Starter Relay, brake pedal position sensor, immobilizer, or transmission DTCs are set that would cause the ECM to disable engine starting.
 - **If DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**
 - **If no DTCs are set**
3. Verify the scan tool 5 V Ignition Switch parameter is Crank Request while attempting to start the vehicle.
 - **If parameter does not display Crank Request**

Refer to **Vehicle Will Not Change Power Mode**
 - **If parameter displays Crank Request**
4. Verify the scan tool TCM Internal Mode Switch parameter displays Park when in park.
 - **If the TCM Internal Mode Switch parameter does not indicate Park .**

Refer to **Park/Neutral Position Switch Inspection**
 - **If the TCM Internal Mode Switch parameter displays Park**
5. Verify the scan tool ECM Crankshaft Position Active Counter parameter is not incrementing.
 - **If the counter increments**

Replace the B26 Crankshaft Position Sensor.
 - **If the counter does not increment**
6. Verify the engine cranks in park or neutral.

- **If the KR27 Starter Relay does not click or the engine does not crank**

Refer to Circuit/System Testing.

- **If the engine cranks**

7. All OK

Manual Transmission

1. Ignition ON.
2. Verify that no ignition, KR27 Starter Relay, clutch pedal position sensor, brake pedal position sensor, or immobilizer DTCs are set that would cause the ECM to disable engine starting.

- **If DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**

- **If no DTCs are set**

3. Verify the scan tool 5 V Ignition Switch parameter is Crank Request while attempting to start the vehicle.

- **If parameter does not display Crank Request**

Refer to **Power Mode Mismatch**

4. Ignition ON.
5. Verify the scan tool Clutch Pedal Starter Inhibit Switch parameter changes between On and Off while depressing and releasing the clutch pedal.

- **If the Clutch Pedal Starter Inhibit parameter does not change**

Refer to **Clutch Pedal Position Sensor Learn**

- **If the clutch pedal starter inhibit parameter does change**

6. Fully depress clutch pedal.
7. Attempt to start the vehicle.
8. Verify the scan tool ECM Crankshaft Position Active Counter parameter is not incrementing.

- **If the counter increments**

Replace the B26 Crankshaft Position Sensor.

- **If the counter does not increment**

9. Verify the crank relay does click and the engine begins cranking.

- **If the KR27 Starter Relay does not click or the engine does not begin cranking**

Refer to Circuit/System Testing.

- **If the KR27 Starter Relay does click and the engine does begin cranking**

10. All OK

Circuit/System Testing

1. Ignition ON.
2. Verify the scan tool ECM Ignition 1 Signal parameter is greater than 10 V.
 - **If 10 V or less**
 1. Ignition OFF, disconnect the harness connector at the K20 engine control module.
 2. Test for infinite resistance between the ignition voltage circuits and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 engine control module.
 - **If greater than 10 V**
3. Ignition OFF, disconnect the KR27 starter relay, ignition ON.
4. Verify that a test lamp illuminates between the B+ circuit terminal 30 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance,
 3. Disconnect X2 harness connector at the M64 starter motor.
 4. Test for infinite resistance between the control circuit terminal 87 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the M64 starter motor.
 - **If the test lamp illuminates**
5. Ensure the parking brake is applied and the automatic transmission is in PARK or the manual transmission is in neutral. Momentarily install a 30 A fused jumper wire between the B+ circuit terminal 30 and the control circuit terminal 87.
6. Verify the M64 starter motor is activated.
 - **If the M64 starter motor does not activate**
 1. Disconnect the X1 harness connector at the M64 starter motor.
 2. Test for less than 2 ohms in the control circuit end to end.

- If greater the 2 ohms, repair the open/high resistance in the circuit.
- If less than 2 ohms, replace the M64 starter motor.

- **If the M64 starter motor activates**

7. Test or replace the KR27 starter relay.

Component Testing

Relay Test

1. Ignition OFF. Disconnect the KR27 Starter Relay.
2. Test for 60-180 ohms between terminals 85 and 86.
 - **If less than 60 or greater than 180 ohms**

Replace the relay.

- **If between 60-180 ohms**

3. Test for infinite resistance between the terminals listed below:
 - 30 and 86
 - 30 and 87
 - 30 and 85
 - 85 and 87
 - **If less than infinite resistance**

Replace the relay.

- **If infinite resistance**

4. Install a 20 A fused jumper wire between relay terminal 85 and B+.
5. Install a jumper wire between relay terminal 86 and ground.
6. Test for less than 2 ohms between terminals 30 and 87.
 - **If 2 ohms or greater**

Replace the relay.

- **If less than 2 ohms**

7. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Relay Replacement (Within an Electrical Center)** , **Relay Replacement (Attached to Wire Harness)**
- **Crankshaft Position Sensor Replacement** for the 1.0L, 1.19L, 1.2L engines
- **Control Module References** for ECM replacement, programming, and setup.

STARTER SOLENOID CLICKS, ENGINE DOES NOT CRANK

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Starting System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, measure and record the battery voltage at the C1 terminals.
2. Verify the measured voltage is between 12-15 V.
 - If voltage is less than 12 V or greater than 15 V

Refer to **Battery Inspection/Test**.

- If voltage is between 12-15V
3. Remove the drive belts. Refer to **Water Pump and Generator Belt Replacement**
 4. Verify the crankshaft rotates rotate the crankshaft by hand using the appropriate tools.
 - If the crankshaft does not rotate

Refer to **Engine Will Not Crank - Crankshaft Will Not Rotate**

- **If the crankshaft rotates**

5. Verify the engine does not crank when attempting to start the vehicle.

- **If the engine cranks**

Inspect the engine and belt drive system for mechanical binding, seized engine, or seized generator.

- **If the engine does not crank**

6. Verify that a test lamp illuminates between the M64 starter motor B+ terminal 1 X2 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Ignition OFF.

2. Test for less than 2 ohms in the B+ circuit end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Ignition OFF.

2. Test for greater than 100 ohms between the B+ circuit and ground.

- If 100 ohms or less, repair the short to ground on the circuit.

- If greater than 100 ohms, replace the M64 starter motor.

- **If the test lamp illuminates**

7. Test for less than 0.5 V between the positive battery cable and M64 Starter Motor B+ terminal 1 X2 with the ignition in the START position.

- **If 0.5 V or greater**

Replace the positive battery cable.

- **If less than 0.5 V**

8. Test for less than 0.5 V between the negative battery cable and the M64 starter motor case with the ignition in the START position.

- **If 0.5 V or greater**

Replace the negative battery cable.

- **less than 0.5 V**

9. Replace the M64 starter motor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Battery Positive and Negative Cable Replacement (LL0), Battery Positive and Negative Cable**

Replacement (LFM)

- **Starter Replacement**

ENGINE CRANKS SLOWLY

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Starting System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, measure and record the battery voltage at the C1 Battery terminals.
2. Verify the measured voltage is between 12-15 V.
 - **If voltage is less than 12 V or greater than 15 V**

Refer to **Battery Inspection/Test**.

- **If voltage is between 12-15 V**

3. Remove the water pump and generator belt. Refer to **Water Pump and Generator Belt Replacement** .
4. Verify the engine cranks slowly when attempting to start the vehicle.
 - **If the engine cranks at normal speed**

Inspect the engine and belt drive system for mechanical binding, seized engine, or seized generator.

- **If the engine cranks slowly**
5. Verify that a test lamp illuminates between the M64 starter motor B+ terminal 1 X2 and ground.
 - **If the test lamp does not illuminate**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp illuminates**
 6. Test for less than 0.5 V between the positive battery cable and M64 Starter Motor B+ terminal 1 X2 with the ignition in the START position.
 - **If 0.5 V or greater**

Replace the positive battery cable.

- **If less than 0.5 V**
7. Test for less than 0.5 V between the negative battery cable and the M64 starter motor case with the ignition in the START position.
 - **If 0.5 V or greater**

Replace the negative battery cable.

- **If less than 0.5 V**
8. Replace the M64 starter motor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Battery Positive and Negative Cable Replacement (LL0), Battery Positive and Negative Cable Replacement (LFM)**
- **Starter Replacement**

STARTER NOISE DIAGNOSIS

Circuit/System Testing

1. Remove the flywheel inspection cover.

2. Inspect the flywheel for the following:

- Loose flywheel bolts
- Chipped gear teeth
- Missing gear teeth
- Bent flywheel
- If not within specifications, secure the flywheel bolts or replace the flywheel.
- If all inspections were within specification, replace the starter motor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- Refer to **Fastener Tightening Specifications (LL0)** , **Fastener Tightening Specifications (LFM)** .
- Refer to **Engine Flywheel Replacement** .
- Refer to **Starter Replacement**.

REPAIR INSTRUCTIONS

BATTERY NEGATIVE CABLE DISCONNECTION AND CONNECTION

Disconnect Procedure

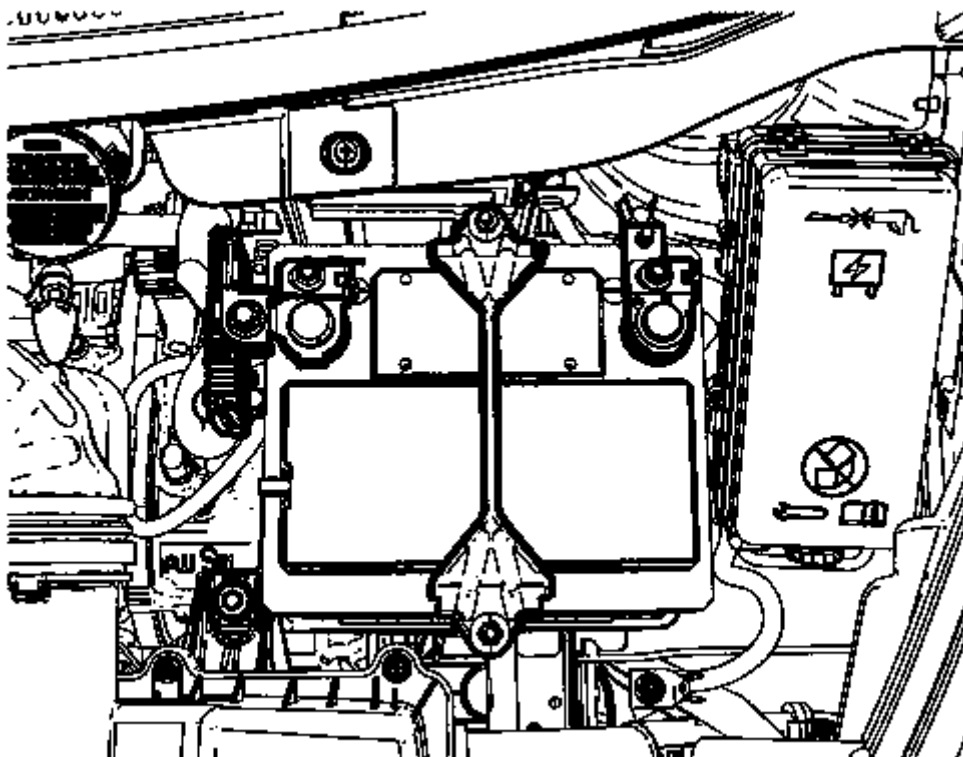


Fig. 3: Negative Battery Cable And Cable Nut
Courtesy of GENERAL MOTORS COMPANY

1. Ensure that all lamps and accessories are turned off. Turn the ignition OFF and remove the ignition key.
2. Loosen the negative battery cable nut.
3. Remove the negative battery cable from the battery.

Connect Procedure

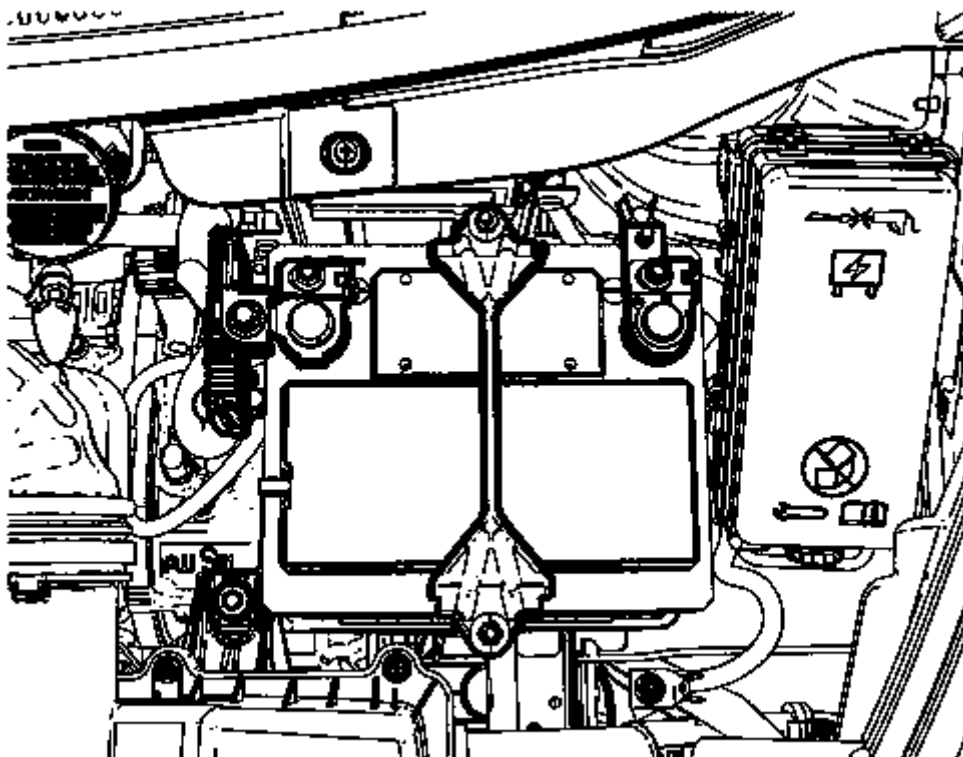


Fig. 4: Negative Battery Cable And Cable Nut
Courtesy of GENERAL MOTORS COMPANY

1. Install the negative battery cable to the battery.

CAUTION: Refer to Fastener Caution .

2. Fasten the negative battery cable nut and tighten to 12 (9 lb ft).
3. Insert the ignition key and turn the ignition to the ON position.
4. Program all of the customer radio station presets and set the radio clock to the current time.

BATTERY CURRENT SENSOR REPLACEMENT

Removal Procedure

1. Remove the battery. Refer to **Battery Replacement**.
2. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
3. Remove the battery tray. Refer to **Battery Tray Replacement**.

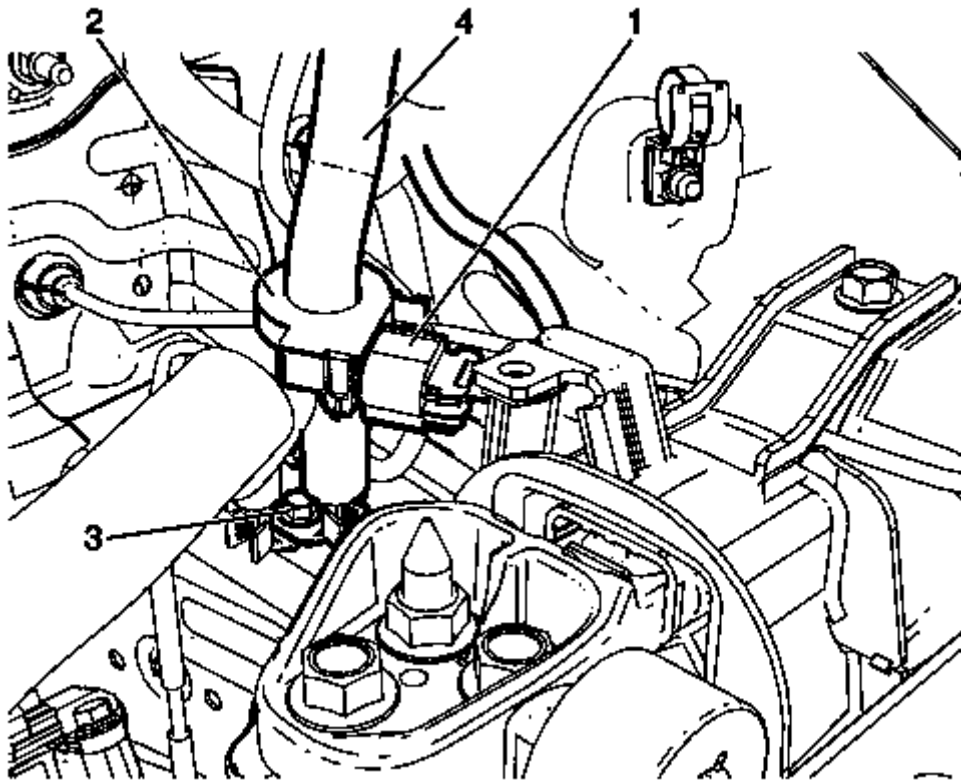


Fig. 5: Body Harness Connector

Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the body harness connector (1) from the battery current sensor (2).
5. Remove the battery negative ground cable fastener (3) and the battery negative cable (4) from the frame rail.

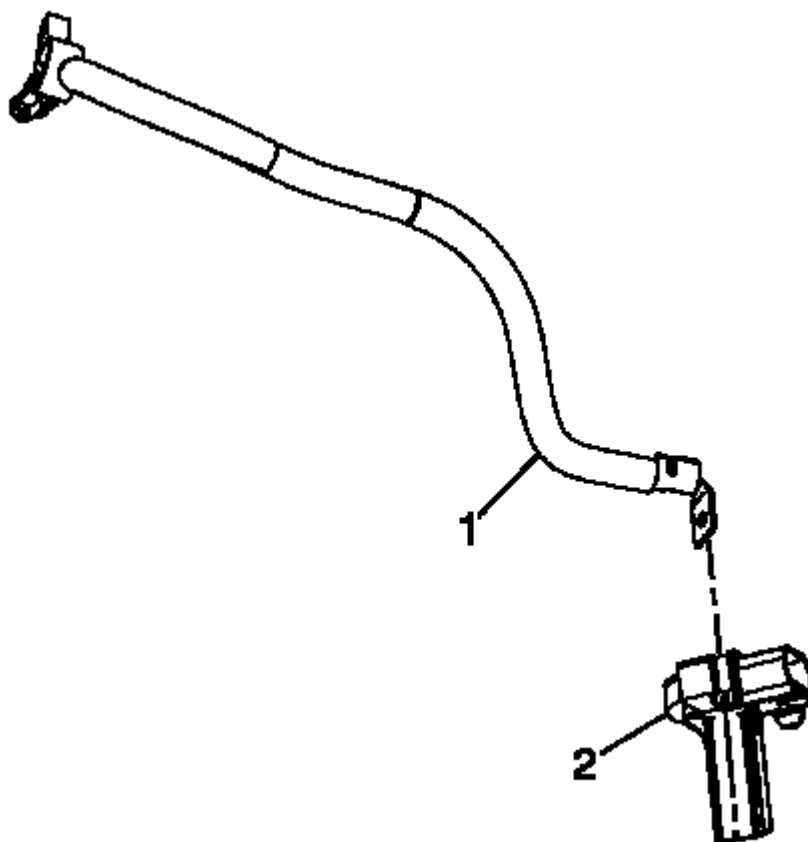


Fig. 6: Battery Current Sensor

Courtesy of GENERAL MOTORS COMPANY

NOTE: Note the orientation of the battery current sensor when removing.

6. Remove the battery current sensor (2) from the battery negative cable (1).

Installation Procedure

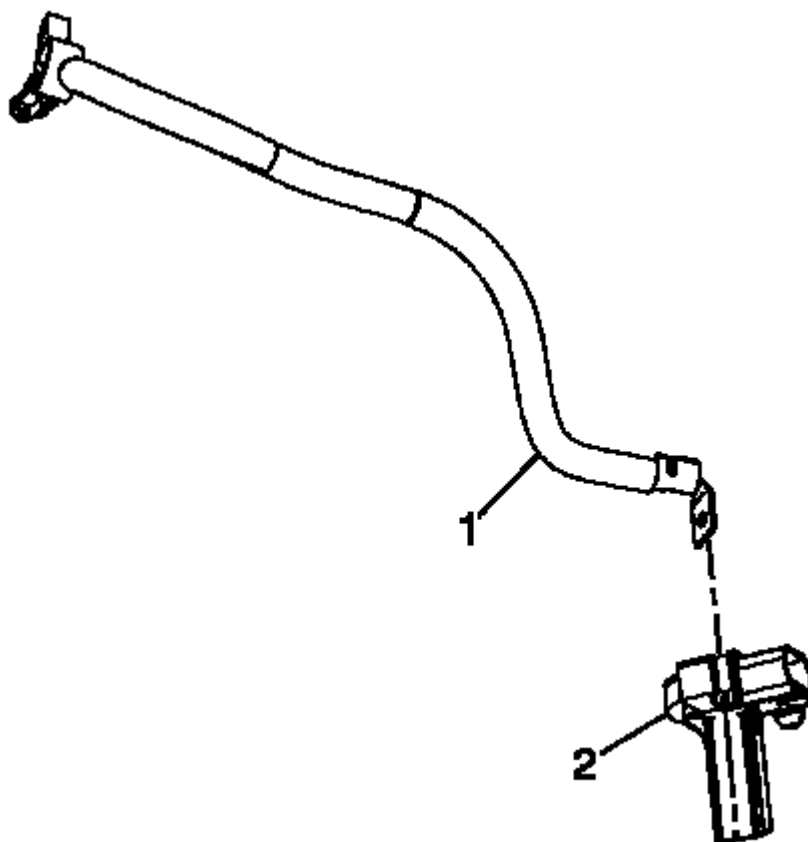


Fig. 7: Battery Current Sensor

Courtesy of GENERAL MOTORS COMPANY

1. Install the battery current sensor (2) onto the battery negative cable (1) as shown.

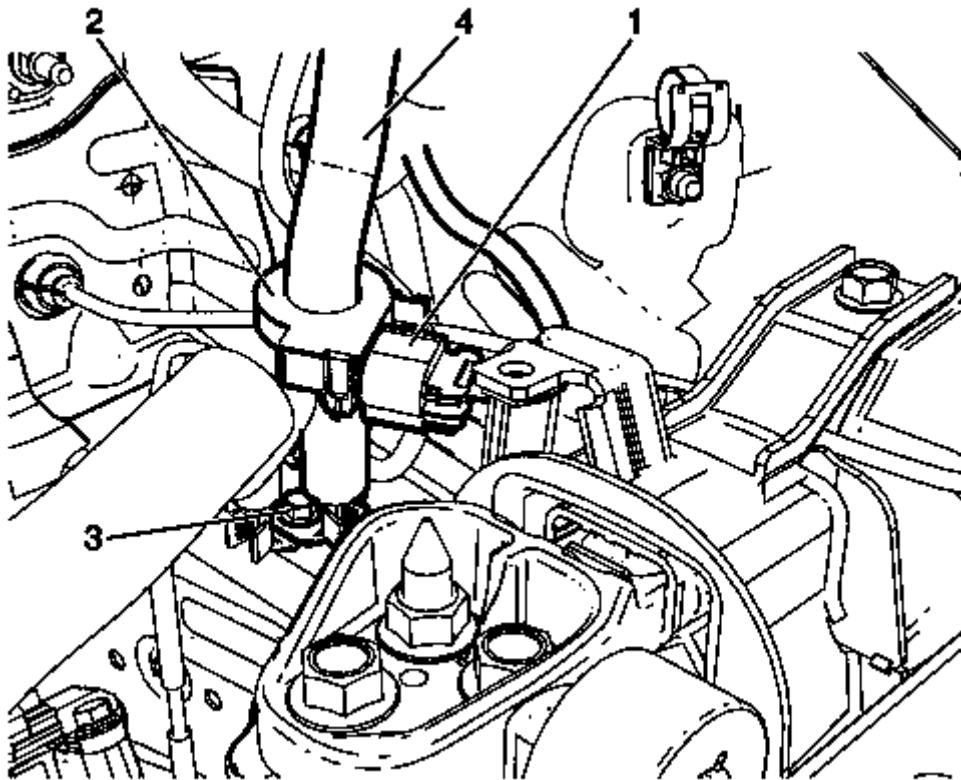


Fig. 8: Body Harness Connector

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

2. Install the battery negative cable (2) to the frame rail and tighten the battery negative ground cable fastener (3) to 9 (80 lb in).
3. Connect the body harness connector (1) to the battery current sensor (2).
4. Install the battery tray. Refer to Battery Tray Replacement.
5. Install the air cleaner assembly. Refer to Air Cleaner Assembly Replacement .
6. Install the battery. Refer to Battery Replacement.

BATTERY POSITIVE AND NEGATIVE CABLE REPLACEMENT (LL0)

Removal Procedure

1. Open the hood.
2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
3. Remove the air cleaner assembly. Refer to Air Cleaner Assembly Replacement .

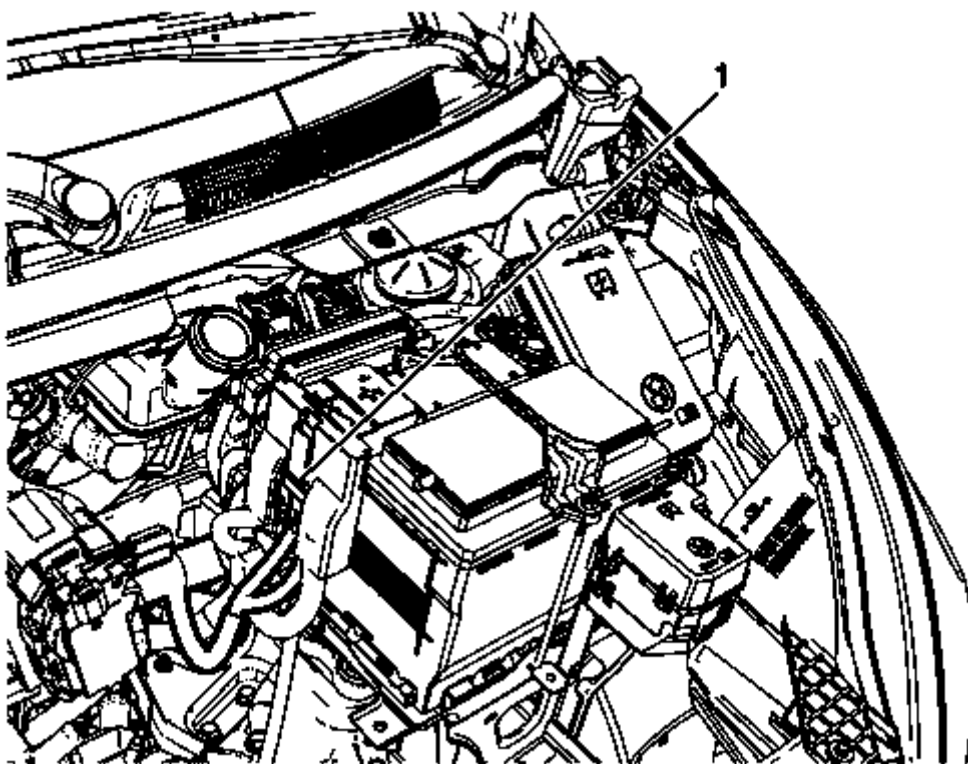


Fig. 9: Body Wiring Master Harness Connector
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the body wiring master harness connector (1) from the battery positive cable junction block.
5. Remove the battery. Refer to **Battery Replacement**.

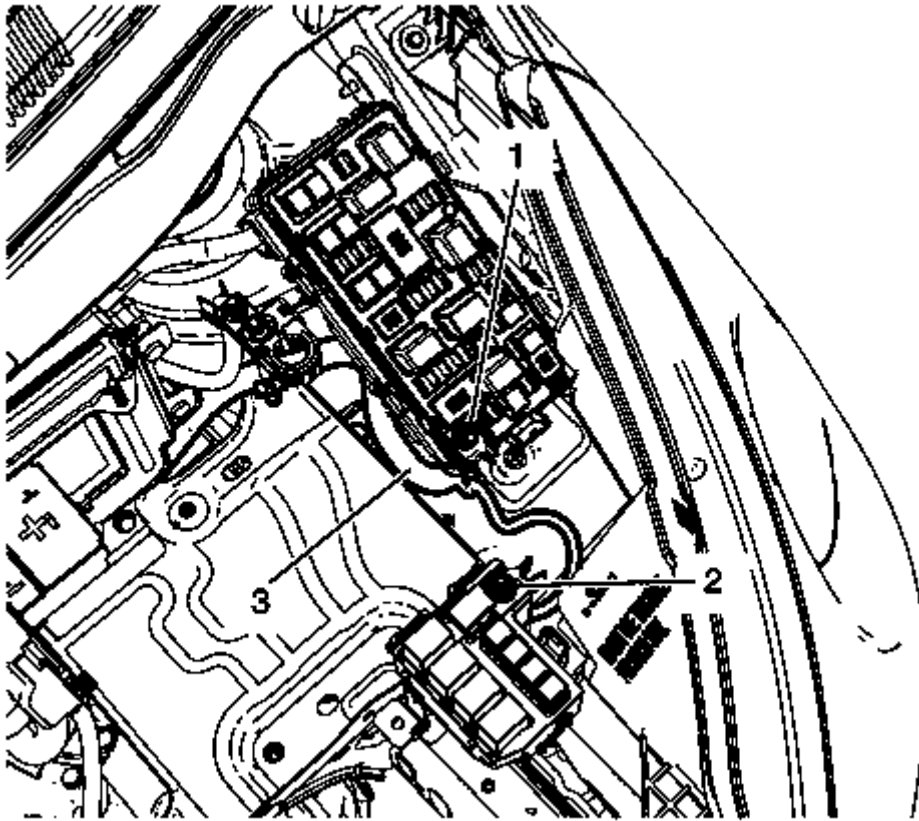


Fig. 10: Positive Battery Cable Nut
Courtesy of GENERAL MOTORS COMPANY

6. Remove the junction block cover.
7. Remove the relay box cover.
8. Remove the positive battery cable nut (1) from the junction block.
9. Remove the positive battery cable nut (2) from the relay box.
10. Remove the positive battery cable (3) from the junction block and relay box.
11. Remove the battery tray. Refer to **Battery Tray Replacement**.

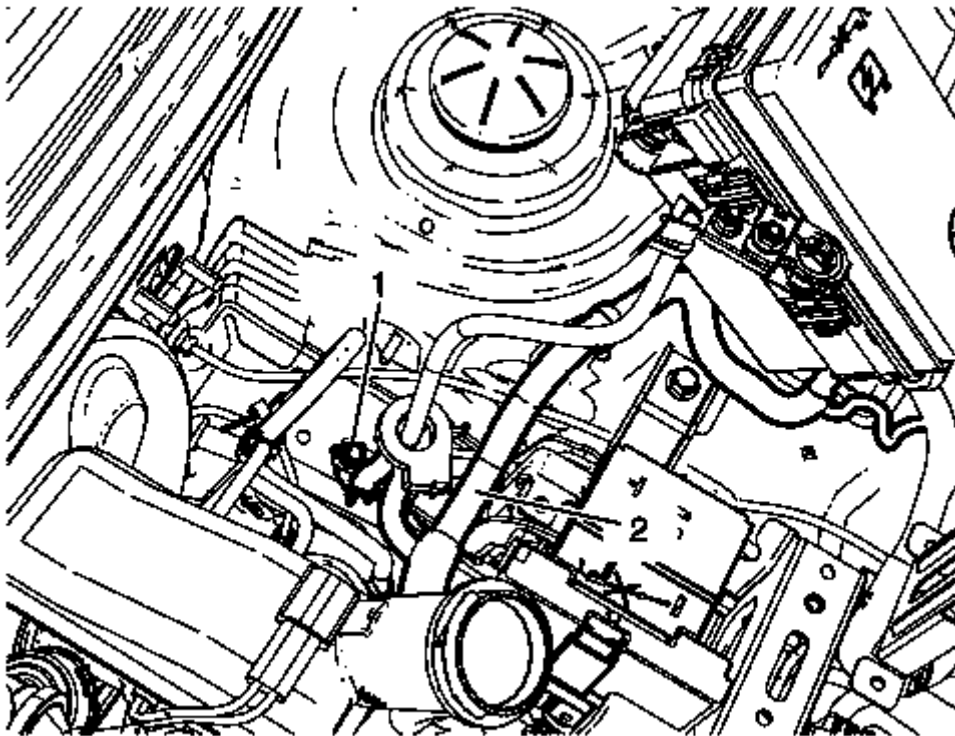


Fig. 11: Battery Negative Cable Frame Ground Bolt
Courtesy of GENERAL MOTORS COMPANY

12. Remove the battery negative cable frame ground bolt (1).
13. Remove the battery negative cable (2).
14. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** .
15. Remove the exhaust front pipe assembly. Refer to **Exhaust Front Pipe Replacement (LL0)** .

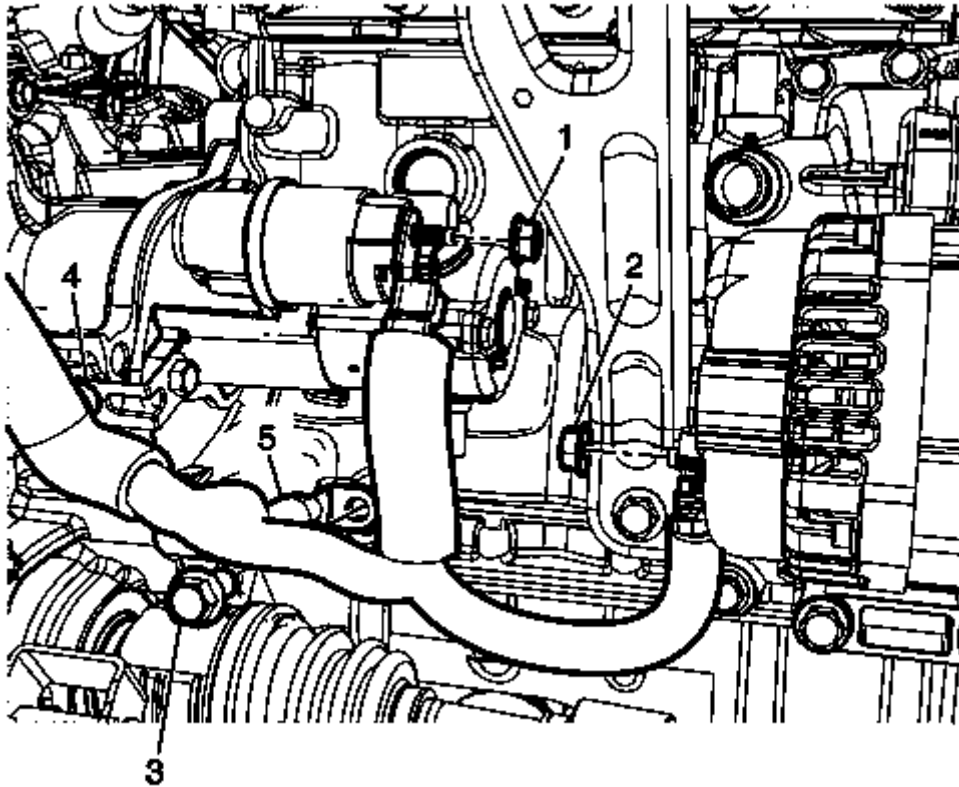


Fig. 12: Starter Solenoid B (+) Nut
Courtesy of GENERAL MOTORS COMPANY

16. Remove the starter solenoid B (+) nut (1).
17. Remove the generator B (+) nut (2).
18. Remove the engine harness and battery cable male ground bolt (3).
19. Remove the retainer (4).
20. Remove the battery positive and negative cable (5) from the vehicle.

Installation Procedure

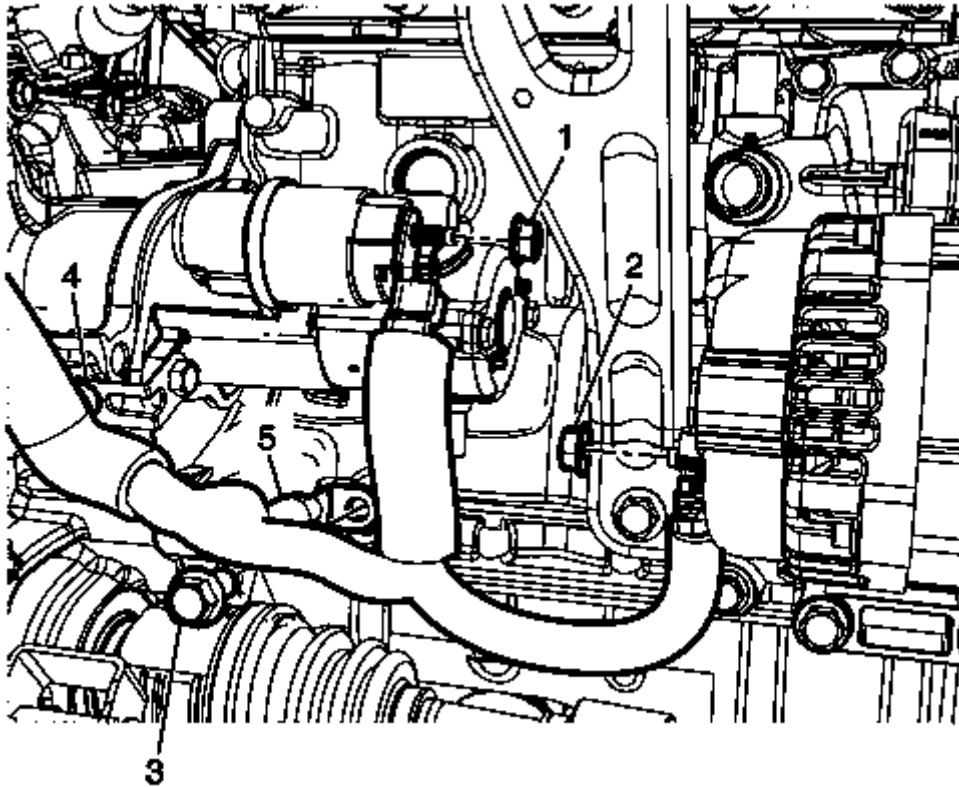


Fig. 13: Starter Solenoid B (+) Nut
Courtesy of GENERAL MOTORS COMPANY

1. Install the battery positive and negative cable (5) to the vehicle.

CAUTION: Refer to Fastener Caution .

2. Install the engine harness and battery cable male ground bolt (3) and tighten to 40 (30 lb ft).
3. Install the generator B (+) nut (2) and tighten to 11 (8 lb in).
4. Install the starter solenoid B (+) nut (1) and tighten to 12 (9 lb in).
5. Install the retainer (4).
6. Install the exhaust front pipe assembly. Refer to Exhaust Front Pipe Replacement (LL0) .
7. Lower the vehicle.

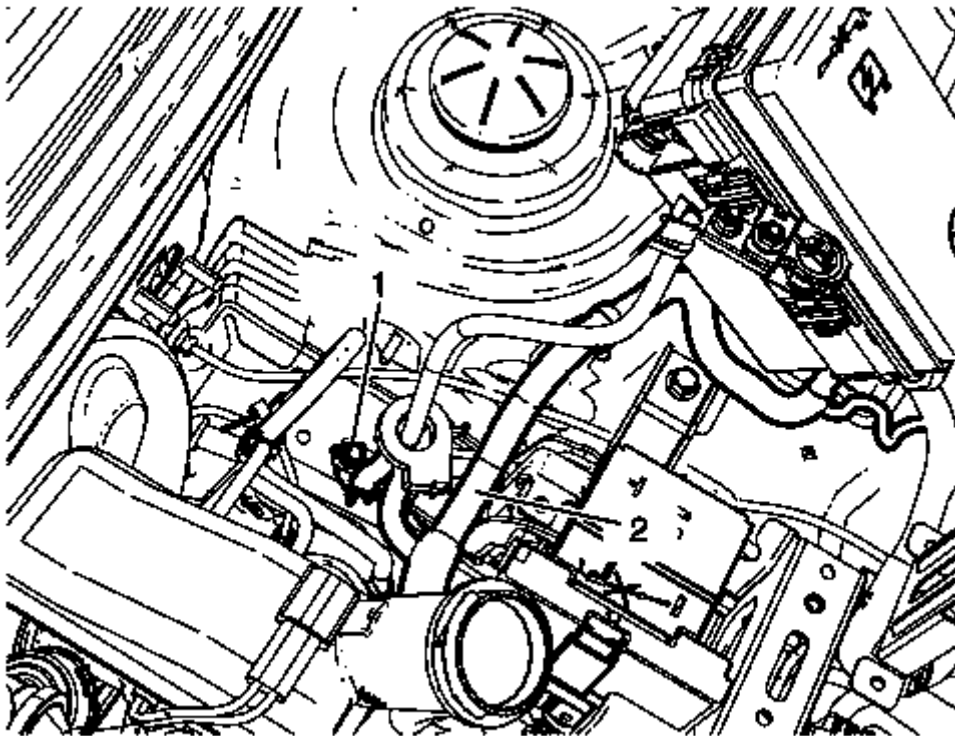


Fig. 14: Battery Negative Cable Frame Ground Bolt
Courtesy of GENERAL MOTORS COMPANY

8. Install the battery negative cable (2).
9. Install the battery negative cable frame ground bolt (1) and tighten to 12 (9 lb in).
10. Remove the battery tray. Refer to **Battery Tray Replacement**.

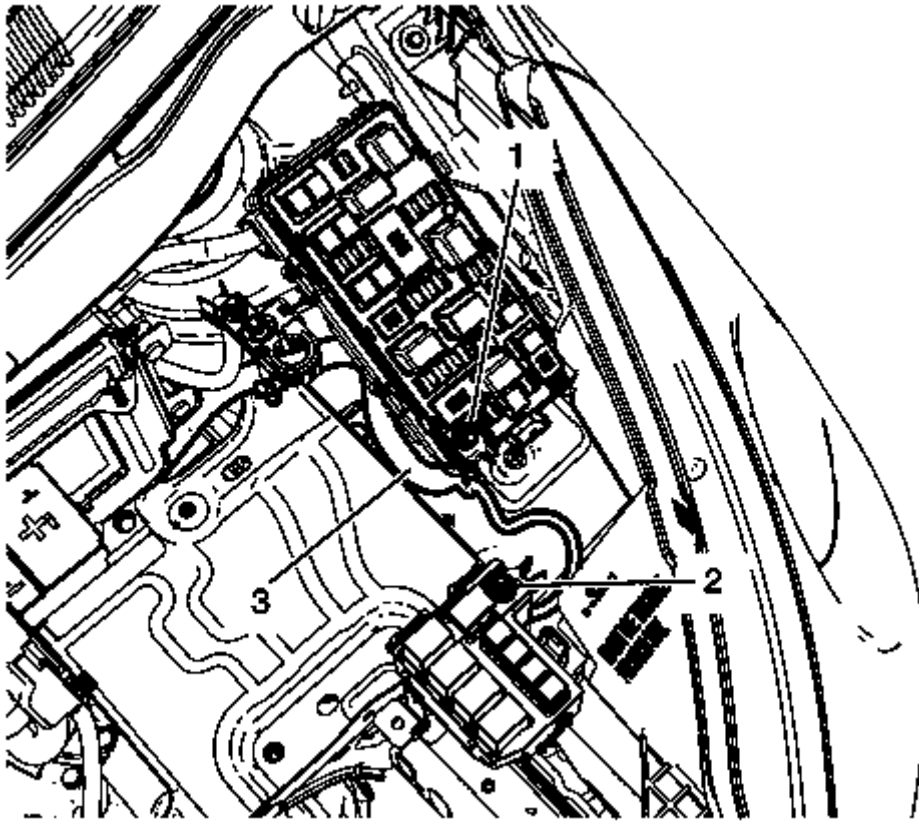


Fig. 15: Positive Battery Cable Nut
Courtesy of GENERAL MOTORS COMPANY

11. Install the positive battery cable (3) to the junction block and relay box.
12. Install the positive battery cable nut (2) and tighten to 12 (9 lb in).
13. Install the positive battery cable nut (1) and tighten to 12 (9 lb in).
14. Install the relay box cover.
15. Install the junction block cover.
16. Install the battery. Refer to **Battery Replacement**.

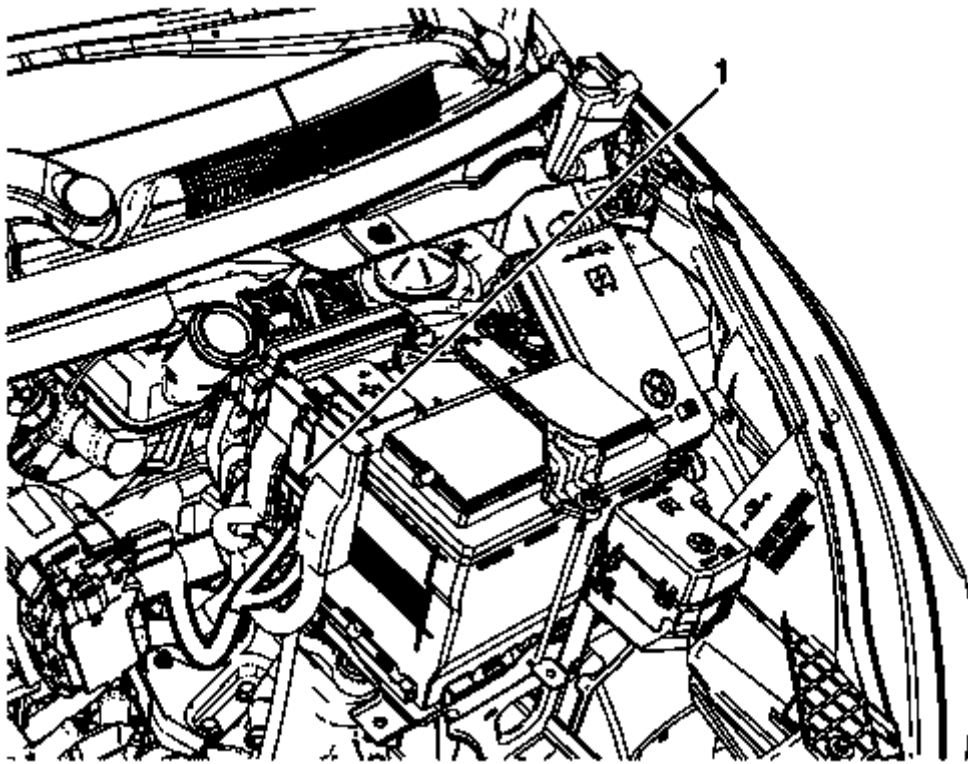


Fig. 16: Body Wiring Master Harness Connector
Courtesy of GENERAL MOTORS COMPANY

17. Connect the body wiring master harness connector (1) to the battery positive cable junction block.
18. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
19. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection.**
20. Close the hood.

BATTERY POSITIVE AND NEGATIVE CABLE REPLACEMENT (LFM)

Removal Procedure

1. Open the hood.
2. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection.**
3. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .

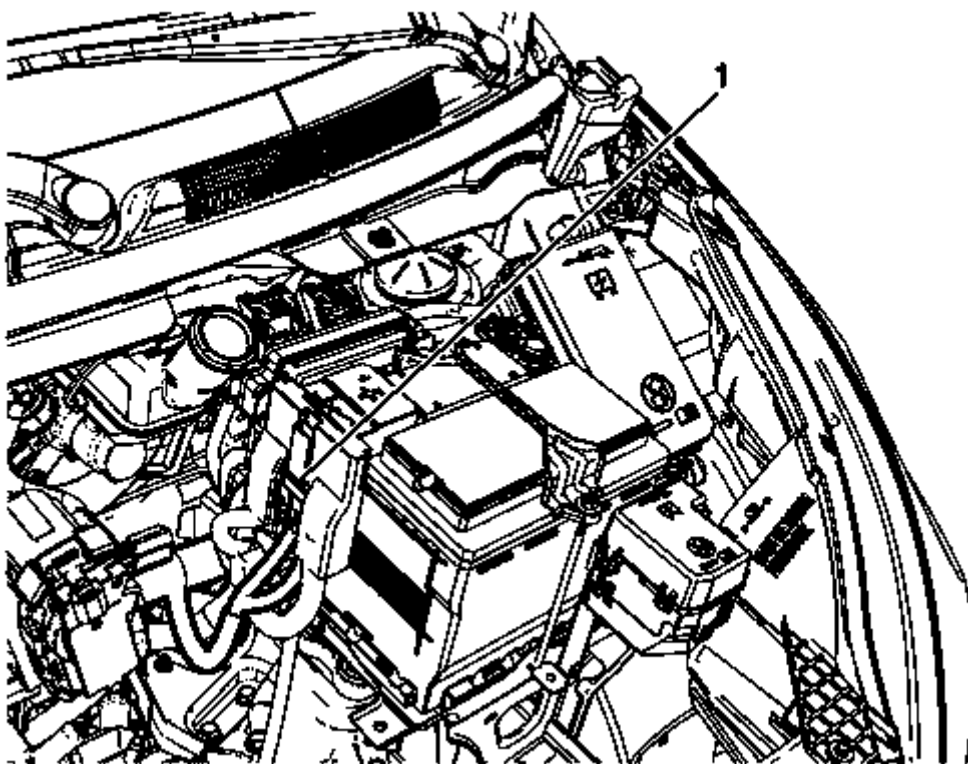


Fig. 17: Body Wiring Master Harness Connector
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the body wiring master harness connector (1) from the battery positive cable junction block.
5. Remove the battery. Refer to **Battery Replacement**.

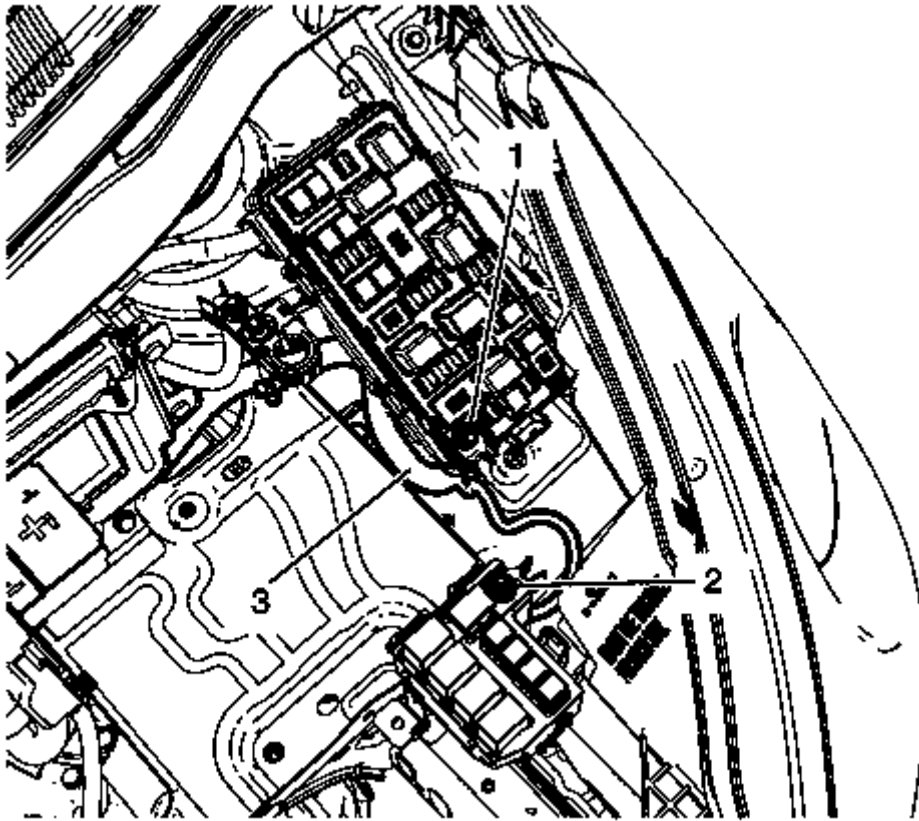


Fig. 18: Positive Battery Cable Nut

Courtesy of GENERAL MOTORS COMPANY

6. Remove the fuse block cover.
7. Remove the auxiliary fuse block cover.
8. Remove the positive battery cable nut (1) from the fuse block.
9. Remove the positive battery cable nut (2) from the auxiliary fuse block.
10. Remove the positive battery cable (3) from the fuse block and auxiliary fuse block.
11. Remove the battery tray. Refer to **Battery Tray Replacement**.

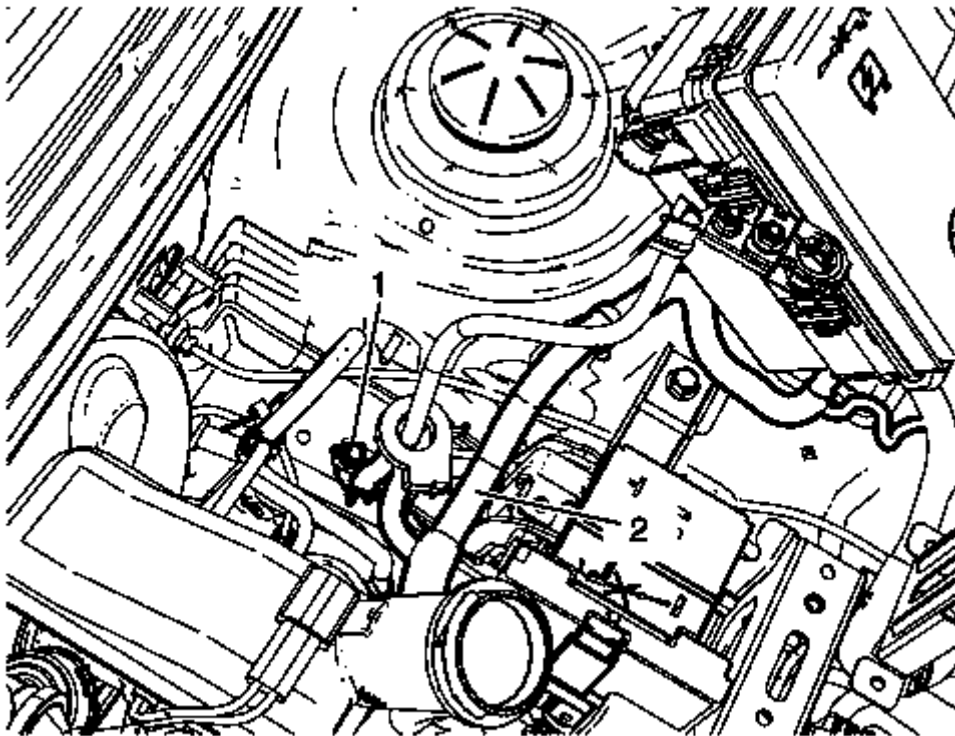


Fig. 19: Battery Negative Cable Frame Ground Bolt
Courtesy of GENERAL MOTORS COMPANY

12. Remove the battery negative cable frame ground bolt (1).
13. Remove the battery negative cable (2).
14. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** .
15. Remove the exhaust pipe assembly. Refer to **Exhaust Pipe Replacement (LFM)** .

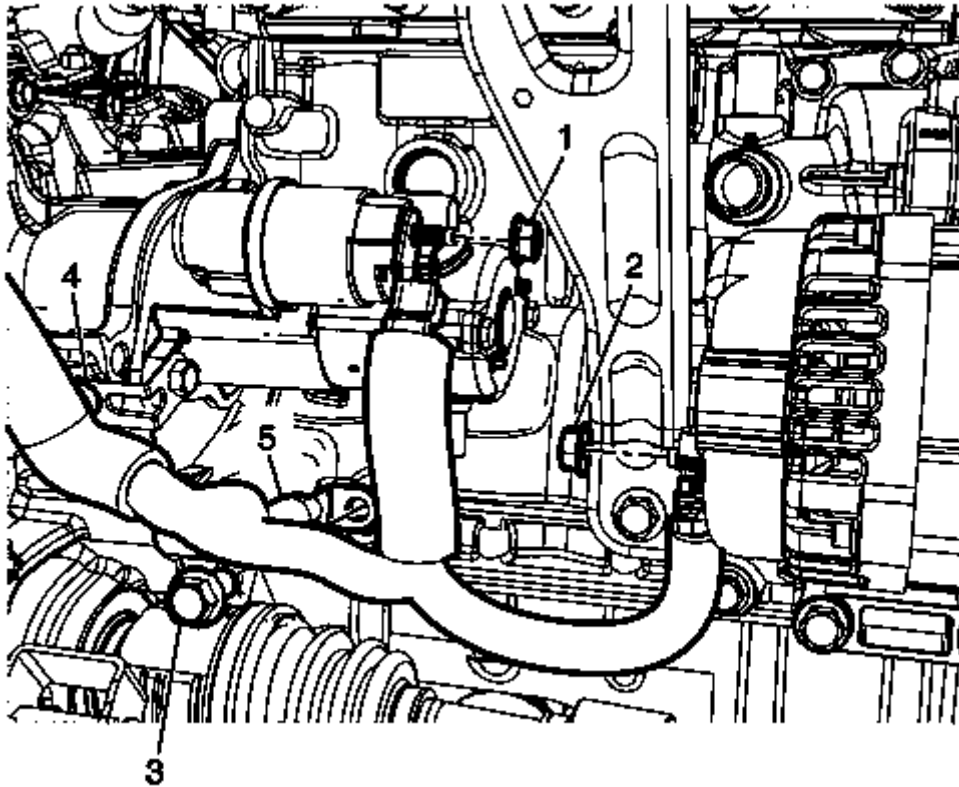


Fig. 20: Starter Solenoid B (+) Nut
Courtesy of GENERAL MOTORS COMPANY

16. Remove the starter solenoid B (+) nut (1).
17. Remove the generator B (+) nut (2).
18. Remove the engine harness and battery cable male ground bolt (3).
19. Remove the retainer (4).
20. Remove the battery positive and negative cable (5) from the vehicle.

Installation Procedure

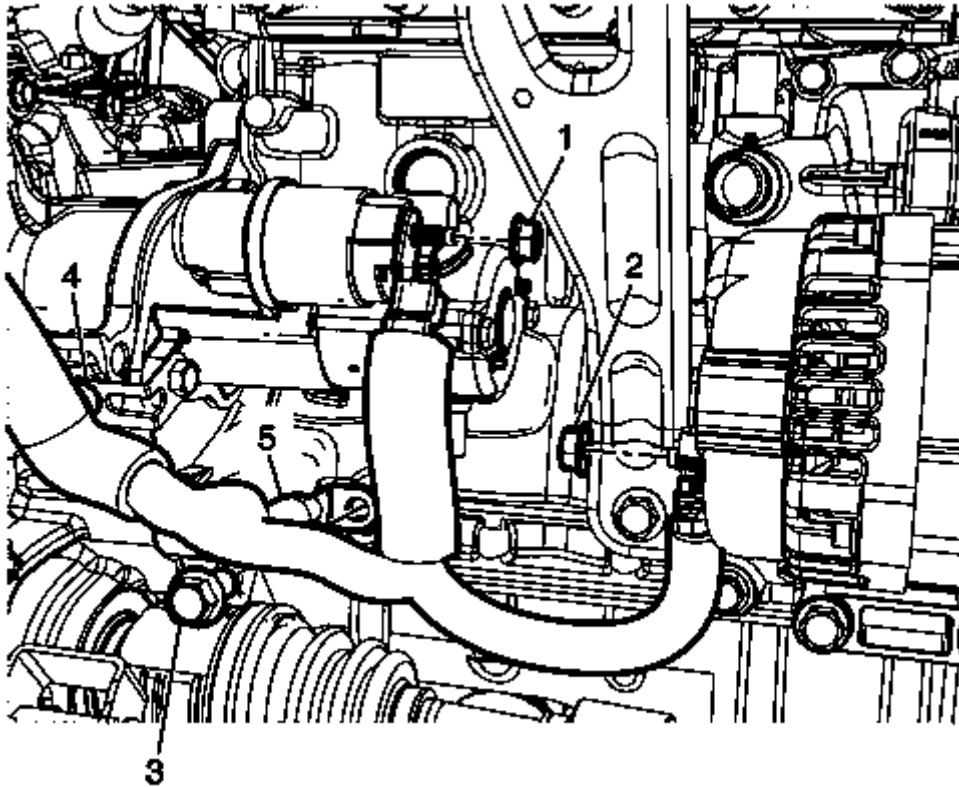


Fig. 21: Starter Solenoid B (+) Nut
Courtesy of GENERAL MOTORS COMPANY

1. Install the battery positive and negative cable (5) to the vehicle.

CAUTION: Refer to Fastener Caution .

2. Install the engine harness and battery cable male ground bolt (3) and tighten to 40 (30 lb ft).
3. Install the generator B (+) nut (2) and tighten to 11 (8 lb ft).
4. Install the starter solenoid B (+) nut (1) and tighten to 12 (9 lb ft).
5. Install the retainer (4).
6. Install the exhaust pipe assembly. Refer to **Exhaust Pipe Replacement (LFM)** .
7. Lower the vehicle.

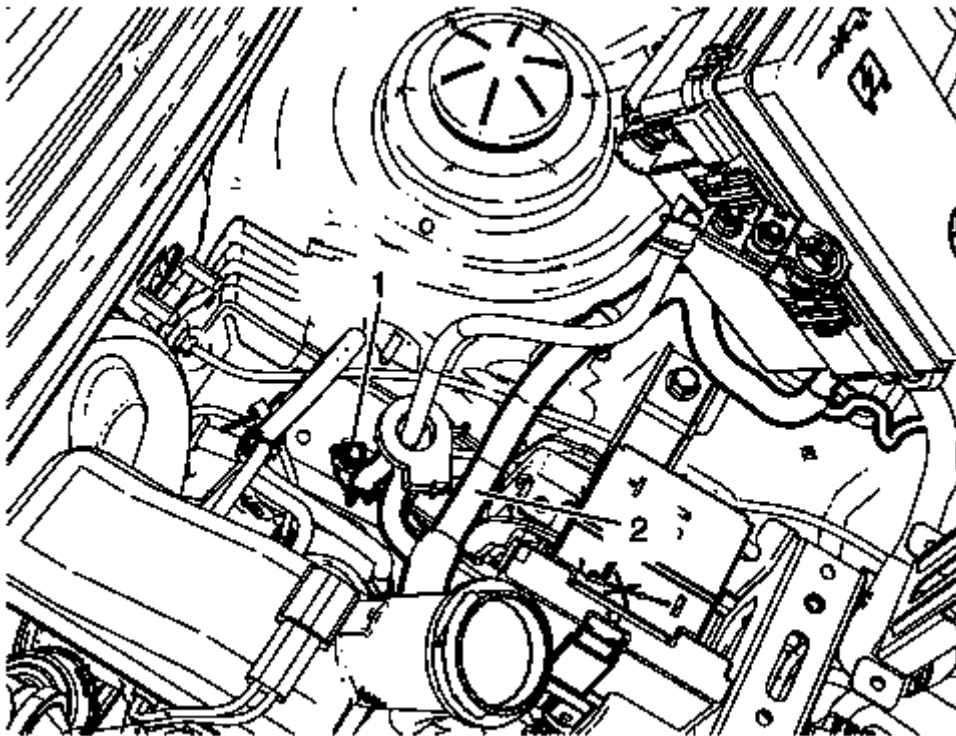


Fig. 22: Battery Negative Cable Frame Ground Bolt
Courtesy of GENERAL MOTORS COMPANY

8. Install the battery negative cable (2).
9. Install the battery negative cable frame ground bolt (1) and tighten to 9 (80 lb in).
10. Remove the battery tray. Refer to **Battery Tray Replacement**.

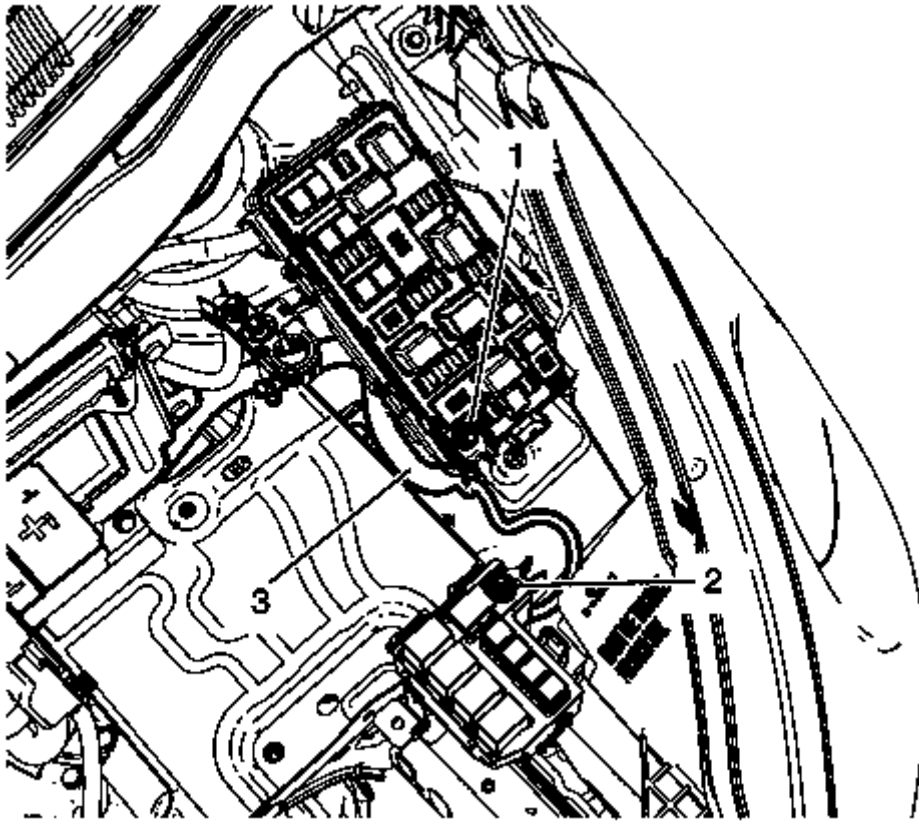


Fig. 23: Positive Battery Cable Nut
Courtesy of GENERAL MOTORS COMPANY

11. Install the positive battery cable (3) to the fuse block and auxiliary fuse block.
12. Install the positive battery cable nut (1, 2) and tighten to 12 (9 lb ft).
13. Install the fuse box cover.
14. Install the auxiliary fuse block cover.
15. Install the battery. Refer to **Battery Replacement**.

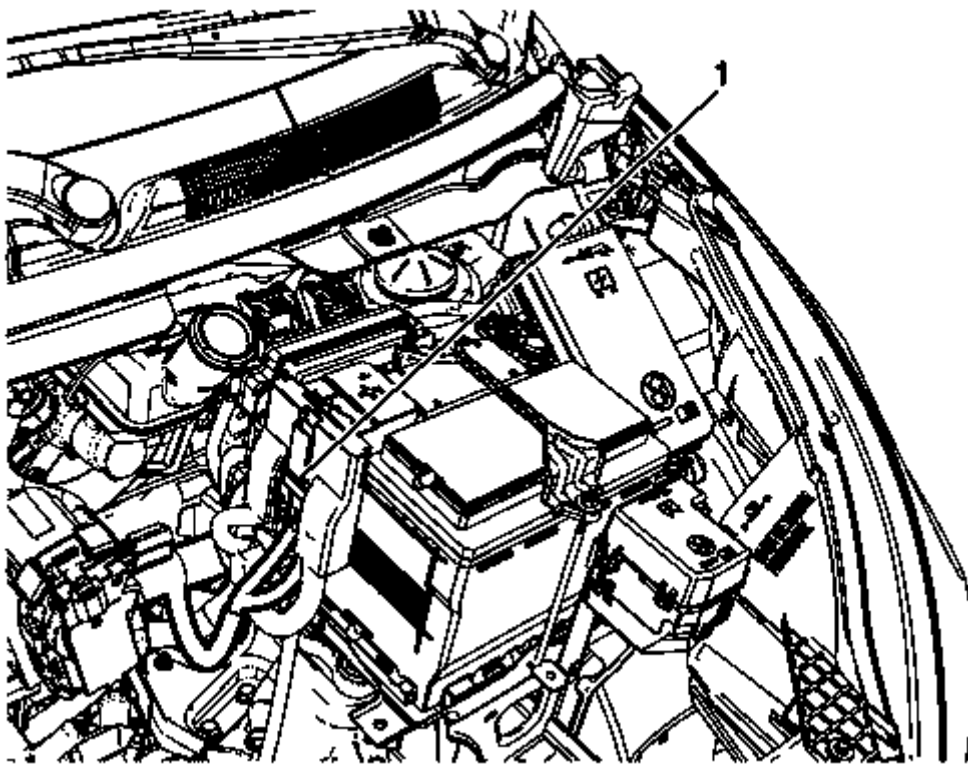


Fig. 24: Body Wiring Master Harness Connector
Courtesy of GENERAL MOTORS COMPANY

16. Connect the body wiring master harness connector (1) to the battery positive cable junction block.
17. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
18. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection**.
19. Close the hood.

BATTERY REPLACEMENT

Removal Procedure

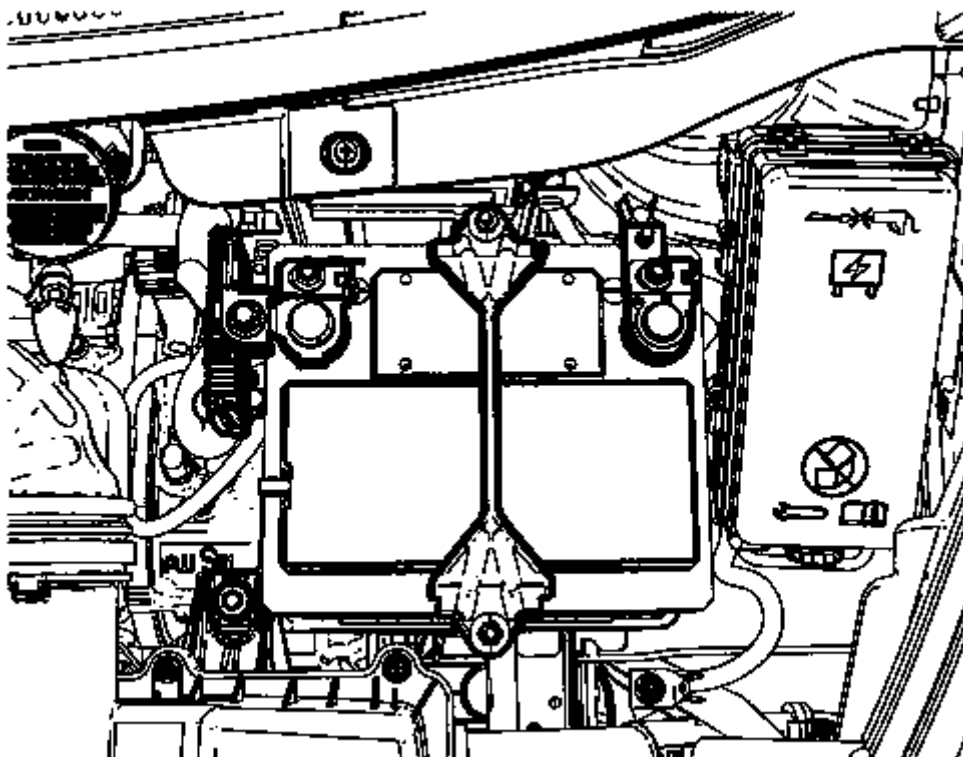


Fig. 25: Negative Battery Cable And Cable Nut
Courtesy of GENERAL MOTORS COMPANY

1. Disconnect the battery negative cable from the battery. Refer to **Battery Negative Cable Disconnection and Connection**.
2. Disconnect the battery positive cable from the battery.
3. Remove the battery holder mounting nut and the battery holder.
4. Remove the battery.

Installation Procedure

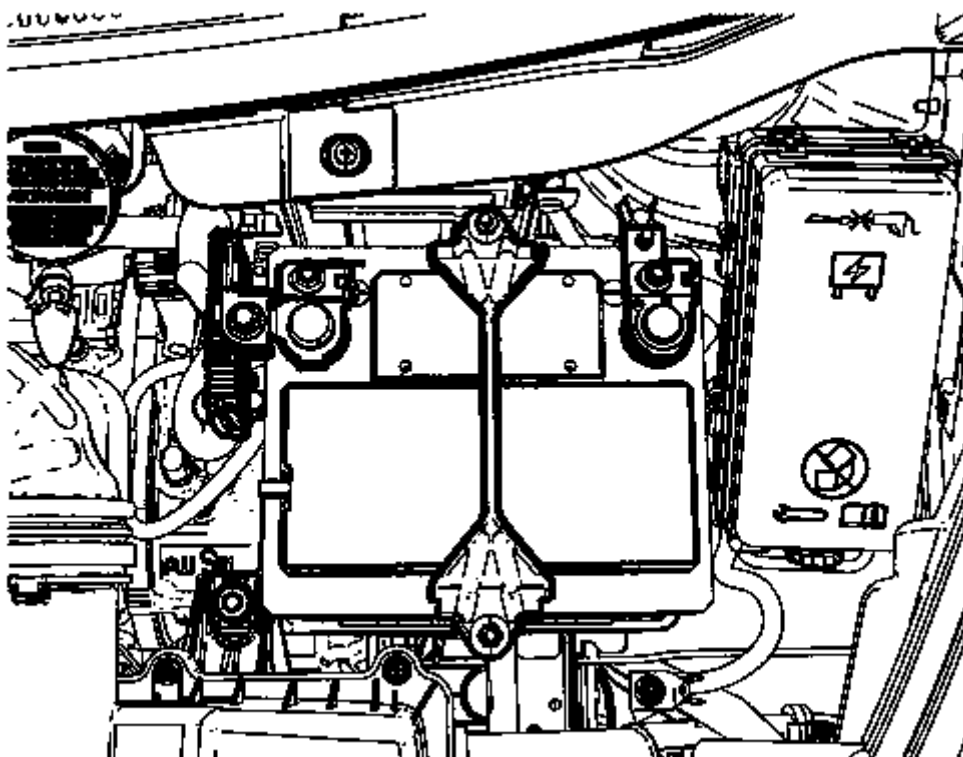


Fig. 26: Negative Battery Cable And Cable Nut
Courtesy of GENERAL MOTORS COMPANY

1. Install the battery.

CAUTION: Refer to Fastener Caution .

2. Install the battery holder and tighten the retaining nut to 6 (53 lb in).
3. Connect the battery cable.

BATTERY TRAY REPLACEMENT

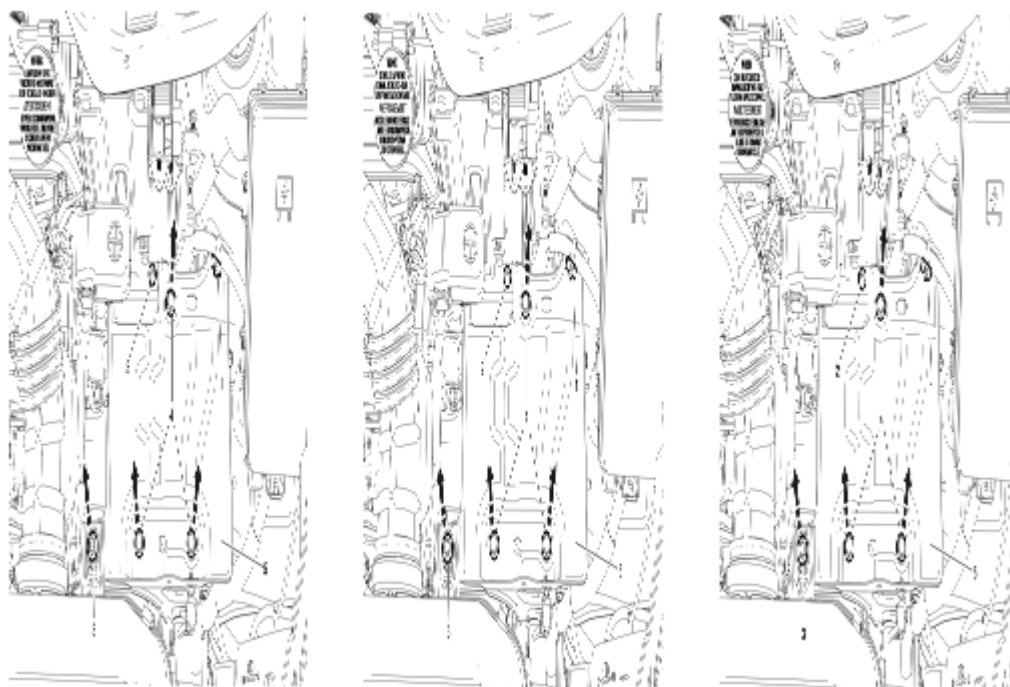


Fig. 27: Battery Tray
 Courtesy of GENERAL MOTORS COMPANY

Battery Tray Replacement

Callout	Component Name
Preliminary Procedure	
Remove the battery. Refer to Battery Replacement .	
1	Wiring Harness Clip Retaining Nut CAUTION: Refer to Fastener Caution . Tighten 12 (9 lb in)
2	ECM Bracket Retaining Bolt (Qty: 2) Tighten 10 (89 lb in)
3	Air Cleaner Assembly - Battery Tray Retaining Bolt Tighten 6 (53 lb in)
4	Battery Tray Mounting Bolt Tighten 12 (9 lb ft)
5	Battery Tray

STARTER REPLACEMENT

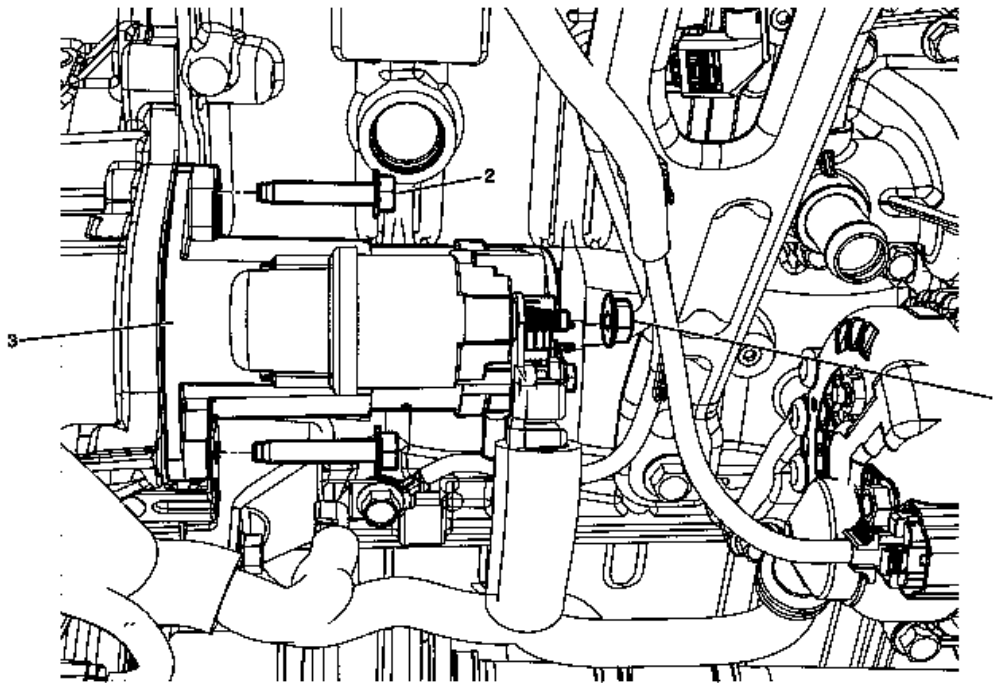


Fig. 28: Starter

Courtesy of GENERAL MOTORS COMPANY

Starter Replacement

Callout	Component Name
Preliminary Procedures	
1. Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u>. 2. Raise the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u>. 3. Disconnect the starter connector.	
1	Starter Solenoid B (+) Nut CAUTION: Refer to <u>Fastener Caution</u>. Procedure Remove the starter solenoid B (+) nut. Tighten 12 (9 lb ft)
2	Starter Retaining Bolt (Qty: 2) Procedure Remove the starter retaining bolts.

	Tighten 22 (16 lb ft)
3	Starter Procedure Transfer parts as necessary.

GENERATOR BRACKET REPLACEMENT

Removal Procedure

1. Remove the generator. Refer to Generator Replacement.

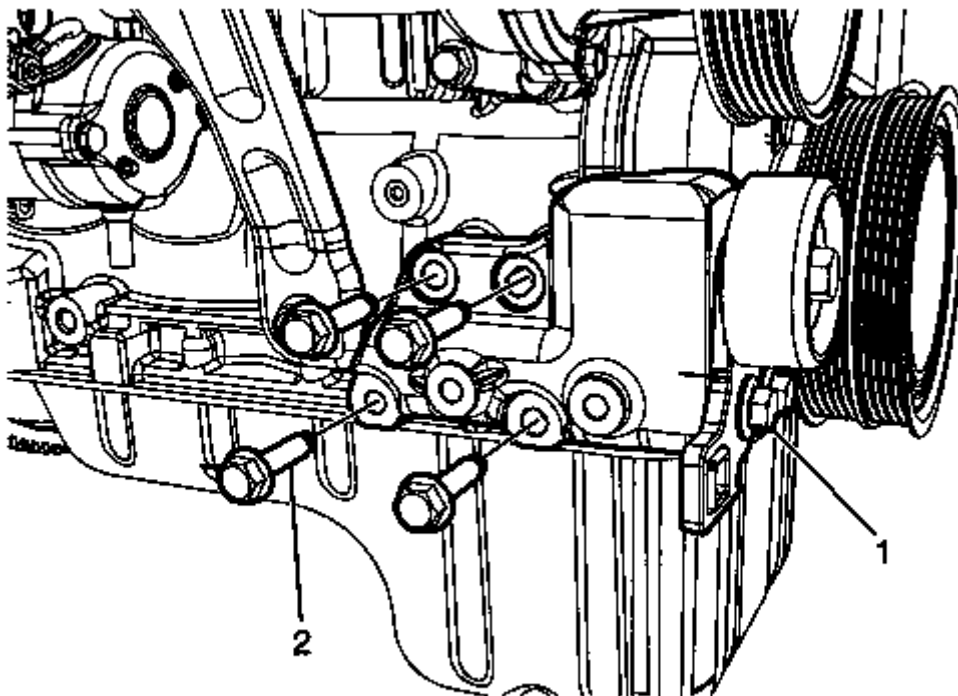


Fig. 29: Generator Bracket

Courtesy of GENERAL MOTORS COMPANY

2. Remove the 4 generator bracket retaining bolts (2).
3. Remove the generator bracket (1).

Installation Procedure

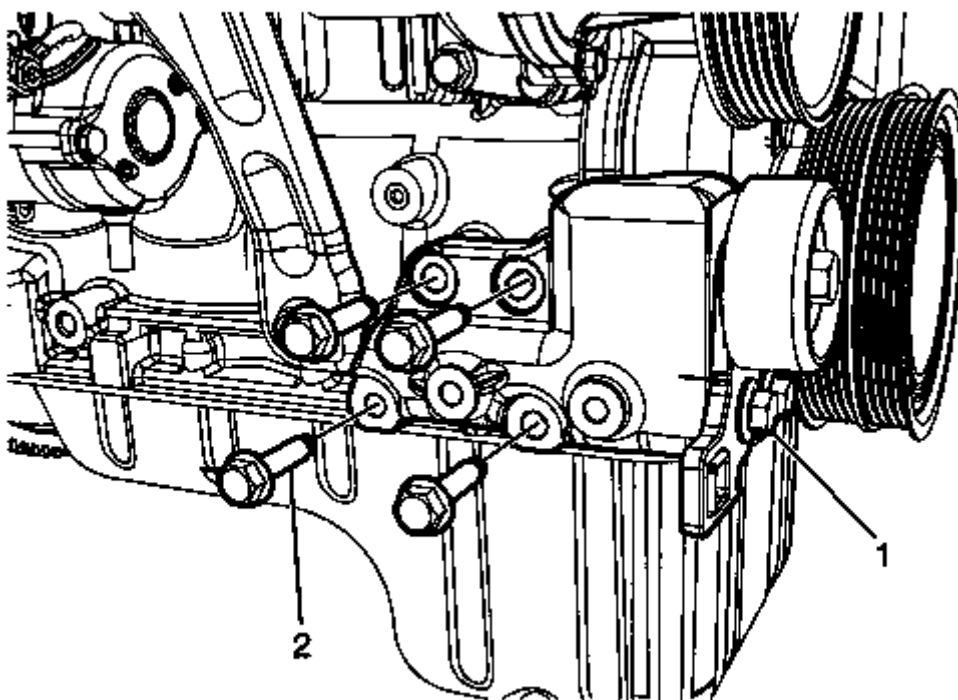


Fig. 30: Generator Bracket

Courtesy of GENERAL MOTORS COMPANY

1. Install the generator bracket (1).

CAUTION: Refer to Fastener Caution .

2. Tighten the 4 generator bracket retaining bolts (2) to 22 (16 lb ft).
3. Install the generator. Refer to Generator Replacement.

GENERATOR REPLACEMENT

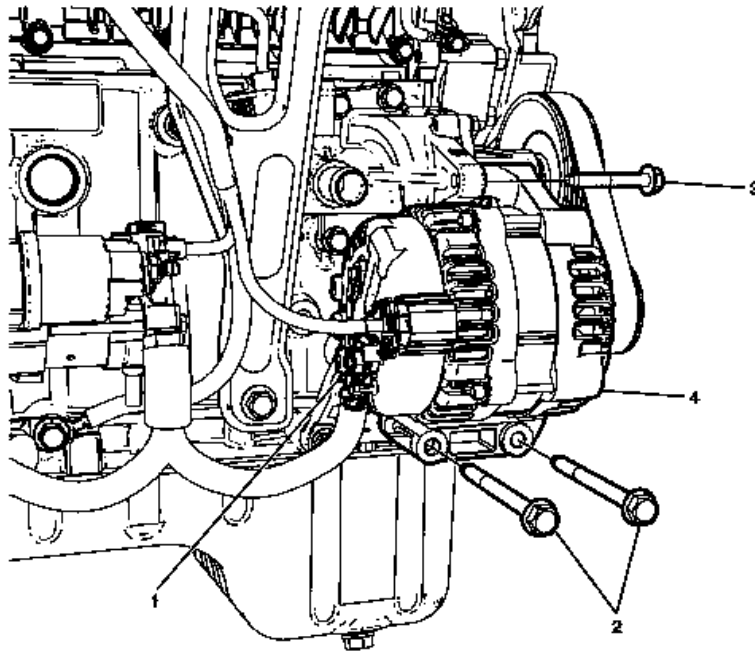


Fig. 31: Generator
 Courtesy of GENERAL MOTORS COMPANY

Generator Replacement

Callout	Component Name
Preliminary Procedures 1. Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u>. 2. Remove the water pump and generator belt. Refer to <u>Water Pump and Generator Belt Replacement</u>. 3. Disconnect the generator connector.	
1	Generator B (+) Nut CAUTION: Refer to <u>Fastener Caution</u> . Procedure Remove the generator B (+) nut. Tighten 11 (8 lb ft)
2	Generator Under Bolt (Qty: 2) Procedure Remove the under bolts. Tighten

	22 (16 lb ft)
3	Generator Upper Bolt Procedure Remove the generator upper bolt. Tighten 22 (16 lb ft)
4	Generator

DESCRIPTION AND OPERATION

BATTERY DESCRIPTION AND OPERATION

WARNING: Batteries produce explosive gases, contain corrosive acid, and supply levels of electrical current high enough to cause burns. Therefore, to reduce the risk of personal injury when working near a battery:

- Always shield your eyes and avoid leaning over the battery whenever possible.
- Do not expose the battery to open flames or sparks.
- Do not allow the battery electrolyte to contact the eyes or the skin. Flush immediately and thoroughly any contacted areas with water and get medical help.
- Follow each step of the jump starting procedure in order.
- Treat both the booster and the discharged batteries carefully when using the jumper cables.

Batteries that are no longer wanted must be disposed of by an approved battery recycler and must never be thrown in the trash or sent to a landfill.

Batteries that are not part of the vehicle itself, not the battery under the hood, must only be transported on public streets for business purposes via approved hazardous material transportation procedures.

Battery storage, charging and testing facilities in repair shops must meet various requirements for ventilation, safety equipment, material segregation, etc.

The maintenance free battery is standard. There are no vent plugs in the cover. The battery is completely sealed except for 2 small vent holes in the side. These vent holes allow the small amount of gas that is produced in the battery to escape.

The battery has 3 functions as a major source of energy:

- Engine cranking
- Voltage stabilizer
- Alternate source of energy with generator overload

Battery Low Start Vehicle Message

The body control module (BCM) monitors battery positive voltage to determine battery state of charge. If one or more of the BCM battery positive voltage terminals measure less than approximately 11.6V compared to the BCM ground circuits, this message will display and four chimes may sound. Start the vehicle immediately. If the vehicle is not started and the battery continues to discharge, the climate controls, heated seats, and audio systems will shut off and the vehicle may require a jump start. These systems will function again after the vehicle is started.

Battery Ratings

A battery has 2 ratings:

- Cold cranking amperage
- Amperage hours

When a battery is replaced use a battery with similar ratings. See battery specification label on the original battery.

Amperage Hours

The amperage hour rating tells you how much amperage is available when discharged evenly over a 20 hour period. The amperage hour rating is cumulative, so in order to know how many constant amperage the battery will output for 20 h, you have to divide the amperage hour rating by 20. Example: If a battery has an amperage hour rating of 74, dividing by 20 = 3.75. Such a battery can carry a 3.75 A load for 20 hours before dropping to 10.5 V. (10.5 V is the fully discharged level, at which point the battery needs to be recharged.) A battery with an amperage hour rating of 55 will carry a 2.75 A load for 20 hours before dropping to 10.5 V.

Cold Cranking Amperage

The cold cranking amperage is an indication of the ability of the battery to crank the engine at cold temperatures. The cold cranking amperage rating is the minimum amperage the battery must maintain for 30 seconds at -18°C (0°F) while maintaining at least 7.2 V. See battery label for the cold cranking amperage rating of this battery.

CHARGING SYSTEM DESCRIPTION AND OPERATION

Electrical Power Management Overview

The electrical power management system is designed to monitor and control the charging system and send diagnostic messages to alert the driver of possible problems with the battery and generator. This electrical power management system primarily utilizes existing on-board computer capability to maximize the effectiveness of the generator, to manage the load, improve battery state-of-charge and life, and minimize the system's impact on fuel economy. The electrical power management system performs 3 functions:

- It monitors the battery voltage and estimates the battery condition.
- It takes corrective actions by boosting idle speeds, and adjusting the regulated voltage.

- It performs diagnostics and driver notification.

The battery condition is estimated during ignition-off and during ignition-on. During ignition-off the state-of-charge of the battery is determined by measuring the open-circuit voltage. The state-of-charge is a function of the acid concentration and the internal resistance of the battery, and is estimated by reading the battery open circuit voltage when the battery has been at rest for several hours.

The state-of-charge can be used as a diagnostic tool to tell the customer or the dealer the condition of the battery. Throughout ignition-on, the algorithm continuously estimates state-of-charge based on adjusted net amp hours, battery capacity, initial state-of-charge, and temperature.

While running, the battery degree of discharge is primarily determined by a battery current sensor, which is integrated to obtain net amp hours.

In addition, the electrical power management function is designed to perform regulated voltage control to improve battery state-of-charge, battery life, and fuel economy. This is accomplished by using knowledge of the battery state-of-charge and temperature to set the charging voltage to an optimum battery voltage level for recharging without detriment to battery life.

The Charging System Description and Operation is divided into 3 sections. The first section describes the charging system components and their integration into the electrical power management. The second section describes charging system operation. The third section describes the instrument panel cluster operation of the charge indicator, driver information center messages, and voltmeter operation.

Charging System Components

Generator

The generator is a serviceable component. If there is a diagnosed failure of the generator it must be replaced as an assembly. The engine drive belt drives the generator. When the rotor is spun it induces an alternating current (AC) into the stator windings. The AC voltage is then sent through a series of diodes for rectification. The rectified voltage has been converted into a direct current (DC) for use by the vehicles electrical system to maintain electrical loads and the battery charge. The voltage regulator integral to the generator controls the output of the generator. It is not serviceable. The voltage regulator controls the amount of current provided to the rotor. If the generator has field control circuit failure, the generator defaults to an output voltage of 13.8 V.

Body Control Module (BCM)

The body control module (BCM) is a GMLAN device. It communicates with the engine control module (ECM) and the instrument panel cluster for electrical power management (electrical power management) operation. The BCM determines the output of the generator and sends the information to the ECM for control of the generator turn on signal circuit. It monitors the generator field duty cycle signal circuit information sent from the ECM for control of the generator. It monitors a battery current sensor, the battery positive voltage circuit, and estimated battery temperature to determine battery state of charge. The BCM performs idle boost.

Battery Current Sensor

The battery current sensor is a serviceable component that is connected to either the negative or positive battery cable at the battery. The battery current sensor is a 3-wire hall effect current sensor. The battery current sensor monitors the battery current. It directly inputs to the BCM. It creates a 5-volt pulse width modulation (PWM) signal of 128 Hz with a duty cycle of 0-100 percent. Normal duty cycle is between 5-95 percent. Between 0-5 percent and 95-100 percent are for diagnostic purposes.

Engine Control Module (ECM)

When the engine is running, the generator turn-on signal is sent to the generator from the ECM, turning on the regulator. The generator's voltage regulator controls current to the rotor, thereby controlling the output voltage. The rotor current is proportional to the electrical pulse width supplied by the regulator. When the engine is started, the regulator senses generator rotation by detecting AC voltage at the stator through an internal wire. Once the engine is running, the regulator varies the field current by controlling the pulse width. This regulates the generator output voltage for proper battery charging and electrical system operation. The generator field duty terminal is connected internally to the voltage regulator and externally to the ECM. When the voltage regulator detects a charging system problem, it grounds this circuit to signal the ECM that a problem exists. The ECM monitors the generator field duty cycle signal circuit, and receives control decisions based on information from the BCM.

Instrument Panel Cluster

The instrument panel cluster provides the customer notification in case a concern with the charging system. There are 2 means of notification, a charge indicator and a driver information center message of SERVICE BATTERY CHARGING SYSTEM if equipped.

Charging System Block Diagram

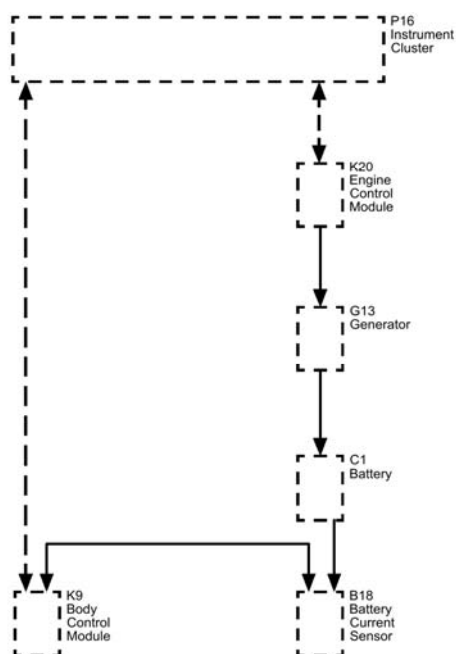


Fig. 32: Charging System Block Diagram
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
DB	Serial Data - GMLAN Low Speed
HW	Hard-Wired
HW	Hard-Wired
HW	Hard-Wired
HW	Hard-Wired
DB	Serial Data - GMLAN Low Speed
P16	P16 Instrument Cluster
K20	K20 Engine Control Module
G13	G13 Generator
C1	C1 Battery
B18	B18 Battery Current Sensor
K9	K9 Body Control Module

Charging System Operation

The purpose of the charging system is to maintain the battery charge and vehicle loads. There are 6 modes of operation and they include:

- Battery Sulfation Mode

- Charge Mode
- Fuel Economy Mode
- Headlamp Mode
- Start Up Mode
- Voltage Reduction Mode

The engine control module (ECM) controls the generator through the generator turn ON signal circuit. The ECM monitors the generator performance through the generator field duty cycle signal circuit. The signal is a pulse width modulation (PWM) signal of 128 Hz with a duty cycle of 0-100 percent. Normal duty cycle is between 5-95 percent. Between 0-5 percent and 95-100 percent are for diagnostic purposes. The following table shows the commanded duty cycle and output voltage of the generator:

Commanded Duty Cycle	Generator Output Voltage
10%	11 V
20%	11.56 V
30%	12.12 V
40%	12.68 V
50%	13.25 V
60%	13.81 V
70%	14.37 V
80%	14.94 V
90%	15.5 V

The generator provides a feedback signal of the generator voltage output through the generator field duty cycle signal circuit to the ECM. This information is sent to the body control module (BCM). The signal is PWM signal of 128 Hz with a duty cycle of 0-100 percent. Normal duty cycle is between 5-99 percent. Between 0-5 percent and 100 percent are for diagnostic purposes.

Battery Sulfation Mode

The BCM will enter this mode when the interpreted generator output voltage is less than 13.2 V for 45 minutes. When this condition exists the BCM will enter Charge Mode for 2-3 minutes. The BCM will then determine which mode to enter depending on voltage requirements.

Charge Mode

The BCM will enter Charge Mode when ever one of the following conditions are met.

- The wipers are ON for more than 3 seconds.
- GMLAN (Climate Control Voltage Boost Mode Request) is true, as sensed by the HVAC control head. High speed cooling fan, rear defogger and HVAC high speed blower operation can cause the BCM to enter the Charge Mode.
- The estimated battery temperature is less than 0°C (32°F).
- Battery State of Charge is less than 80 percent.

- Vehicle speed is greater than 145 km/h (90 mph)
- Current sensor fault exists.
- System voltage was determined to be below 12.56 V

When any one of these conditions is met, the system will set targeted generator output voltage to a charging voltage between 13.9-15.5 V, depending on the battery state of charge and estimated battery temperature.

Fuel Economy Mode

The BCM will enter Fuel Economy Mode when the estimated battery temperature is at least 0°C (32°F) but less than or equal to 80°C (176°F), the calculated battery current is less than 15 amperes and greater than -8 amperes, and the battery state-of-charge is greater than or equal to 80 percent. Its targeted generator output voltage is the open circuit voltage of the battery and can be between 12.5-13.1 V. The BCM will exit this mode and enter Charge Mode when any of the conditions described above are present.

Headlamp Mode

The BCM will enter Headlamp Mode when ever the headlamps are ON (high or low beams). Voltage will be regulated between 13.9-14.5 V.

Start Up Mode

When the engine is started the BCM sets a targeted generator output voltage of 14.5 V for 30 seconds.

Voltage Reduction Mode

The BCM will enter Voltage Reduction Mode when the calculated ambient air temperature is above 0°C (32°F). The calculated battery current is less than 1 ampere and greater than -7 amperes, and the generator field duty cycle is less than 99 percent. Its targeted generator output voltage is 12.9 V. The BCM will exit this mode once the criteria are met for Charge Mode.

Instrument Panel Cluster Operation

Charge Indicator Operation

The instrument panel cluster illuminates the charge indicator and displays a warning message in the driver information center if equipped, when the one or more of the following occurs:

- The engine control module (ECM) detects that the generator output is less than 11 V or greater than 16 V. The instrument panel cluster receives a GMLAN message from the ECM requesting illumination.
- The instrument panel cluster determines that the system voltage is less than 11 V or greater than 16 V for more than 30 seconds. The instrument panel cluster receives a GMLAN message from the body control module (BCM) indicating there is a system voltage range concern.
- The instrument panel cluster performs the displays test at the start of each ignition cycle. The indicator illuminates for approximately 3 seconds.

Display Message: BATTERY NOT CHARGING SERVICE CHARGING SYSTEM or SERVICE

BATTERY CHARGING SYSTEM

The BCM and the ECM will send a serial data message to the driver information center for the BATTERY NOT CHARGING SERVICE CHARGING SYSTEM or SERVICE BATTERY CHARGING SYSTEM message to be displayed. It is commanded ON when a charging system DTC is a current DTC. The message is turned OFF when the conditions for clearing the DTC have been met.

ELECTRICAL POWER MANAGEMENT DESCRIPTION AND OPERATION

Electrical Power Management

The electrical power management is used to monitor and control the charging system and alert the driver of possible problems within the charging system. The electrical power management system makes the most efficient use of the generator output, improves the battery state-of-charge, extends battery life, and manages system electrical loads.

The load shed operation is a means of reducing electrical loads during a low voltage or low battery state-of-charge condition.

The idle boost operation is a means of improving generator performance during a low voltage or low battery state-of-charge condition.

Each electrical power management function, either idle boost or load shed, is discrete. No two functions are active at the same time. Idle boost is activated in incremental steps, idle boost 1 must be active before idle boost 2 can be active. The criteria used by the body control module (BCM) to regulate electrical power management are outlined below:

Electrical Power Management Block Diagram

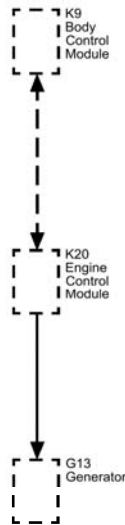


Fig. 33: Electrical Power Management Block Diagram
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
DD	Serial Data - GMLAN High Speed
HW	Hard-Wired
K9	K9 Body Control Module
K20	K20 Engine Control Module
G13	G13 Generator

Function	Battery Temperature Calculation	Battery Voltage Calculation	Amp-Hour Calculation	Action Taken
Idle Boost 1 Start	Less Than -15°C (5°F)	Less Than 13 V	-	First level Idle boost requested
Idle Boost 1 Start	-	-	Battery has a net loss greater than 0.6 Ah	First level Idle boost requested
Idle Boost 1 Start	-	Less Than 10.9 V	-	First level Idle boost requested
Idle Boost 1 End	Greater Than -15°C (5°F)	Greater Than -12 V	Battery has a net loss less than 0.2 Ah	First level Idle boost request cancelled

Load Shed 1 Start	-	-	Battery has a net loss of 4 Ah	Rear Defrost, Heated Mirrors, Heated Seats cycled OFF for 20% of their cycle
Load Shed 1 Start	-	Less Than 10.9 V	-	Rear Defrost, Heated Mirrors, Heated Seats cycled OFF for 20% of their cycle
Load Shed 1 End	-	Greater Than 12 V	Battery has a net loss of less than 2 Ah	Clear Load Shed 1
Idle Boost 2 Start	-	-	Battery has a net loss greater than 1.6 Ah	Second level Idle boost requested
Idle Boost 2 Start	-	Less Than 10.9 V	-	Second level Idle boost requested
Idle Boost 2 End	-	Greater Than 12 V	Battery has a net loss less than 0.8 Ah	Second level Idle boost request cancelled
Idle Boost 3 Start	-	-	Battery has a net loss of 10 Ah	Third level Idle boost requested
Idle Boost 3 Start	-	Less Than 10.9 V	-	Third level Idle boost requested
Idle Boost 3 End	-	Greater Than 12 V	Battery has a net loss of less than 6.0 Ah	Third level Idle boost request cancelled
Load Shed 2 Start	-	Less Than 10 V	Battery has a net loss greater than 12 Ah	Rear Defrost, Heated Mirrors, Heated Seats cycled OFF for 50% of their cycle. The BATTERY SAVER ACTIVE message will be displayed on the DIC
Load Shed 2 Start	-	Less Than 10.9 V	-	Rear Defrost, Heated Mirrors, Heated Seats cycled OFF for 50% of their cycle. The BATTERY SAVER ACTIVE message will be displayed on the DIC

Load Shed 2 End	-	Greater Than 12.6 V	Battery has a net loss of less than 10.5 Ah	Clear Load Shed 2
Load Shed 3 Start	-	Less Than 11.9 V	Battery has a net loss greater than 20 Ah	Rear Defrost, Heated Mirrors, Heated Seats cycled OFF for 100% of their cycle. The BATTERY SAVER ACTIVE message will be displayed on the DIC
Load Shed 3 End	-	Greater Than 12.6 V	Battery has a net loss of less than 15 Ah	Clear Load Shed 3

STARTING SYSTEM DESCRIPTION AND OPERATION

The starter motors are non-repairable starter motors. They have pole pieces that are arranged around the armature. Both solenoid windings are energized. The pull-in winding circuit is completed to the ground through the starter motor. The windings work together magnetically to pull and hold in the plunger. The plunger moves the shift lever. This action causes the starter drive assembly to rotate on the armature shaft spline as it engages with the flywheel ring gear on the engine. Moving at the same time, the plunger also closes the solenoid switch contacts in the starter solenoid. Full battery voltage is applied directly to the starter motor and it cranks the engine.

As soon as the solenoid switch contacts close, current stops flowing thorough the pull-in winding because battery voltage is applied to both ends of the windings. The hold-in winding remains energized. Its magnetic field is strong enough to hold the plunger, shift lever, starter drive assembly, and solenoid switch contacts in place to continue cranking the engine. When the engine starts, pinion overrun protects the armature from excessive speed until the switch is opened.

When the ignition switch is released from the START position, the START relay opens and battery voltage is removed from the starter solenoid S terminal. Current flows from the motor contacts through both windings to the ground at the end of the hold-in winding. However, the direction of the current flow through the pull-in winding is now opposite the direction of the current flow when the winding was first energized.

The magnetic fields of the pull-in and hold-in windings now oppose one another. This action of the windings, along with the help of the return spring, causes the starter drive assembly to disengage and the solenoid switch contacts to open simultaneously. As soon as the contacts open, the starter circuit is turned off.

Circuit Description (Key Start)

When the ignition switch is placed in the Start position, a discrete signal is supplied to the body control module (BCM) notifying it that the ignition is in the Start position. The BCM then sends a message to the engine control module (ECM) notifying it that CRANK has been requested. The ECM verifies that the transmission is in Park or Neutral. If it is, the ECM then supplies 12 V to the control circuit of the crank relay. When this

occurs, battery positive voltage is supplied through the switch side of the crank relay to the S terminal of the starter solenoid.

Starting System Block Diagram

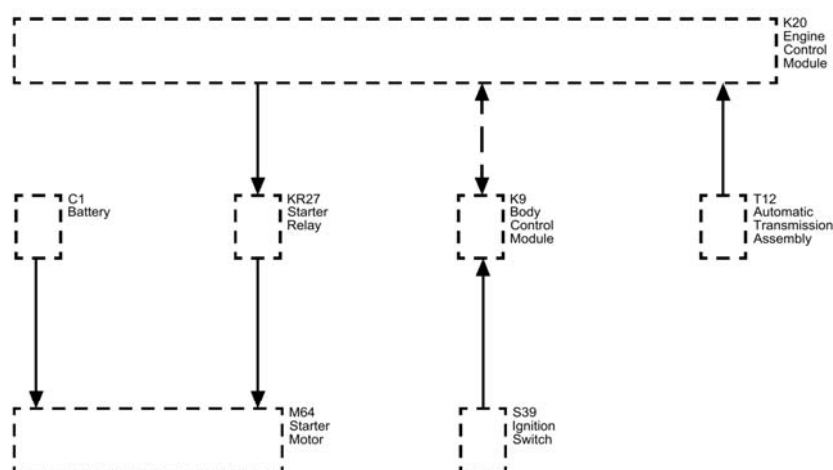
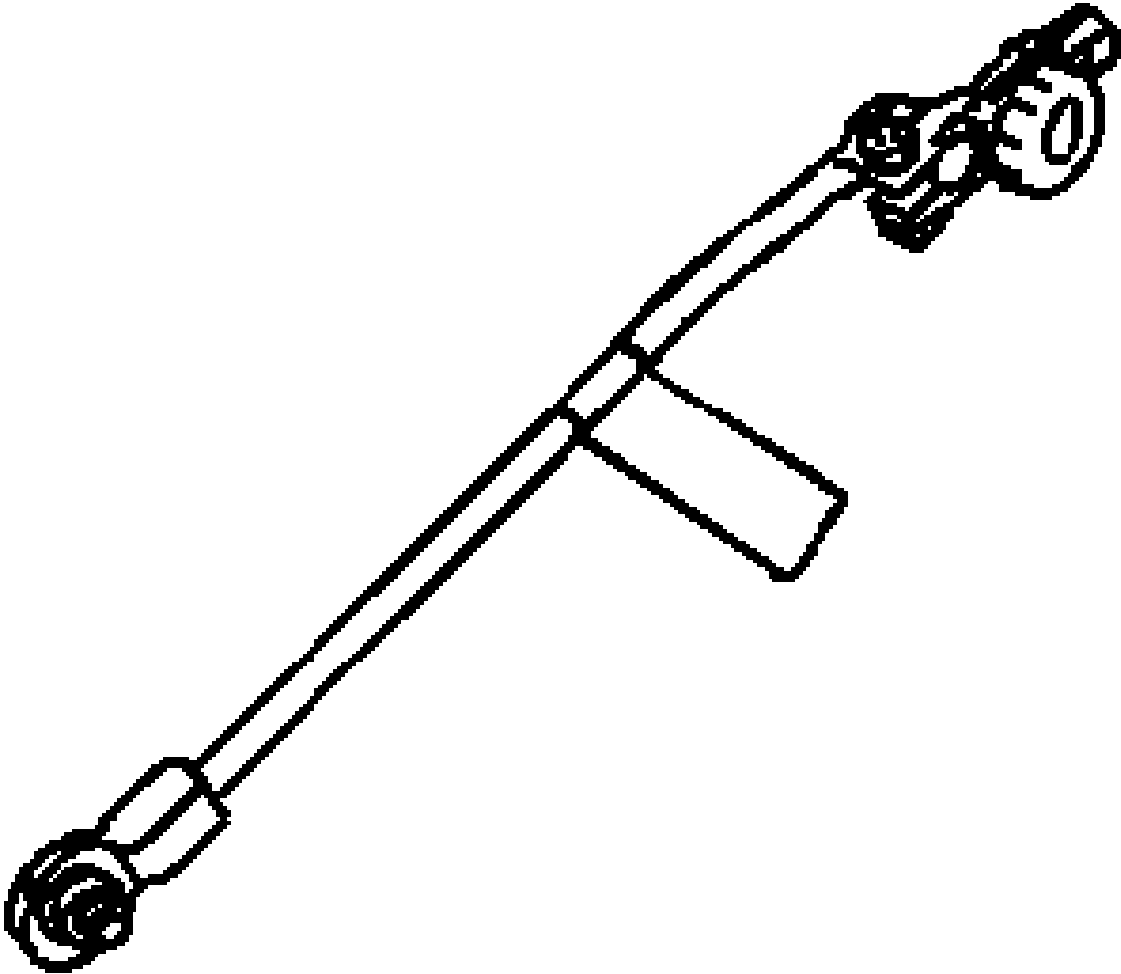


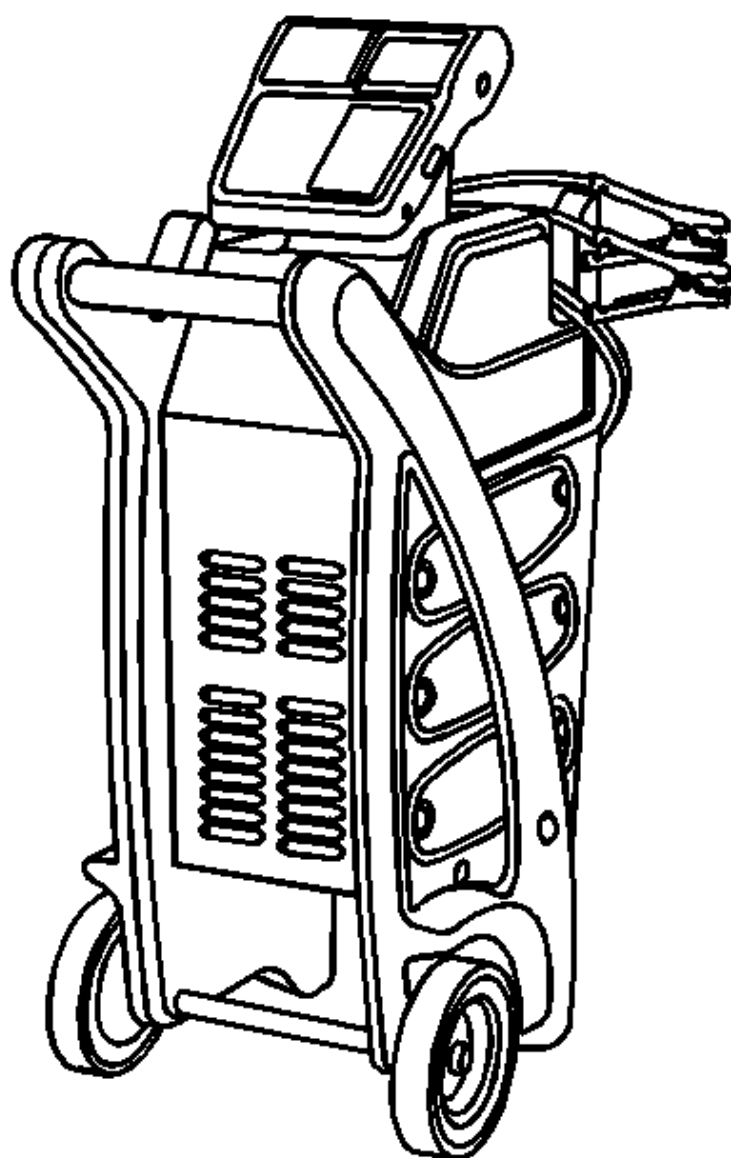
Fig. 34: Starting System Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
HW	Hard-Wired
HW	Hard-Wired
HW	Hard-Wired
HW	Hard-Wired
DD	Serial Data - GMLAN High Speed
HW	Hard-Wired
K20	K20 Engine Control Module
C1	C1 Battery
KR27	KR27 Starter Relay
K9	K9 Body Control Module
T12	T12 Automatic Transmission Assembly
M64	M64 Starter Motor
S39	S39 Ignition Switch

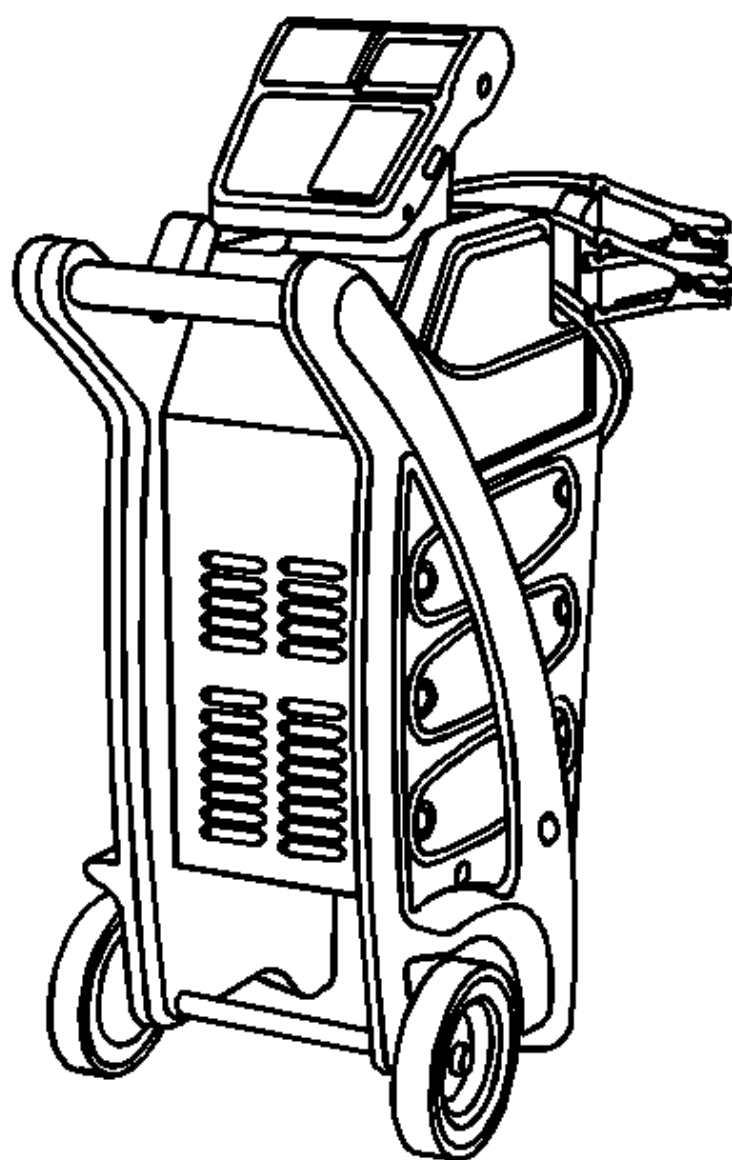
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Descrip
	EL 38758 EL 50074 J 38758 Parasitic Draw T Switch



EL 50313
EL 42000
EL 50076
J 42000
Battery Tester



ACCESSORIES & EQUIPMENT

Bolted Exterior Body Panels and Closures - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Front Fender Bolt	7.5 N.m	66 lb in
Front Side Door Check Bolt	5.5 N.m	49 lb in
Front Side Door Check Link Bolt	28 N.m	21 lb ft
Front Side Door Hinge Bolt	30 N.m	22 lb ft
Front Side Door Lower Hinge Bolt	28 N.m	21 lb ft
Front Side Door Upper Hinge Bolt	28 N.m	21 lb ft
Fuel Tank Filler Door Bolt	5.5 N.m	49 lb in
Hood Hinge Bolt	18 N.m	13 lb ft
Hood Hinge Nut	18 N.m	13 lb ft
Hood Primary and Secondary Latch	8.5 N.m	75 lb in
Liftgate Hinge Bolt	20 N.m	15 lb ft
Liftgate Hinge Nut	22 N.m	16 lb ft
Liftgate Strut Bracket Bolt	20 N.m	15 lb ft
Plenum Lower Panel Bolt	11.5 N.m	102 lb in
Rear Side Door Check Bolt	5.5 N.m	49 lb in
Rear Side Door Check Link Bolt	28 N.m	21 lb ft
Rear Side Door Hinge Bolt	30 N.m	22 lb ft
Rear Side Door Lower Hinge Bolt	28 N.m	21 lb ft
Rear Side Door Upper Hinge Bolt	28 N.m	21 lb ft

SCHEMATIC WIRING DIAGRAMS

HOOD LATCH WIRING SCHEMATICS

Hood Latch Wiring Schematics

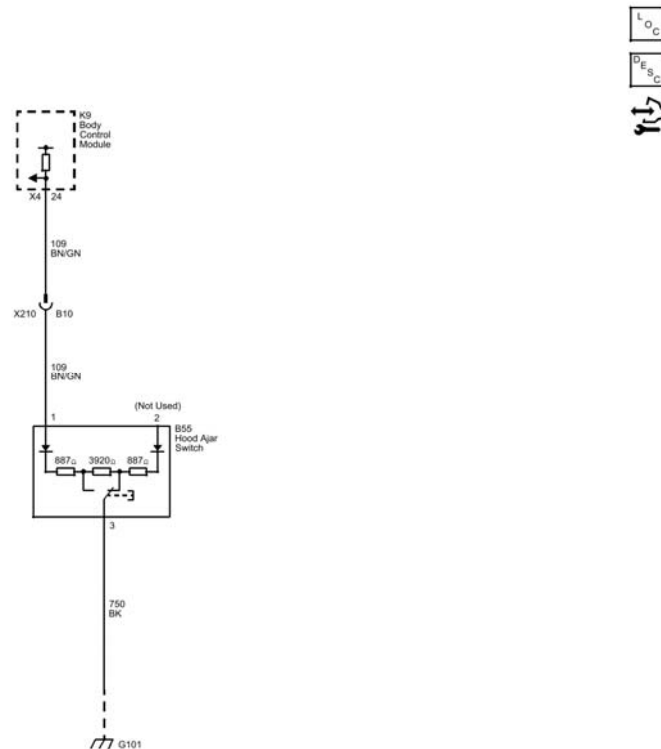


Fig. 1: Hood Latch Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC B3006</u>	DTC B3006 01 Hood Ajar Circuit Short to Battery DTC B3006 02 Hood Ajar Circuit Short to Ground DTC B3006 04 Hood Ajar Circuit Open

DTC B3006: HOOD AJAR CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B3006 01

Hood Ajar Circuit Short to Battery

DTC B3006 02

Hood Ajar Circuit Short to Ground

DTC B3006 04

Hood Ajar Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	B3006 02	B3006 04	B3006 01	-
Ground	-	B3006 04	-	-

Circuit/System Description

The body control module (BCM) applies B+ to the hood ajar signal circuit and monitors the voltage to determine the position of the hood. When the hood is closed, the switch is open and voltage remains high. When the hood is open, the switch is closed and the voltage is pulled low.

Conditions for Running the DTC

The BCM continuously monitors for this DTC

Conditions for Setting the DTC

B3006 01

The BCM detects that the hood ajar switch signal circuit is shorted to battery.

B3006 02

The BCM detects that the hood ajar switch signal circuit is shorted to ground.

B3006 04

The BCM detects that the hood ajar switch signal circuit is open.

Action Taken When the DTC Sets

- The hood ajar switch input will be ignored as a content theft deterrent trigger.
- Remote vehicle start will be disabled.

Conditions for Clearing the DTC

- A current DTC will clear when the conditions for setting the DTC are no longer present.
- A history DTC will clear after 40 malfunction free ignition cycles.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Hood Ajar Switch parameter is Open when the hood is open and Closed when the hood is closed.
 - **If the parameter does not change**

Refer to Circuit/System Testing.
 - **If the parameter changes**
3. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B55 Hood Ajar Switch. It may take up to 2 minutes for all vehicle systems to power down.

2. Test for less than 10 ohms between the ground circuit terminal 3 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Ignition ON.
4. Test for greater than 11.5 V between the signal circuit terminal 1 and ground.
 - **If 11.5 V or less**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If Infinite resistance.
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If greater than 11.5 V**
5. Ignition OFF, disconnect the X4 and X7 harness connector at the K9 Body Control Module. Ignition ON.
6. Test for less than 1 V between the signal circuit terminal 1 and ground.
 - **If 1 V or greater**

Repair the short to voltage on the circuit.
 - **If less than 1 V**
7. Test or replace the B55 Hood Ajar Switch.

Component Testing

1. Ignition OFF, disconnect the harness connector at the B55 Hood Ajar Switch.
2. Test for 2738-3350 ohms between the signal terminal 1 and the signal terminal 2 with the hood latch in the CLOSED position.
 - **If not between 2738-3350 ohms**

Replace the B55 Hood Ajar Switch.
 - **If between 2738-3350 ohms**
3. Test for 658-806 ohms between the signal terminal 2 and the ground terminal 3 with the hood latch in the CLOSED position.
 - **If not between 658-806 ohms**

Replace the B55 Hood Ajar Switch.

- **If between 658-806 ohms**

4. Test for 2080-2545 ohms between the signal terminal 1 and the ground terminal 3 with the hood latch in the CLOSED position.

- **If not between 2080-2545 ohms**

Replace the B55 Hood Ajar Switch.

- **If between 2080-2545 ohms**

5. Test for 2738-3350 ohms between the signal terminal 1 and the signal terminal 2 with the hood latch in the OPEN position.

- **If not between 2738-3350 ohms**

Replace the B55 Hood Ajar Switch.

- **If between 2738-3350 ohms**

6. Test for 2080-2545 ohms between the signal terminal 2 and the ground terminal 3 with the hood latch in the OPEN position.

- **If not between 2080-2545 ohms**

Replace the B55 Hood Ajar Switch.

- **If between 2080-2545 ohms**

7. Test for 658-806 ohms between the signal terminal 1 and the ground terminal 3 with the hood latch in the OPEN position.

- **If not between 658-806 ohms**

Replace the B55 Hood Ajar Switch.

- **If between 658-806 ohms**

8. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Hood Primary and Secondary Latch Replacement**
- **Control Module References** for Body Control Module replacement, programming and setup

SYMPTOMS - BOLTED EXTERIOR BODY PANELS AND CLOSURES

IMPORTANT: The following steps must be completed before using the symptom tables.

1. Perform the **Diagnostic System Check - Vehicle** before using the symptom tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data links.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Hood Ajar Indicator Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the systems. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to **Hood Ajar Indicator/Message Malfunction** in order to diagnose the symptom.

HOOD AJAR INDICATOR/MESSAGE MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B3006 01

Hood Ajar Circuit Short to Battery

DTC B3006 02

Hood Ajar Circuit Short to Ground

DTC B3006 04

Hood Ajar Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	B3006 02	B3006 04	B3006 01	-
Ground	-	B3006 04	-	-

Circuit/System Description

The body control module (BCM) applies B+ to the hood ajar signal circuit and monitors the voltage to determine the position of the hood. When the hood is closed, the switch is open and voltage remains high. When the hood is open, the switch is closed and the voltage is pulled low.

Conditions for Running the DTC

The BCM continuously monitors for this DTC

Conditions for Setting the DTC

B3006 01

The BCM detects that the hood ajar switch signal circuit is shorted to battery.

B3006 02

The BCM detects that the hood ajar switch signal circuit is shorted to ground.

B3006 04

The BCM detects that the hood ajar switch signal circuit is open.

Action Taken When the DTC Sets

- The hood ajar switch input will be ignored as a content theft deterrent trigger.
- Remote vehicle start will be disabled.

Conditions for Clearing the DTC

- A current DTC will clear when the conditions for setting the DTC are no longer present.
- A history DTC will clear after 40 malfunction free ignition cycles.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Hood Ajar Switch parameter is Open when the hood is open and Closed when the hood is closed.
 - **If the parameter does not change**

Refer to Circuit/System Testing.

- **If the parameter changes**
3. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B55 Hood Ajar Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 3 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Ignition ON.
4. Test for greater than 11.5 V between the signal circuit terminal 1 and ground.
 - **If 11.5 V or less**

1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If Infinite resistance.
3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If greater than 11.5 V**
5. Ignition OFF, disconnect the X4 and X7 harness connector at the K9 Body Control Module. Ignition ON.
6. Test for less than 1 V between the signal circuit terminal 1 and ground.
 - **If 1 V or greater**

Repair the short to voltage on the circuit.
 - **If less than 1 V**
7. Test or replace the B55 Hood Ajar Switch.

Component Testing

1. Ignition OFF, disconnect the harness connector at the B55 Hood Ajar Switch.
2. Test for 2738-3350 ohms between the signal terminal 1 and the signal terminal 2 with the hood latch in the CLOSED position.
 - **If not between 2738-3350 ohms**

Replace the B55 Hood Ajar Switch.
 - **If between 2738-3350 ohms**
3. Test for 658-806 ohms between the signal terminal 2 and the ground terminal 3 with the hood latch in the CLOSED position.
 - **If not between 658-806 ohms**

Replace the B55 Hood Ajar Switch.
 - **If between 658-806 ohms**
4. Test for 2080-2545 ohms between the signal terminal 1 and the ground terminal 3 with the hood latch in the CLOSED position.
 - **If not between 2080-2545 ohms**

Replace the B55 Hood Ajar Switch.
 - **If between 2080-2545 ohms**
5. Test for 2738-3350 ohms between the signal terminal 1 and the signal terminal 2 with the hood latch in

the OPEN position.

- **If not between 2738-3350 ohms**

Replace the B55 Hood Ajar Switch.

- **If between 2738-3350 ohms**

6. Test for 2080-2545 ohms between the signal terminal 2 and the ground terminal 3 with the hood latch in the OPEN position.

- **If not between 2080-2545 ohms**

Replace the B55 Hood Ajar Switch.

- **If between 2080-2545 ohms**

7. Test for 658-806 ohms between the signal terminal 1 and the ground terminal 3 with the hood latch in the OPEN position.

- **If not between 658-806 ohms**

Replace the B55 Hood Ajar Switch.

- **If between 658-806 ohms**

8. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Hood Primary and Secondary Latch Replacement**
- **Control Module References** for Body Control Module replacement, programming and setup

REPAIR INSTRUCTIONS

HOOD PRIMARY LATCH RELEASE CABLE REPLACEMENT

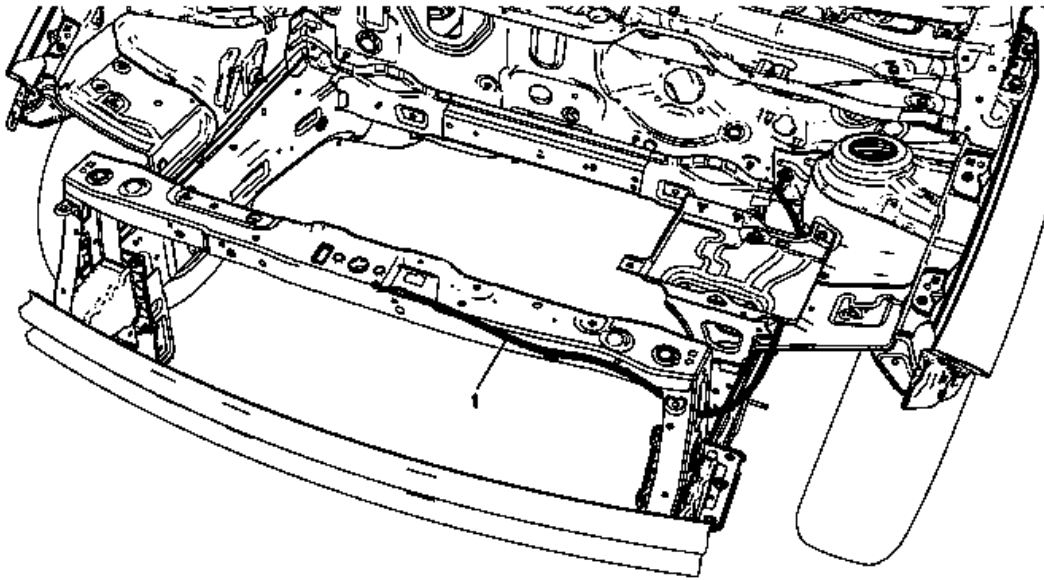


Fig. 2: Hood Primary Latch Release Cable
Courtesy of GENERAL MOTORS COMPANY

Hood Primary Latch Release Cable Replacement

Callout	Component Name
Preliminary Procedures	
1. Remove hood primary latch release cable handle. Refer to <u>Hood Primary Latch Release Cable Handle Replacement</u> .	
2. Remove air cleaner assembly. Refer to <u>Air Cleaner Assembly Replacement</u> .	
1	Hood Primary Latch Release Cable Procedure To release the hood primary latch release cable, unhook from hood primary and secondary latch.

REAR SIDE DOOR CHECK REPLACEMENT

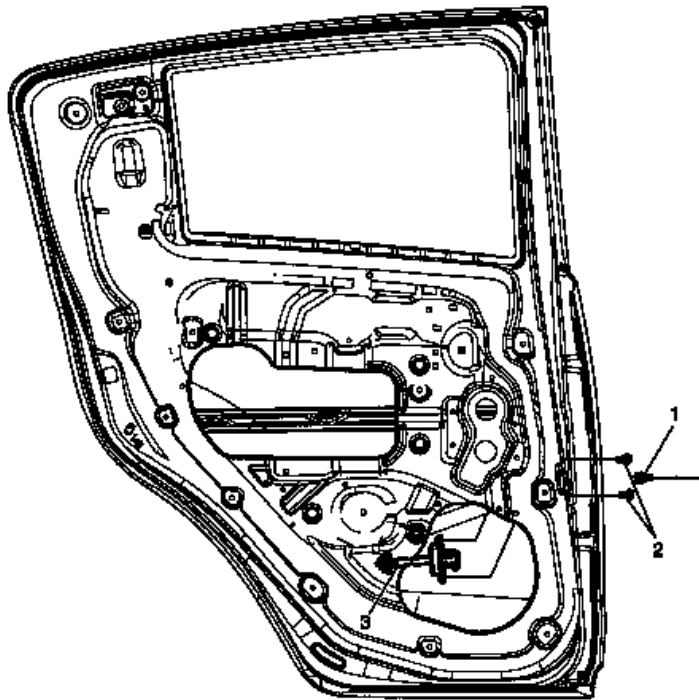


Fig. 3: Rear Side Door Check
 Courtesy of GENERAL MOTORS COMPANY

Rear Side Door Check Replacement

Callout	Component Name
Preliminary Procedure Remove rear side door trim panel. Refer to Rear Side Door Trim Panel Replacement .	
1	Rear Side Door Check Link Bolt CAUTION: Refer to Fastener Caution . TIP: Place the door in the full open position. Tighten 28 N.m (21 lb ft)
2	Rear Side Door Check Bolt Procedure Remove the water deflector. Tighten 5.5 N.m (49 lb in)
3	Rear Side Door Check

FRONT SIDE DOOR ADJUSTMENT

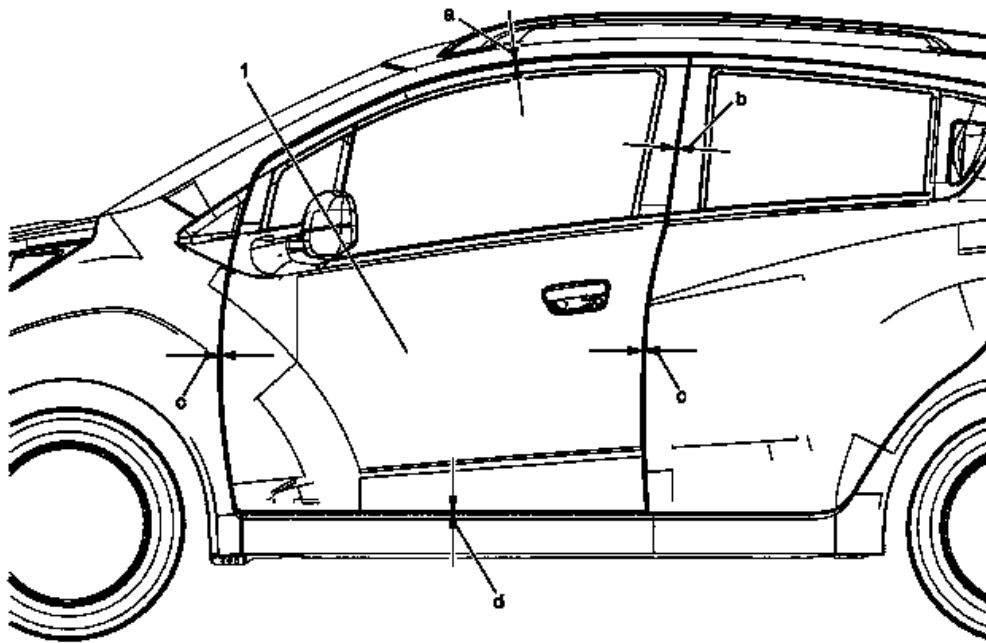


Fig. 4: Front Side Door

Courtesy of GENERAL MOTORS COMPANY

Front Side Door Adjustment

Callout	Component Name
Preliminary Procedure	
Remove the front wheelhouse liner. Refer to Front Wheelhouse Liner Replacement .	
1	Front Side Door to Roof CAUTION: Refer to Fastener Caution . Procedure 1. Loosen the 4 front side door hinge bolts to adjust the front side door. 2. Adjust the front side door in order to obtain an even gap between the front side door and the roof, the rear door, the rocker panel and the front fender and so that the front side door is flush with the roof, the rear door, the rocker panel and the front fender. Adjustment: • Front side door to roof (a) 4.0 mm $\pm$ 1.0 mm (0.16 in $\pm$ 0.04 in) • Front side door to rear door (b) 3.5 mm $\pm$ 0.75 mm (0.14 in $\pm$ 0.03 in) • Front side door to rocker panel (c) 5.0 mm $\pm$ 1.0 mm (0.20 in $\pm$ 0.04 in)

- Front side door to front fender (d) $3.5 \text{ mm} \pm 0.75 \text{ mm}$ ($0.14 \text{ in} \pm 0.03 \text{ in}$)

Tighten

28 N.m (21 lb ft)

FRONT SIDE DOOR REPLACEMENT

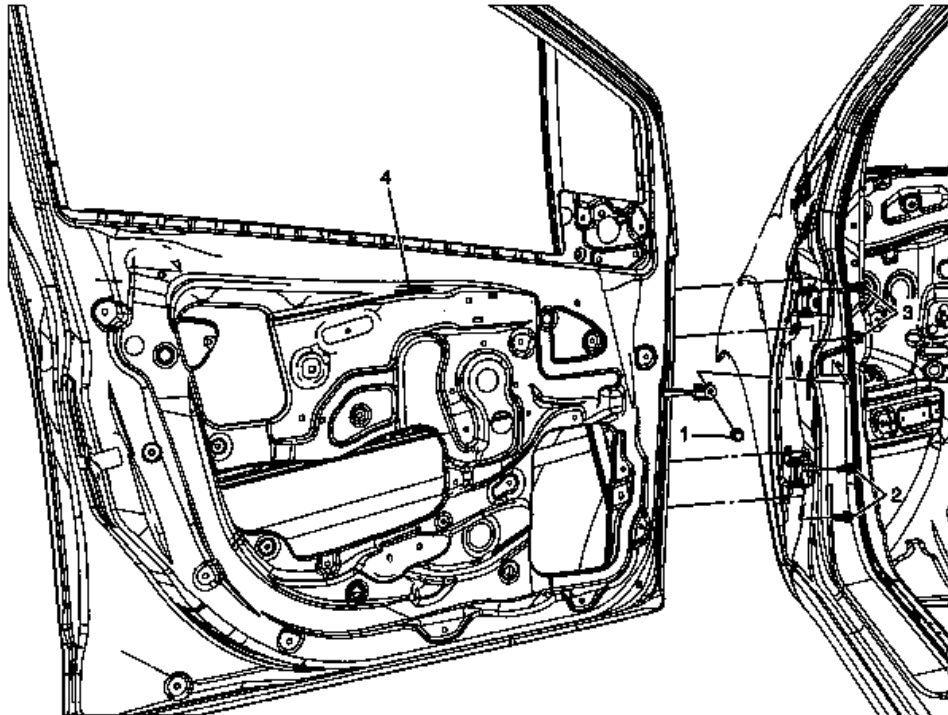


Fig. 5: Front Side Door & Mounting Components
Courtesy of GENERAL MOTORS COMPANY

Front Side Door Replacement

Callout	Component Name
Preliminary Procedure	
Remove the front side door trim panel. Refer to <u>Front Side Door Trim Panel Replacement</u> .	
1	Front Side Door Check Link Bolt CAUTION: Refer to <u>Fastener Caution</u> . Procedure 1. Remove the water deflector. 2. Disconnect the door electrical connector.

	- Support the door before removing the hinge bolts. - With the aid of an assistant, remove the door. Tighten 28 N.m (21 lb ft)
2	Front Side Door Lower Hinge Bolt (Qty: 2) Tighten 28 N.m (21 lb ft)
3	Front Side Door Upper Hinge Bolt (Qty: 2) Tighten 28 N.m (21 lb ft)
4	Front Side Door Procedure - Transfer all of the internal components. - Adjust the front side door as needed. Refer to <u>Front Side Door Adjustment</u>.

REAR SIDE DOOR ADJUSTMENT

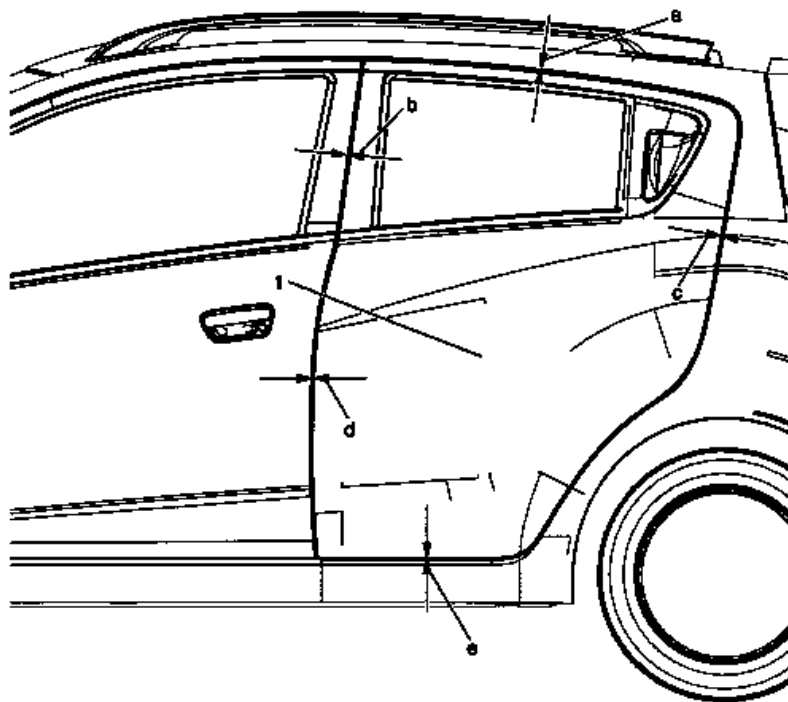


Fig. 6: Rear Side Door
Courtesy of GENERAL MOTORS COMPANY

Rear Side Door Adjustment

Callout	Component Name
1	Rear Side Door CAUTION: Refer to <u>Fastener Caution</u> . Procedure 1. Loosen the 4 rear door hinge bolts to adjust the rear door. 2. Adjust the rear door in order to obtain an even gap between the rear door and the roof, the quarter outer panel, the rocker panel and the front side door and so that the rear door is flush with the roof, the quarter outer panel, the rocker panel and the front side door. Adjustment: • Rear side door to roof (a) 4.0 mm $\pm$ 1.0 mm (0.16 in $\pm$ 0.04 in) • Rear side door to quarter outer panel (b) 3.5 mm $\pm$ 0.75 mm (0.14 in $\pm$ 0.03 in) • Rear side door to rocker panel (c) 5.0 mm $\pm$ 1.0 mm (0.20 in $\pm$ 0.04 in) • Rear side door to front side door (d) 3.5 mm $\pm$ 0.75 mm (0.14 in $\pm$ 0.03 in) Tighten 28 N.m (21 lb ft)

REAR SIDE DOOR REPLACEMENT

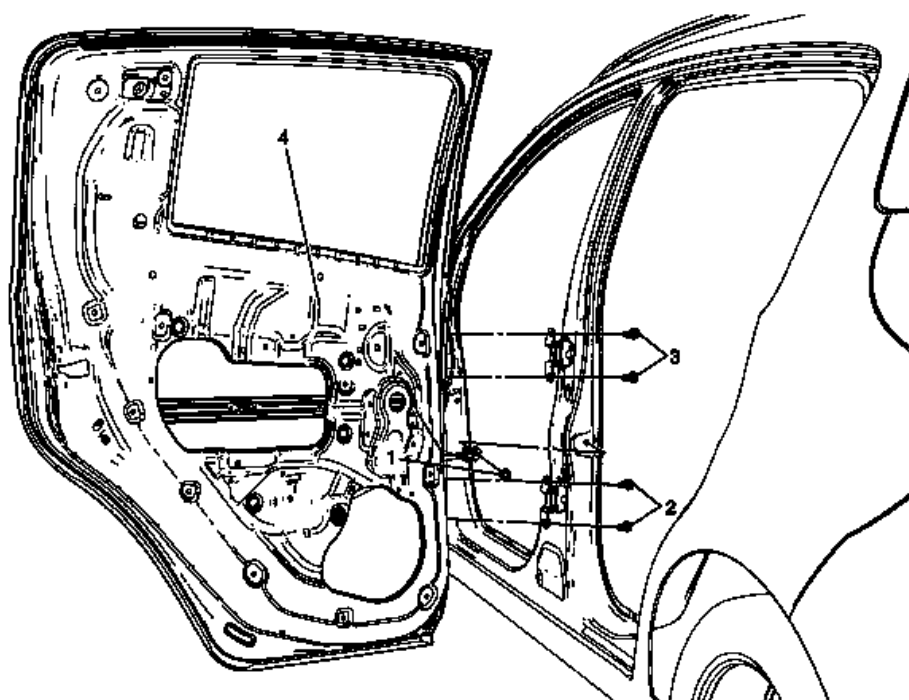


Fig. 7: Rear Side Door
Courtesy of GENERAL MOTORS COMPANY

Rear Side Door Replacement

Callout	Component Name
Preliminary Procedure Remove the rear side door trim panel. Refer to <u>Rear Side Door Trim Panel Replacement</u> .	
1	Rear Side Door Check Link Bolt CAUTION: Refer to <u>Fastener Caution</u> . Procedure 1. Remove the water deflector. 2. Disconnect the door electrical connector. 3. Support the door before removing the hinge bolts. 4. With the aid of an assistant, remove the door. Tighten 28 N.m (21 lb ft)
2	Rear Side Door Lower Hinge Bolt (Qty: 2) Tighten

	28 N.m (21 lb ft)
3	Rear Side Door Upper Hinge Bolt (Qty: 2) Tighten 28 N.m (21 lb ft)
4	Rear Side Door Procedure 1. Transfer all of the internal components. 2. Adjust the rear side door as needed. Refer to <u>Rear Side Door Adjustment</u> .

FRONT FENDER REPLACEMENT

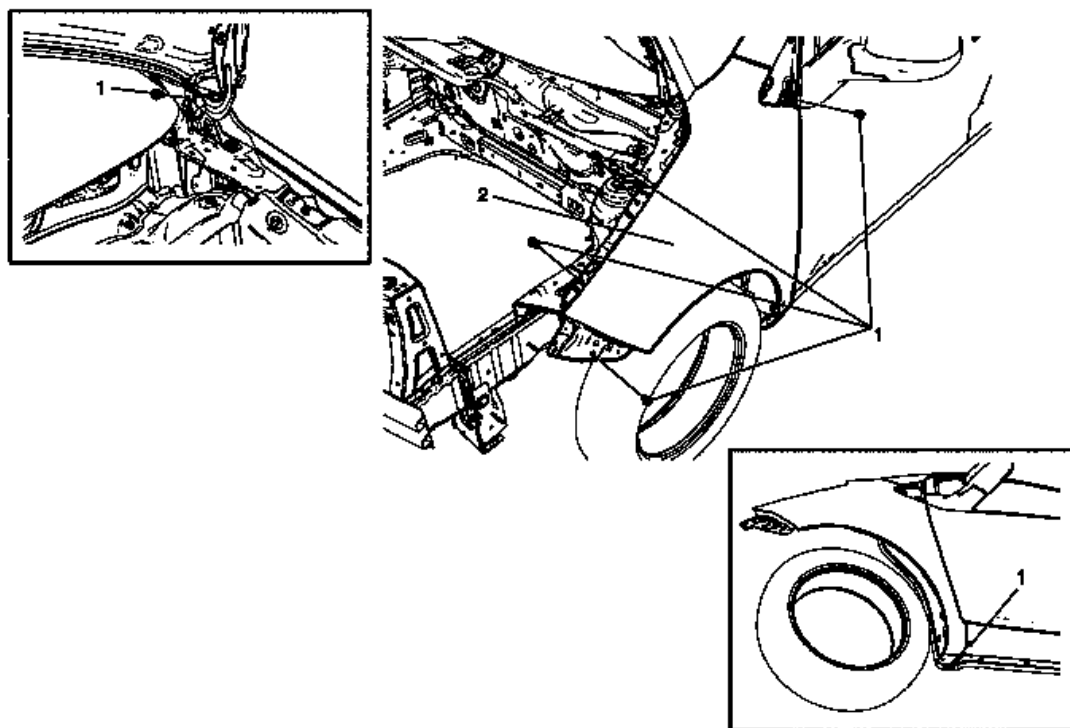


Fig. 8: Front Fender

Courtesy of GENERAL MOTORS COMPANY

Front Fender Replacement

Callout	Component Name
Preliminary Procedure	
1.	Remove the front bumper fascia. Refer to <u>Front Bumper Fascia Replacement</u> .
2.	Remove the headlamp. Refer to <u>Headlamp Replacement</u> .
3.	Remove front bumper fascia guide. Refer to <u>Front Bumper Fascia Guide Replacement</u> .
4.	Remove the wheelhouse liner. Refer to <u>Front Wheelhouse Liner Replacement</u> .

5. Remove the air inlet grille panel. Refer to <u>Air Inlet Grille Panel Replacement</u> .	
1	Front Fender Bolt (Qty: 6) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 7.5 N.m (66 lb in)
2	Front Fender

LIFTGATE ADJUSTMENT

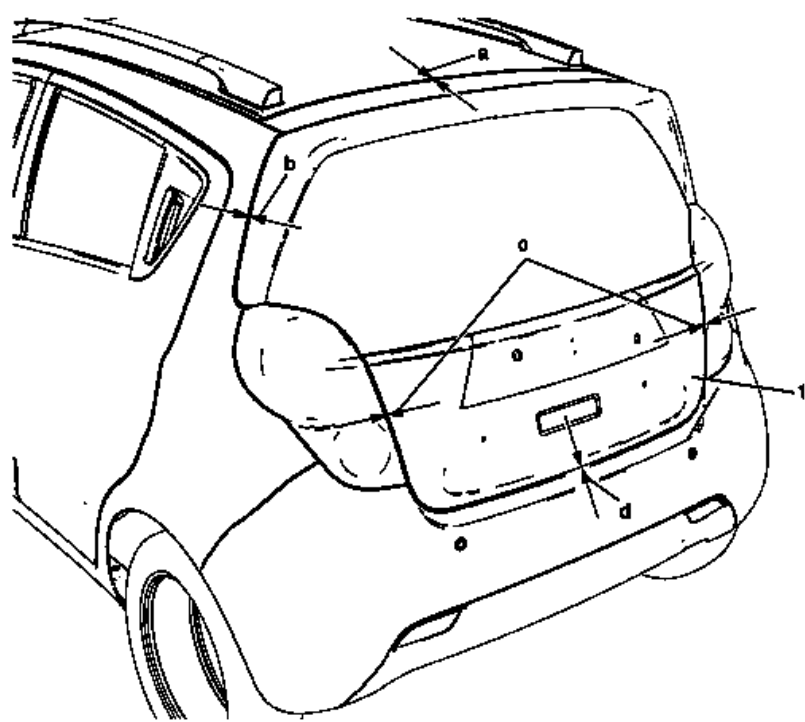


Fig. 9: Liftgate
 Courtesy of GENERAL MOTORS COMPANY

Liftgate Adjustment

Callout	Component Name
	Liftgate CAUTION: Refer to <u>Fastener Caution</u> . Procedure

1. Loosen the 4 liftgate hinge bolts to adjust the liftgate.
2. Adjust the liftgate in order to obtain an even gap between the liftgate and the roof, the quarter outer panel, the tail lamp and rear bumper fascia and so that the liftgate is flush with the roof, the quarter outer panel, the tail lamp and rear bumper fascia.

Adjustment:

1

- Liftgate to roof (a) $5.5 \text{ mm} \pm 1.0 \text{ mm}$ ($0.22 \text{ in} \pm 0.04 \text{ in}$)
- Liftgate to quarter outer panel (b) $4.0 \text{ mm} \pm 1.0 \text{ mm}$ ($0.16 \text{ in} \pm 0.04 \text{ in}$)
- Liftgate to tail lamp (c) $3.5 \text{ mm} \pm 1.5 \text{ mm}$ ($0.14 \text{ in} \pm 0.06 \text{ in}$)
- Liftgate to rear bumper fascia (d) $5.1 \text{ mm} \pm 1.0 \text{ mm}$ ($0.20 \text{ in} \pm 0.04 \text{ in}$)

Tighten
28 N.m (15 lb ft)

LIFTGATE REPLACEMENT

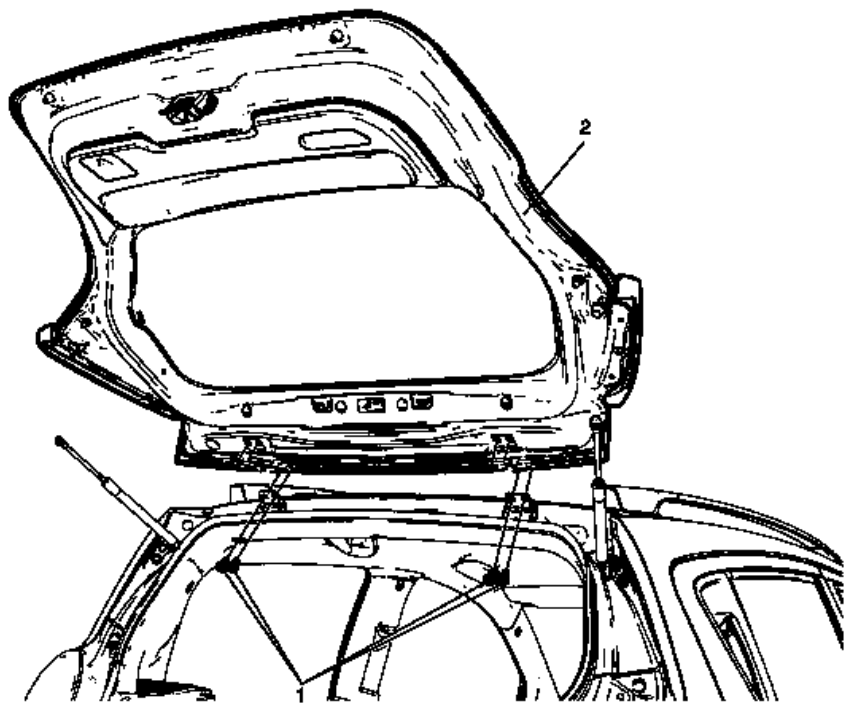


Fig. 10: Liftgate Hinge Bolt
Courtesy of GENERAL MOTORS COMPANY

Liftgate Replacement

Callout	Component Name

WARNING:

When a lift gate hold open device is being removed or installed, provide alternate support to avoid the possibility of damage to the vehicle or personal injury.

Preliminary Procedure Release the liftgate strut from the liftgate. Refer to Liftgate Strut Replacement.

1	Liftgate Hinge Bolt (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . Procedure 1. Disconnect the electrical connector. 2. Pull the liftgate wiring grommet, the connectors and the rear washer hose out of the body. 3. Mark the location of the liftgate hinges to the body with a grease pencil. Tighten 20 N.m (15 lb ft)
2	Liftgate Procedure 1. Transfer components as necessary. 2. Adjust liftgate as needed. Refer to <u>Liftgate Adjustment</u>.

FRONT SIDE DOOR WIRING HARNESS REPLACEMENT

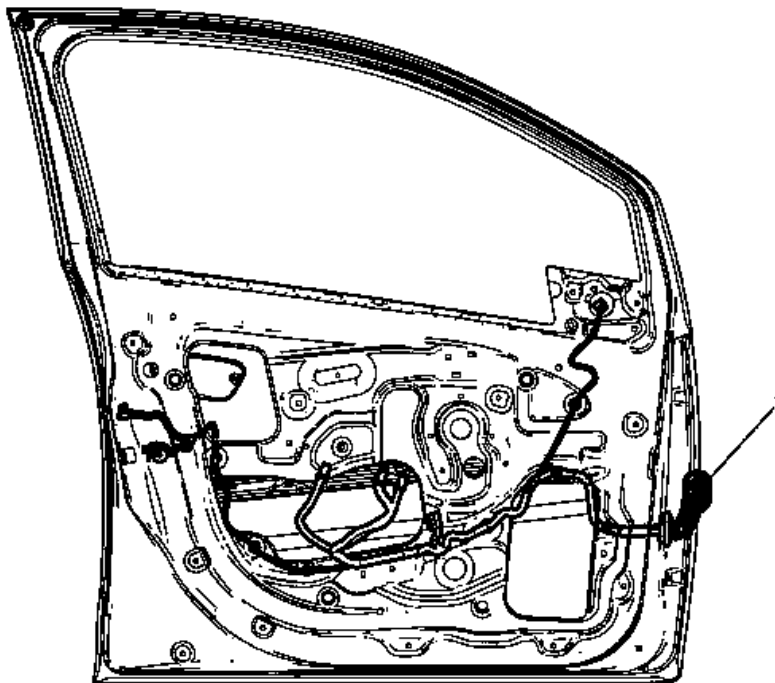


Fig. 11: Front Side Door Wiring Harness
 Courtesy of GENERAL MOTORS COMPANY

Front Side Door Wiring Harness Replacement

Callout	Component Name
Preliminary Procedure	
Remove the front side door inner panel trim. Refer to Front Side Door Trim Panel Replacement .	
1	Front Side Door Wiring Harness WARNING: Unless directed otherwise, the ignition and start switch must be in the OFF or LOCK position and all electrical loads must be OFF before servicing any electrical component. Disconnect the negative battery cable to prevent an electrical spark should a tool or equipment come in contact with an exposed electrical terminal. Failure to follow these precautions may result in personal injury and/or damage to the vehicle or its components. For Vehicles equipped with OnStar® (UE1) with Back Up Battery: The Back Up Battery is a redundant power supply to allow limited OnStar® functionality in the event of a main vehicle battery power disruption to the VCIM (OnStar® module). Do not disconnect the main vehicle battery or remove the OnStar® fuse with the ignition key in any position other than OFF. Retained accessory power should be allowed to time out or be disabled (simply opening the driver door should disable retained accessory power) before disconnecting power. Disconnecting power to the OnStar® module in any way while the ignition is On or with retained accessory power activated may cause activation of the OnStar® Back-Up Battery system and will

discharge and permanently damage the back-up battery. Once the Back-Up Battery is activated it will stay on until it has completely discharged. The back-up battery is not rechargeable and once activated the back-up battery must be replaced.

Procedure

1. Disconnect the battery.
2. Remove the water deflector.
3. Disconnect electrical connectors as needed.

LIFTGATE WIRING HARNESS REPLACEMENT

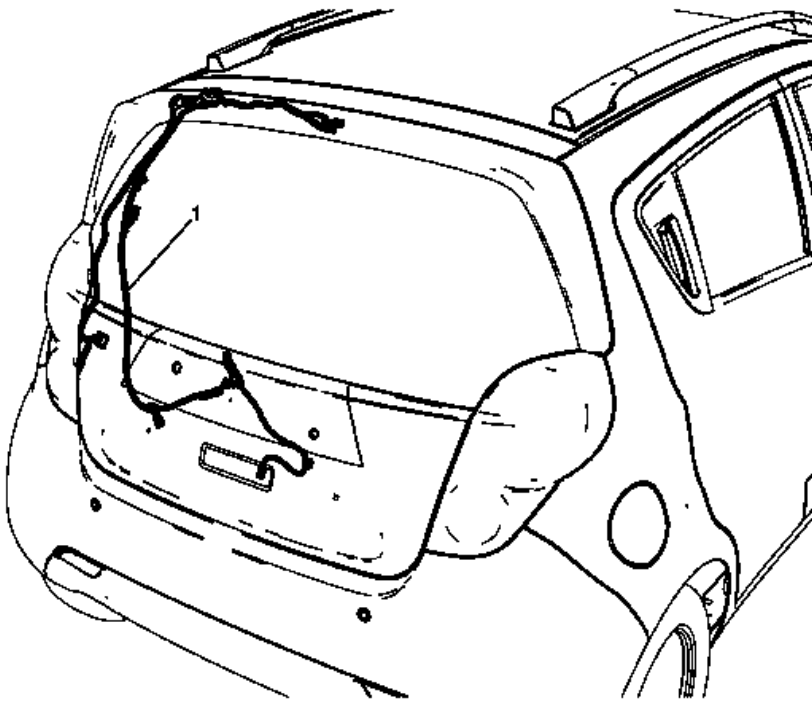


Fig. 12: Liftgate Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

Liftgate Wiring Harness Replacement

Callout	Component Name
Preliminary Procedure	
1. Remove the liftgate trim panel. Refer to <u>Liftgate Trim Panel Replacement</u> . 2. Remove the rear window. Refer to <u>Rear Window Replacement</u> .	
	Liftgate Wiring Harness
	WARNING:

1

Unless directed otherwise, the ignition and start switch must be in the OFF or LOCK position and all electrical loads must be OFF before servicing any electrical component. Disconnect the negative battery cable to prevent an electrical spark should a tool or equipment come in contact with an exposed electrical terminal. Failure to follow these precautions may result in personal injury and/or damage to the vehicle or its components.

For Vehicles equipped with OnStar® (UE1) with Back Up Battery:

The Back Up Battery is a redundant power supply to allow limited OnStar® functionality in the event of a main vehicle battery power disruption to the VCIM (OnStar® module). Do not disconnect the main vehicle battery or remove the OnStar® fuse with the ignition key in any position other than OFF. Retained accessory power should be allowed to time out or be disabled (simply opening the driver door should disable retained accessory power) before disconnecting power. Disconnecting power to the OnStar® module in any way while the ignition is On or with retained accessory power activated may cause activation of the OnStar® Back-Up Battery system and will discharge and permanently damage the back-up battery. Once the Back-Up Battery is activated it will stay on until it has completely discharged. The back-up battery is not rechargeable and once activated the back-up battery must be replaced.

Procedure

1. Disconnect the battery.
2. Disconnect electrical connectors as needed.

REAR SIDE DOOR WIRING HARNESS REPLACEMENT

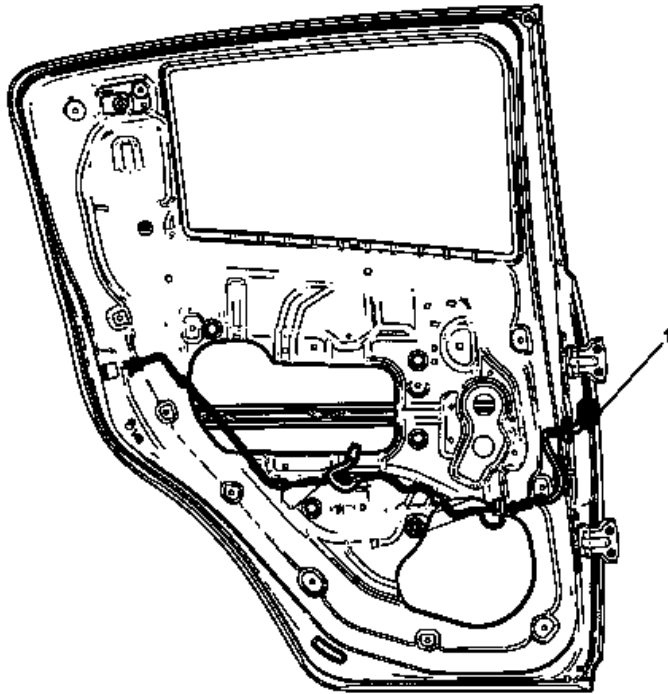


Fig. 13: Rear Side Door Wiring Harness
 Courtesy of GENERAL MOTORS COMPANY

Rear Side Door Wiring Harness Replacement

Callout	Component Name
Preliminary Procedure	
Remove the rear side door inner panel trim. Refer to <u>Rear Side Door Trim Panel Replacement</u> .	
1	Rear Side Door Wiring Harness WARNING: Unless directed otherwise, the ignition and start switch must be in the OFF or LOCK position and all electrical loads must be OFF before servicing any electrical component. Disconnect the negative battery cable to prevent an electrical spark should a tool or equipment come in contact with an exposed electrical terminal. Failure to follow these precautions may result in personal injury and/or damage to the vehicle or its components. For Vehicles equipped with OnStar® (UE1) with Back Up Battery: The Back Up Battery is a redundant power supply to allow limited OnStar® functionality in the event of a main vehicle battery power disruption to the VCIM (OnStar® module). Do not disconnect the main vehicle battery or remove the OnStar® fuse with the ignition key in any position other than OFF. Retained accessory power should be allowed to time out or be disabled (simply opening the driver door should disable retained accessory power) before disconnecting power. Disconnecting power to the OnStar® module in any way while the ignition is On or with retained accessory power activated may cause activation of the OnStar® Back-Up Battery system and will

discharge and permanently damage the back-up battery. Once the Back-Up Battery is activated it will stay on until it has completely discharged. The back-up battery is not rechargeable and once activated the back-up battery must be replaced.

Procedure

1. Disconnect the battery.
2. Remove the water deflector.
3. Disconnect electrical connectors as needed.

HOOD PRIMARY LATCH RELEASE CABLE HANDLE REPLACEMENT

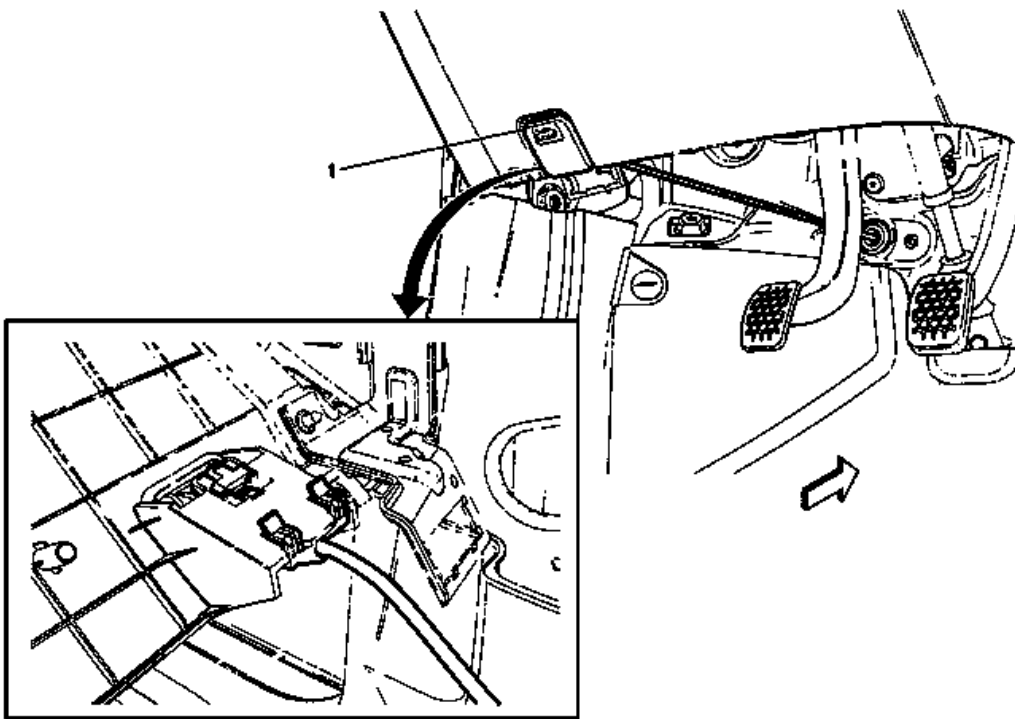


Fig. 14: Hood Primary Latch Release Cable Handle
Courtesy of GENERAL MOTORS COMPANY

Hood Primary Latch Release Cable Handle Replacement

Callout	Component Name
1	Hood Primary Latch Release Cable Handle Procedure 1. Pull down the hood primary latch release cable handle. 2. To release the handle, pull down the cable and unhook from the handle.

FRONT SIDE DOOR UPPER HINGE AND LOWER HINGE REPLACEMENT

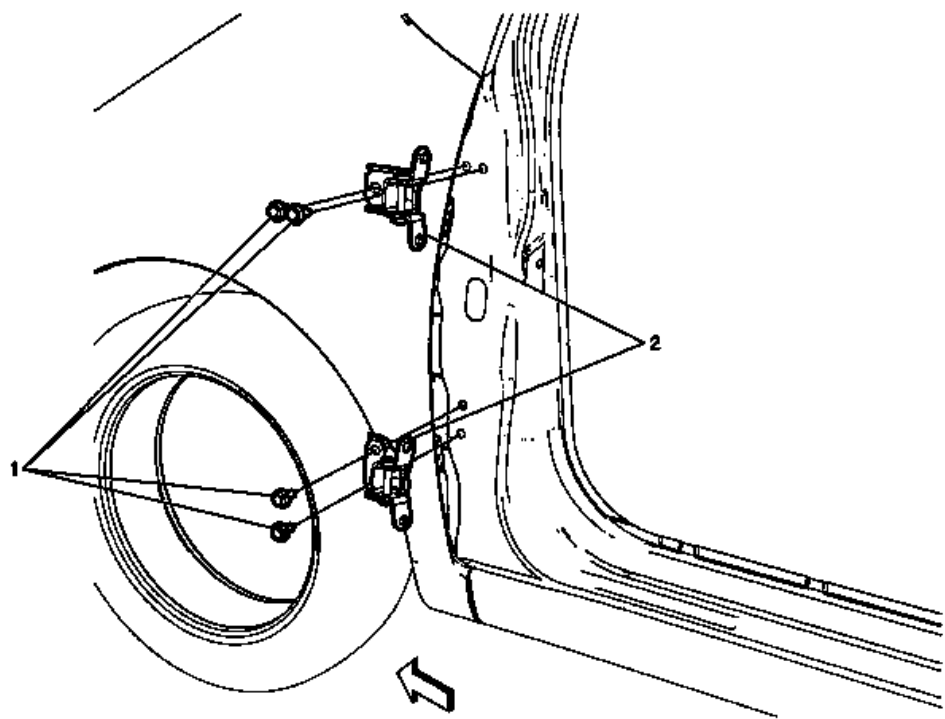


Fig. 15: Front Side Door Upper Hinge and Lower Hinge
Courtesy of GENERAL MOTORS COMPANY

Front Side Door Upper Hinge and Lower Hinge Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the front wheelhouse liner. Refer to <u>Front Wheelhouse Liner Replacement</u> . 2. Remove the front fender insulator. Refer to <u>Front Fender Insulator Replacement</u> . 3. Remove the front side door. Refer to <u>Front Side Door Replacement</u> .	
1	Front Side Door Hinge Bolt (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 30 N.m (22 lb ft)
2	Front Side Door Hinge Procedure Adjust front side door as needed. Refer to <u>Front Side Door Adjustment</u> .

HOOD HINGE REPLACEMENT

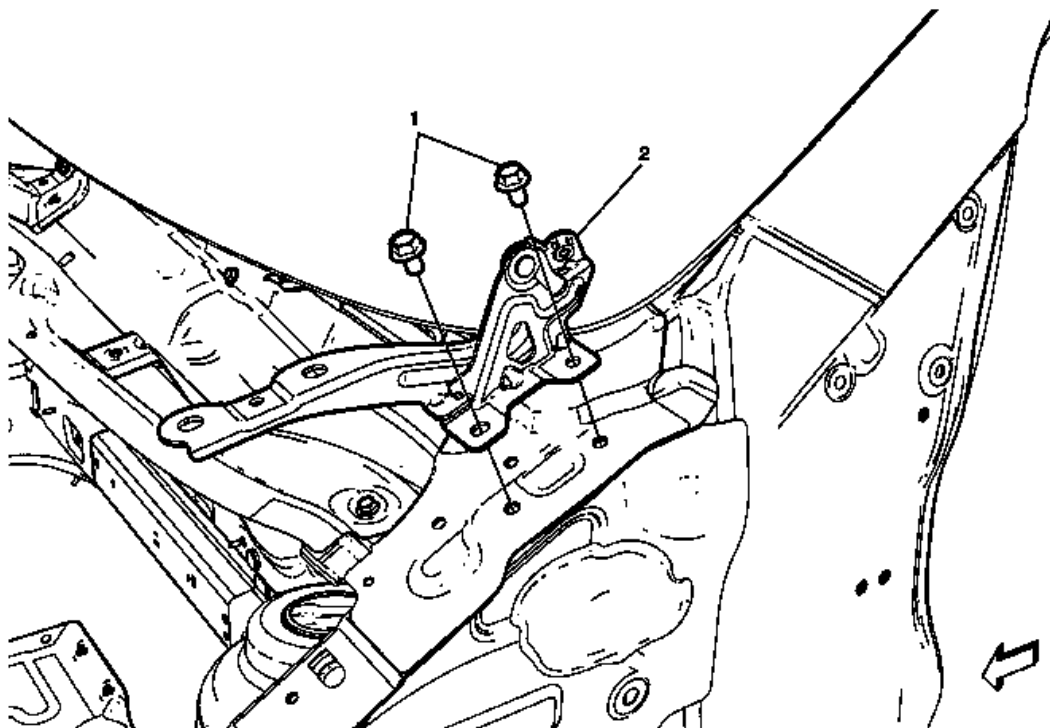


Fig. 16: Hood Hinge

Courtesy of GENERAL MOTORS COMPANY

Hood Hinge Replacement

Callout	Component Name
Preliminary Procedure Remove the hood. Refer to <u>Hood Replacement</u> .	
1	Hood Hinge Bolt (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 18 N.m (13 lb ft)
2	Hood Hinge

LIFTGATE HINGE REPLACEMENT

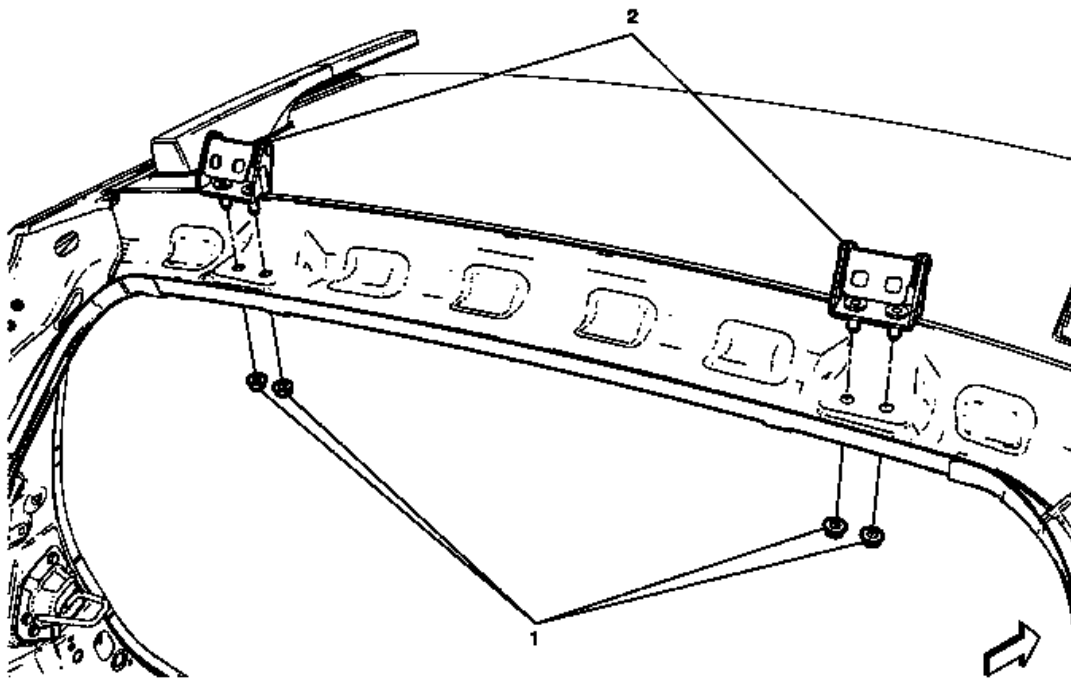


Fig. 17: Liftgate Hinge
 Courtesy of GENERAL MOTORS COMPANY

Liftgate Hinge Replacement

Callout	Component Name
Preliminary Procedure Remove the liftgate. Refer to <u>Liftgate Replacement</u> .	
1	Liftgate Hinge Nut (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 22 N.m (16 lb ft)
2	Liftgate Hinge

REAR SIDE DOOR UPPER HINGE AND LOWER HINGE REPLACEMENT

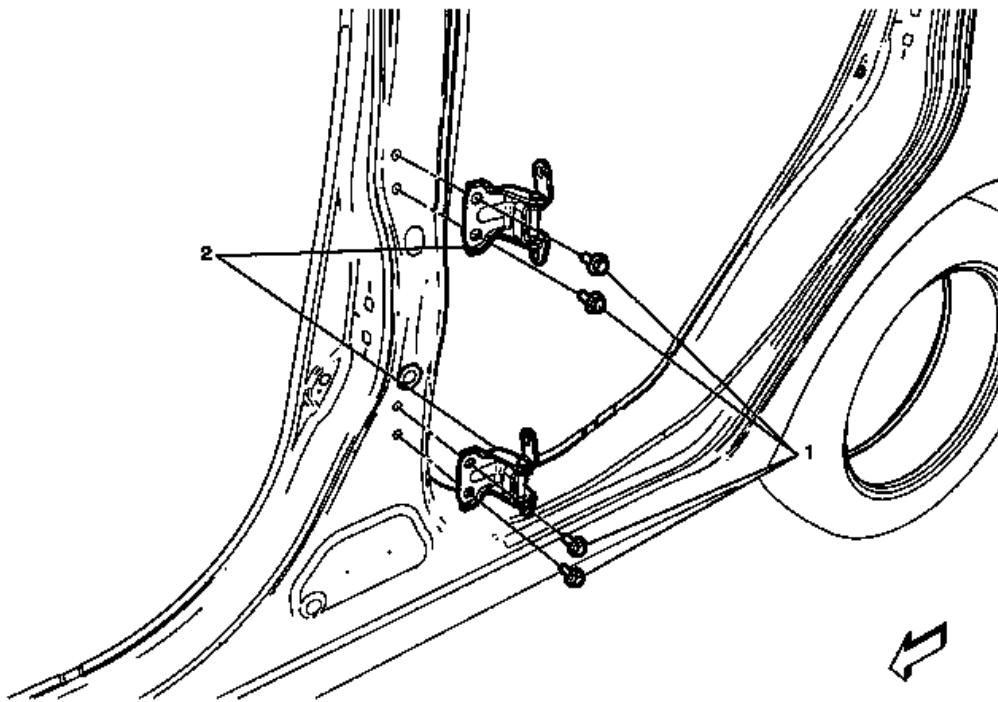


Fig. 18: Rear Side Door Upper Hinge and Lower Hinge
 Courtesy of GENERAL MOTORS COMPANY

Rear Side Door Upper Hinge and Lower Hinge Replacement

Callout	Component Name
Preliminary Procedure	
Remove the rear side door. Refer to <u>Rear Side Door Replacement</u> .	
1	Rear Side Door Hinge Bolt (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 30 N.m (22 lb ft)
2	Rear Side Door Hinge Procedure Adjust rear side door as needed. Refer to <u>Rear Side Door Adjustment</u> .

HOOD ADJUSTMENT

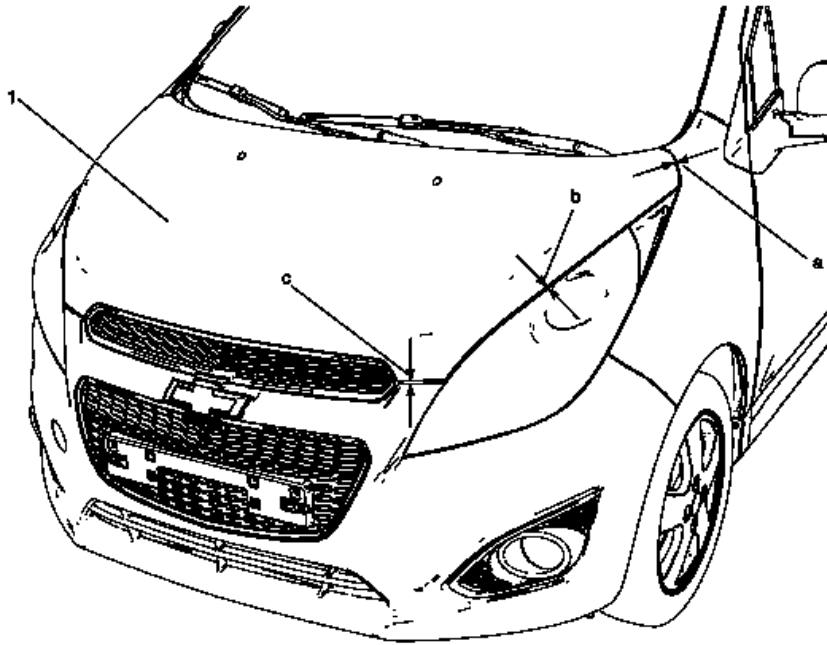


Fig. 19: Hood

Courtesy of GENERAL MOTORS COMPANY

Hood Adjustment

Callout	Component Name
1	Hood CAUTION: Refer to <u>Fastener Caution</u> . Procedure 1. Loosen the 4 hood hinge nuts. 2. Adjust the hood in order to obtain an even gap on both sides between the hood and the fenders, the headlamps and the front bumper fascia and so that the hood is flush with both fenders on the front edge, the front bumper fascia and the headlamps. Adjustment: • Hood to front fender (a) 3.0 mm $\pm$ 0.75 mm (0.12 in $\pm$ 0.03 in) • Hood to headlamp (b) 3.0 mm $\pm$ 1.0 mm (0.12 in $\pm$ 0.04 in) • Hood to front bumper fascia (c) 5.0 mm $\pm$ 1.0 mm (0.20 in $\pm$ 0.04 in) Tighten 18 (13 lb ft)

HOOD REPLACEMENT

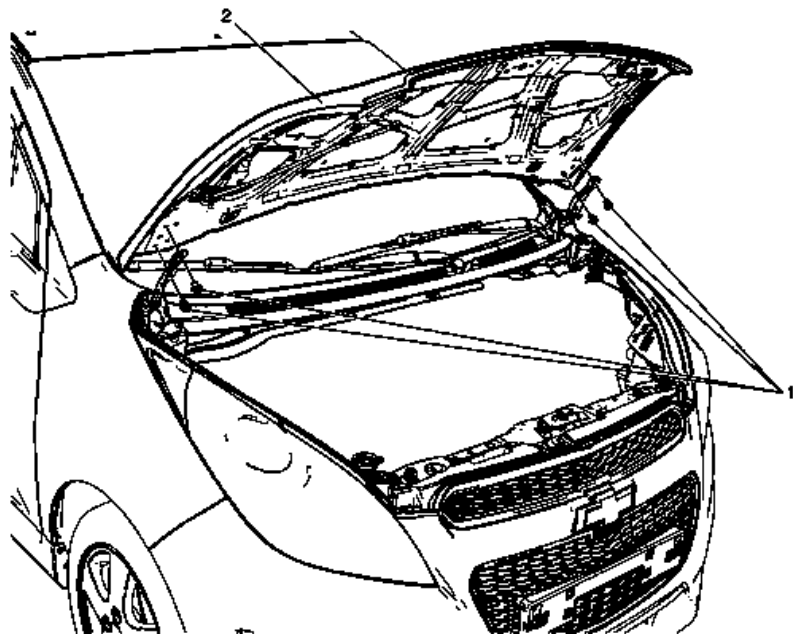


Fig. 20: Hood Hinge Nut
Courtesy of GENERAL MOTORS COMPANY

Hood Replacement

Callout	Component Name
WARNING: When a hood hold open device is being removed or installed, provide alternate support to avoid the possibility of damage to the vehicle or personal injury.	
Preliminary Procedure Remove the windshield washer nozzle hose. Refer to <u>Windshield Washer Nozzle Hose Replacement</u> .	
1	Hood Hinge Nut (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 18 (13 lb ft)
2	Hood Procedure 1. Transfer components as necessary.

2. Adjust hood as needed. Refer to **Hood Adjustment**.

FRONT FENDER INSULATOR REPLACEMENT

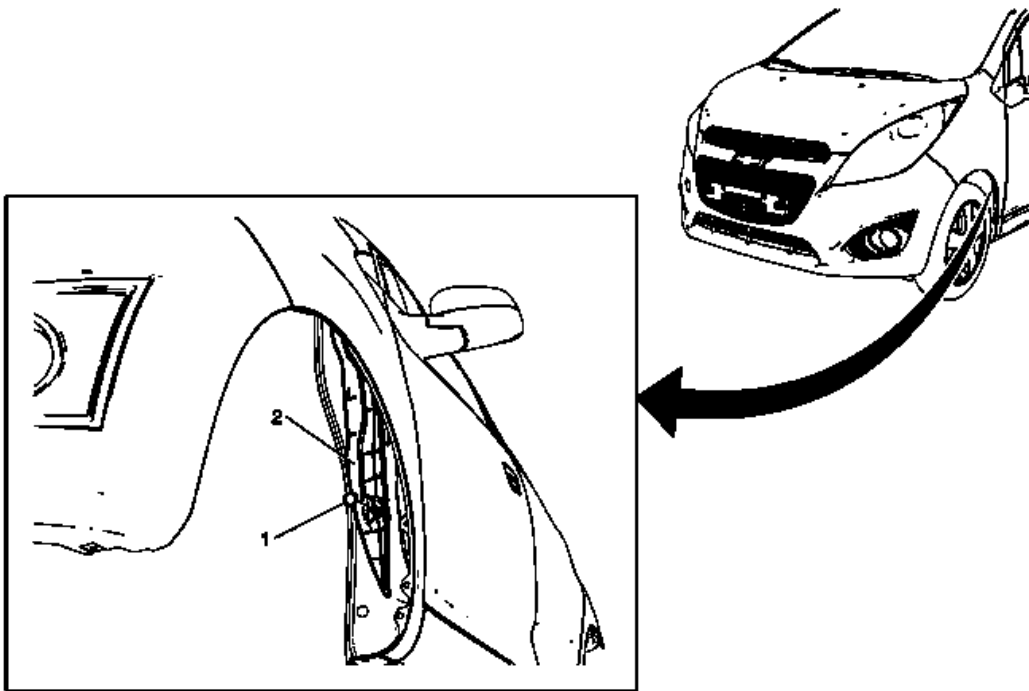


Fig. 21: Front Fender Insulator

Courtesy of GENERAL MOTORS COMPANY

Front Fender Insulator Replacement

Callout	Component Name
Preliminary Procedure	
Remove the front wheelhouse liner. Refer to <u>Front Wheelhouse Liner Replacement</u> .	
1	Front Fender Insulator Retainer
2	Front Fender Insulator

HOOD PRIMARY AND SECONDARY LATCH REPLACEMENT

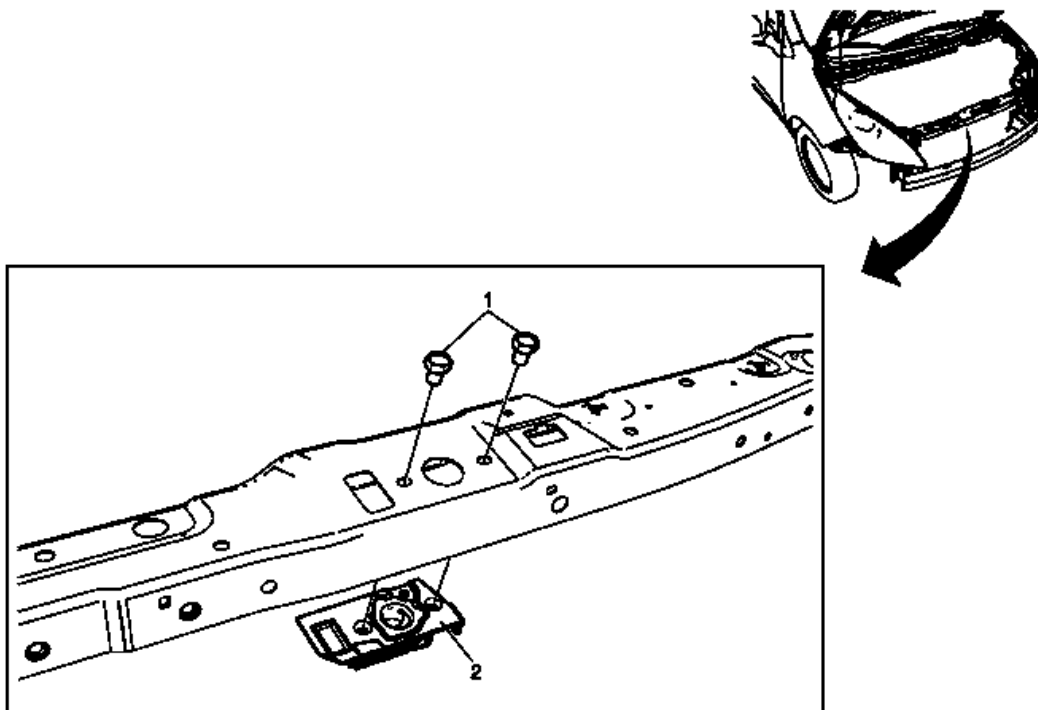


Fig. 22: Hood Primary and Secondary Latch
 Courtesy of GENERAL MOTORS COMPANY

Hood Primary and Secondary Latch Replacement

Callout	Component Name
Preliminary Procedure Remove air cleaner assembly. Refer to Air Cleaner Assembly Replacement .	
1	Hood Primary and Secondary Latch Retainer Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 8.5 N.m (75 lb in)
2	Hood Primary and Secondary Latch Procedure To release the hood primary and secondary latch unhook the hood primary latch release cable.

FRONT SIDE DOOR CHECK REPLACEMENT

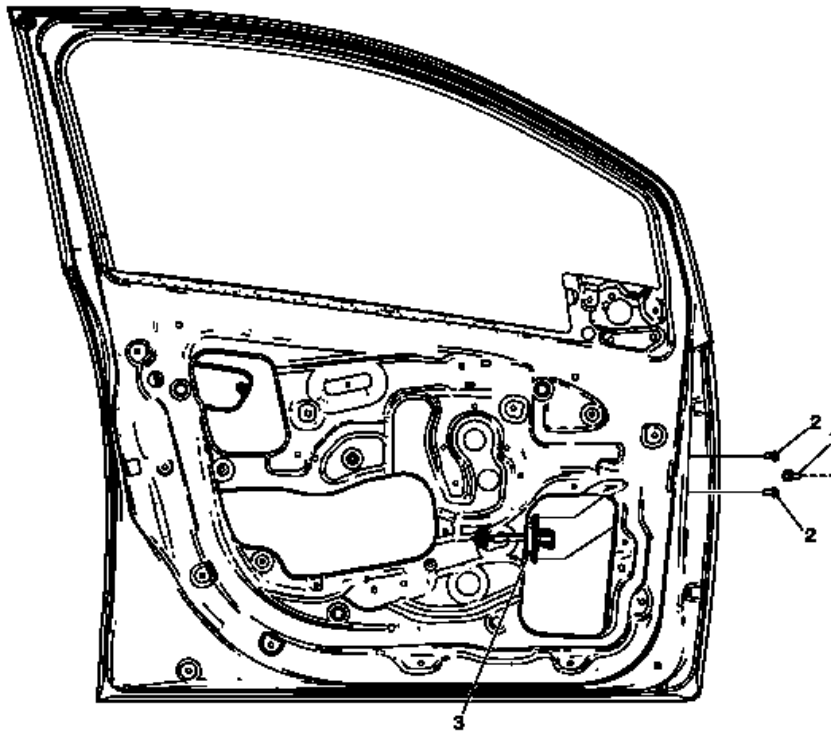


Fig. 23: Front Side Door Check

Courtesy of GENERAL MOTORS COMPANY

Front Side Door Check Replacement

Callout	Component Name
Preliminary Procedure Remove front side door trim panel. Refer to Front Side Door Trim Panel Replacement .	
1	Front Side Door Check Link Bolt CAUTION: Refer to Fastener Caution . TIP: Place the door in the full open position. Tighten 28 N.m (21 lb ft)
2	Front Side Door Check Bolt (Qty: 2) Procedure Remove the water deflector. Tighten 5.5 N.m (49 lb in)
3	Front Side Door Check

FUEL TANK FILLER DOOR REPLACEMENT

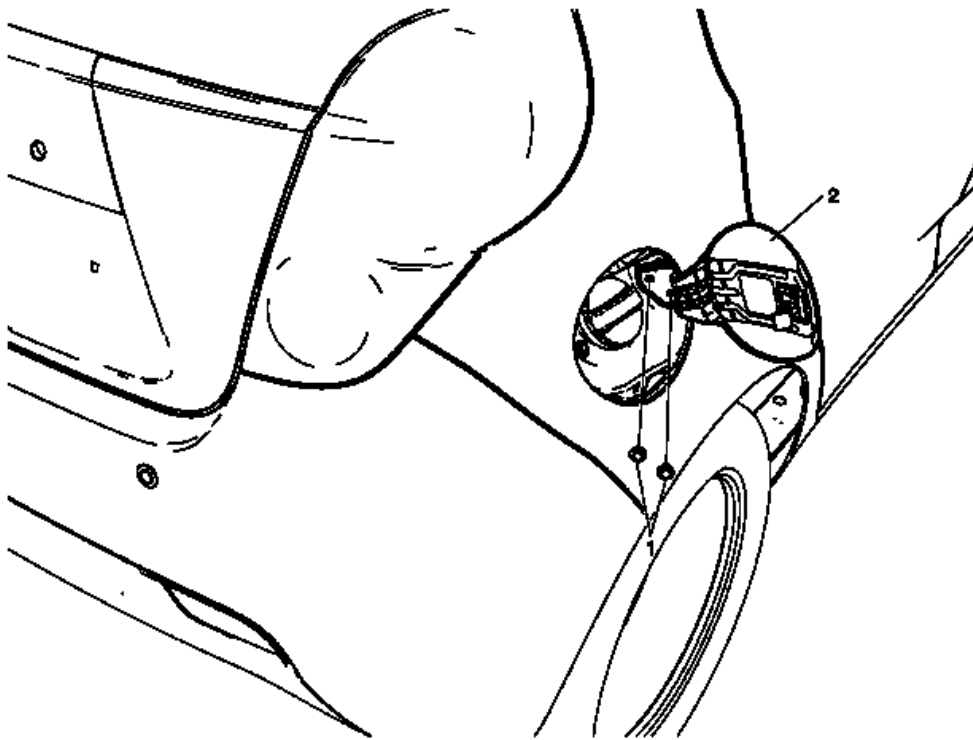


Fig. 24: Fuel Tank Filler Door
 Courtesy of GENERAL MOTORS COMPANY

Fuel Tank Filler Door Replacement

Callout	Component Name
1	Fuel Tank Filler Door Bolt (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 5.5 N.m (49 lb in)
2	Fuel Tank Filler Door

HOOD HOLD-OPEN ROD REPLACEMENT

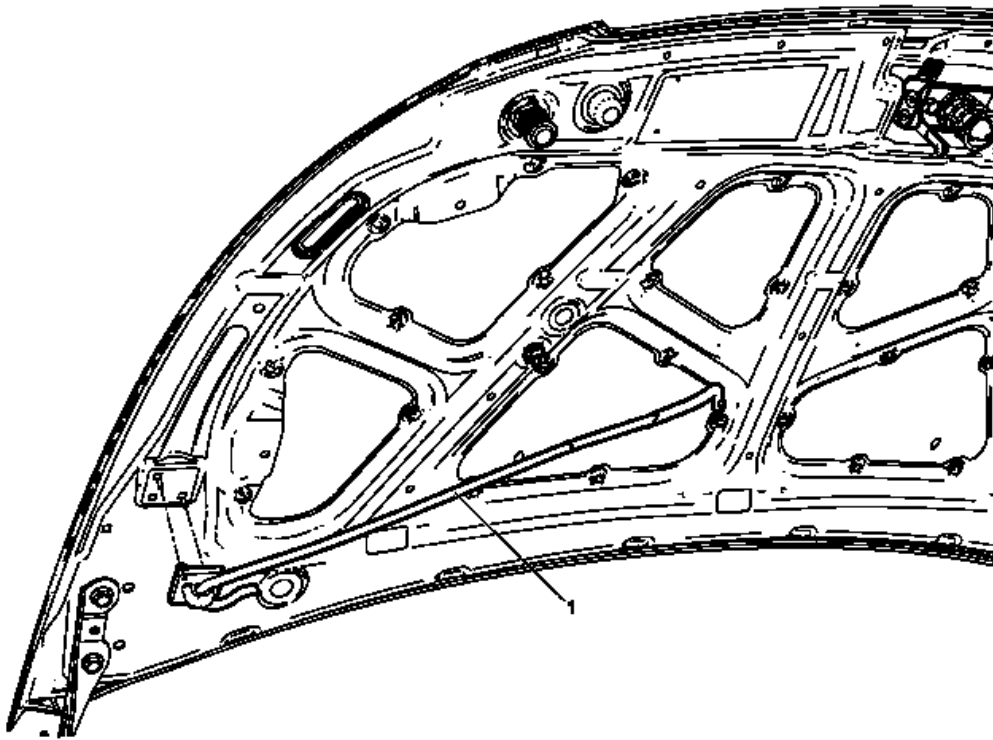


Fig. 25: Hood Hold-Open Rod
Courtesy of GENERAL MOTORS COMPANY

Hood Hold-Open Rod Replacement

Callout	Component Name
WARNING: Refer to <u>Hood Hold-Open Device Warning</u> .	
1	Hood Hold-Open Rod

HOOD REAR WEATHERSTRIP REPLACEMENT

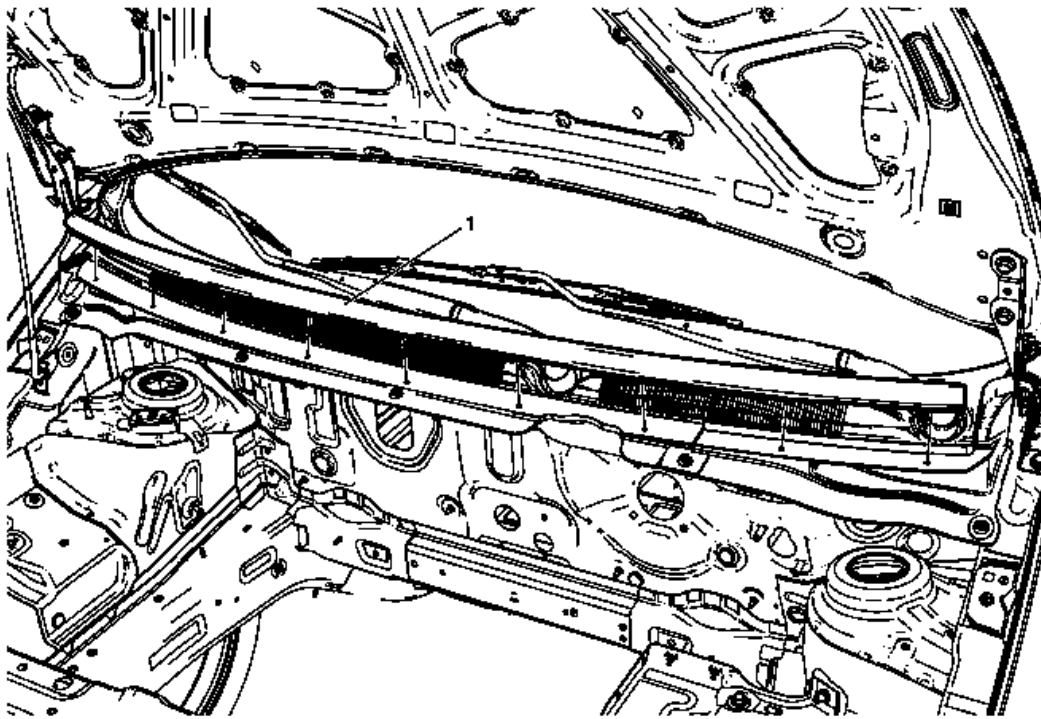


Fig. 26: Hood Rear Weatherstrip
Courtesy of GENERAL MOTORS COMPANY

Hood Rear Weatherstrip Replacement

Callout	Component Name
1	Hood Rear Weatherstrip

PLENUM LOWER PANEL REPLACEMENT

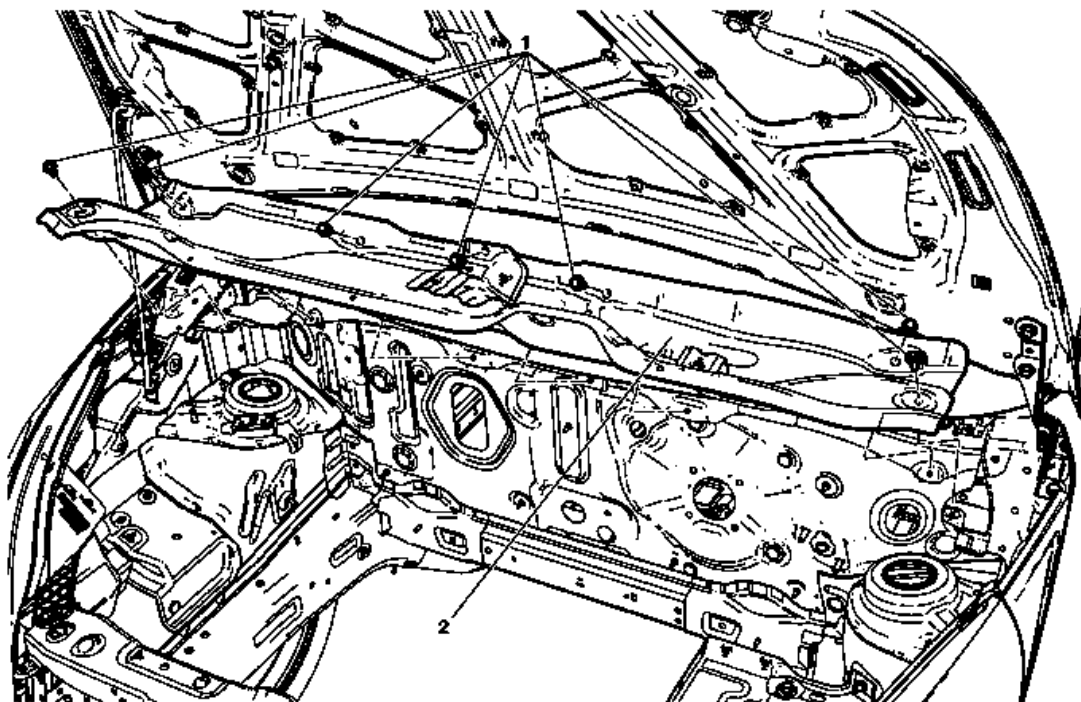


Fig. 27: Plenum Lower Panel

Courtesy of GENERAL MOTORS COMPANY

Plenum Lower Panel Replacement

Callout	Component Name
Preliminary Procedure 1. Remove the windshield wiper arm. Refer to <u>Windshield Wiper Arm Replacement</u> . 2. Remove the air inlet grille panel. Refer to <u>Air Inlet Grille Panel Replacement</u> . 3. Remove the windshield wiper transmission. Refer to <u>Windshield Wiper Transmission Replacement</u> .	
1	Plenum Lower Panel Bolt (Qty: 7) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 11.5 N.m (102 lb in)
2	Plenum Lower Panel

LIFTGATE STRUT REPLACEMENT

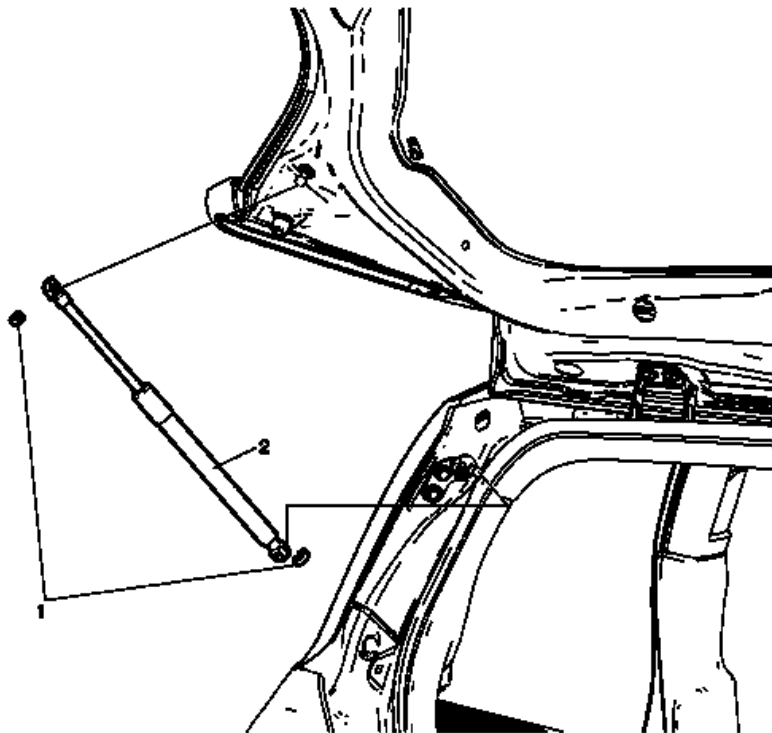


Fig. 28: Liftgate Strut

Courtesy of GENERAL MOTORS COMPANY

Liftgate Strut Replacement

Callout	Component Name
WARNING: When a lift gate hold open device is being removed or installed, provide alternate support to avoid the possibility of damage to the vehicle or personal injury.	
1	Liftgate Strut Clip (Qty: 2)
2	Liftgate Strut

LIFTGATE STRUT BRACKET REPLACEMENT

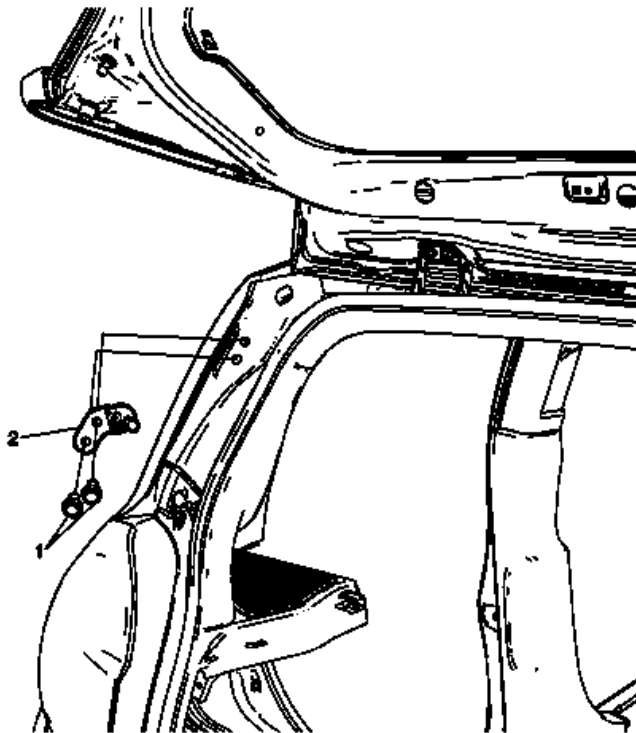


Fig. 29: Liftgate Strut Bracket
 Courtesy of GENERAL MOTORS COMPANY

Liftgate Strut Bracket Replacement

Callout	Component Name
WARNING: When a lift gate hold open device is being removed or installed, provide alternate support to avoid the possibility of damage to the vehicle or personal injury.	
Preliminary Procedure Release the liftgate strut from the liftgate. Refer to <u>Liftgate Strut Replacement</u> .	
1	Liftgate Strut Bracket Bolt (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 20 N.m (15 lb ft)
2	Liftgate Strut Bracket

FRONT SIDE DOOR WEATHERSTRIP REPLACEMENT - DOOR SIDE

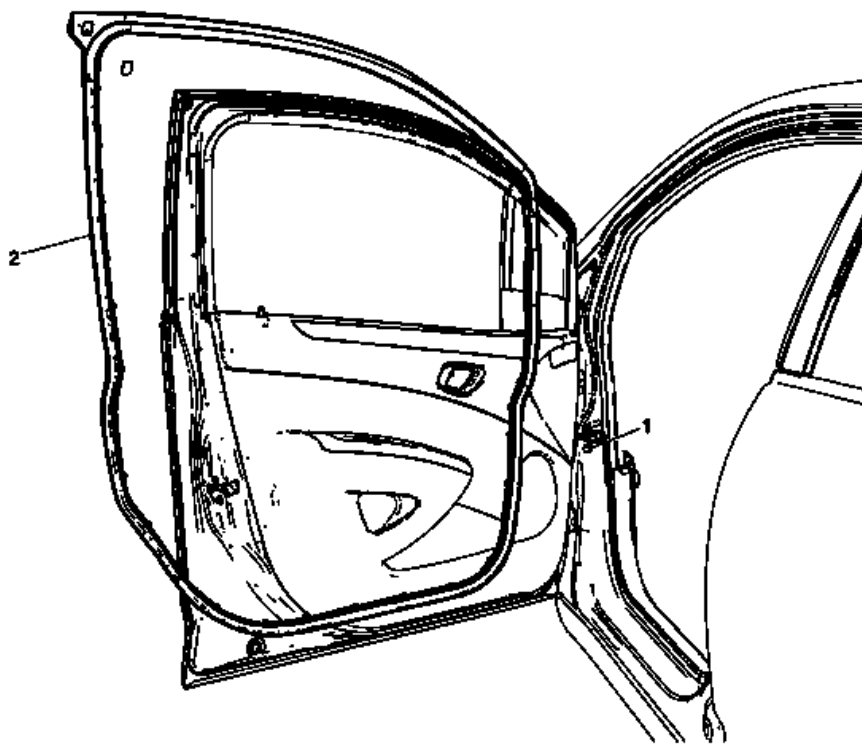


Fig. 30: Front Side Door Weatherstrip -- Door Side
 Courtesy of GENERAL MOTORS COMPANY

Front Side Door Weatherstrip Replacement - Door Side

Callout	Component Name
1	Front Side Door Check Link Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 28 N.m (21 lb ft)
2	Front Side Door Weatherstrip - Door Side Procedure Unclip weatherstrip from front side door.

FRONT SIDE DOOR WEATHERSTRIP REPLACEMENT - BODY SIDE

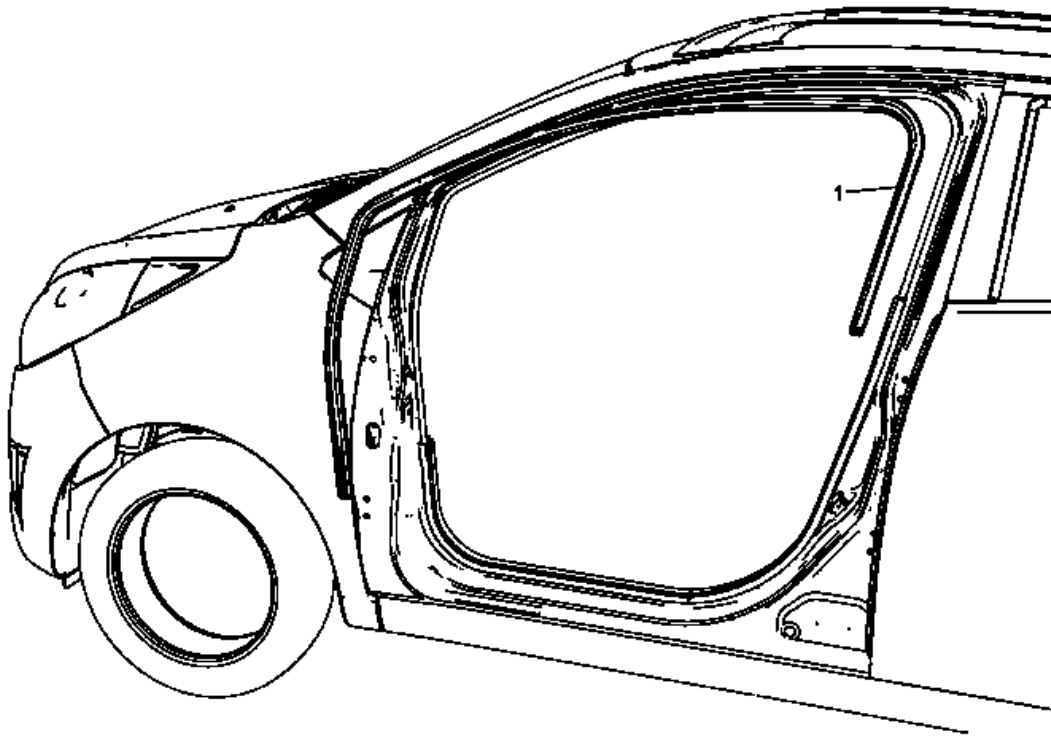


Fig. 31: Front Side Door Weatherstrip - Body Side
 Courtesy of GENERAL MOTORS COMPANY

Front Side Door Weatherstrip Replacement - Body Side

Callout	Component Name
1	Front Side Door Weatherstrip- Body Side Procedure 1. Start at the rear upper corner of the door opening and pull the weatherstrip away from the door opening flange. 2. Position the weatherstrip in the upper corner of the center pillar. 3. Working downward along the front edge, install the weatherstrip on the door opening flange ensuring that the carrier is fully seated in the corners. 4. Using a rubber mallet, ensure that the weatherstrip is seated on the entire door opening flange.

LIFTGATE WEATHERSTRIP REPLACEMENT

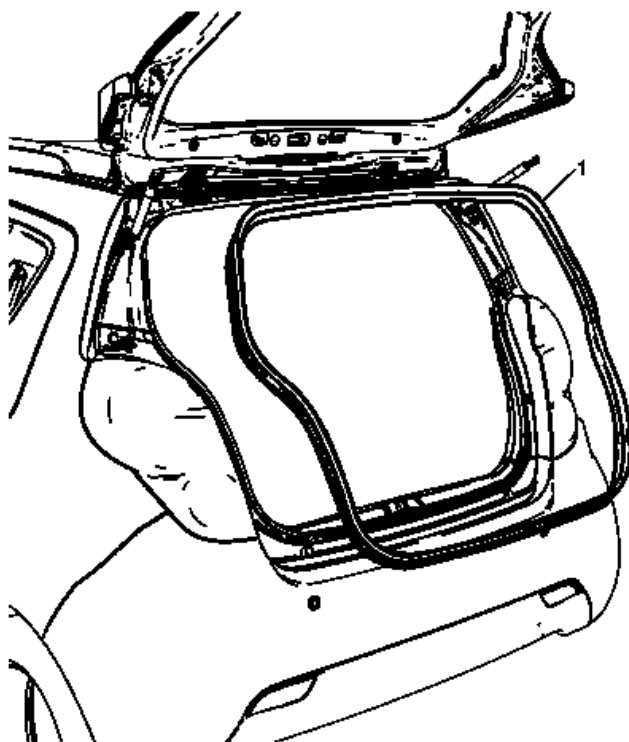


Fig. 32: Liftgate Weatherstrip
 Courtesy of GENERAL MOTORS COMPANY

Liftgate Weatherstrip Replacement

Callout	Component Name
1	Liftgate Weatherstrip Procedure 1. Start at the upper corner of the liftgate opening and pull the weatherstrip away from the liftgate opening flange. 2. Position the weatherstrip in the upper corner of the liftgate opening. 3. Working downward along the edge, install the weatherstrip on the liftgate opening flange ensuring that the carrier is fully seated in the corners. 4. Using a rubber mallet, ensure that the weatherstrip is seated on the entire liftgate opening flange.

REAR SIDE DOOR WEATHERSTRIP REPLACEMENT - DOOR SIDE

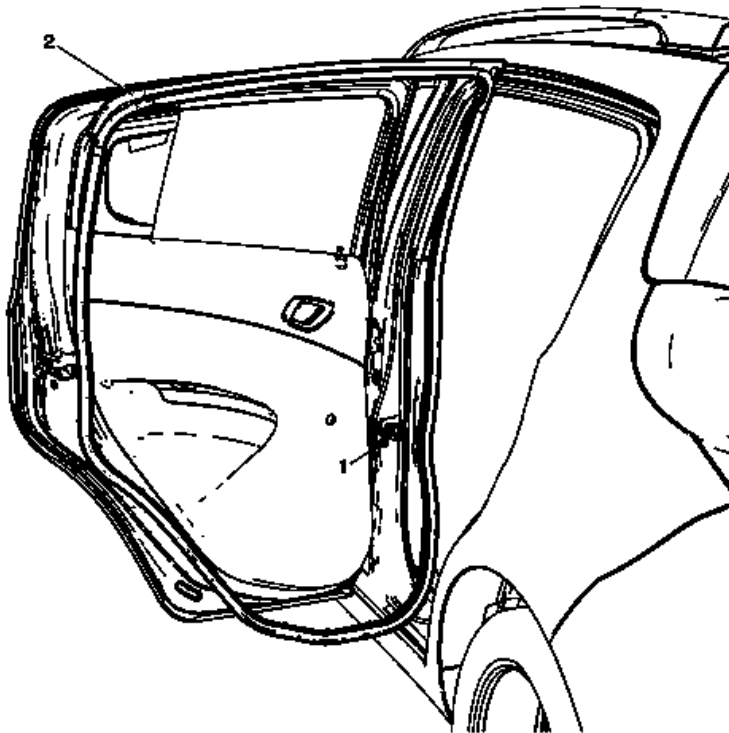


Fig. 33: Rear Side Door Weatherstrip - Door Side
 Courtesy of GENERAL MOTORS COMPANY

Rear Side Door Weatherstrip Replacement - Door Side

Callout	Component Name
1	Rear Side Door Check Link Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 28 N.m (21 lb ft)
2	Rear Side Door Weatherstrip - Door Side Procedure Unclip weatherstrip from front side door.

REAR SIDE DOOR WEATHERSTRIP REPLACEMENT - BODY SIDE

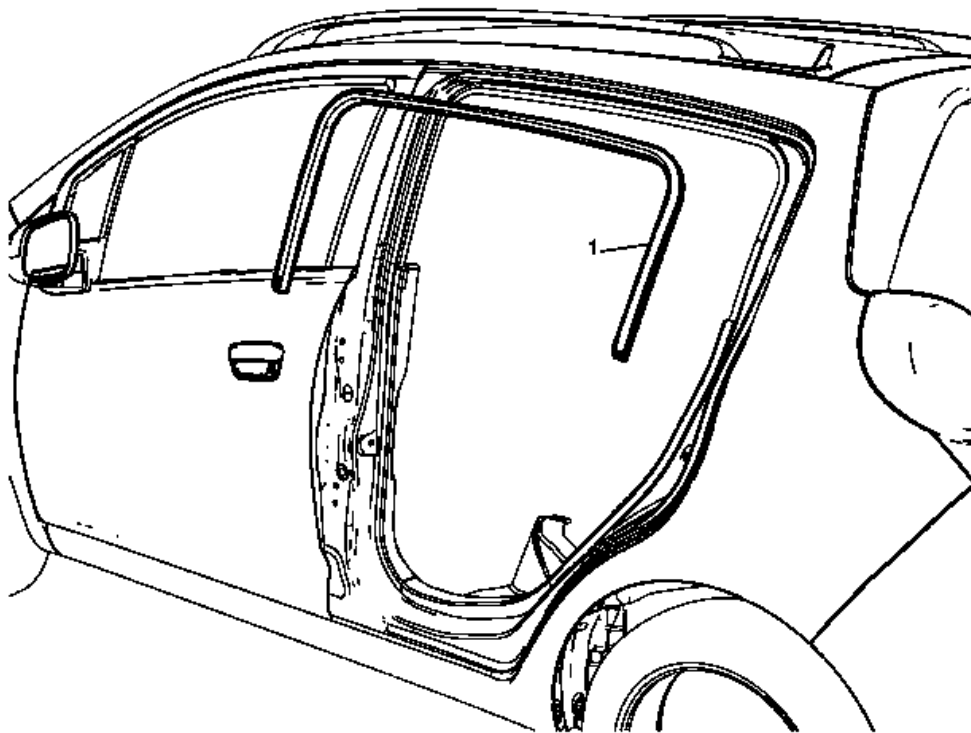


Fig. 34: Rear Side Door Weatherstrip - Body Side
 Courtesy of GENERAL MOTORS COMPANY

Rear Side Door Weatherstrip Replacement - Body Side

Callout	Component Name
1	Rear Side Door Weatherstrip- Body Side Procedure 1. Start at the rear upper corner of the door opening and pull the weatherstrip away from the door opening flange. 2. Position the weatherstrip in the upper corner of the center pillar. 3. Working downward along the front edge, install the weatherstrip on the door opening flange ensuring that the carrier is fully seated in the corners. 4. Using a rubber mallet, ensure that the weatherstrip is seated on the entire door opening flange.

DESCRIPTION AND OPERATION

HOOD AJAR INDICATOR DESCRIPTION AND OPERATION

Hood Ajar Switch

The body control module (BCM) applies B+ to the hood ajar signal circuit and monitors the voltage to

determine the position of the hood. When the hood is closed, the switch is open and voltage remains high. When the hood is open, the switch is closed and the voltage is pulled low.

The BCM uses the hood ajar switch as a content theft deterrent alarm trigger.

ACCESSORIES & EQUIPMENT

Bumpers and Fascias - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Front Bumper Fascia Screw	1.5	13 lb in
Front Bumper Fascia Side Screw	2.5	22 lb in
Front Bumper Impact Bar Bolt	22	16 lb ft
Front Bumper Lower Impact Bar Bolt	25	18 lb ft
Front Bumper Opening Lower Bolt	9	80 lb in
Rear Bumper Fascia Screw	1.8	16 lb in
Rear Bumper Fascia Side Screw	2.5	22 lb in
Rear Bumper Impact Bar Bolt	22	16 lb ft

REPAIR INSTRUCTIONS

FRONT BUMPER ENERGY ABSORBER REPLACEMENT

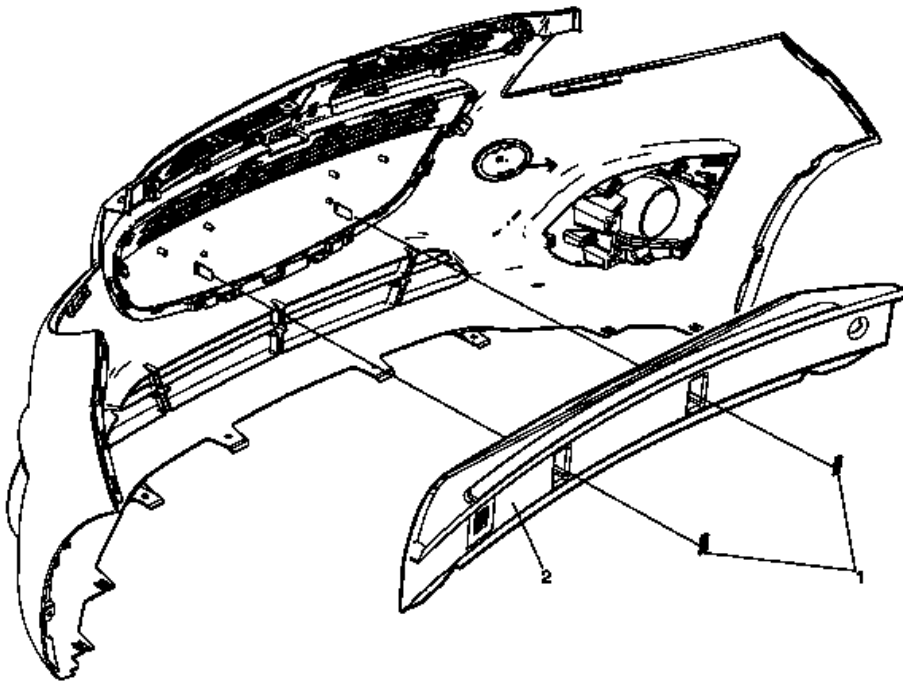


Fig. 1: Front Bumper Energy Absorber

Courtesy of GENERAL MOTORS COMPANY

Front Bumper Energy Absorber Replacement

Callout	Component Name
Preliminary Procedure Remove the front bumper fascia. Refer to Front Bumper Fascia Replacement .	
1	Front Bumper Energy Absorber Clip
2	Front Bumper Energy Absorber

FRONT BUMPER IMPACT BAR REPLACEMENT

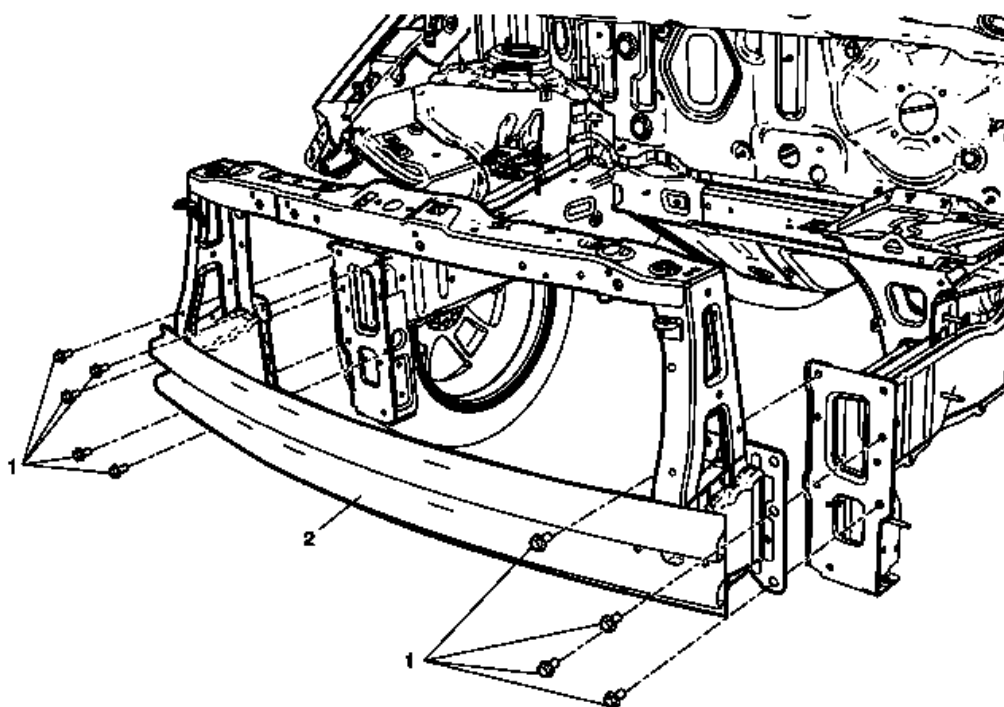


Fig. 2: Front Bumper Impact Bar

Courtesy of GENERAL MOTORS COMPANY

Front Bumper Impact Bar Replacement

Callout	Component Name
Preliminary Procedure 1. Remove the front bumper fascia. Refer to Front Bumper Fascia Replacement . 2. Remove the headlamp. Refer to Headlamp Replacement . 3. Remove the air cleaner assembly. Refer to Air Cleaner Assembly Replacement . 4. Remove the hood primary and secondary latch. Refer to Hood Primary and Secondary Latch Replacement . 5. Remove the radiator support bracket. Refer to Radiator Support Bracket Replacement .	

6. Remove the horn. Refer to <u>Horn Replacement</u> .	
1	Front Bumper Impact Bar Bolt (Qty: 9) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 22 N.m (16 lb ft)
2	Front Bumper Impact Bar

FRONT BUMPER LOWER IMPACT BAR REPLACEMENT

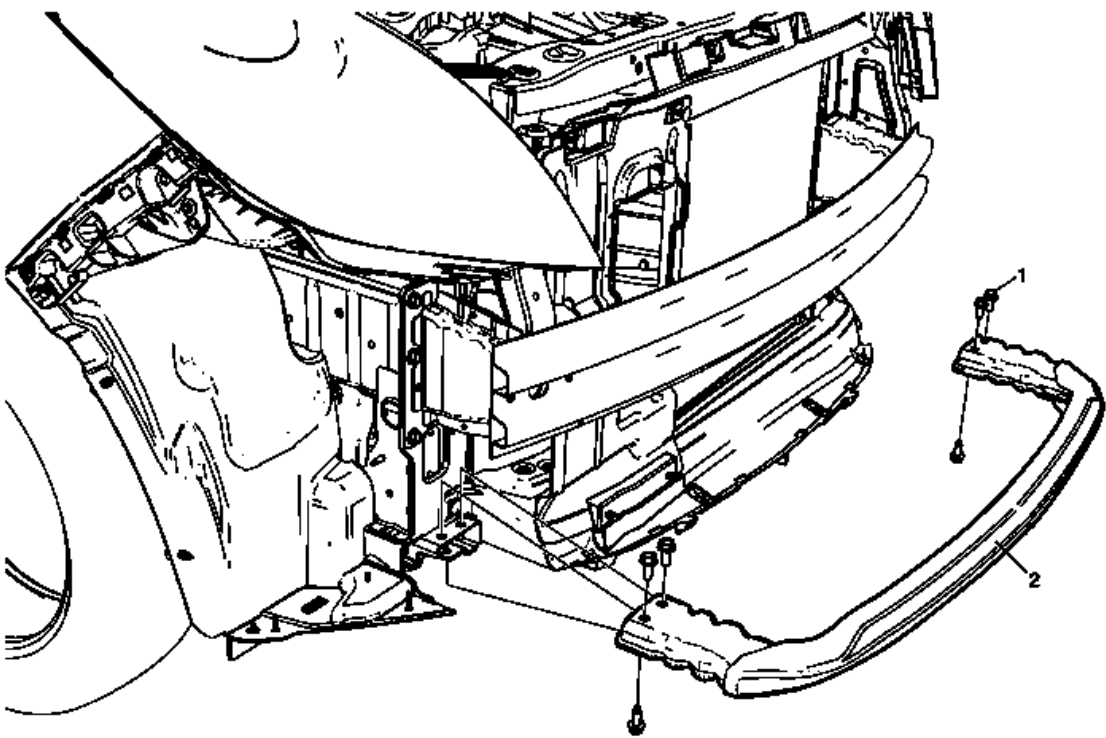


Fig. 3: Front Bumper Lower Impact Bar
 Courtesy of GENERAL MOTORS COMPANY

Front Bumper Lower Impact Bar Replacement

Callout	Component Name
Preliminary Procedure Remove the front bumper fascia. Refer to <u>Front Bumper Fascia Replacement</u> .	
	Front Bumper Lower Impact Bar Bolt (Qty :6) CAUTION: Refer to <u>Fastener Caution</u> .

1	Tighten 25 N.m (18 lb ft)
2	Front Bumper Lower Impact Bar

FRONT BUMPER FASCIA REPLACEMENT

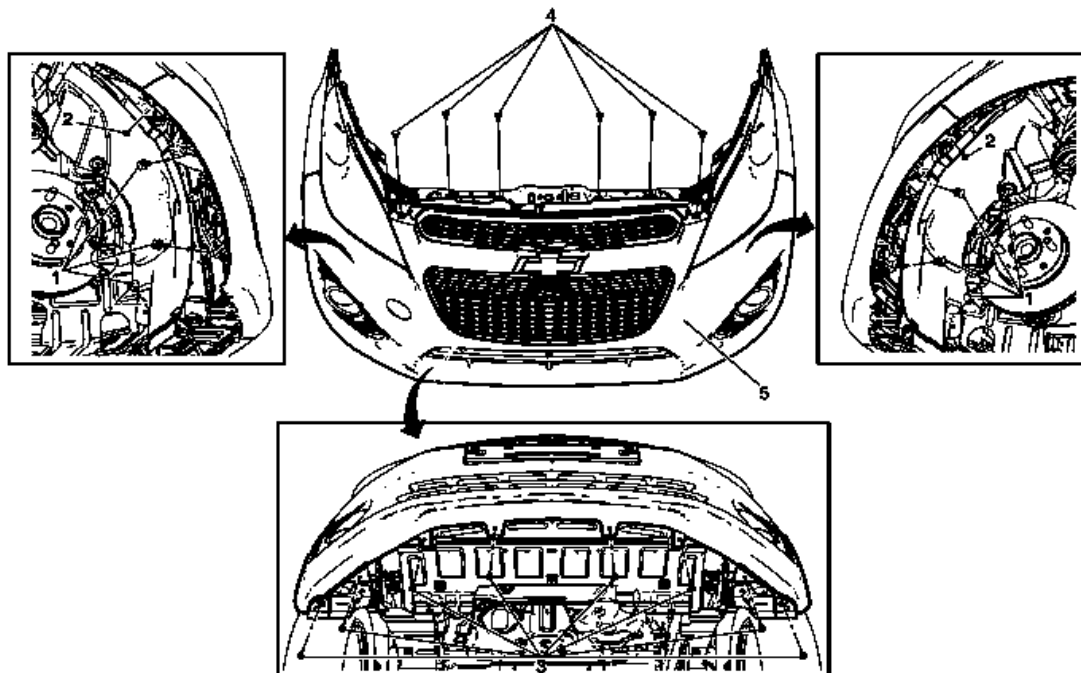


Fig. 4: Front Bumper Fascia
Courtesy of GENERAL MOTORS COMPANY

Front Bumper Fascia Replacement

Callout	Component Name
1	Front Wheelhouse Liner Retainer (Qty: 8)
2	Front Bumper Fascia Side Screw (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2.5 (22 lb in)
3	Front Bumper Fascia Screw (Qty: 8) Tighten 1.5 (13 lb in)
4	Front Bumper Fascia Retainer (Qty: 6)

Front Bumper Fascia	
Procedure	
5	1. Unclip from front bumper fascia guides. 2. Pull forward to remove the front bumper fascia. 3. Disconnect any electrical connectors. 4. Transfer parts as needed.

FRONT BUMPER FASCIA GUIDE REPLACEMENT

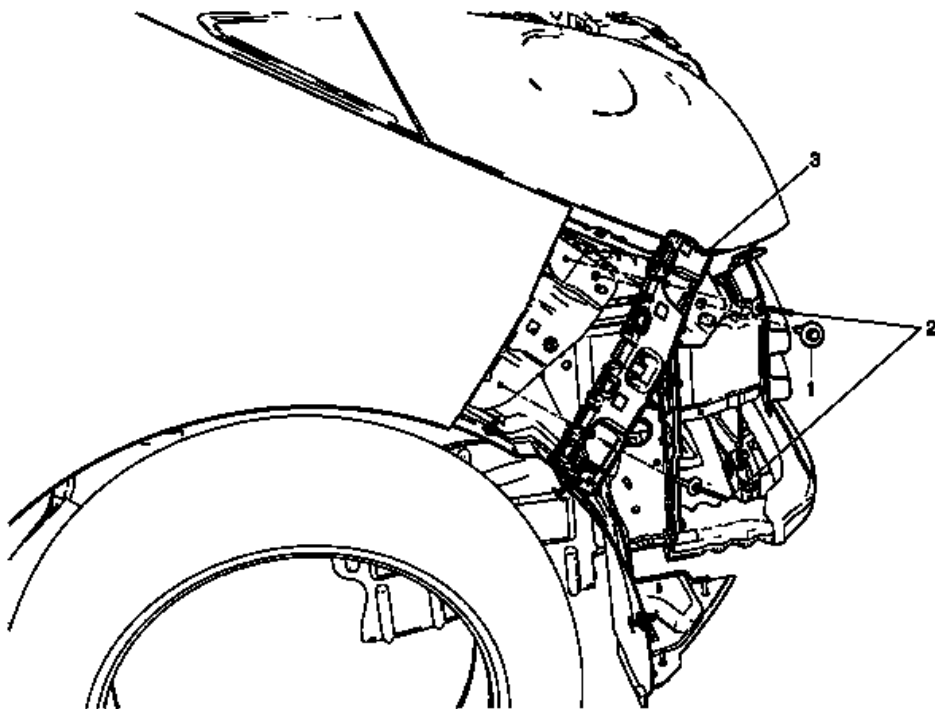


Fig. 5: Front Bumper Fascia Guide
 Courtesy of GENERAL MOTORS COMPANY

Front Bumper Fascia Guide Replacement

Callout	Component Name
Preliminary Procedure	
Remove the front bumper fascia. Refer to <u>Front Bumper Fascia Replacement</u> .	
1	Headlamp Screw CAUTION: Refer to <u>Fastener Caution</u> .

	Tighten 2.5 N.m (22 lb in)
2	Front Bumper Fascia Guide Rivet (Qty: 2) Special Tools BO-594-A Hand Rivet Tongs For equivalent regional tools, refer to Special Tools .
3	Front Bumper Fascia Guide

FRONT BUMPER FASCIA OPENING COVER REPLACEMENT

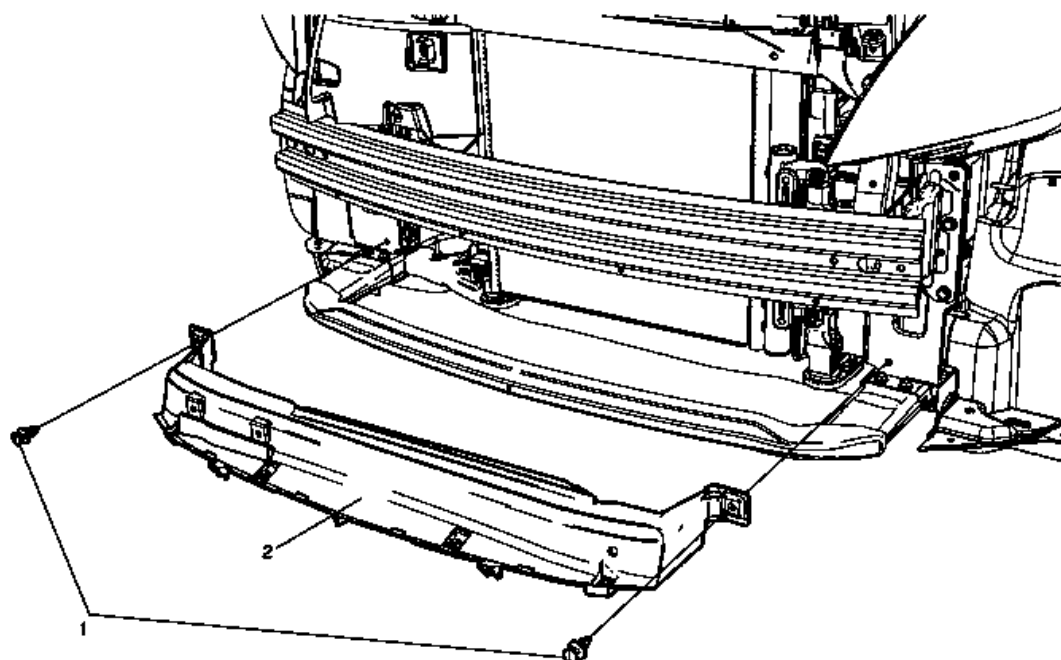


Fig. 6: Front Bumper Fascia Opening Cover
Courtesy of GENERAL MOTORS COMPANY

Front Bumper Fascia Opening Cover Replacement

Callout	Component Name
Preliminary Procedures Remove the front bumper fascia. Refer to Front Bumper Fascia Replacement .	
1	Front Bumper Fascia Opening Cover Retainer (Qty: 4)
2	Front Bumper Fascia Opening Cover

FRONT BUMPER FASCIA OPENING LOWER COVER REPLACEMENT

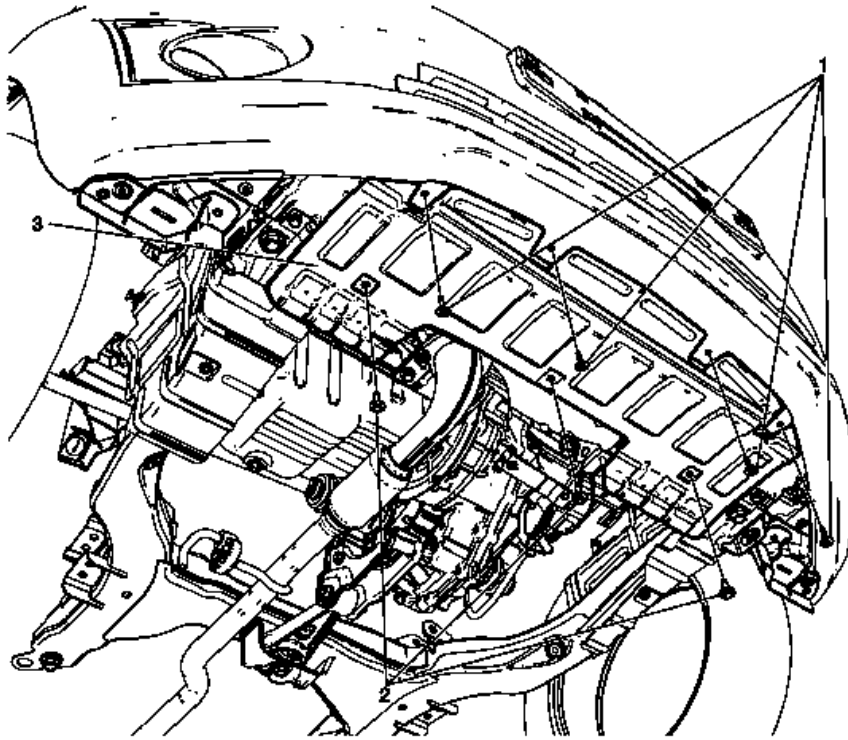


Fig. 7: Front Bumper Fascia Opening Lower Cover
 Courtesy of GENERAL MOTORS COMPANY

Front Bumper Fascia Opening Lower Cover Replacement

Callout	Component Name
1	Front Bumper Fascia Screw (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 1.8 N.m (16 lb in)
2	Front Bumper Opening Lower Bolt (Qty: 3) Tighten 9 N.m (80 lb in)
3	Front Bumper Fascia Opening Lower Cover

REAR BUMPER FASCIA LOWER SKID PLATE REPLACEMENT

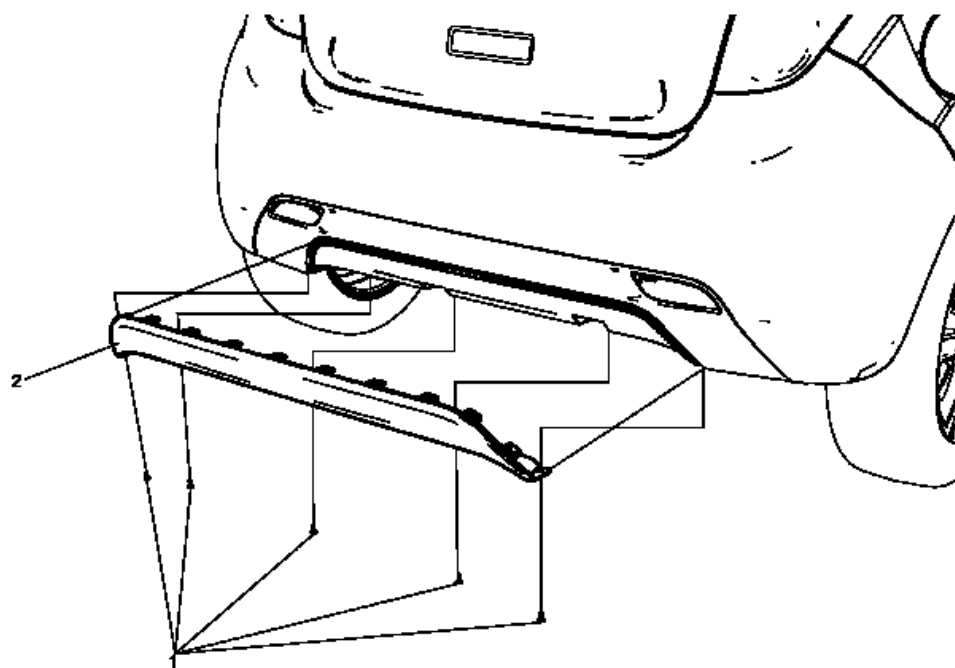


Fig. 8: Rear Bumper Fascia Lower Skid Plate
 Courtesy of GENERAL MOTORS COMPANY

Rear Bumper Fascia Lower Skid Plate Replacement

Callout	Component Name
1	Rear Bumper Fascia Lower Skid Plate Screw (Qty: 5)
2	Rear Bumper Fascia Lower Skid Plate

REAR BUMPER FASCIA REPLACEMENT

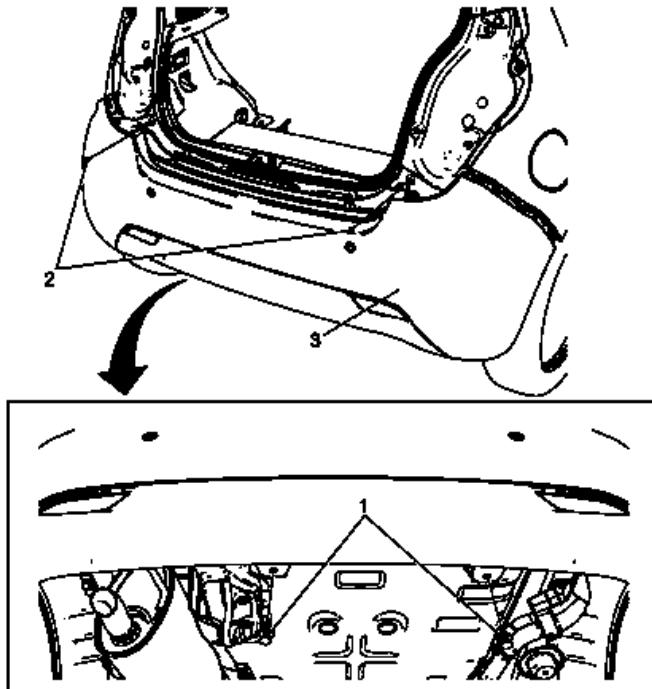


Fig. 9: Rear Bumper Fascia
 Courtesy of GENERAL MOTORS COMPANY

Rear Bumper Fascia Replacement

Callout	Component Name
Preliminary Procedures	
1. Remove the tail lamps. Refer to <u>Tail Lamp Replacement</u> . 2. Remove the rear wheelhouse liner. Refer to <u>Rear Wheelhouse Liner Replacement</u> .	
1	Rear Bumper Fascia Retainer (Qty: 2)
2	Rear Bumper Fascia Screw (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 1.8 (16 lb in)
3	Rear Bumper Fascia Procedure 1. Unclip from rear bumper fascia guides. 2. Pull forward to remove the rear bumper fascia.

3. Disconnect any electrical connectors.
4. Transfer parts as needed.

REAR BUMPER FASCIA GUIDE REPLACEMENT

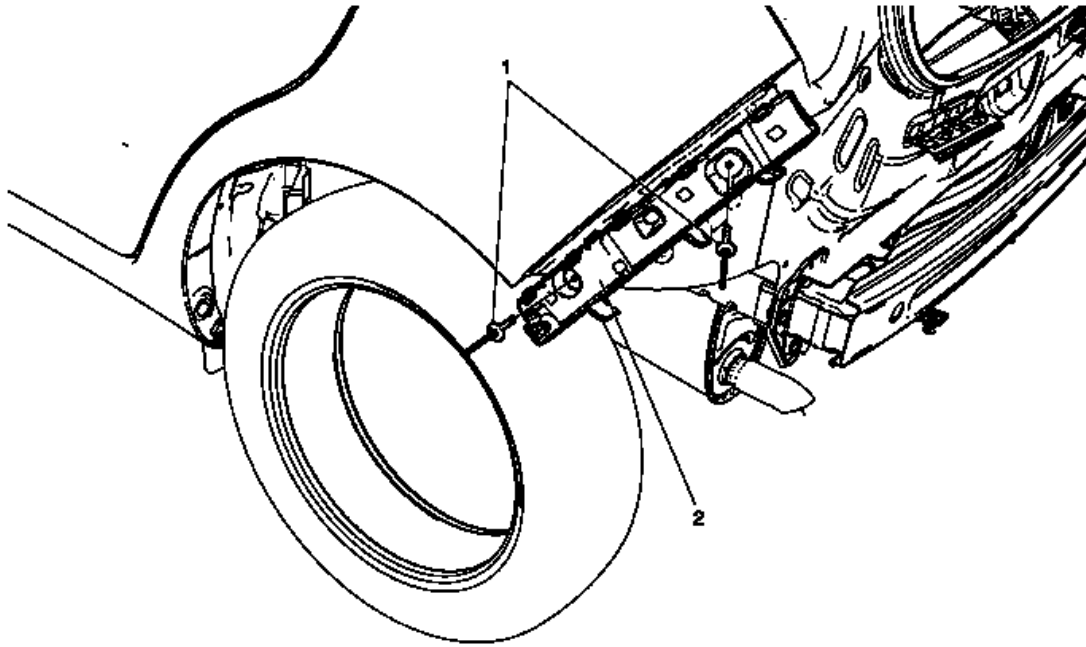


Fig. 10: Rear Bumper Fascia Guide
Courtesy of GENERAL MOTORS COMPANY

Rear Bumper Fascia Guide Replacement

Callout	Component Name
Preliminary Procedure Remove the rear bumper fascia. Refer to Rear Bumper Fascia Replacement .	
1	Rear Bumper Fascia Guide Rivet (Qty: 2) Special Tools BO-594-A Hand Rivet Tongs For equivalent regional tools, refer to Special Tools .
2	Rear Bumper Fascia Guide

REAR BUMPER LOWER FASCIA REPLACEMENT

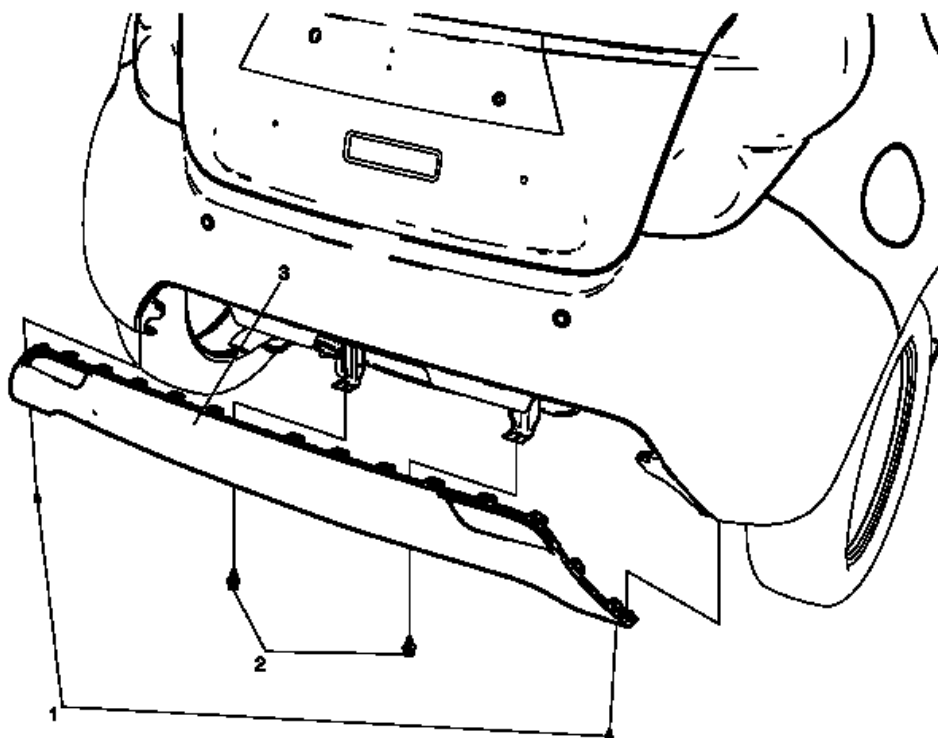


Fig. 11: Rear Bumper Lower Fascia
 Courtesy of GENERAL MOTORS COMPANY

Rear Bumper Lower Fascia Replacement

Callout	Component Name
1	Rear Bumper Lower Fascia Screw (Qty: 2)
2	Rear Bumper Fascia Retainer (Qty: 2)
3	Rear Bumper Lower Fascia
	Procedure 1. Unclip from rear bumper fascia. 2. Pull forward to remove the rear bumper lower fascia. 3. Transfer parts as needed.

REAR BUMPER IMPACT BAR REPLACEMENT

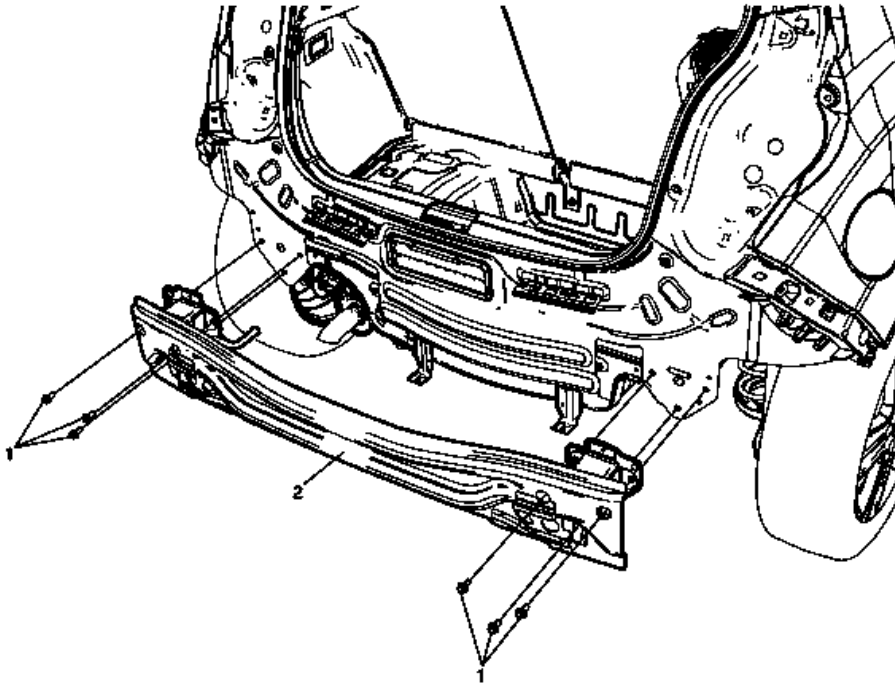


Fig. 12: Rear Bumper Impact Bar
 Courtesy of GENERAL MOTORS COMPANY

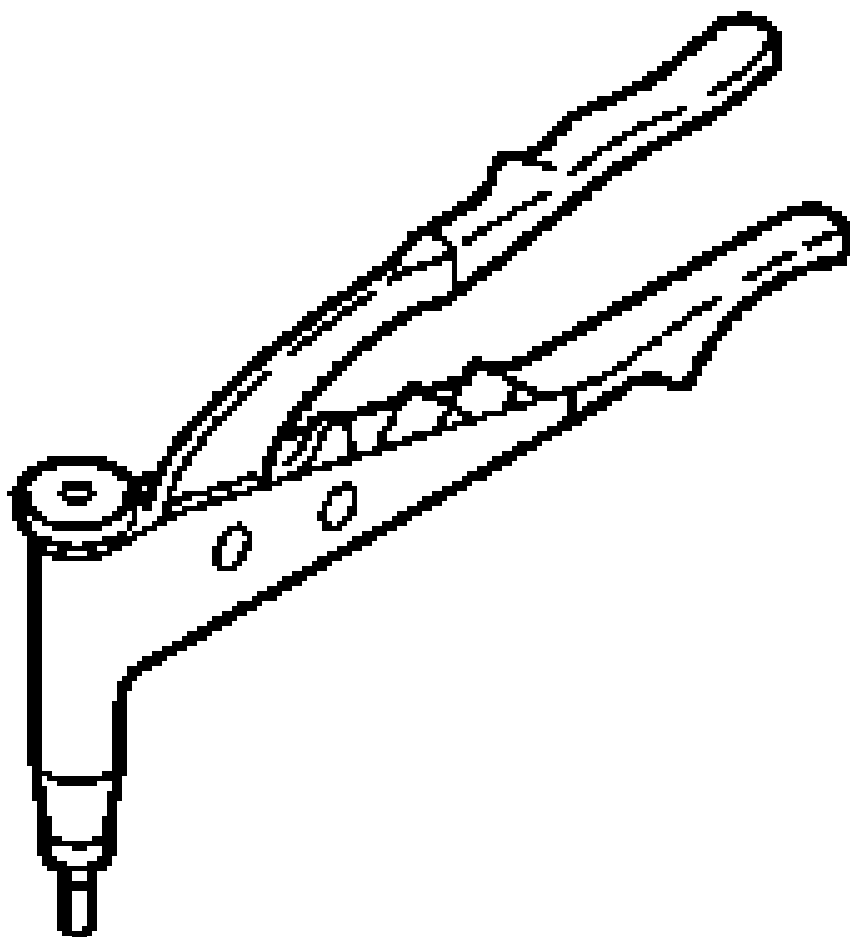
Rear Bumper Impact Bar Replacement

Callout	Component Name
Preliminary Procedure Remove the rear bumper fascia. Refer to <u>Rear Bumper Fascia Replacement</u> .	
1	Rear Bumper Impact Bar Bolt (Qty: 6) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 22 (16 lb ft)
2	Rear Bumper Impact Bar

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description



BO-594-A
MKM-594-
A
Hand Rivet
Tongs

CABIN AIR FILTER

GM - Spark

REMOVAL & INSTALLATION

NOTE: Manufacturer's terminology for this filter is passenger compartment air filter.

CABIN AIR FILTER

Removal Procedure

1. Remove the instrument panel (I/P) compartment. Refer to Instrument Panel Compartment Replacement .

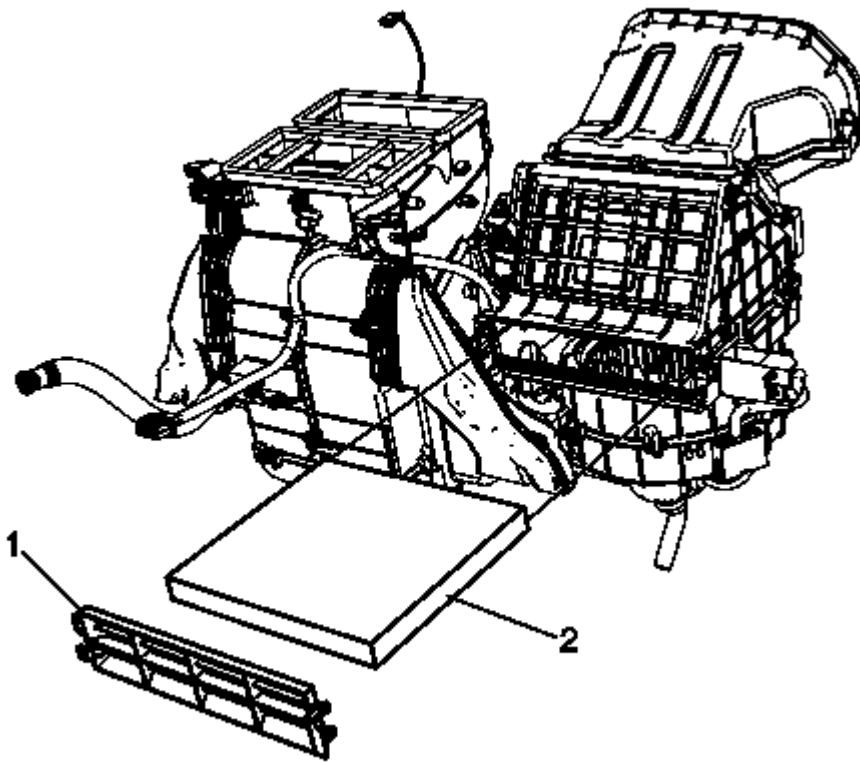


Fig. 1: Passenger Compartment Air Filter Housing Cover
Courtesy of GENERAL MOTORS COMPANY

2. Remove the passenger compartment air filter housing cover (1).
3. Remove the passenger compartment air filter (2).

Installation Procedure

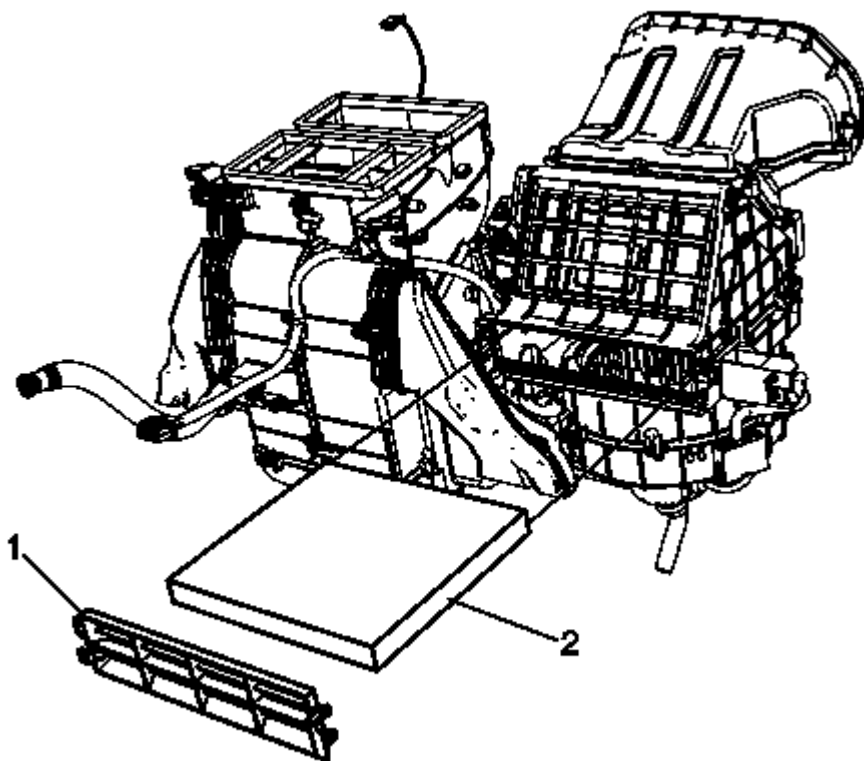


Fig. 2: Passenger Compartment Air Filter Housing Cover
Courtesy of GENERAL MOTORS COMPANY

1. Install the passenger compartment air filter (2).
2. Install the passenger compartment air filter housing cover (1).
3. Install the I/P compartment. Refer to **Instrument Panel Compartment Replacement** .

ACCESSORIES & EQUIPMENT

Cellular, Entertainment, and Navigation - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Communication Interface Module Battery Bolt	9	80 lb in
Communication Interface Module Bolt/Nut	10	89 lb in
Radio Antenna Base Nut	3	27 lb in
Radio Front Speaker Screw	3	27 lb in
Radio Rear Speaker Screw	3	27 lb in
Radio Screw	2.5	23 lb in

SCHEMATIC WIRING DIAGRAMS

RADIO/NAVIGATION SYSTEM WIRING SCHEMATICS

Power, Ground, Serial Data, Antenna, and Audio Input Wiring Schematics

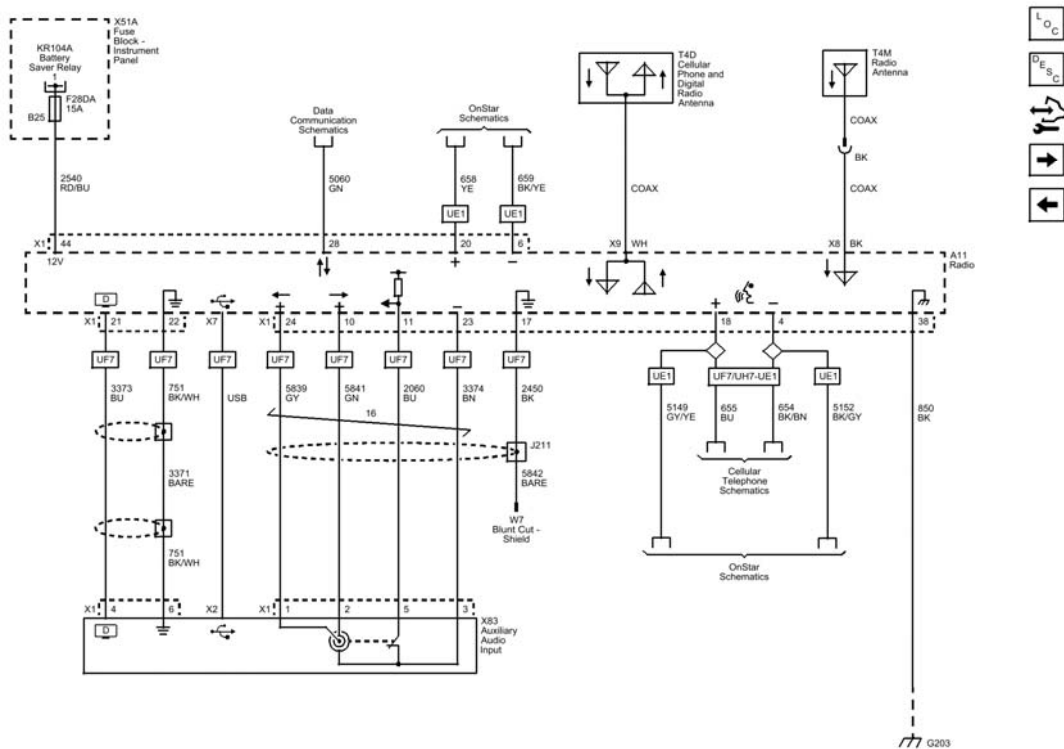


Fig. 1: Power, Ground, Serial Data, Antenna, and Audio Input Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

Speakers Wiring Schematics

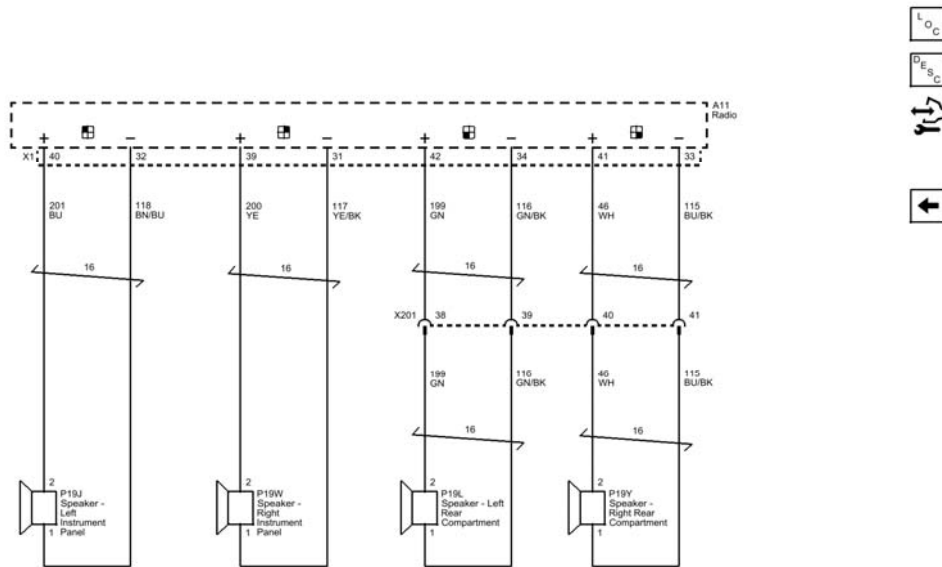


Fig. 2: Speakers Wiring Schematic

Courtesy of GENERAL MOTORS COMPANY

ONSTAR/TELEMATICS WIRING SCHEMATICS

OnStar (UE1) Wiring Schematics

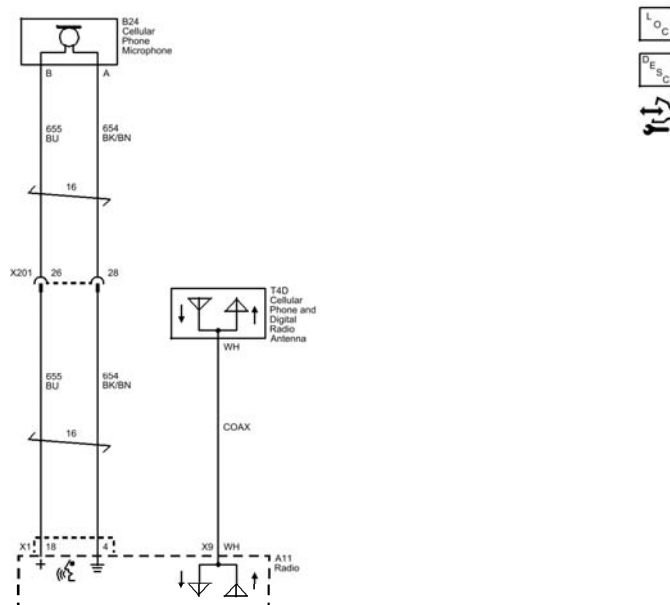


Fig. 4: Cellular Telephone Microphone (UF7) Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC B1025, B1035, B1045, or B1055</u>	DTC B1025 Left Front Audio Output Circuit DTC B1035 Right Front Audio Output Circuit DTC B1045 Left Rear Audio Output Circuit DTC B1055 Right Rear Audio Output Circuit
<u>DTC B125A</u>	DTC B125A 02 Antenna Signal Circuit Short to Ground DTC B125A 04 Antenna Signal Circuit Open Circuit
<u>DTC B125B</u>	DTC B125B 02 Antenna 2 Signal Circuit Short to Ground DTC B125B 04 Antenna 2 Signal Circuit Open Circuit
<u>DTC B125C</u>	DTC B125C 01 Satellite Antenna Circuit Short to Battery DTC B125C 02 Satellite Antenna Circuit Short to Ground

	DTC B125C 04 Satellite Antenna Circuit Open
<u>DTC B1271</u>	DTC B1271 00 Theft Protection Active
<u>DTC B1446 or B1447</u>	DTC B1446 Replace Backup Power Source Below Minimum Threshold DTC B1447 Backup Power Source Open Circuit
<u>DTC B2455</u>	DTC B2455 02 Cellular Phone Microphone Circuit Short to Ground DTC B2455 04 Cellular Phone Microphone Circuit Open/High Resistance
<u>DTC B2455 (Radio)</u>	DTC B2455 01 Cellular Phone Microphone Circuit Short to Battery DTC B2455 02 Cellular Phone Microphone Circuit Short to Ground DTC B2455 04 Cellular Phone Microphone Circuit Open
<u>DTC B2470</u>	DTC B2470 02 Cellular Phone Antenna Circuit Malfunction Short to Ground DTC B2470 04 Cellular Phone Antenna Circuit Malfunction Open Circuit
<u>DTC B2476 or B2482</u>	DTC B2476 04 Cellular Phone Select Service Switch Open DTC B2476 59 Cellular Phone Select Service Switch Protection Time-out DTC B2482 00 Cellular Phone Select Service Switch Range/Performance
<u>DTC B2485</u>	DTC B2485 02 Wireless Communication (BT) Antenna Circuit Short to Ground DTC B2485 04 Wireless Communication (BT) Antenna Circuit Open

DTC B1025, B1035, B1045, OR B1055: AUDIO OUTPUT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B1025

Left Front Audio Output Circuit

DTC B1035

Right Front Audio Output Circuit

DTC B1045

Left Rear Audio Output Circuit

DTC B1055

Right Rear Audio Output Circuit

For symptom byte information refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Left Front Speaker Output Signal	B1025 02, 1	B1025 04, 1	B1025 01, 1, 2	-
Right Front Speaker Output Signal	B1035 02, 1	B1035 04, 1	B1035 01, 1, 2	-
Left Rear Speaker Output Signal	B1045 02, 1	B1045 04, 1	B1045 01, 1, 2	-
Right Rear Speaker Output Signal	B1055 02, 1	B1055 04, 1	B1055 01, 1, 2	-
1. No or reduced audio from speaker(s) on the affected audio circuit. 2. Noticeable audio distortion may be present.				

Circuit/System Description

Each of the audio output channel circuits (+) and (-), at the radio have a DC bias voltage that is approximately one half of battery voltage. When using a DMM, each of the audio output channel circuits will measure approximately 6.5 V DC. The audio being played on the system is produced by a varying AC voltage that is centered around the DC bias voltage on the same circuit. The AC voltage is what causes the speaker cone to move and produce sound. The frequency (Hz) of the AC voltage signal is directly related to the frequency of the input (audio source playing) to the audio system. Both the DC bias voltage and the AC voltage signals are needed for the audio system to properly produce sound.

Conditions for Running the DTC

- Ignition is ON or in the ACC position
- The system voltage is 9-16 V
- The test is run once during radio wake up

Conditions for Setting the DTC

B1025 01, B1035 01, B1045 01, B1055 01

The radio detects a short to voltage on the specified audio (+) or (-) circuit.

B1025 02, B1035 02, B1045 02, B1055 02

The radio detects a short to ground on the specified audio (+) or (-) circuit.

B1025 04, B1035 04, B1045 04, B1055 04

The radio detects an open on the specified audio (+) or (-) circuit.

Action Taken When the DTC Sets

The radio continues to send the output signal to the speaker signal circuit with the current fault.

Conditions for Clearing the DTC

- A current DTC clears when the conditions for setting the DTC are no longer present and the ignition has been cycled from OFF to ON.
- A history DTC clears after 50 malfunction-free ignition cycles.

Diagnostic Aids

- Improper speaker mounting or loose trim may cause an audible buzz or distortion. Inspect the appropriate speaker and the surrounding interior trim for proper and secure mounting.
- The EL-50334-6 Audio System Diagnostic CD contains audio tracks that can be used to duplicate and isolate such concerns. Tracks 11 and 12 contain audio sweep tones for testing for speaker and grill rattles.
- The test tones on the CD may be copied to a USB drive or other device to use during testing.
- If the speaker or surrounding interior trim is found to be loose or improperly secured, correctly secure the item.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

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Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- **Circuit Testing**

- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON, A11 Radio ON, mute OFF.
2. Verify clear audio is heard from each speaker, adjusting fade and balance controls to test each speaker individually.
 - **If audio is inoperative from one or more speakers, or the audio emitted is not clear.**

Refer to Circuit/System Testing.

 - **If clear audio is heard from all speakers.**
3. All OK.

Circuit/System Testing

NOTE: **Some circuits supply audio signals to more than one speaker. It may be necessary to disconnect all speakers on the affected audio circuit when performing circuit tests.**

1. Ignition OFF, disconnect the harness connector at the appropriate P19 Speaker. Ignition ON, A11 Radio ON, mute OFF.
2. Test for 5-7 V between each audio signal circuit terminal 1 and terminal 2 and ground.
 - **If less than 5 V**
 1. Ignition OFF, disconnect the X1 harness connector at the A11 Radio.
 2. Test for infinite resistance between the signal circuits and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the A11 Radio.
 - **If greater than 7 V**
 1. Ignition OFF, disconnect the X1 harness connector at the A11 Radio. Ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the A11 Radio.

- If between 5-7 V

3. Test or replace the P19 Speaker.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Speaker Replacement Reference**
- **Control Module References** for radio replacement, programming, and setup.

DTC B125A: ANTENNA SIGNAL CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B125A 02

Antenna Signal Circuit Short to Ground

DTC B125A 04

Antenna Signal Circuit Open Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Radio Antenna Coax	B125A 02	B125A 04	1	-
Ground	-	1	-	-
1. May exhibit possible AM/FM interference.				

Circuit/System Description

The multi-band antenna is located on the roof of the vehicle. The radio antenna is enabled when the radio is turned on. The radio provides battery voltage to the antenna using the center conductor of the antenna coaxial cable. When a 12 V signal is seen on the center conductor of the antenna coax, both AM and FM signals are amplified.

Conditions for Running the DTC

- Ignition ON.

- Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

B125A 02

The radio detects a short to ground in the antenna signal circuit center conductor.

B125A 04

The radio detects an open in the antenna signal circuit center conductor.

Action Taken When the DTC Sets

Radio reception may be poor or not available.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear after 50 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

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Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON, A11 Radio ON.
2. Verify station reception is normal when tuned to several known good AM and FM stations.
 - **If AM or FM reception is poor.**

Refer to Circuit/System Testing

- **If reception is normal**
3. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the radio antenna coax cable from the A11 Radio and from the T4M Radio Antenna.
 2. Verify the antenna coax cable passes the coax cable component test. Refer to Component Testing.
 - **If the coax cable does not pass the test**
- Replace the antenna coax cable
- **If the coax cable passes the test**
3. Connect the radio antenna coax cable to the A11 Radio.
 4. Ignition ON, A11 Radio ON.
 5. Verify a test lamp illuminates between the antenna coax cable center terminal at the T4M Radio Antenna and chassis ground.
 - **If the test lamp does not illuminate**

Replace the A11 Radio.

- **If the test lamp illuminates**
6. Test or replace the T4M Radio Antenna.

Component Testing

CAUTION: Refer to Test Probe Caution .

NOTE: Before testing the coax cable, check the cable exterior for being pinched, cut, damaged, or having loose connections at the components, which can cause reception issues.

To prevent false reading when testing the center coax terminals, use care not to ground the test probe on the outer housing/shield.

Coax Cable Test

1. Ignition OFF, disconnect the coax cable at both components.
2. Test for less than 5 ohms between coax cable center terminal end to end.
 - **If 5 ohms or greater**

Replace the coax cable

- **If less than 5 ohms**
3. Test for less than 5 ohms between the coax cable outer shield end to end.
 - **If 5 ohms or greater**

Replace the coax cable

- **If less than 5 ohms**
4. Test for infinite resistance between the coax cable center terminal and the coax cable outer shield.
 - **If less than infinite resistance**

Replace the coax cable

- **If infinite resistance**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Radio Antenna Base Replacement**
- **Control Module References** for radio replacement, programming, and setup.

DTC B125B: ANTENNA 2 SIGNAL CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B125B 02

Antenna 2 Signal Circuit Short to Ground

DTC B125B 04

Antenna 2 Signal Circuit Open Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Radio Antenna Coax	B125A 02	B125A 04	1	-
Ground	-	1	-	-
1. May exhibit possible AM/FM interference.				

Circuit/System Description

The multi-band antenna is located on the roof of the vehicle. The radio antenna is enabled when the radio is turned on. The radio provides battery voltage to the antenna using the center conductor of the antenna coaxial cable. When a 12 V signal is seen on the center conductor of the antenna coax, the digital signal is amplified.

Conditions for Running the DTC

- Ignition ON.
- Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

B125B 02

The radio detects a short to ground in the antenna signal circuit center conductor.

B125B 04

The radio detects an open in the antenna signal circuit center conductor.

Action Taken When the DTC Sets

Radio reception may be poor or not available.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear after 50 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

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Radio/Audio System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON, A11 Radio ON. Verify station reception is normal when tuned to several known good digital stations.

- **If digital reception is poor.**

Refer to Circuit/System Testing

- **If reception is normal**

2. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the radio antenna coax cable from the A11 Radio and from the T4M Radio Antenna.

2. Verify the antenna coax cable passes the coax cable component test. Refer to Component Testing.

- **If the coax cable does not pass the test**

Replace the antenna coax cable

- **If the coax cable passes the test**

3. Connect the radio antenna coax cable to the A11 Radio.

4. Ignition ON, A11 Radio ON.

5. Verify a test lamp illuminates between the antenna coax cable center terminal at the T4M Radio Antenna and chassis ground.

- **If the test lamp does not illuminate**

Replace the A11 Radio.

- **If the test lamp illuminates**
- 6. Test or replace the T4M Radio Antenna.

Component Testing

CAUTION: Refer to Test Probe Caution .

NOTE: Before testing the coax cable, check the cable exterior for being pinched, cut, damaged, or having loose connections at the components, which can cause reception issues.

To prevent false reading when testing the center coax terminals, use care not to ground the test probe on the outer housing/shield.

Coax Cable Test

1. Ignition OFF, disconnect the coax cable at both components.
2. Test for less than 5 ohms between coax cable center terminal end to end.
 - **If 5 ohms or greater**
Replace the coax cable
 - **If less than 5 ohms**
3. Test for less than 5 ohms between the coax cable outer shield end to end.
 - **If 5 ohms or greater**
Replace the coax cable
 - **If less than 5 ohms**
4. Test for infinite resistance between the coax cable center terminal and the coax cable outer shield.
 - **If less than infinite resistance**
Replace the coax cable
 - **If infinite resistance**
5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Radio Antenna Base Replacement
- Control Module References for radio replacement, programming, and setup.

DTC B125C: SATELLITE ANTENNA CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B125C 01

Satellite Antenna Circuit Short to Battery

DTC B125C 02

Satellite Antenna Circuit Short to Ground

DTC B125C 04

Satellite Antenna Circuit Open

Circuit/System Description

The digital radio receiver, located inside the radio, receives digital radio information from the digital radio antenna located on the outside of the vehicle. The digital radio receiver is connected to the digital radio antenna via a shielded coax cable. The digital radio antenna contains an amplifier which is powered by the radio through the coax cable.

Conditions for Running the DTC

This DTC is run every 300 milliseconds.

Conditions for Setting the DTC

The radio detects a circuit fault in the digital radio antenna.

Action Taken When the DTC Sets

The radio displays No XM Signal or Check Antenna.

Conditions for Clearing the DTC

- A current DTC clears when the condition for setting the DTC is no longer present.
- A history DTC clears after 100 malfunction-free ignition cycles.

Diagnostic Aids

The digital radio antenna requires a clear line of sight to the sky to operate properly. Reception may be limited, intermittent, or unavailable inside structures.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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Radio/Audio System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Special Tools

EL-48028 Digital Radio Test Antenna

Circuit/System Verification

1. With the vehicle outside in an area with an unobstructed view of the southern sky, tune to XM.
2. Verify DTC B125C is not set as current and the No XM Signal or Check Antenna message is not displayed on the radio.
 - **If DTC B125C is set as current or the No XM Signal or Check Antenna message is displayed.**

Refer to Circuit/System Testing.
 - **If DTC B125C is not set as current and the No XM Signal or Check Antenna message is not displayed.**
3. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the digital radio antenna coax cable from the A11 radio. Connect the **EL-48028** digital radio test antenna to the radio and place on the roof of the vehicle.
2. Ignition ON, radio tuned to XM channel 1.

3. Verify DTC B125C is not set as current and XM reception is improved.

- **If DTC B125C is set as current or XM reception is not improved**

Replace the A11 radio.

- **If DTC B125C is not set as current and XM reception is improved**

4. Ignition OFF, disconnect the digital radio antenna coax cable from the T4D cellular phone, navigation, and digital radio antenna.

5. Verify the digital radio antenna coax cable passes the coax cable component test. Refer to Component Testing.

- **If the coax cable does not pass the test**

Replace the antenna coax cable

- **If the coax cable passes the test**

6. Replace the T4D cellular phone, navigation, and digital radio antenna.

Component Testing

CAUTION: Refer to Test Probe Caution .

NOTE: Before testing the coax cable, check the cable exterior for being pinched, cut, damaged, or having loose connections at the components, which can cause reception issues.

To prevent false reading when testing the center coax terminals, use care not to ground the test probe on the outer housing/shield.

Coax Cable Test

1. Ignition OFF, disconnect the coax cable at both components.

2. Test for less than 5 ohms between coax cable center terminal end to end.

- **If 5 ohms or greater**

Replace the coax cable

- **If less than 5 ohms**

3. Test for less than 5 ohms between the coax cable outer shield end to end.

- **If 5 ohms or greater**

Replace the coax cable

- **If less than 5 ohms**

4. Test for infinite resistance between the coax cable center terminal and the coax cable outer shield.
 - **If less than infinite resistance**

Replace the coax cable

- **If infinite resistance**

5. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Radio Antenna Base Replacement**
- **Control Module References** for radio replacement, programming, and setup.

DTC B1271: THEFT PROTECTION ACTIVE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B1271 00

Theft Protection Active

Circuit/System Description

When the radio is initially installed in the vehicle, the radio receives VIN information via serial data. The radio stores a portion of the VIN and compares this sequence to the VIN information received each time the radio powers on. The VIN in the radio is a single one-time learn.

The radio theft deterrent system is intended to disable or limit radio functionality if incorrect vehicle information is received by the radio. The radio disables functionality if the VIN information received by the radio does not match the VIN information that has been learned by the radio. This DTC is generated by the module when the Theft Protection is activated.

Conditions for Running the DTC

This DTC test runs when the radio changes from OFF to ON.

Conditions for Setting the DTC

The radio has learned a correct VIN sequence and the VIN information received via serial data does NOT match the learned VIN sequence.

Action Taken When the DTC Sets

- The radio may be disabled or have limited functionality.
- The radio display will indicate that theft protection is active.

Conditions for Clearing the DTC

The radio receives the correct VIN information via serial data.

Diagnostic Aids

A possible cause of incorrect VIN info could be the radio was originally installed in another vehicle.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

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Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON, A11 Radio ON.
2. Verify DTC B1271 is not set.
 - **If DTC B1271 is set**

Replace the A11 Radio.

- If DTC B1271 is not set

3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Radio replacement, programming, and setup

DTC B1446 OR B1447: BACKUP POWER SOURCE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B1446

Replace Backup Power Source Below Minimum Threshold

DTC B1447

Backup Power Source Open Circuit

For symptom byte information refer to **Symptom Byte List**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Backup Battery B+	B1447 03	B1447 04	-	-
Backup Battery Low Reference	B1447 03	B1447 04	-	-

Circuit/System Description

The backup power source provides voltage to the telematics communication interface control module, to be able to successfully place a call in the event of a main battery disconnect during a collision event.

Conditions for Running the DTC

B1446 03

- Ignition is ON.
- System voltage is between 9.5 and 15.5 V.
- DTC B1447 is not set.

B1447 04

- Ignition is ON.
- System voltage is between 9.5 and 15.5 V.
- The above conditions are present for greater than 10 s.

Conditions for Setting the DTC

B1446 03

The telematics communication interface control module detects that the backup power source voltage has dropped below the minimum threshold value.

B1447 04

The telematics communication interface control module detects no voltage from the backup power source.

Action Taken When the DTC Sets

B1446 03

The OnStar® status LED turns red.

B1447 04

- The OnStar® status LED turns red.
- The telematics communication interface control module will be unable to place a call in the event of a main battery disconnect during a collision event.

Conditions for Clearing the DTC

- A current DTC B1446 will clear when the telematics communication interface control module detects the voltage of the backup power source is above the minimum threshold value.
- A current DTC B1447 will clear when the telematics communication interface control module detects voltage from the backup power source.
- A history DTC clears after 50 malfunction-free ignition cycles.

Diagnostic Aids

- Shorting the backup power source positive voltage circuit to the backup power source ground circuit or chassis ground will activate the internal circuit protection of the backup power source, rendering the backup power source inoperative.

- DTC B1447 may set if the K73 Telematics Communication Interface Control Module has been incorrectly disconnected or serviced. When disconnecting the K73 Telematics Communication Interface Control Module, disconnect the harness connector X1 at the K73 Telematics Communication Interface Control Module prior to disconnecting any other harness connectors. This will ensure the backup power source is preserved when voltage is removed from the K73 Telematics Communication Interface Control Module.

Reference Information

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

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Description and Operation

OnStar Description and Operation

Electrical Information Reference

- **Testing for Intermittent Conditions and Poor Connections**
- **Circuit Testing**
- **Wiring Repairs**
- **Connector Repairs**

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the X1 harness connector at the K73 Telematics Communication Interface Control Module. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for greater than 9.5 V between the B+ circuit terminal 14 and the low reference circuit terminal 13.
 - **If 9.5 V or less**

Test or replace the C3 Telematics Communication Interface Control Module Battery.

- **If greater than 9.5 V**
3. Replace the K73 Telematics Communication Interface Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Communication Interface Module Battery Replacement**

- **Control Module References** for telematics communication interface control module replacement, programming and setup.

DTC B2455: CELLULAR PHONE MICROPHONE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provide an overview of each diagnostic category.

DTC Descriptors

DTC B2455 02

Cellular Phone Microphone Circuit Short to Ground

DTC B2455 04

Cellular Phone Microphone Circuit Open/High Resistance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Microphone Signal	B2455 02	B2455 04	B2455 04	-
Microphone Low Signal	B2455 02	B2455 04	B2455 04	-

Circuit/System Description

The telematics communication interface control module provides the cellular phone microphone with a supplied voltage on the cellular phone microphone high signal circuit. When the microphone is in use, voice data from the user is sent back to the telematics communication interface control module on the microphone low signal circuit.

Conditions for Running the DTC

- The ignition must be in the RUN or ACC position.
- The system voltage is at least 9.5 V and no more than 15.5 V.
- All the above conditions are present for greater than 10 s.

Conditions for Setting the DTC

B2455 02

The telematics communication interface control module detects an short to ground in the cellular phone

microphone high signal circuit for 10 s or greater.

B2455 04

The following conditions will set this DTC:

- The telematics communication interface control module detects an open/high resistance in the cellular phone microphone high signal circuit for 10 s or greater.
- The telematics communication interface control module detects an open/high resistance in the microphone low signal circuit for 10 s or greater.

Action Taken When the DTC Sets

- The OnStar® status LED turns red.
- The telematics communication interface control module will not receive a signal from the cellular phone microphone.
- Calls can be placed but the caller cannot be heard.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 50 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

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Description and Operation

OnStar Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the B24 Cellular Phone Microphone, ignition ON.
2. Test for 8.0-10.5 V between the signal circuit terminal B and ground.
 - **If less than 8.0 V**
 1. Ignition OFF, disconnect the X2 harness connector at the K73 Telematics Communication Interface Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the vehicle K73 Telematics Communication Interface Control Module.
 - **If greater than 10.5 V**
 1. Ignition OFF, disconnect the X2 harness connector at the K73 Telematics Communication Interface Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K73 Telematics Communication Interface Control Module.
 - **If between 8.0-10.5 V**
3. Test for less than 1 V between the signal circuit terminal A and ground.
 - **If greater than 1 V**
 1. Ignition OFF, disconnect the X2 harness connector at the K73 Telematics Communication Interface Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage in the circuit.
 - If less than 1 V, repair the K73 Telematics Communication Interface Control Module.
 - **If less than 1 V**
4. Test for greater than 8 V between the signal circuit terminal B and the signal circuit terminal A.
 - **If less than 8 V**
 1. Ignition OFF, disconnect the X2 harness connector at the K73 Telematics Communication Interface Control Module.
 2. Test for infinite resistance between the low signal circuit and ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, replace the vehicle K73 Telematics Communication Interface Control Module.

- **If greater than 8 V**

5. Test or replace the B24 Cellular Phone Microphone.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Mobile Telephone Microphone Replacement**
- **Control Module References** for telematics communication interface control module replacement, programming and setup.

DTC B2455: CELLULAR PHONE MICROPHONE (RADIO)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provide an overview of each diagnostic category.

DTC Descriptors

DTC B2455 01

Cellular Phone Microphone Circuit Short to Battery

DTC B2455 02

Cellular Phone Microphone Circuit Short to Ground

DTC B2455 04

Cellular Phone Microphone Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Microphone High Signal	B2455 02	B2455 04	1	-
Microphone Low Signal	-	B2455 04	B2455 01	-
1. Microphone Inoperative - Caller Cannot Be Heard				

Circuit/System Description

The radio provides the Cellular Phone Microphone with a supplied voltage on the Cellular Phone microphone high signal circuit. When the Microphone is in use, voice data from the user is sent back to the radio on the microphone low signal circuit.

Conditions for Running the DTC

- The ignition must be in the RUN or ACC position.
- The system voltage is at least 9.5 V and no more than 15.5 V.
- All the above conditions are present for greater than 10 seconds.

Conditions for Setting the DTC

B2455 01

- The radio detects a short to voltage in the low signal circuit for 10 seconds or greater.

B2455 02

- The radio detects a short to ground in the high signal circuit for 10 seconds or greater.

B2455 04

- The radio detects an open/high resistance in the high signal circuit for 10 seconds or greater.
- The radio detects an open/high resistance in the low signal circuit for 10 seconds or greater.

Action Taken When the DTC Sets

- The radio will not receive a signal from the Cellular Phone Microphone.
- Calls can be placed but the caller cannot be heard.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 50 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

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Radio/Audio System Description and Operation

Electrical Information Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **It is necessary to have the vehicle in a quiet, open outside area where a cellular call can be successfully placed.**

1. Ignition ON.
2. Verify that DTC B2455 is set.
 - **If DTC B2455 is not set**

All OK.
 - **If DTC B2455 is set**
3. Verify that your voice can be heard clearly after placing a cellular call.
 - **If your voice can not be heard clearly**

Refer to Circuit/System Testing.
 - **If your voice can be heard clearly**
4. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the B24 Cellular Phone Microphone, ignition ON.
2. Test for 9.5-10.5 V between the signal circuit terminal B and ground.
 - **If less than 9.5 V**
 1. Ignition OFF, disconnect the X1 harness connector at the A11 Radio.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the signal circuit end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.
- If less than 2 ohms, replace the A11 Radio.
- **If greater than 10.5 V**
- 1. Ignition OFF, disconnect the X1 harness connector at the A11 Radio, ignition ON.
- 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the A11 Radio.
- **If between 9.5-10.5 V**
- 3. Ignition ON.
- 4. Test for less than 1 V between the signal circuit terminal A and ground.
 - **If greater than 1 V**
 - 1. Ignition OFF, disconnect the X1 harness connector at the A11 Radio, ignition ON.
 - 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage in the circuit.
 - If less than 1 V, replace the A11 Radio.
 - **If less than 1 V**
- 5. Test for 9.5-10.5 V between the signal circuit terminal B and the signal circuit terminal A.
 - **If less than 9.5 V**
 - 1. Ignition OFF, disconnect the X1 harness connector at the A11 Radio.
 - 2. Test for infinite resistance between the signal circuit terminal A and ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance
 - 3. Test for less than 2 ohms in the signal circuit terminal A end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the vehicle A11 Radio.
 - **If greater than 10.5 V**
 - 1. Ignition OFF, disconnect the X1 harness connector at the A11 Radio, ignition ON.
 - 2. Test for less than 1 V between the signal circuit terminal A and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the A11 Radio.
 - **If between 9.5-10.5 V**
- 6. Test or replace the B24 Cellular Phone Microphone.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Mobile Telephone Microphone Replacement**
- **Control Module References** for Radio replacement, programming and setup.

DTC B2470: CELLULAR PHONE ANTENNA

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B2470 02

Cellular Phone Antenna Circuit Malfunction Short to Ground

DTC B2470 04

Cellular Phone Antenna Circuit Malfunction Open Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Cellular Antenna Signal	B2470 02	B2470 04	-	-

Circuit/System Description

The cellular phone, navigation, and digital radio antenna is connected to the telematics communication interface control module. This module supplies 5 V to the cellular phone, navigation, and digital radio antenna to power the internal amplifier.

Conditions for Running the DTC

- Ignition in the RUN or ACC position.
- System voltage is between 9.5 V and 15.5 V.
- The above conditions are present for greater than 1 s.

Conditions for Setting the DTC

The telematics communication interface control module does not detect the presence of a cellular phone antenna.

Action Taken When the DTC Sets

- The vehicle is unable to connect to the OnStar® Call Center.
- The OnStar® status LED turns red.

Conditions for Clearing the DTC

- The telematics communication interface control module detects the presence of a cellular phone antenna.
- A history DTC clears after 50 malfunction-free ignition cycles.

Reference Information

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OnStar/Telematics Schematics

Connector End View Reference

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- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-49903 GM OnStar Antenna Diagnostic Tool Kit

Circuit/System Verification

NOTE: The following verification requires the vehicle to be outside with an unobstructed view of the southern sky. Allow 5 minutes after turning the ignition ON for the GPS satellites to acquire vehicle signal.

1. Ignition ON.
2. Verify that DTC B2470 is not set.
 - **If DTC B2470 is set**

Refer to Circuit/System Testing

- **If DTC B2470 is not set**
- 3. Verify that a call can be successfully placed to the OnStar Call Center by pressing the blue OnStar button.
 - **If unable to connect with the OnStar Call Center.**

Refer to **Unable to Contact OnStar Call Center**

- **If able to connect with the OnStar Call Center**
- 4. All OK.

Circuit/System Testing

NOTE:

- **The vehicle may be equipped with sectioned coax. Test each section and replace only the faulty section, not the entire length of coax.**
- **The following verification requires the vehicle to be outside with an unobstructed view of the southern sky. Allow 5 min after turning the ignition ON for the GPS satellites to acquire vehicle signal.**

1. Ignition OFF and all vehicle systems OFF, disconnect the GPS and cellular coax cable connector at the K73 Telematics Communication Interface Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Using the EL-49903-3 kit (EL-49903-5 adapter and EL-49903-4 coax cable), connect the **EL-49903** GM OnStar antenna diagnostic tool kit to the K73 Telematics Communication Interface Control Module. Place the test antenna on the roof of the vehicle, ignition ON.
3. Verify the DTC does not set while operating the vehicle within the conditions for running the DTC.
 - **If the DTC sets**

Replace the K73 Telematics Communications Interface Control Module.

- **If the DTC does not set**
- 4. Ignition OFF.
- 5. Disconnect the **EL-49903** GM OnStar antenna diagnostic tool kit from the K73 Telematics Communication Interface Control Module
- 6. Test the coax cable. Refer to Component Testing.
 - **If the coax cable does not pass the test**

Replace the coax cable.

- **If the coax cable passes the test**
- 7. Test or replace the T4G Cellular Phone, Navigation, and Digital Radio Antenna.

Component Testing

CAUTION: Refer to **Test Probe Caution**

NOTE:

- Before testing the coax cable, check the cable exterior for being pinched, cut, damaged, or having loose connections at the components, which can cause reception issues.
- To prevent false readings when testing the center coax terminals, use care not to ground the test probe on the outer housing/shield.

Coax Cable Test

1. Ignition OFF, disconnect the coax cable at both components.
2. Test for less than 5 ohms between the coax cable center terminal end to end.
 - **If 5 ohms or greater**

Replace the coax cable.

- **If less than 5 ohms**
3. Test for greater than 5 ohms between the coax cable outer shield end to end.
 - **If 5 ohms or greater**

Replace the coax cable.

- **If less than 5 ohms**
4. Test for infinite resistance between the coax cable center terminal and the coax cable outer shield.
 - **If less than infinite resistance**

Replace the coax cable.

- **If infinite resistance**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Radio Antenna Base Replacement**
- **Control Module References** for telematics communication interface control module replacement, setup, and programming

DTC B2476 OR B2482: CELLULAR PHONE SELECT SERVICE SWITCH

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provide an overview of each diagnostic category.

DTC Descriptors

DTC B2476 04

Cellular Phone Select Service Switch Open

DTC B2476 59

Cellular Phone Select Service Switch Protection Time-out

DTC B2482 00

Cellular Phone Select Service Switch Range/Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
10 V Reference	B2476 04	B2476 04	B2476 04	-
Signal Terminal B	B2476 04	B2476 04	B2476 59	B2476 59, B2482 00
Ground	-	B2476 04	-	-

Circuit/System Description

The OnStar® button assembly consists of 3 buttons: Call/Answer, OnStar® Call Center, and OnStar® Emergency. The telematics communication interface control module supplies the OnStar® button assembly with 10 V via the 10 V reference circuit. Each of the buttons, when pressed, completes the circuit across a resistor allowing a specific voltage to be returned to the telematics communication interface control module over the keypad signal circuit. Depending upon the voltage range returned, the telematics communication interface control module is able to identify which button has been pressed.

Conditions for Running the DTC

- Vehicle ON.
- Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

B2476 04

The telematics communication interface control module detects an open/high resistance on the keypad supply voltage circuit.

B2482 and B2476 59

The telematics communication interface control module detects a valid signal on the keypad signal circuit for longer than 15 s. If one of the OnStar® buttons is held or stuck for 15 s or greater, the telematics communication interface control module will set this DTC.

Action Taken When the DTC Sets

- The OnStar® status LED turns red.
- No calls can be placed.
- The telematics communication interface control module will ignore all inputs from the OnStar® button assembly.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 50 consecutive malfunction-free ignition cycles have occurred.

Reference Information

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OnStar/Telematics Schematics

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

NOTE:

- **10 V reference circuit measurement may vary with vehicle battery voltage.**
- **Test for voltage range with vehicle battery measuring at a minimum of 11.5 V**

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the A10 Inside Rearview Mirror. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal E and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Ignition ON.
4. Test for 8.0-10.5 V between the 10 V reference circuit terminal A and ground.
 - **If less than 8.0 V**
 1. Ignition OFF, disconnect the harness connector at the K73 Telematics Communication Interface Control Module.
 2. Test for infinite resistance between the 10 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the 10 V reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K73 Telematics Communication Interface Control Module.
 - **If greater than 10.5 V**
 1. ignition OFF, disconnect the harness connector at the K73 Telematics Communication Interface Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the 10 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K73 Telematics Communication Interface Control Module.
 - **If between 8.0-10.5 V**
5. ignition OFF.
6. Test for 500-900 ohms between the signal circuit terminal B and ground.
 - **If less than 500 ohms**
 1. Disconnect the X1 harness connector at the K73 Telematics Communication Interface Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K73 Telematics Communication Interface Control Module.

- **If greater than 900 ohms**
- 1. Disconnect the X1 harness connector at the K73 Telematics Communication Interface Control Module, vehicle in Service Mode.
- 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
- 3. ignition OFF.
- 4. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K73 Telematics Communication Interface Control Module.
- **If between 500-900 ohms**
- 7. Test or replace the A10 Inside Rearview Mirror.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Inside Rearview Mirror Replacement**
- **Control Module References** for telematics communication interface control module replacement, programming and setup.

DTC B2485: WIRELESS COMMUNICATION (BT) ANTENNA

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provide an overview of each diagnostic category.

DTC Descriptors

DTC B2485 02

Wireless Communication (BT) Antenna Circuit Short to Ground

DTC B2485 04

Wireless Communication (BT) Antenna Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	B2485 02	B2485 04	-	-

Circuit/System Description

Bluetooth ® wireless technology is a short-range communications technology intended to replace the cables connecting portable and/or fixed devices while maintaining high levels of security. The operating range of the signal is approximately 30 feet.

The Bluetooth ® antenna is a small fixed antenna connected directly to the telematics communication interface control module and is used to send and receive signals from a Bluetooth ® enabled cellular phone.

Conditions for Running the DTC

- The ignition is in OFF, ACCESSORY or RUN position.
- The system voltage is between 9-16 V.
- The telematics communication interface control module tests the antenna once every second.

Conditions for Setting the DTC

B2485 02

- The signal voltage is less than 1 V.
- The above conditions must be met for 500 ms.

B2485 04

- The signal voltage is greater than 2 V.
- The above conditions must be met for 500 ms.

Actions Taken When the DTC Sets

- The OnStar ® status LED turns red.
- Bluetooth ® functionality is disabled.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Diagnostic Aids

- Verify the mobile device is properly configured for the feature being used. Refer to the device manufacturers information.
- Verify the function/feature that is being used is supported by the mobile device.
- The device must be paired to the telematics communication interface control module to use the available Bluetooth ® feature(s). The pairing process must only be performed once for each device, unless that device's information is deleted.
- The system can store pairing information for multiple devices, but can only be actively connected to one

at any given time.

Reference Information

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Special Tools

EL-50334-20 Multi-Media Interface Tester (Multi-Media Interface Tool)

Circuit/System Testing

1. Verify that the T4S Wireless Communication Antenna - Bluetooth ® is properly connected to the K73 Telematics Communication Interface Control Module and is not damaged.
 - **If the antenna is disconnected**

Connect the T4S Wireless Communication Antenna - Bluetooth ® to the module.
 - **If the antenna is damaged**

Test or replace the T4S Wireless Communication Antenna - Bluetooth ®.
 - **If the antenna is connected and not damaged**

NOTE: **The Multi-Media Interface Tool tool can be used to test either cellular phone or streaming audio functions. Refer to the tool instructions, and perform the appropriate test(s) related to the customers concern in the following steps.**

2. Ignition ON, infotainment system ON.
3. Verify the infotainment system successfully pairs with the Multi-Media Interface Tool.
 - **If the infotainment system does not successfully pair with the Multi-Media Interface Tool.**
 1. Test or replace the T4S Wireless Communication Antenna - Bluetooth ®.
 2. Clear the DTC, ignition OFF.
 3. Ignition ON.
 4. Verify the DTC is not set.
 - If the DTC is set, replace the K73 Telematics Communication Interface Control Module.
 - If the DTC is not set
 5. All OK.
 - **If the infotainment system successfully pairs with the Multi-Media Interface Tool.**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for telematics communication interface control module replacement, programming and setup.

SYMPTOMS - CELLULAR COMMUNICATION

NOTE: **The following steps must be completed before using the symptom table.**

1. Perform the **Diagnostic System Check - Vehicle** before using the Symptom Tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to **OnStar Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Radio/Audio System. Refer to **Checking Aftermarket Accessories** .
- Inspect for easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **No Global Positioning System (GPS) Reception**
- **OnStar Microphone Malfunction**
- **OnStar Audio Malfunction**
- **OnStar Button LED Malfunction**
- **OnStar Call Center Remote Function Requests Malfunction**
- **OnStar Button Malfunction**
- **Unable to Contact OnStar Call Center**
- **OnStar Voice Recognition Malfunction**
- **OnStar Steering Wheel Control Functions Malfunction**

SYMPTOMS - ENTERTAINMENT

IMPORTANT: The following steps must be completed before using the symptom table.

1. Perform the **Diagnostic System Check - Vehicle** before using the Symptom Tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Radio/Audio System Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Radio/Audio System. Refer to **Checking Aftermarket Accessories**.
- Inspect for easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections**.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Application Malfunction**
- **Auxiliary Audio Input Malfunction**
- **Bluetooth Malfunction (UF7/UH7), Bluetooth Malfunction (UE1 without UF7/UH7)**

- **Digital Radio Poor or No Reception**
- **Radio Poor Reception**
- **Speaker Malfunction**

APPLICATION MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provide an overview of each diagnostic category.

Circuit/System Description

The term application refers to any piece of software that works on a system (hardware) that is being operated by its own software. Applications are typically small software programs which uses the hardware to perform a specific task, as opposed to operating the entire system.

Diagnostic Aids

- For an application to be used, it must be installed on both the vehicle infotainment system and a compatible mobile device.
- The application must work correctly on the device to work with the vehicle infotainment system.
- The user may be required to log-in to the application on the mobile device before using the application from the vehicle controls.
- Applications use the mobile device and connection to a service provider to operate. Connection quality issues, or service provider data transmission issues can give the appearance of a vehicle malfunction.
- The device must be connected to the system. This may be done wirelessly via Bluetooth ®, or via the vehicle USB port.

When a mobile device is connected via Bluetooth®, some or all of the device controls may be unavailable from the radio controls. This varies dependant upon the device being used. Refer to the vehicle owners manual, supplements, and the device manufacturers information for information on devices, control, and operation.

Refer to the device manufacturers information for the preferred connection method.

- The device must be unlocked, and any additional applications should be closed.
- If the device has any sound enhancement features such as noise reduction or echo control, these features should be turned off.
- A low battery condition in the mobile device may not allow the device to connect to the system, or can create communication issues with the device. Verify the device battery state of charge and re-charge or replace as needed.
- If a 'Please See Device' or similar type error message is displayed, this may indicate the device has lost its connection to the vehicle, or the device has lost its external data connection.

- If a cable is used for connection, attempt to connect the device using a different cable; cables can deteriorate over time or become damaged.

Reference Information

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Connector End View Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the application is installed on the mobile device and is up to date.
 - **If the application is not installed or is not up to date.**

Install or update the application on the device.
 - **If the application is installed on the mobile device and is up to date**
2. Verify the application operates correctly on the mobile device.
 - **If the application is not operating correctly on the mobile device.**

Refer to the application website.
 - **If the application is operating correctly on the mobile device.**
3. Verify the A11 Radio calibrations are current.
 - **If the radio calibrations are not current**

Reprogram the A11 Radio and re-evaluate the concern.

- **If no update calibrations are available**

4. Verify the application is installed on the A11 Radio and is up to date.

- **If the application is not installed or is not up to date.**

Install or update the application on the A11 Radio.

- **If the application is installed on the A11 Radio and is up to date**

5. Ignition ON, A11 Radio ON.

6. Verify the mobile device can connect to the infotainment system. Refer to the owners manual for information on the preferred connection method for the device.

- **If the mobile device cannot connect to the vehicle infotainment system.**

- If unable to connect via Bluetooth, refer to **Bluetooth Malfunction (UF7/UH7)**, **Bluetooth Malfunction (UE1 without UF7/UH7)**.

- If unable to connect via USB, refer to **Auxiliary Audio Input Malfunction**.

- **If the mobile device connects to the vehicle infotainment system.**

7. Launch the application.

8. Verify the applications operates properly with the vehicle infotainment system.

- **If the application does not function properly**

Refer to diagnostic aids.

- **If the application functions properly**

9. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for radio replacement, programming, and setup.

AUXILIARY AUDIO INPUT MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
---------	-----------------	----------------------	------------------	--------------------

Auxiliary Audio Common Signal	-	6	-	-
Auxiliary Detection Signal	5	6	-	-
Left Auxiliary Audio Signal	2	2	2, 4	-
Right Auxiliary Audio Signal	3	3	3, 4	-
USB Cable	1	1	1	-
1. USB port Inoperative 2. No left side audio from device connected to AUX jack 3. No right side audio from device connected to AUX jack 4. Noticeable distortion may be present in affected audio channel 5. Radio does not detect auxiliary device connection, AUX not available as input selection 6. AUX always available as an input selection, with or without auxiliary device connected				

Circuit/System Description

Auxiliary Audio Input Jack

The 3.5 mm auxiliary audio input jack is located in the console. All circuits from the auxiliary jack are connected directly to the radio. Audio signals from the device are sent to the radio from the auxiliary input jack via the left, right, and common audio signal circuits.

The infotainment system may also have an additional auxiliary audio input jack available on the radio face. This input interfaces internally with the radio, no external circuits are involved.

When a portable audio playback device is connected to an auxiliary jack, an internal switch detects the connection and the radio will switch to AUX as the audio source.

USB Port

The vehicle may be equipped with a USB port in the console. This port allows USB connectivity to the infotainment system from portable media players or a USB storage device (memory stick/flash drive). When a device is connected to the USB port, the system detects the device and switches to USB as the audio source. Once connected, the device can be controlled from the radio controls.

The USB port is connected to the radio via a standard USB cable. Mini type USB connectors are used to connect the cable at the USB port and at the radio. Standard USB male to female connections are typically used for connecting USB cables together where an in-line connection is required. An in-line cable connection is typically found between the console and I/P harness.

Not all portable media player devices are compatible. Refer to the owner's manual for information on USB devices, control, and operation.

Diagnostic Aids

Auxiliary Audio Input Jack

- When a device is first connected to the 3.5 mm (1/8 in) input jack the infotainment system automatically

switches to that device. If an auxiliary device has already been connected, press the AUX or CD/AUX button to select the device.

- If the system detects the device, but the audio is not heard or is not clear, attempt to connect the device using a different cable; cables can deteriorate over time or become damaged.
- Playback of an audio device that is connected to the 3.5 mm jack can only be controlled using the controls on the device.
- The volume control on the device may need to be adjusted to ensure sufficient playback volume through the infotainment system.

USB

- When a device is first connected to the USB port, the infotainment system automatically switches to that device. If an auxiliary device has already been connected, press the AUX or CD/AUX button to select the device.
- A low battery condition in a portable media player may not allow the device to connect to the system, or can create communication issues with the device. Verify the device battery state of charge and re-charge or replace as needed.
- Connect the device directly to the USB port if possible. Only use a cable if it is required to connect the device. The use of extension cables can cause communication issues.
- If a cable is required for connection, attempt to connect the device using a different cable; cables can deteriorate over time or become damaged.
- Attempt audio playback from multiple USB devices when diagnosing USB concerns. Device compatibility can vary based on vehicle equipment. If the infotainment system is capable of operating any USB type device, the cause of the concern is not with the vehicle system. The inoperative device(s) may be incompatible or contain no recognized media types.
- If a 'Device Not Supported' or similar type error message is displayed, this indicates the system has connected to the device but cannot communicate with it properly. This does not indicate an issue with the vehicle system. The device may be incompatible, may require a 'reset', or may require an update to its software/firmware.
- If a 'No Supported Data Found' or similar type error message is displayed, this indicates the system has connected to the device and is communicating, but cannot find any compatible files/data. This does not indicate an issue with the vehicle system. Verify the device contains compatible media/file types.
- Poor connections or damaged USB cables can cause intermittent or no operation of USB devices. Inspect connectors, terminals, and cables for damage and replace components as necessary. Ensure all USB inline connections and connections at components are fully seated and connector position retainers/locks are secure.

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Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **EL-50334-20** Multi-Media Interface Tester (MIT)
- **EL-50334-50** USB Cable and Adapter Kit

Circuit/System Verification

Auxiliary Audio Input Jack - Console

1. Verify no DTCs are present.
 - **If any DTCs are present**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If no DTCs are present**

2. Ignition ON, radio ON.
3. Verify the infotainment system switches to AUX as the audio source with the **EL-50334-20** Multi-Media Interface Tester (MIT) connected to the auxiliary audio input jack.
 - **If the infotainment system does not switch to AUX as the audio source**

Refer to Circuit/System Testing - Auxiliary Audio Input Jack.

- **If the infotainment system switches to AUX as the audio source**

4. Verify the audio from the **EL-50334-20** Multi-Media Interface Tester (MIT) is heard through the vehicle infotainment system while operating the test tool to begin audio playback.
 - **If audio is not heard from the test tool**

Refer to Circuit/System Testing - Auxiliary Audio Input Jack

- **If audio is heard from the test tool**

5. All OK

Auxiliary Audio Input Jack - Radio (If Equipped)

1. Verify no DTCs are present.

- **If any DTCs are present**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If no DTCs are present**

2. Ignition ON, radio ON.

3. Verify the infotainment system switches to AUX as the audio source with the **EL-50334-20** Multi-Media Interface Tester (MIT) connected to the auxiliary audio input jack.

- **If the infotainment system does not switch to AUX as the audio source**

Replace the A11 Radio.

- **If the infotainment system switches to AUX as the audio source**

4. Verify the audio from the **EL-50334-20** Multi-Media Interface Tester (MIT) is heard through the vehicle infotainment system while operating the test tool to begin audio playback.

- **If audio is not heard from the test tool**

Replace the A11 Radio.

- **If audio is heard from the test tool**

5. All OK.

USB Port

1. Verify no DTCs are present.

- **If any DTCs are present**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If no DTCs are present**

2. Ignition ON, radio ON.

3. Verify the infotainment system switches to USB as the audio source with the **EL-50334-20** Multi-Media Interface Tester (MIT) connected to the USB port.

- **If the infotainment system does not switch to USB as the audio source**

Refer to Circuit/System Testing - USB Port.

- **If the infotainment system switches to USB as the audio source**

4. Verify the audio from the **EL-50334-20** Multi-Media Interface Tester (MIT) is heard through the vehicle infotainment system while operating the system to play audio from the test tool.

- **If audio is not heard from the test tool**

Refer to Circuit/System Testing - USB Port.

- **If audio is heard from the test tool**

5. All OK.

Circuit/System Testing

Auxiliary Audio Input Jack

1. Ignition OFF, disconnect the X1 harness connector at the X83 Auxiliary Audio Input. Ignition ON, radio ON.

2. Test for 2.5-3.5 V between the signal circuit terminal 5 and ground.

- **If less than 2.5 V**

1. Ignition OFF, disconnect the X1 harness connector at the A11 Radio.

2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance

3. Test for less than 2 ohms in the signal circuit end to end

- If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, replace the A11 Radio.

- **If greater than 3.5 V**

1. Ignition OFF, disconnect the X1 harness connector at the A11 Radio, ignition ON.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.

- If less than 1 V, replace the A11 Radio.

- **If between 2.5-3.5 V**

3. Test for less than 1 V between the signal circuits listed below and ground:

- Left auxiliary audio signal circuit terminal 1

- Right auxiliary audio signal circuit terminal 2

- Auxiliary audio common signal circuit terminal 3

- **If 1 V greater**

1. Ignition OFF, disconnect the X1 harness connector at the A11 Radio. Ignition ON.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.

- If less than 1 V, replace the A11 Radio.

- **If less than 1 V**

4. Ignition OFF, disconnect the X1 harness connector at the A11 Radio.
5. Test for infinite resistance between the signal circuits listed below and ground:
 - Auxiliary audio common signal circuit terminal 23
 - Left auxiliary audio signal circuit terminal 24
 - rRght auxiliary audio signal circuit terminal 10
 - **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**
6. Test for less than 5 ohms between the signal circuit terminals listed below:
 - A11 Radio terminal 24 X1 and the X83 Auxiliary Audio Input terminal 1 X1
 - A11 Radio terminal 10 X1 and the X83 Auxiliary Audio Input terminal 2 X1
 - A11 Radio terminal 23 X1 and the X83 Auxiliary Audio Input terminal 3 X1
 - **If 5 ohms greater**

Repair the open/high resistance in the circuit.

- **If less than 5 ohms**
7. Replace the X83 Auxiliary Audio Input. Connect all harness connectors.
 8. Connect and operate the **EL-50334-20** Multi-Media Interface Tester (MIT).
 9. Verify the audio from the test tool is heard through the vehicle infotainment system.
 - **If audio is not heard from the test tool**

Replace the A11 Radio.

- **If audio is heard from the test tool**
10. All OK.

USB Port

1. Ignition OFF, disconnect the USB cable connection at the A11 Radio.

NOTE: **USB cables and adapters for the following tests are found in the EL-50334-50 USB Cable and Adapter Kit.**

2. Connect the EL-50334-2 Type A female to Mini B male USB Cable to the A11 Radio.
3. Connect the **EL-50334-20** Multi-Media Interface Tester (MIT) to the EL-50334-2 cable. Ignition ON, radio ON
4. Verify the infotainment system switches to USB as the audio source.
 - **If the infotainment system does not switch to USB as the audio source**

Replace the A11 Radio.

- **If the infotainment system switches to USB as the audio source**

5. Ignition OFF, connect the vehicle USB cable to the A11 Radio. Disconnect the USB cable at the X83 Auxiliary Audio Input.

NOTE: **The EL-50334-4 adapter may be required for the following test.**

6. Connect the **EL-50334-20** Multi-Media Interface Tester (MIT) to the vehicle USB cable. Ignition ON, radio ON.
7. Verify the infotainment system switches to USB as the audio source.
 - **If the infotainment system does not switch to USB as the audio source**

Replace the USB cable assembly.

- **If the infotainment system switches to USB as the audio source**

8. Test or replace the X83 Auxiliary Audio Input.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **USB Receptacle Replacement**
- **Control Module References** for radio replacement, programming, and setup.

BLUETOOTH MALFUNCTION (UF7/UH7)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provide an overview of each diagnostic category.

Circuit/System Description

Bluetooth ® wireless technology is a short-range communications technology intended to replace the cables connecting portable and/or fixed devices while maintaining high levels of security. The operating range of the signal is approximately 30 feet.

The available features and functions are determined by the type of device and the software within the devices being used. For a feature or function to operate, it must be supported in both devices.

The Bluetooth ® hardware is internal to the radio. The radio supports streaming of data (music, voice, information) from cellular phones and other mobile devices that support those features. The radio may also be capable of interfacing with cellular phones for hands-free features.

Refer to the vehicle owners manual, supplements, and the device manufacturers information for information on devices, control, operation. and pairing instructions.

Diagnostic Aids

- Verify the mobile device is properly configured for the feature being used. Refer to the device manufacturers information.
- Verify the function/feature that is being used is supported by the mobile device.
- The device must be paired to the radio to use the available Bluetooth ® feature(s). The pairing process must only be performed once for each device, unless that device's information is deleted.
- The system can store pairing information for multiple devices, but can only be actively connected to one at any given time.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

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Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-50334-20 Multi-Media Interface Tester (MIT)

For equivalent regional tools, refer to **Special Tools**, **Special Tools (MIT tool instructions)**.

Circuit/System Verification

1. Verify no DTCs are present.
 - **If any DTCs are present**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If no DTCs are present**
2. Verify the A11 Radio calibrations are current.
 - **If the radio calibrations are not current**

Reprogram the A11 Radio and re-evaluate the concern.

- **If no update calibrations are available**

NOTE: **The MIT tool can be used to test either cellular phone or streaming audio functions. Refer to the tool instructions, and perform the appropriate test (s) related to the customers concern in the following steps.**

3. Ignition ON, infotainment system ON.
4. Verify the infotainment system successfully pairs with the MIT tool.
 - **If the infotainment system does not successfully pair with the MIT tool.**

Replace the A11 Radio.

- **If the infotainment system successfully pairs with the MIT tool.**

5. Verify the infotainment system successfully completes the desired feature test using the MIT tool.
 - **If the feature test is not successful**

Replace the A11 Radio.

- **If the feature test is successful**

6. All OK. Refer to Diagnostic Aids.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for radio replacement, programming, and setup

BLUETOOTH MALFUNCTION (UE1 WITHOUT UF7/UH7)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.

- **Diagnostic Procedure Instructions** provide an overview of each diagnostic category.

Circuit/System Description

The Bluetooth ® antenna is internal to, or is a small fixed antenna connected directly to, the telematics communication interface control module and is used to send and receive signals from a Bluetooth ® enabled cellular phone. The antenna utilizes no cabling and is not external to the vehicle.

In order to use hands-free calling, the cellular phone must be paired to the vehicle. Up to five devices can be paired to the vehicle at one time, but only one can be connected at any given time. To pair a phone, the customer must know how to operate the Bluetooth ® functionality of their phone. The pairing process must only be done one time for each phone, unless that phone's information is deleted. For safety reasons, the pairing process is disabled while the vehicle is moving.

Diagnostic Aids

- The purpose of this diagnostic is to verify the ability of the telematics communication interface control module to pair to a Bluetooth ® device.
- Before performing this test, verify compatibility of the cellular phone(s) the customer is attempting to use with the vehicle. Based on the cellular phone's service provider and the manufacturer's implementation of Bluetooth ®, not all phones support all available Bluetooth ® functionality. A vehicle and feature compatibility list will be provided via the GM Bluetooth ® website:
<http://www.onstar.com/web/Bluetooth/>
- If the vehicle passes the following tests and a compatible device is being used, the concern may be due to a device malfunction or an incomplete/improper pairing attempt.
- A Bluetooth ® test tool or equivalent can also be used to verify the ability of the customers cellular phone (s) to pair with another device.

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

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OnStar Description and Operation

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-50334-20 Multi-Media Interface Tester (Multi-Media Interface Tool)

Circuit/System Verification

1. Ignition ON.
2. Verify no DTCs are set.
 - **If any DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**

- **If no DTCs are set**

NOTE: **The Multi-Media Interface Tool can be used to test either cellular phone or streaming audio functions. Refer to the tool instructions, and perform the appropriate test(s) related to the customers concern in the following steps.**

3. Ignition ON, infotainment system ON.
4. Verify the infotainment system successfully pairs with the Multi-Media Interface Tool.
 - **If the infotainment system does not successfully pair with the Multi-Media Interface Tool.**
 1. Verify the vehicle is equipped with an external Bluetooth® Antenna.
 - If not equipped with an external Bluetooth® Antenna, replace the K73 Telematics Communication Interface Control Module
 - If equipped with an external Bluetooth® Antenna
 2. Replace the Bluetooth® Antenna.
 3. Verify the infotainment system successfully pairs with the Multi-Media Interface Tool.
 - If the infotainment system does not successfully pair with the Multi-Media Interface Tool, replace the K73 Telematics Communication Interface Control Module.
 - If the infotainment system successfully pairs with the Multi-Media Interface Tool.
 4. All OK.
 - **If the infotainment system successfully pairs with the Multi-Media Interface Tool.**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair procedure.

Control Module References for telematics communication interface control module replacement, programming, and setup.

DIGITAL RADIO POOR OR NO RECEPTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B125C 01

Satellite Antenna Circuit Short to Battery

DTC B125C 02

Satellite Antenna Circuit Short to Ground

DTC B125C 04

Satellite Antenna Circuit Open

Circuit/System Description

The digital radio receiver, located inside the radio, receives digital radio information from the digital radio antenna located on the outside of the vehicle. The digital radio receiver is connected to the digital radio antenna via a shielded coax cable. The digital radio antenna contains an amplifier which is powered by the radio through the coax cable.

Conditions for Running the DTC

This DTC is run every 300 milliseconds.

Conditions for Setting the DTC

The radio detects a circuit fault in the digital radio antenna.

Action Taken When the DTC Sets

The radio displays No XM Signal or Check Antenna.

Conditions for Clearing the DTC

- A current DTC clears when the condition for setting the DTC is no longer present.
- A history DTC clears after 100 malfunction-free ignition cycles.

Diagnostic Aids

The digital radio antenna requires a clear line of sight to the sky to operate properly. Reception may be limited, intermittent, or unavailable inside structures.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Special Tools

EL-48028 Digital Radio Test Antenna

Circuit/System Verification

1. With the vehicle outside in an area with an unobstructed view of the southern sky, tune to XM.
2. Verify DTC B125C is not set as current and the No XM Signal or Check Antenna message is not displayed on the radio.
 - **If DTC B125C is set as current or the No XM Signal or Check Antenna message is displayed.**

Refer to Circuit/System Testing.
 - **If DTC B125C is not set as current and the No XM Signal or Check Antenna message is not displayed.**
3. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the digital radio antenna coax cable from the A11 radio. Connect the **EL-48028** digital radio test antenna to the radio and place on the roof of the vehicle.
2. Ignition ON, radio tuned to XM channel 1.

3. Verify DTC B125C is not set as current and XM reception is improved.

- **If DTC B125C is set as current or XM reception is not improved**

Replace the A11 radio.

- **If DTC B125C is not set as current and XM reception is improved**

4. Ignition OFF, disconnect the digital radio antenna coax cable from the T4D cellular phone, navigation, and digital radio antenna.

5. Verify the digital radio antenna coax cable passes the coax cable component test. Refer to Component Testing.

- **If the coax cable does not pass the test**

Replace the antenna coax cable

- **If the coax cable passes the test**

6. Replace the T4D cellular phone, navigation, and digital radio antenna.

Component Testing

CAUTION: Refer to Test Probe Caution .

NOTE: Before testing the coax cable, check the cable exterior for being pinched, cut, damaged, or having loose connections at the components, which can cause reception issues.

To prevent false reading when testing the center coax terminals, use care not to ground the test probe on the outer housing/shield.

Coax Cable Test

1. Ignition OFF, disconnect the coax cable at both components.

2. Test for less than 5 ohms between coax cable center terminal end to end.

- **If 5 ohms or greater**

Replace the coax cable

- **If less than 5 ohms**

3. Test for less than 5 ohms between the coax cable outer shield end to end.

- **If 5 ohms or greater**

Replace the coax cable

- **If less than 5 ohms**

4. Test for infinite resistance between the coax cable center terminal and the coax cable outer shield.
 - **If less than infinite resistance**

Replace the coax cable

- **If infinite resistance**
5. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Radio Antenna Base Replacement**
- **Control Module References** for radio replacement, programming, and setup.

ONSTAR MICROPHONE MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Microphone High Signal Terminal 9	B2455 02	B2455 04	B2455 04	-
Microphone Low Signal Terminal 10	B2455 02	B2455 04	B2455 04	-

Circuit/System Description

The telematics communication interface control module provides the Cellular Phone Microphone with a supplied voltage on the cellular phone microphone signal circuit. When the cellular phone microphone is in use, voice data from the user is sent back to the telematics communication interface control module on the signal circuit.

Reference Information

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC B2455 is not set.
 - **If DTC B2455 is set**

Refer to **DTC B2455, DTC B2455 (Radio)**.

- **If DTC B2455 is not set**
3. Verify that a successful OnStar voice command can be made.
 - **If your voice can not be heard clearly.**

Refer to Circuit/System Testing - Microphone Malfunction.

- **If your voice can be heard clearly**
4. All OK.

Circuit/System Testing

Microphone Malfunction

1. Ignition OFF, disconnect the harness connector at the B24 Cellular Phone Microphone, ignition ON.
2. Test for 8.0-10.5 V between the signal circuit terminal B and ground.
 - **If less than 8.0 V**
 1. Ignition OFF, disconnect the X2 harness connector at the K73 Telematics Communication Interface Control Module.
 2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground in the circuit.
- If infinite resistance
- 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the vehicle K73 Telematics Communication Interface Control Module.
 - **If greater than 10.5 V**
- 1. Ignition OFF, disconnect the X2 harness connector at the K73 Telematics Communication Interface Control Module, ignition ON.
- 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K73 Telematics Communication Interface Control Module.
 - **If between 8.0-10.5 V**
- 3. Test for less than 1 V between the signal circuit terminal A and ground.
 - **If greater than 1 V**
- 1. Ignition OFF, disconnect the X2 harness connector at the K73 Telematics Communication Interface Control Module, ignition ON.
- 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage in the circuit.
 - If less than 1 V, repair the K73 Telematics Communication Interface Control Module.
 - **If less than 1 V**
- 4. Test for greater than 8 V between the signal circuit terminal B and the signal circuit terminal A.
 - **If less than 8 V**
- 1. Ignition OFF, disconnect the X2 harness connector at the K73 Telematics Communication Interface Control Module.
- 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance
- 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the vehicle K73 Telematics Communication Interface Control Module.
 - **If greater than 9 V**
- 5. Test or replace the B24 Cellular Phone Microphone.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair procedure.

• **Mobile Telephone Microphone Replacement**

- **Control Module References** for radio or telematics communication interface control module replacement, programming, and setup.

ONSTAR AUDIO MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Audio High Signal terminal 1	1	1	1	-
Audio Low Signal terminal 2	1	1	1	-
1. No (or Noisy) OnStar® Audio				

Circuit/System Description

When an OnStar® keypress is made, a serial data message is sent to the audio system to mute all radio functions and output OnStar® originated audio. After the audio system is muted, the telematics communication interface control module transmits signals to the audio system on the audio signal and audio common circuits.

Reference Information

Schematic Reference

- **OnStar/Telematics Schematics**
- **Radio/Navigation System Schematics**

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**

- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON, radio ON.
2. Verify that audio is heard clearly through all speaker channels when tuning radio to a known good station.
 - **If audio is not heard clearly**

Refer to **Speaker Malfunction**

- **If audio is heard clearly**
- 3. Verify that the Connecting to OnStar® message is heard clearly through the audio system when the OnStar® blue button is pressed.
 - **If OnStar message is noisy or distorted**

Refer to Circuit/System Testing

- **If OnStar message is heard clearly**
- 4. All OK.

Circuit/System Testing

1. Ignition OFF and vehicle systems OFF, disconnect the X2 harness connector at the K73 Telematics Communication Interface Control Module, ignition ON.
2. Test for less than 4 V between each of the signal circuits listed below and ground:
 - Terminal 1
 - Terminal 2
 - **If 4 V or greater**
 1. Ignition OFF, disconnect the X1 harness connector at the A11 Radio, ignition ON.
 2. Test for less than 1 V between the signal circuits and ground.
 - If greater than 1 V, repair the short to voltage in the circuit.
 - If less than 1 V, replace the A11 Radio.
 - **If less than 4 V**
3. Ignition OFF.
4. Test for infinite resistance between each of the signal circuits listed below and ground:
 - Terminal 1
 - Terminal 2
 - **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

5. Disconnect the X1 harness connector at the A11 Radio.
6. Test for less than 2 ohms in each of the signal circuits listed below end to end:
 - K73 Telematics Communication Interface Control Module Terminal 1 X2
 - K73 Telematics Communication Interface Control Module Terminal 2 X2
- **If 2 ohms or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 ohms**

7. Replace the K73 Telematics Communication Interface Control Module.
8. Verify that the Connecting to OnStar® message is heard clearly through the audio system when the OnStar® blue button is pressed.
 - **If audio is not heard clearly**

Replace the A11 Radio.

- **If audio is heard clearly**

9. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair procedure.

Control Module References for radio or telematics communication interface control module replacement, programming, and setup.

NO GLOBAL POSITIONING SYSTEM (GPS) RECEPTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The navigation antenna is connected to the Telematics Communication Interface Control Module. The module supplies 5 V to the antenna to power the internal amplifier through the center conductor of the antenna coax cable.

Diagnostic Aids

- The scan tool Telematics Communication Interface Control Module GPS signal parameter will display a Yes or No dependent upon whether or not the module sees an increment of the seconds transmitted by GPS signals to the Telematics Communication Interface Control Module. Upon entering this screen, the GPS signal title will initially display Yes, regardless of the presence of time increment, for at least 2 seconds, while the algorithm in the scan tool determines the status of the clock. If increment is found, Yes is continually displayed. If the clock remains static, No is displayed. The scan tool looks for increment every second, regardless of current display.
- Inaccurate or aged GPS position concerns which are no longer present may have been due to the temporary loss of GPS signal reception by the vehicle. Conditions such as tunnels or parking structures will restrict the cellular phone and navigation antenna from a clear view of the satellites in the sky and may have caused this temporary data loss.
- The GPS requires a clear line of sight to the sky to operate properly. In most cases the GPS will not have reception near tall buildings or inside structures.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

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- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **The following verification requires the vehicle to be outside with an unobstructed view of the southern sky. Allow 5 minutes after turning the ignition ON for the vehicle to acquire the GPS satellites signal.**

1. Ignition ON.

2. Verify that no DTCs are set.

- **If any DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If no DTCs are set**

3. Verify that an OnStar advisor can locate the vehicle after performing a blue button press.

- **If the advisor can not locate the vehicle**

Refer to Circuit System Testing.

- **If the advisor can locate the vehicle**

4. All OK.

Circuit/System Testing

NOTE: **The global positioning system (GPS) requires a clear line of sight to the sky to operate properly. It may take up to 15 minutes for the Nav Radio to acquire a GPS signal. In most cases the GPS will not have reception near tall buildings or inside structures.**

1. Ignition OFF, disconnect the GPS and cellular coax cable connector at the K73 Telematics Communication Interface Control Module.

2. Using the **EL-49903** OnStar Antenna Diagnostic Tool Kit, connect the EL-49903-3 antenna to the K73 telematics communication interface module. Place the test antenna on the roof of the vehicle, ignition ON.

3. Verify that an OnStar advisor can locate the vehicle after performing a blue button press.

- **If the advisor can not locate the vehicle**

Replace the K73 Telematics Communication Interface Control Module.

- **If the advisor can locate the vehicle**

4. Test the coax cable between the K73 Telematics Communication Interface Control Module and the T4G Cellular Phone, Navigation, and Digital Radio Antenna. Refer to component testing.

- **If the coax cable does not pass the test**

Replace the coax cable.

- **If the coax cable passes the test**

5. Test or replace the T4G Cellular Phone, Navigation, and Digital Radio Antenna.

Component Testing

CAUTION: Refer to **Test Probe Caution** .

NOTE:

- Before testing the coax cable, check the cable exterior for being pinched, cut, damaged, or having loose connections at the components, which can cause reception issues.
- To prevent false reading when testing the center coax terminals, use care not to ground the test probe on the outer housing/shield.
- The vehicle may be equipped with sectioned coax. Test each section and replace only the faulty section, not the entire length of coax.

Coax Cable Test

1. Ignition OFF, disconnect the coax cable at both components.
2. Test for less than 5 ohms between the coax cable center terminal end to end.
 - **If 5 ohms or greater**

Replace the coax cable.

- **If less than 5 ohms**

3. Test for greater than 5 ohms between the coax cable outer shield end to end.
 - **If 5 ohms or greater**

Replace the coax cable.

- **If less than 5 ohms**

4. Test for infinite resistance between the coax cable center terminal and the coax cable outer shield.
 - **If less than infinite resistance**

Replace the coax cable.

- **If infinite resistance**

5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Radio Antenna Base Replacement**
- **Control Module References** for Radio replacement, setup, and programming

ONSTAR BUTTON LED MALFUNCTION**Diagnostic Instructions**

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
10 V Reference	3	B2476 04	B2476 04	-
Control Terminal G	1	1	2	-
Control Terminal F	1	1	2	-
Ground	-	B2476 04	-	-
1. OnStar® LED Inoperative 2. LED Illuminated At All Times 3. OnStar® Buttons Inoperative				

Circuit Description

The OnStar® status LEDs are located with the OnStar buttons. The green LED is illuminated when the system is ON and operating normally. When the green LED is green and flashing, it is an indication that a call is in progress. When the red LED is illuminated, a system malfunction is present. In the event there is a system malfunction and the OnStar® system is still able to make a call, the LED will flash red during the call. The OnStar® LEDs are controlled by the telematics communication interface control module via the keypad green LED signal circuit and the keypad red LED signal circuit.

Reference Information

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OnStar/Telematics Schematics

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: If the green LED is off with the ignition ON and the LED does not function when commanded with the scan tool, contact the OnStar Center to confirm the vehicle has a current subscription.

1. Ignition ON.
2. Verify that the green LED turns ON and OFF when commanding the K73 telematics communication interface control module green indicator ON and OFF with a scan tool.
 - **If the green LED does not turn ON and OFF**

Refer to Circuit/System Testing - Green LED Test

- **If the green LED turns ON and OFF**
- 3. Verify that the red LED turns ON and OFF when commanding the K73 telematics communication interface control module red indicator ON and OFF with a scan tool.
 - **If the red LED does not turn ON and OFF**

Refer to Circuit/System Testing - Red LED Test

- **If the red LED turns ON and OFF**
- 4. All OK.

Circuit/System Testing

NOTE:

- **10 V reference circuit measurement may vary with vehicle battery voltage.**
- **Test for voltage range with vehicle battery measuring at a minimum of 11.5 V**

Green LED Test

1. Ignition OFF, and all vehicle systems OFF, disconnect the harness connector at the A10 Inside Rearview Mirror. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal E and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.

- **If less than 10 ohms**
- 3. Ignition ON.
- 4. Test for less than 1 V between the control circuit terminal F and ground while commanding the Green Indicator OFF with a scan tool.
 - **If 1 V or greater**
 1. Ignition OFF, disconnect the X1 harness connector at the K73 Telematics Communication Interface Control Module, Ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K73 Telematics Communication Interface Control Module.
 - **If less than 1 V**
- 5. Test for greater than 8 V between the control circuit terminal F and ground while commanding the Green Indicator ON with a scan tool.
 - **If 8 V or less**
 1. Ignition OFF, disconnect the X1 harness connector at the K73 Telematics Communication Interface Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K73 Telematics Communication Interface Control Module.
 - **If greater than 8 V**
- 6. Test or replace the A10 Inside Rearview Mirror.

Red LED Test

1. Ignition OFF, and all vehicle systems OFF, disconnect the harness connector at the A10 Inside Rearview Mirror. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal E and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Ignition ON.
4. Test for less than 1 V between the control circuit terminal G and ground while commanding the Red Indicator OFF with a scan tool.
 - **If 1 V or greater**

1. Ignition OFF, disconnect the X1 harness connector at the K73 Telematics Communication Interface Control Module, Ignition ON.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K73 Telematics Communication Interface Control Module.
- **If less than 1 V**
5. Test for greater than 8 V between the control circuit terminal G and ground while commanding the Red Indicator ON with a scan tool.
 - **If 8 V or less**
 - 1. Ignition OFF, disconnect the X1 harness connector at the K73 Telematics Communication Interface Control Module.
 - 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 - 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K73 Telematics Communication Interface Control Module.
 - **If greater than 8 V**
6. Test or replace the A10 Inside Rearview Mirror.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Inside Rearview Mirror Replacement**
- **Control Module References** for telematics communication interface control module replacement, programming and setup.

ONSTAR CALL CENTER REMOTE FUNCTION REQUESTS MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The telematics communication interface control module has the capability of commanding the horn, initiating door lock/unlock, or operating the exterior lamps using the serial data circuits. These functions are commanded by the OnStar® Call Center per a customer request.

Diagnostic Aids

The customer concern may have been due to a lack of cellular service in a given area, or a failure in the National Cellular Network infrastructure that has since been corrected.

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OnStar/Telematics Schematics

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- It is necessary to inform the OnStar® Call Center advisor that this call is for vehicle diagnostic purposes.
- It is necessary to have the vehicle in an open outside area where a cellular call can be successfully placed and GPS data can be received from satellites.

1. Ignition ON.
2. Verify that the horn, lights, and the door locks on the vehicle operate properly.
 - **If an applicable vehicle system does not operate properly**

Refer to **Diagnostic System Check - Vehicle** .

- **If all applicable vehicle systems operate properly**
3. Verify that a call can be successfully placed to the OnStar Call Center by pressing the blue OnStar button.
 - **If unable to contact the OnStar® call center**

Refer to **Unable to Contact OnStar Call Center**

- **If able to contact the OnStar Call Center**

4. Verify with the OnStar advisor that all remote functions (door locks, lights, and horn) work.

- **If the remote functions do not operate when requested**

Replace the K73 Telematics Communication Interface Control Module

- **If the remote functions operate when requested**

5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for telematics communication interface control module replacement, programming and setup.

ONSTAR BUTTON MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
10 V Reference	1	B2476 04	B2476 04	-
Signal Terminal B	B2476 04	B2476 04	B2476 59	B2476 59, B2482 00
Ground	-	B2476 04	-	-
1. OnStar® LED Inoperative				

Circuit/System Description

The OnStar® button assembly consists of 3 buttons: Call/Answer, OnStar® Call Center, and OnStar® Emergency. The telematics communication interface control module supplies the OnStar® button assembly with 10 V via the keypad supply voltage circuit. Each of the buttons, when pressed, completes the circuit across a resistor allowing a specific voltage to be returned to the telematics communication interface control module over the keypad signal circuit. Depending upon the voltage range returned, the telematics communication interface control module is able to identify which button has been activated.

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **Contact the OnStar® Call Center first before pressing the emergency button in order to notify them of the test.**

1. Ignition ON.
2. Verify that each button of the S51 telematics button assembly operates normally by pressing each button individually.
 - **If none of the buttons operate normally**

Refer to Circuit/System Testing.
 - **If some, but not all, of the buttons operate normally**

Test or replace the A10 Inside Rearview Mirror.
 - **If all of the buttons operate normally**
3. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the A10 Inside Rearview Mirror. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 15 ohms between the ground circuit terminal E and ground.
 - **If 15 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 15 ohms**
3. Ignition ON.
4. Test for 9.5-10.5 V between the 10 V reference circuit terminal A and ground.
 - **If less than 9.5 V**
 1. Ignition OFF, disconnect the harness connector at the K73 Telematics Communication Interface Control Module.
 2. Test for infinite resistance between the 10 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the 10 V reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K73 Telematics Communication Interface Control Module.
 - **If greater than 10.5 V**
 1. Ignition OFF, disconnect the harness connector at the K73 Telematics Communication Interface Control Module, ignition ON.
 2. Test for less than 1 V between the 10 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K73 Telematics Communication Interface Control Module.
 - **If between 9.5-10.5 V**
5. Ignition OFF.
6. Test for 500-900 ohms between the signal circuit terminal B and ground.
 - **If less than 500 ohms**
 1. Disconnect the X1 harness connector at the K73 Telematics Communication Interface Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K73 Telematics Communication Interface Control Module.
 - **If greater than 900 ohms**
 1. Disconnect the X1 harness connector at the K73 Telematics Communication Interface Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.

- If less than 1 V
- 3. Ignition OFF.
- 4. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K73 Telematics Communication Interface Control Module.
- **If between 500-900 ohms**
- 7. Test or replace the A10 Inside Rearview Mirror.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Inside Rearview Mirror Replacement**
- **Control Module References** for telematics communication interface control module replacement, programming and setup.

ONSTAR STEERING WHEEL CONTROL FUNCTIONS MALFUNCTION

Some vehicles equipped with the OnStar® system have the capability of accessing voice mailboxes and other automated phone systems by means of the steering wheel controls, while the OnStar® Personal Calling feature is in use. If the "Talk" or "Mute" button (depending upon the vehicle) on the steering wheel controls is depressed during an OnStar® Personal Calling call, the telematics communication interface control module receives the message on the serial data bus from either the radio or body control module. This message is interpreted as a request to turn any spoken numbers into dual tone multi-frequency tones to be delivered over the airwaves to the phone system the user is communicating with. Complete instructions for operation of these features can be found in the information provided to the customer with the OnStar® system.

The steering wheel controls are a resistor network that consist of multiple momentary contact switches and a series of resistors. The switches and resistor network are arranged so that each switch has a different resistance value. When a switch is pressed, a voltage drop occurs in the resistor network, which produces a specific voltage value unique to the switch selected, to be interpreted by either the radio or BCM. In the event the OnStar® steering wheel control functions are inoperative, technicians should refer to **Steering Wheel Controls Malfunction** , to begin diagnosis of the steering wheel control concern.

RADIO POOR RECEPTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B125A 02

Antenna Signal Circuit Short to Ground

DTC B125A 04

Antenna Signal Circuit Open Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Radio Antenna Coax	B125A 02	B125A 04	1	-
Ground	-	1	-	-
1. May exhibit possible AM/FM interference.				

Circuit/System Description

The multi-band antenna is located on the roof of the vehicle. The radio antenna is enabled when the radio is turned on. The radio provides battery voltage to the antenna using the center conductor of the antenna coaxial cable. When a 12 V signal is seen on the center conductor of the antenna coax, both AM and FM signals are amplified.

Conditions for Running the DTC

- Ignition ON.
- Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

B125A 02

The radio detects a short to ground in the antenna signal circuit center conductor.

B125A 04

The radio detects an open in the antenna signal circuit center conductor.

Action Taken When the DTC Sets

Radio reception may be poor or not available.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear after 50 consecutive malfunction-free ignition cycles have occurred.

Reference Information

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Radio/Navigation System Schematics

Connector End View Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON, A11 Radio ON.
2. Verify station reception is normal when tuned to several known good AM and FM stations.
 - **If AM or FM reception is poor.**

Refer to Circuit/System Testing
 - **If reception is normal**
3. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the radio antenna coax cable from the A11 Radio and from the T4M Radio Antenna.
2. Verify the antenna coax cable passes the coax cable component test. Refer to Component Testing.
 - **If the coax cable does not pass the test**

Replace the antenna coax cable
 - **If the coax cable passes the test**
3. Connect the radio antenna coax cable to the A11 Radio.

4. Ignition ON, A11 Radio ON.
5. Verify a test lamp illuminates between the antenna coax cable center terminal at the T4M Radio Antenna and chassis ground.
 - **If the test lamp does not illuminate**

Replace the A11 Radio.
 - **If the test lamp illuminates**
6. Test or replace the T4M Radio Antenna.

Component Testing

CAUTION: Refer to Test Probe Caution .

NOTE: Before testing the coax cable, check the cable exterior for being pinched, cut, damaged, or having loose connections at the components, which can cause reception issues.

To prevent false reading when testing the center coax terminals, use care not to ground the test probe on the outer housing/shield.

Coax Cable Test

1. Ignition OFF, disconnect the coax cable at both components.
2. Test for less than 5 ohms between coax cable center terminal end to end.
 - **If 5 ohms or greater**

Replace the coax cable
 - **If less than 5 ohms**
3. Test for less than 5 ohms between the coax cable outer shield end to end.
 - **If 5 ohms or greater**

Replace the coax cable
 - **If less than 5 ohms**
4. Test for infinite resistance between the coax cable center terminal and the coax cable outer shield.
 - **If less than infinite resistance**

Replace the coax cable
 - **If infinite resistance**

5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Radio Antenna Base Replacement**
- **Control Module References** for radio replacement, programming, and setup.

SPEAKER REPLACEMENT REFERENCE

Speaker Replacement Reference

Component	Repair Instruction
Front Door Speaker	Refer to <u>Radio Front Speaker Replacement</u>
Rear Door Speaker	Refer to <u>Radio Rear Quarter Trim Panel Speaker Replacement</u>

SPEAKER MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Left Front Speaker Output Signal	B1025 02, 1	B1025 04, 1	B1025 01, 1, 2	-
Right Front Speaker Output Signal	B1035 02, 1	B1035 04, 1	B1035 01, 1, 2	-
Left Rear Speaker Output Signal	B1045 02, 1	B1045 04, 1	B1045 01, 1, 2	-
Right Rear Speaker Output Signal	B1055 02, 1	B1055 04, 1	B1055 01, 1, 2	-
1. No or reduced audio from speaker(s) on the affected audio circuit. 2. Noticeable audio distortion may be present.				

Circuit/System Description

Each of the audio output channel circuits (+) and (-), at the radio have a DC bias voltage that is approximately one half of battery voltage. When using a DMM, each of the audio output channel circuits will measure approximately 6.5 V DC. The audio being played on the system is produced by a varying AC voltage that is centered around the DC bias voltage on the same circuit. The AC voltage is what causes the speaker cone to

move and produce sound. The frequency (Hz) of the AC voltage signal is directly related to the frequency of the input (audio source playing) to the audio system. Both the DC bias voltage and the AC voltage signals are needed for the audio system to properly produce sound.

Diagnostic Aids

- Improper speaker mounting or loose trim may cause an audible buzz or distortion. Inspect the appropriate speaker and the surrounding interior trim for proper and secure mounting.
- The EL-50334-6 Audio System Diagnostic CD contains audio tracks that can be used to duplicate and isolate such concerns. Tracks 11 and 12 contain audio sweep tones for testing for speaker and grill rattles.
- The test tones on the CD may be copied to a USB drive or other device to use during testing.
- If the speaker or surrounding interior trim is found to be loose or improperly secured, correctly secure the item.

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Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-50334-50 USB Cable and Adapter Kit

Circuit/System Verification

1. Ignition ON, A11 Radio ON, mute OFF.

2. Verify clear audio is heard from each speaker, adjusting fade and balance controls to test each speaker individually.

- **If audio is inoperative from one or more speakers, or the audio emitted is not clear**

Refer to Circuit/System Testing.

- **If clear audio is heard from all speakers**

3. All OK.

Circuit/System Testing

NOTE: Some circuits supply audio signals to more than one speaker. It may be necessary to disconnect all speakers on the affected audio circuit when performing circuit tests.

1. Ignition OFF, disconnect the harness connector at the appropriate P19 Speaker. Ignition ON, radio ON, mute OFF.
2. Test for 5-7 V between each audio signal circuit terminal 1 and terminal 2 and ground.

- **If less than 5 V**

1. Ignition OFF, disconnect the X1 harness connector at the A11 Radio.
2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the A11 Radio.

- **If greater than 7 V**

1. Ignition OFF, disconnect the X1 harness connector at the A11 Radio. Ignition ON.
2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the A11 Radio.

- **If between 5-7 V**

NOTE: In the following tests, audio signal frequencies (Hz) will be tested. To prevent misdiagnosis, the door chime must be OFF during testing. Ensure the driver door latch is closed during testing.

3. Insert the EL-50334-6 Audio Test CD from the **EL-50334-50** USB cable and adapter kit. Play track number three (50 Hz bass test tone) from the test CD.
4. Test for 49-51 Hz between each signal circuit terminal 1 and terminal 2 and ground.
 - **If not between 49-51 Hz**

Replace the A11 Radio.

- **If between 49-51 Hz**

5. Test or replace the P19 Speaker.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Speaker Replacement Reference**
- **Control Module References** for radio replacement, programming, and setup.

UNABLE TO CONTACT ONSTAR CALL CENTER

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The telematics communication interface control module is a cellular device that allows the user to communicate data and voice signals over the national cellular network. When an OnStar keypress is made, the telematics communication interface control module activates and connects the system to the cellular carriers communication system by interacting with the national cellular infrastructure. The module sends and receives all cellular communications over the cellular phone and navigation antenna and cellular antenna coax.

Diagnostic Aids

- The customer concern may have been due to a lack of cellular service in a given area. A failure in the National Cellular Network infrastructure at the time of the customers failed connection that has since been repaired may also have been the cause.
- If an OnStar® emergency call is able to successfully connect the vehicle to the OnStar® Call Center when an OnStar® Call Center button press is not, there may be a failure in the ability of the OnStar® system in the vehicle to be recognized by the local cellular carrier.
- If the prompt "OnStar® request ended" is heard, without pressing the white dot button at the end of the OnStar® keypress, the OnStar® system at one time has made a successful cellular connection, but was unable to complete the call.
- It is important to have the vehicle in an open outside area where a cellular call can be successfully placed and GPS data can be received from satellites.

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-49903 GM OnStar Antenna Diagnostic Tool Kit

Circuit/System Verification

NOTE: **The following verification requires the vehicle to be outside with an unobstructed view of the southern sky. Allow 5 min after turning the ignition ON for the GPS satellites to acquire vehicle signal.**

1. Ignition ON.
2. Verify that DTC B2470 is not set.
 - **If DTC B2470 is set**

Refer to **DTC B2470**
 - **If DTC B2470 is not set**
3. Verify that a call can be successfully placed to the OnStar Call Center by pressing the blue OnStar button.
 - **If unable to connect with the OnStar Call Center.**

Refer to Circuit/System Testing

- **If able to connect with the OnStar Call Center**
4. All OK.

Circuit/System Testing

NOTE:

- The vehicle may be equipped with sectioned coax. Test each section and replace only the faulty section, not the entire length of coax.
- The following verification requires the vehicle to be outside with an unobstructed view of the southern sky. Allow 5 min after turning the ignition ON for the GPS satellites to acquire vehicle signal.

1. Ignition OFF and all vehicle systems OFF, disconnect the GPS and cellular coax cable connector at the K73 Telematics Communication Interface Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Using the EL-49903-3 kit (EL-49903-5 adapter and EL-49903-4 coax cable), connect the **EL-49903** GM OnStar antenna diagnostic tool kit to the K73 Telematics Communication Interface Control Module.
3. Ignition ON, wait 5 min.
4. Verify that a call can be successfully placed to the OnStar Call Center by pressing the blue OnStar button.
 - **If unable to connect with the OnStar Call Center**

Test or replace the K73 Telematics Communication Interface Control Module.

- **If able to connect with the OnStar Call Center**

5. Ignition OFF, disconnect the **EL-49903** GM OnStar antenna diagnostic tool kit from the K73 Telematics Communication Interface Control Module
6. Test the coax cable between the K73 Telematics Communication Interface Control Module and the T4G Cellular Phone, Navigation, and Digital Radio Antenna. Refer to Component Testing.
 - **If the coax cable does not pass the test**

Replace the coax cable.

- **If the coax cable passes the test**

7. Test or replace the T4G Cellular Phone, Navigation, and Digital Radio Antenna.

Component Testing

CAUTION: Refer to Test Probe Caution .

NOTE:

Before testing the coax cable, check the cable exterior for being pinched, cut, damaged, or having loose connections at the components, which can cause reception issues.

To prevent false reading when testing the center coax terminals, use care not to ground the test probe on the outer housing/shield.

Coax Cable Test

1. Ignition OFF, disconnect the coax cable at both components.
2. Test for less than 5 ohms between the coax cable center terminal end to end.
 - **If 5 ohms or greater**

Replace the coax cable.
 - **If less than 5 ohms**
3. Test for greater than 5 ohms between the coax cable outer shield end to end.
 - **If 5 ohms or greater**

Replace the coax cable.
 - **If less than 5 ohms**
4. Test for infinite resistance between the coax cable center terminal and the coax cable outer shield.
 - **If less than infinite resistance**

Replace the coax cable.
 - **If infinite resistance**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Radio Antenna Base Replacement**
- **Control Module References** for telematics communication interface control module replacement, programming, and setup.

ONSTAR VOICE RECOGNITION MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The telematics communication interface control module is capable of interpreting voice commands received over the cellular microphone circuit. Speech recognition allows the user to speak to one computer in the vehicle, and one reached over the cellular communication network. The module attempts to understand the users command, and responds by speaking back, or by taking the appropriate action, e.g. dialing the phone.

Reference Information

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

OnStar Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Circuit/System Verification

NOTE:

- **It is necessary to have the vehicle in an open outside area where a cellular call can be successfully placed and GPS data can be received from satellites.**
- **The vehicle should be located in a quiet area.**

1. Ignition ON, press the blue OnStar Call button.
2. Verify that your voice is heard clearly by the OnStar Call center.
 - **If your voice can not be heard clearly**

Refer to **OnStar Microphone Malfunction**

- **If your voice can be heard clearly**
3. Verify that the system responds appropriately to all voice commands by pressing the voice command button and attempting to operate the system using multiple voice commands.
 - **If the OnStar system does not respond to any voice commands**

Replace the K73 Telematics Communication Interface Control Module

- **If the OnStar system responds to some, but not all voice commands**

Refer to **OnStar Description and Operation** for tips on proper pronunciation

- **If the OnStar system responds to all voice commands**

4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair procedure.

Control Module References for telematics communication interface control module replacement, programming, and setup.

REPAIR INSTRUCTIONS

MOBILE TELEPHONE MICROPHONE REPLACEMENT

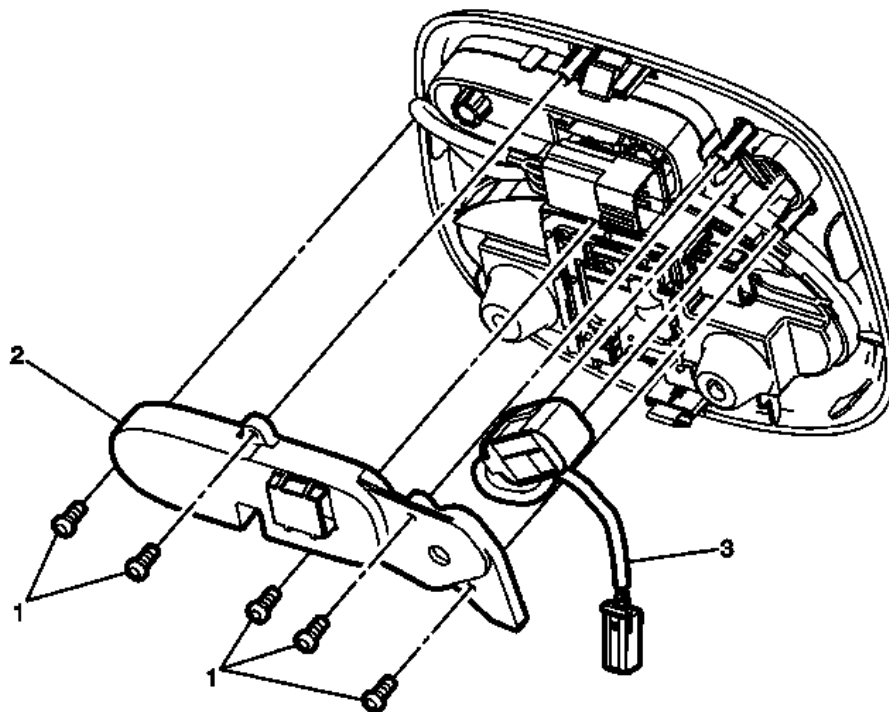


Fig. 5: Mobile Telephone Microphone
Courtesy of GENERAL MOTORS COMPANY

Mobile Telephone Microphone Replacement

Callout	Component Name
Preliminary Procedure Remove the center courtesy lamp. Refer to <u>Center Courtesy Lamp Replacement</u> .	
1	Dome Lamp Housing Fastener (Qty: 5) CAUTION: Refer to <u>Fastener Caution</u> .

2	Dome Lamp Housing
3	Mobile Telephone Microphone

COMMUNICATION INTERFACE MODULE REPLACEMENT

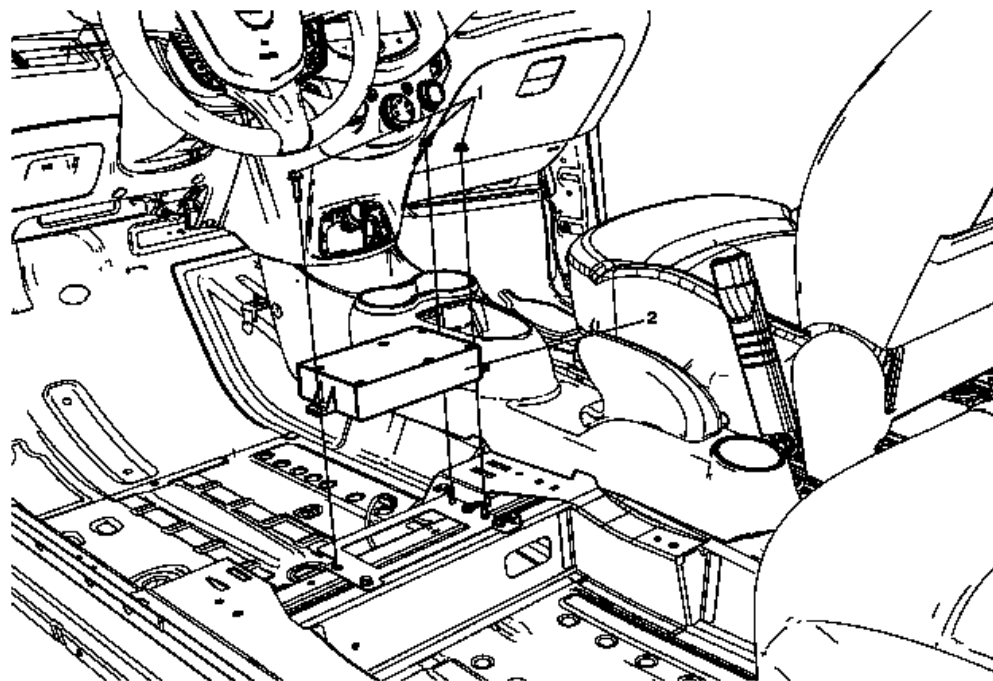


Fig. 6: Communication Interface Module
Courtesy of GENERAL MOTORS COMPANY

Communication Interface Module Replacement

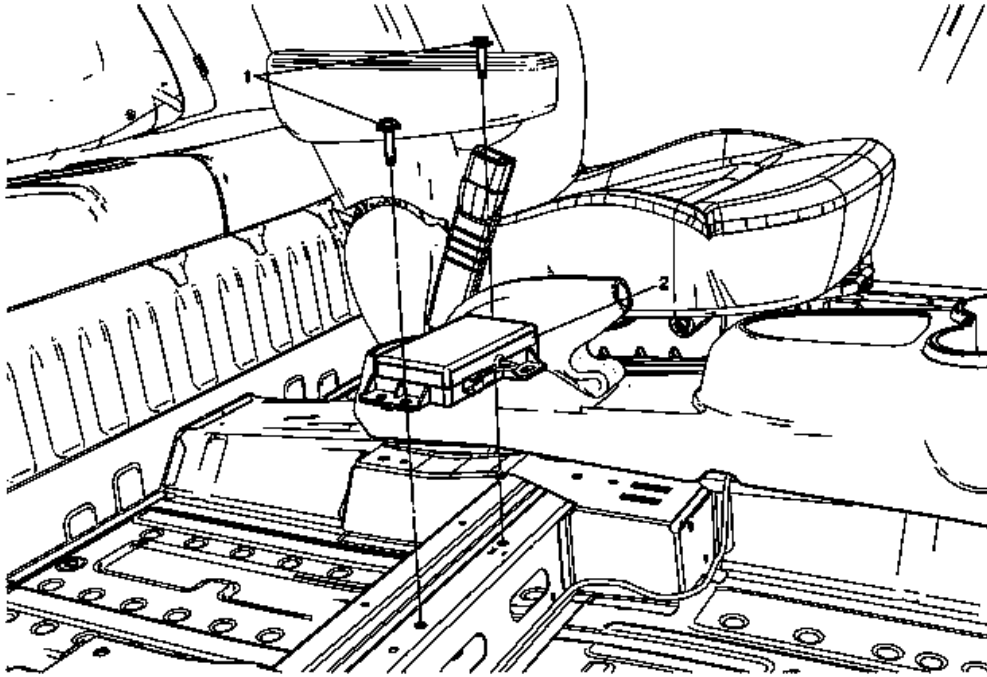
Callout	Component Name
WARNING: Refer to <u>Battery Disconnect Warning</u> .	
Preliminary Procedures	
1. Disconnect the battery negative cable. 2. Remove driver front seat. Refer to <u>Driver or Passenger Seat Removal and Installation</u> .	
1	Communication Interface Module Fastener (Qty: 3) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 10 (89 lb in)

2

Communication Interface Module

Procedure

Disconnect the electrical connector.

COMMUNICATION INTERFACE MODULE BATTERY REPLACEMENT**Fig. 7: Communication Interface Module Battery**

Courtesy of GENERAL MOTORS COMPANY

Communication Interface Module Battery Replacement

Callout	Component Name
WARNING: Refer to <u>Battery Disconnect Warning</u> .	
Preliminary Procedures	
1. Disconnect the battery negative cable. 2. Remove passenger front seat. Refer to <u>Driver or Passenger Seat Removal and Installation</u> .	
1	Communication Interface Module Battery Bolt (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 9 (80 lb in)

Procedure

Disconnect the electrical connector.

COMPACT DISC CARE AND CLEANING**Care of CDs**

Handle CDs carefully. Store them in their original cases or other protective cases and away from direct sunlight and dust. The CD player scans the bottom surface of the disc. If the surface of a CD is damaged, such as cracked, broken, scratched, or wrinkled labeling, the CD will not play properly or not at all. If the surface of a CD is soiled, take a soft, lint free cloth or dampen a clean, soft cloth in a mild, neutral detergent solution mixed with water, and clean it. Make sure the wiping process starts from the center to the edge. Do not touch the bottom side of a CD while handling it. This could damage the surface. Pick up CDs by grasping the outer edges or the edge of the hole and the outer edge.

Care of CD Player

The use of CD lens cleaners for CD players is not advised, due to the risk of contaminating the internal lens of the CD optics with lubricants.

Stuck CDs

Interrupting the battery power by pulling the fuse will sometimes release a stuck CD. If a CD is stuck, and removed, inspect it for warps, cracks, etc. If the CD is damaged, do not replace the radio.

Labelling CDs

Paper labels can eventually warp and wrinkle, and this will cause the disc to jam inside the CD player. Try labeling the top of the discs with a soft magic marker instead.

RADIO REPLACEMENT

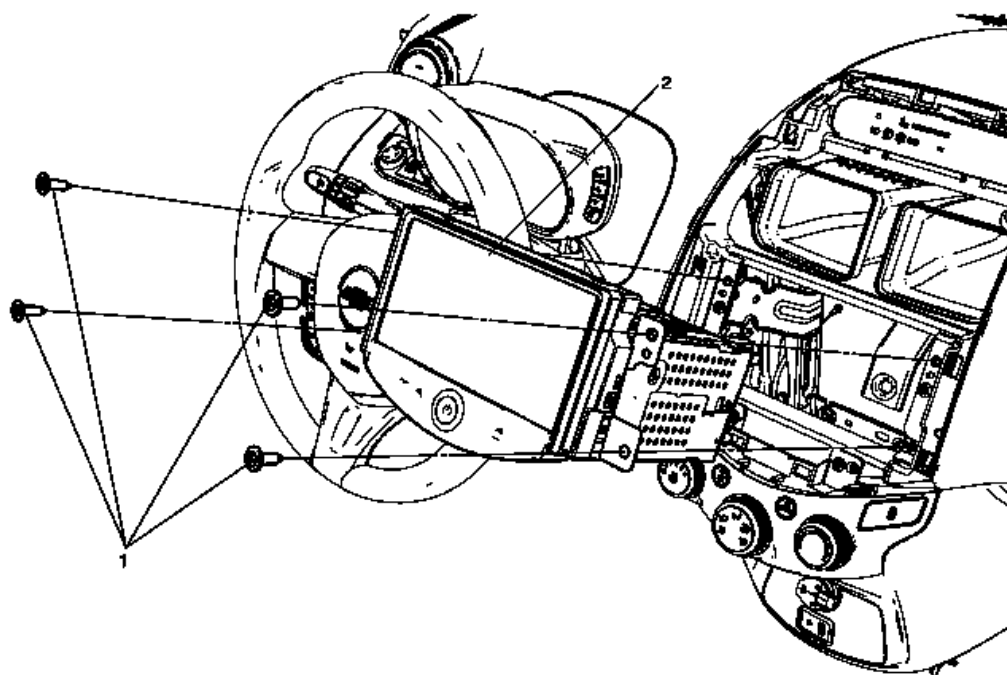


Fig. 8: Radio Assembly
Courtesy of GENERAL MOTORS COMPANY

Radio Replacement

Callout	Component Name
WARNING: Refer to <u>Battery Disconnect Warning</u> .	
Preliminary Procedures	
1. Disconnect the battery negative cable. 2. Remove I/P center molding. Refer to <u>Instrument Panel Center Molding Replacement</u> .	
1	Radio Screw (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 3 (27 lb in)
2	Radio Assembly Procedure 1. Disconnect electrical components.

2. After replacement, refer to **Control Module References** for programming and setup information.

RADIO ANTENNA BASE REPLACEMENT

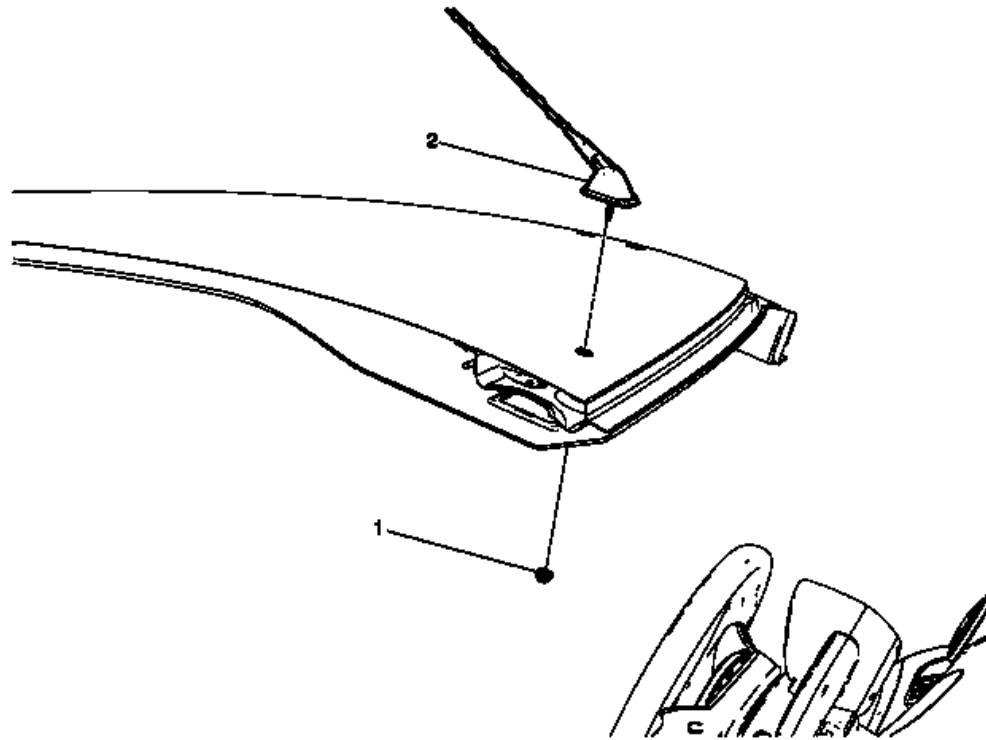


Fig. 9: Radio Antenna Base
Courtesy of GENERAL MOTORS COMPANY

Radio Antenna Base Replacement

Callout	Component Name
Preliminary Procedures Remove the dome lamp. Refer to .	
1	Radio Antenna Base Nut CAUTION: Refer to <u>Fastener Caution</u> . Tighten 3 N.m (27 lb in)
2	Radio Antenna Base Procedure

1. Disconnect electrical connector.
2. Remove the antenna base from the roof panel.

RADIO FRONT SPEAKER REPLACEMENT

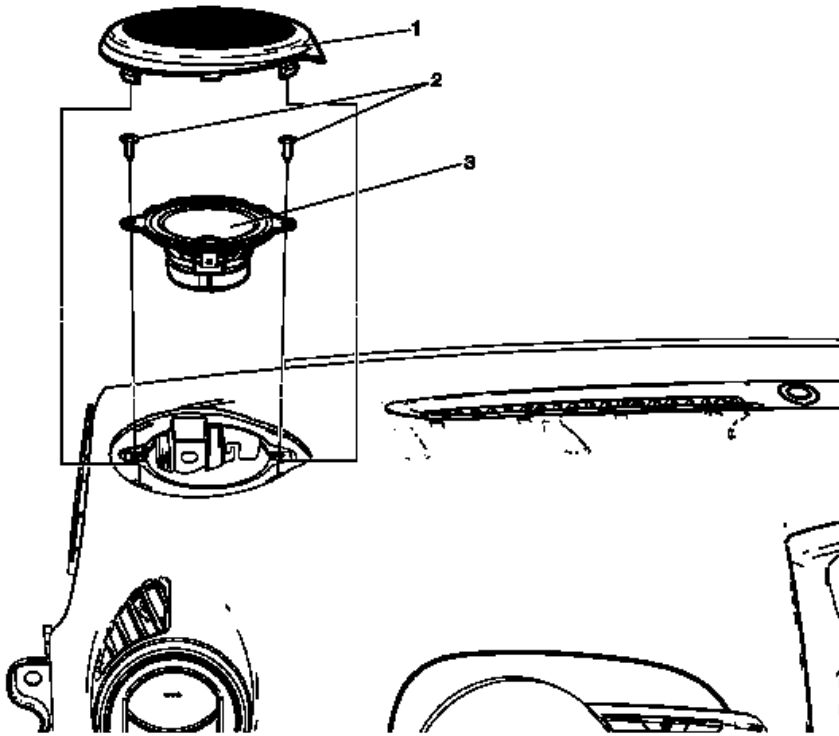


Fig. 10: Radio Front Speaker

Courtesy of GENERAL MOTORS COMPANY

Radio Front Speaker Replacement

Callout	Component Name
1	Radio Front Speaker Cover
2	Radio Front Speaker Screw (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 3 N.m (27 lb in)
3	Radio Front Speaker

USB RECEPTACLE REPLACEMENT

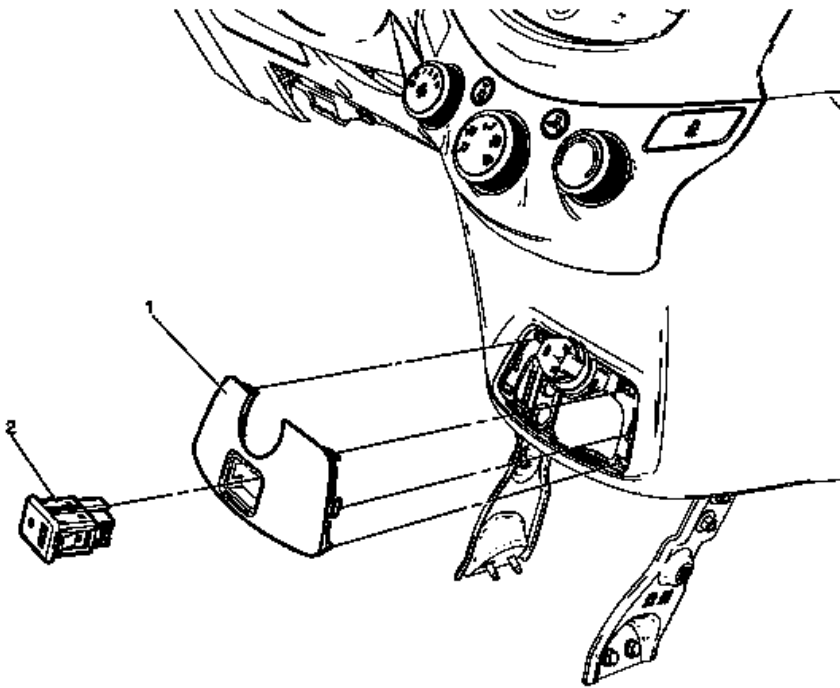


Fig. 11: USB Receptacle
 Courtesy of GENERAL MOTORS COMPANY

USB Receptacle Replacement

Callout	Component Name
1	USB Receptacle and Cover Procedure Remove the USB receptacle cover from the instrument panel by pushing out the taps behind the cover.
2	USB Receptacle Procedure Remove the USB receptacle from the cover.

RADIO REAR QUARTER TRIM PANEL SPEAKER REPLACEMENT

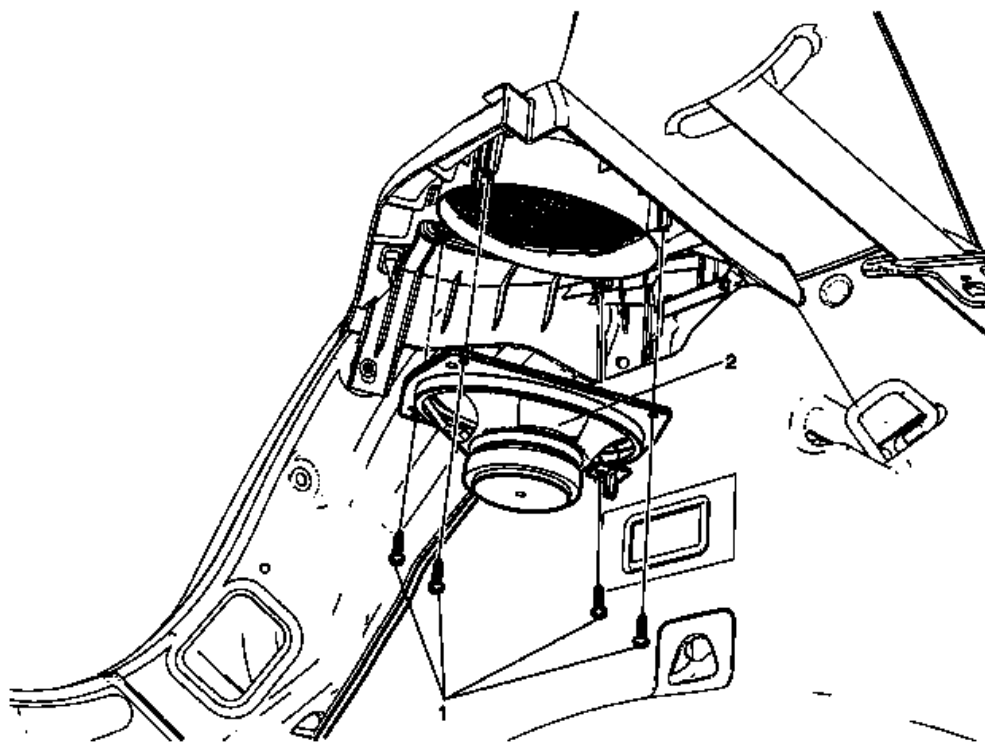


Fig. 12: Radio Rear Quarter Trim Panel Speaker
 Courtesy of GENERAL MOTORS COMPANY

Radio Rear Quarter Trim Panel Speaker Replacement

Callout	Component Name
1	Radio Rear Speaker Screw (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 3 N.m (27 lb in)
2	Radio Rear Quarter Trim Panel Speaker

DESCRIPTION AND OPERATION

ONSTAR DESCRIPTION AND OPERATION

This OnStar® system consists of the following components:

- Telematics communication interface control module
- OnStar® three button assembly
- Microphone

- Cellular antenna
- Navigation antenna
- Bluetooth® antenna (If equipped)
- Back up battery (If equipped)

This system also interfaces with the factory installed vehicle audio system.

Onstar Block Diagram

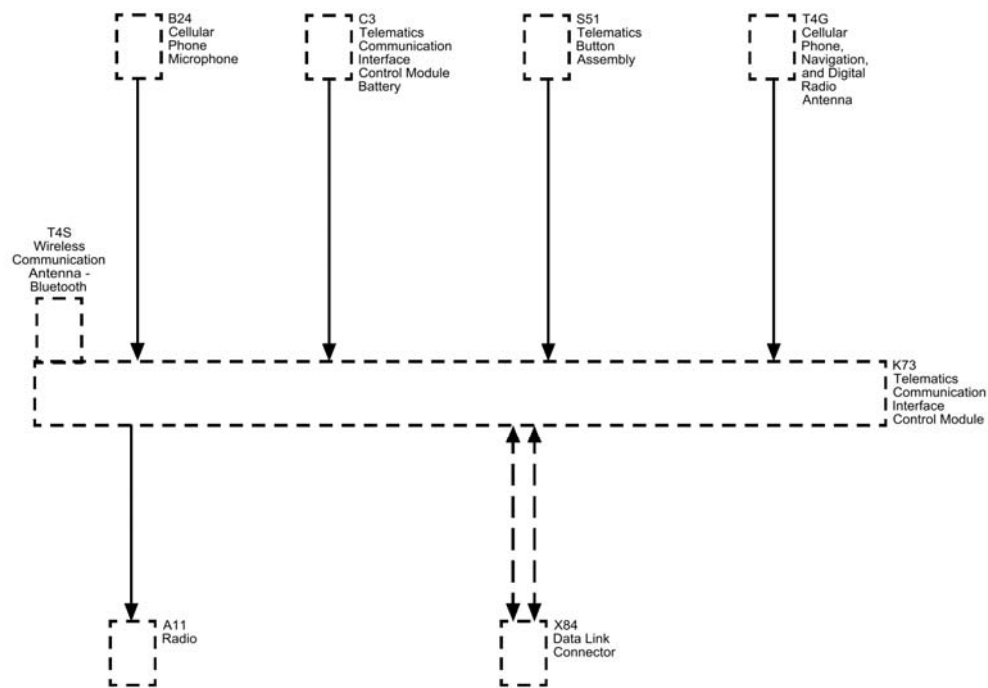


Fig. 13: Identifying Onstar Block Diagram
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
HW	Hard-Wired
HW	Hard-Wired
HW	Hard-Wired

HW	Hard-Wired
HW	Hard-Wired
DB	Serial Data - GMLAN Low Speed
DD	Serial Data - GMLAN High Speed
B24	B24 Cellular Phone Microphone
C3	C3 Telematics Communication Interface Control Module Battery
S51	S51 Telematics Button Assembly
T4G	T4G Cellular Phone, Navigation, and Digital Radio Antenna
T4S	T4S Wireless Communication Antenna - Bluetooth
K73	K73 Telematics Communication Interface Control Module
A11	A11 Radio
X84	X84 Data Link Connector

Telematics Communication Interface Control Module

The telematics communication interface control module is a cellular device that allows the user to communicate data and voice signals over the national cellular network. Power is provided by a dedicated, fused B+ circuit. Ground is provided through the vehicle wiring harness attached to the module. The ignition state is determined by the telematics communication interface control module through serial data messaging.

Dedicated circuits are used to connect the telematics communication interface control module to a microphone, the button assembly, and to command the status LED. The telematics communication interface control module communicates with the rest of the vehicle over the serial data bus.

The module houses 2 technology systems, one to process GPS data, and another for cellular information. The cellular system connects the OnStar® system to the cellular carrier's communication system by interacting with the national cellular infrastructure. The module sends and receives all cellular communications over the cellular antenna and cellular antenna coax. GPS satellites orbiting earth are constantly transmitting signals of their current location. The OnStar® system uses the GPS signals to provide location on demand.

The module also has the capability of activating the horn, initiating door lock/unlock, or activating the exterior lamps using the serial data circuits. These functions can be commanded by the OnStar® Call Center per a customer request.

OnStar® Three Button Assembly

Base Mirror

- The OnStar® button assembly may be part of the rearview mirror, or a separate, stand alone unit. The button assembly is comprised of 3 buttons and a status LED. The buttons are defined as follows:
 - The answer/end call button, which is black with a white phone icon, allows the user to answer and end calls or initiate speech recognition.
 - The blue OnStar® call center button, which displays the OnStar® logo, allows the user to connect to the OnStar® call center.
 - The emergency button, which displays a white cross with a red background, sends a high priority

emergency call to the OnStar® call center when pressed.

The telematics communication interface control module supplies 10 volts to the OnStar® button assembly on the keypad supply voltage circuit. When pressed, each button completes a circuit across a resistor allowing a specific voltage to be returned to the telematics communication interface control module on the keypad signal circuit. Depending upon the voltage range returned the telematics communication interface control module is able to identify which button has been pressed.

The OnStar® status LED is located with the button assembly. The LED is green when the system is ON and operating normally. When the status LED is green and flashing, it is an indication that a call is in progress. When the LED is red, this indicates a system malfunction is present. In the event there is a system malfunction and the OnStar® system is still able to make a call, the LED will flash red during the call.

If the mirror has the rear vision camera display in the mirror, the LED's are then interior to the mirror and controlled via data communication on the Low Speed GMLAN bus from the Telematics Communication Interface Control Module to the mirror.

If the LED does not illuminate, this may indicate that the customers OnStar® subscription is not active or has expired. Push the blue OnStar button to connect to an advisor who can then verify the account status.

Each LED is controlled by the telematics communication interface control module over dedicated LED signal circuits. Ground for the LED is provided by the wiring harness attached to the button assembly.

Prismatic Mirror (If Equipped)

- The OnStar® button assembly is apart of the rearview mirror. The button assembly is comprised of 3 capacitive touch buttons and a status LED. The buttons are defined as follows:
 - The answer/end call button, which is a white driver figure seated with voice signals near it's face, allows the user to answer and end calls or initiate speech recognition.
 - The blue OnStar® call center button, which displays the blue OnStar® logo, allows the user to connect to the OnStar® call center.
 - The emergency button, which displays red letters "SOS" as an illuminated Indicator, sends a high priority emergency call to the OnStar® call center when pressed.

The telematics communication interface control module supplies 10 volts to the OnStar® button assembly on the keypad supply voltage circuit. When pressed, each button press is processed and completes a circuit across an internal resistor allowing a specific voltage to be returned to the telematics communication interface control module on the keypad signal circuit. Depending upon the voltage range returned the telematics communication interface control module is able to identify which button has been pressed.

The OnStar® status LED is located within the mirror near the buttons. The LED is green when the system is ON and operating normally. When the status LED is green and flashing, it is an indication that a call is in progress. When the LED is red, this indicates a system malfunction is present. In the event there is a system malfunction and the OnStar® system is still able to make a call, the LED will flash red during the call.

If the LED does not illuminate, this may indicate that the customers OnStar® subscription is not active or has expired. Push the blue OnStar button to connect to an advisor who can then verify the account status.

Each LED is controlled by the telematics communication interface control module over dedicated LED signal circuits. Ground for the LED is provided by the wiring harness attached to the button assembly.

Electrochromic Mirror (If Equipped)

- The OnStar® button assembly is apart of the rearview mirror. The button assembly is comprised of 3 capacitive touch buttons and an error indicator. The buttons are defined as follows:
 - The answer/end call button, which is a white driver figure seated with voice signals near it's face, allows the user to answer and end calls or initiate speech recognition.
 - The blue OnStar® call center button, which displays the blue OnStar® logo, allows the user to connect to the OnStar® call center.
 - The emergency button, which displays red letters "SOS" as an illuminated Indicator, sends a high priority emergency call to the OnStar® call center when pressed.

The telematics communication interface control module supplies 10 volts to the OnStar® button assembly on the keypad supply voltage circuit. When pressed, each button press is processed and completes a circuit across an internal resistor allowing a specific voltage to be returned to the telematics communication interface control module on the keypad signal circuit. Depending upon the voltage range returned the telematics communication interface control module is able to identify which button has been pressed and illuminate associated indicator above each button.

The OnStar® error indicator is located within the mirror above the buttons between the OnStar® indicator and emergency "SOS" indicator. All three indicators associated with a button press are illuminated when the system is ON and operating normally. When any indicator is illuminated and flashing, it is an indication that a call is in progress. When the OnStar® error indicator is illuminated, this indicates a system malfunction is present. In the event there is a system malfunction and the OnStar® system is still able to make a call, the OnStar® error indicator will remain illuminated during the call.

If the indicators do not illuminate, this may indicate that the customers OnStar® subscription is not active or has expired. Push the blue OnStar button to connect to an advisor who can then verify the account status.

Secondary OnStar® Controls

Some vehicles may have an additional button that when pushed can engage the OnStar® system. The button may be a symbol of a face with sound waves, or may say MUTE, or be a symbol of a radio speaker with a slash through it.

By engaging the OnStar® system with this feature, the user can interact with the system by use of voice commands. A complete list of these commands is supplied in the information provided to the customer. If the information is not available for reference, at any command prompt the user can say "HELP" and the telematics communication interface control module will return an audible list of available commands.

OnStar® Microphone

The OnStar®, or cellular microphone, can be a part of the rearview mirror assembly, or on some vehicle lines, a separate, stand alone unit. In either case, the telematics communication interface control module supplies approximately 10 volts to the microphone on the cellular microphone signal circuit, and voice data from the

user is sent back to the telematics communication interface control module over the same circuit. A cellular microphone low reference circuit or a drain wire provides a ground for the microphone.

Cellular and GPS Antennas

This vehicle will be equipped with one of the following types of antennas:

- A combination cellular and navigation antenna, which brings the functions of both into a single part
- A cellular, GPS, and digital radio receiver antenna, which also incorporates the functionality of the digital radio receiver satellite antenna (XM).
- A cellular, GPS, and digital radio receiver antenna, which also incorporates the AM/FM antenna.

The cellular antenna is the component that allows the OnStar® system to send and receive data over airwaves by means of cellular technology. The antenna is connected at the base to a coax cable that plugs directly into the telematics communication interface control module.

The GPS antenna is used to collect the signals of the orbiting GPS satellites. Within the antenna is housed a low noise amplifier that allows for a more broad and precise reception of this data. The antenna is connected at the base to a coax cable that plugs directly into the telematics communication interface control module. The cable also provides a path for DC current for powering the antenna.

The OnStar® Call Center also has the capability of communicating with the vehicle during an OnStar® call to retrieve the latest GPS location and transmit it to the OnStar® Call Center. A history location of the last recorded position of the vehicle is stored in the module and marked as aged, for as long as the module power is not removed. Actual GPS location may take up to 10 minutes to register in the event of a loss of power.

OnStar® RemoteLink

OnStar® RemoteLink is a mobile app to link mobile devices to a vehicle for limited diagnostics and feature controls. After downloading the app and registering the device, vehicle owners with an eligible vehicle can use their mobile devices to access real-time data from their vehicle and perform specific commands remotely.

All communication between the app and the vehicle is powered by OnStar's® advanced connected vehicle technology. An active OnStar® account as well as a valid OnStar® username and password are required to use the app. The remote commands must be enabled by logging into the user's OnStar® account prior to using the app.

Vehicle Control Features

- Lock/Unlock doors
- Start vehicle remotely
- Activate your Horn & Lights
- Contact an OnStar Advisor, Roadside Assistance or your Preferred Dealer

Available Vehicle Data:

- Real-time fuel information, including fuel range, fuel remaining, and lifetime MPG
- Lifetime mileage
- Remaining oil life
- Current tire pressure information
- OnStar® account information

Compass Heading

The telematics communication interface module has a compass feature to calculate vehicle direction which is displayed via the instrument panel cluster or designated display. The compass heading is determined by dead reckoning until the GPS 3d fix is established. The dead reckoning is accomplished by using the yaw rate sensors and wheel ticks to determine heading changes from a GPS known heading. The GPS 3d fix heading is determined by the differential of two locations.

Bluetooth® (If Equipped)

Bluetooth® wireless technology is a short-range communications technology intended to replace the cables connecting portable and/or fixed devices while maintaining high levels of security. Only vehicles with steering wheel controls will have Bluetooth® functionality. In order to utilize the vehicle's Bluetooth® system, a Bluetooth® equipped cellular phone is required.

The Bluetooth® antenna is a small fixed antenna connected directly to the telematics communication interface control module and is used to send and receive signals from a Bluetooth® enabled cellular phone. The antenna utilizes no cabling and is not external to the vehicle. The available features and functions are determined by the software within the device being used and the telematics communication interface control module. The operating range of the signal from the vehicle is approximately 30 feet. Note that the operating range is dependent upon the cellular phone being used and battery level of the phone.

With Bluetooth® technology customers can experience hands-free calling as their Bluetooth® capable cellular phones are wirelessly connected to the vehicle. It will allow customers to place and receive calls using the steering wheel controls and voice recognition. The vehicle audio system will allow you to listen to your call through the vehicle speakers and adjust volume through steering wheel or radio controls.

Not all Bluetooth® cellular phones are guaranteed to work with the vehicle's Bluetooth® system. Based on the cellular phone's service provider and the manufacturer's implementation of Bluetooth®, not all phones support all available Bluetooth® functionality. Bluetooth® enabled cellular phones will be tested for vehicle compatibility and a feature compatibility list will be provided via the GM Bluetooth® website:
<http://www.gm.com/vc/bluetooth/>

Bluetooth® Features Supported

The following is a list of features supported by the Bluetooth® system. Note that not all devices will support all of the listed functions.

- Automatic reconnection - highest priority phone will automatically be connected to vehicle when vehicle ignition is on

- Hands-free dialing- via digits, redial, name tags (phone number saved to a nametag via voice recognition)
- Answering a call
- Ending a call
- Mute a Call
- Rejecting a call - ignore an incoming call
- Call Waiting
- Three-way Calling - initiated from hands-free system
- Send Number During a Call - this is used when calling a menu-driven phone system
- Transfer a Call - transfer call from vehicle to cellular phone and visa versa
- Voice Pass-Thru - allow access to the voice recognition commands on the cellular phone

Pairing a Bluetooth® Cellular Phone to the Vehicle

In order to use hands-free calling, the cellular phone must be paired to the vehicle. Up to five devices can be paired to the vehicle at one time, but only one can be connected at any given time. To pair a phone, the customer must know how to operate the Bluetooth® functionality of their phone. The pairing process must only be done one time for each phone, unless that phone's information is deleted. For safety reasons, the pairing process is disabled while the vehicle is moving.

Once the Bluetooth® cellular phone has been paired with vehicle, it will automatically connect to the vehicle when the ignition is on and the device is on. When more than one paired phone is in the vehicle, the phone with the highest priority will be connected. If the cellular phone is in use while getting into the vehicle, the phone can be switched to hands-free mode with the press of a button. In addition, a call in progress can be transferred from the vehicle hands-free mode to the phone to continue the call as the customer exits the vehicle.

Complete pairing instructions are provided in the Vehicle Owners Manual.

Back-up Battery (If Equipped)

IMPORTANT: Do not disconnect the main vehicle battery or remove the OnStar® fuse with the ignition key in any position other than OFF. Disconnecting power to the OnStar® module in any way while the ignition is ON or with retained accessory power activated may cause activation of the OnStar® Back-Up Battery. This action is per design as the back-up battery is designed to provide power to the telematics communication interface control module so an emergency notification call can be made after an event where the main battery is disabled. Once the Back-Up Battery is activated it will stay on until the power is restored back to the telematics communication interface control module. The telematics communication interface control module naturally chooses the main supply voltage as it's default supply, but if the main supply is removed or lost for any reason the OnStar® module will use the Back-Up Battery as a power supply as long as the default supply can not be detected. The back-up battery is not rechargeable and once discharged below 9.5 volts the back-up battery must be replaced.

Certain OnStar® equipped vehicles may also be equipped with a back-up battery. The back-up battery is a non-rechargeable, lithium battery intended to provide an auxiliary power source for the telematics communication interface control module in the event where power from the main vehicle battery is lost.

The back-up battery is intended to have a limited life span of approximately 4 years and is designed to maintain an open circuit voltage between 16 V and 9 V throughout this period. This allows the battery to power the basic functions of the telematics communication interface control module for least one 200 second (5 minute) call at the end of the 4 year span, should the main vehicle battery be lost. In the case of a vehicle losing vehicle battery power, OnStar will switch over to the backup battery based on an internal algorithm. It will look for an air-bag deploy, or near-deploy, messages from the SDM. If there are no messages the OnStar module will stay wake for a few minutes longer and monitor the buttons in the mirror. If not pressed, the modules will power down and shut off completely.

The back-up battery is connected to the telematics communication interface control module through the back-up battery positive voltage circuit and back-up battery ground circuit and is protected from a short circuit by means of an internal fuse. In the event the back-up battery, battery positive voltage circuit is shorted to the back-up battery ground circuit or chassis ground, the fuse will open and render the back-up battery permanently inoperable. The status of the back-up battery and its associated wiring is monitored by the telematics communication interface control module.

Audio System Interface

When the OnStar® requires audio output, a serial data message is sent to the audio system to mute all radio functions and transmit OnStar® originated audio. The OnStar® audio is transmitted to the vehicle audio system by a dedicated signal circuit and a low reference circuit.

The audio system will mute and an audible ring will be heard though the speakers if the vehicle receives a call with the radio ON.

On some vehicles, the HVAC blower speed may be reduced when the OnStar® system is active to aid in reducing interior noise. When the system is no longer active, the blower speed will return to its previous setting.

OnStar® Sleep Cycle

The OnStar® system uses a unique sleep cycle to allow the system to receive cellular calls while the ignition is in the OFF position and retained accessory power mode has ended. This cycle enables the telematics communication interface control module to perform remote functions, such as door unlock, as commanded over the air by the OnStar® Call Center, and to continue to maintain an acceptable level of battery electrical drain.

The OnStar® system uses 4 states of readiness, depending upon the type of cellular market the vehicle is in when the ignition is put into the OFF state:

- High power
- Low power
- Sleep
- Digital standby

The high power state is in effect whenever the ignition is in the ON or RUN position, or retained accessory power is enabled, and the OnStar® system is sending or receiving calls or when the system is performing a remote function.

The low power state is in effect when the OnStar® system is idle with the ignition in the ON or RUN position, or with retained accessory power enabled.

The sleep state is entered after the vehicle has been shut off and the retained accessory power has timed out while in an analog cellular area. At a predetermined time recorded within the telematics communication interface control module, the system re-enters the low power state to listen for a call from the OnStar® Call Center for 1 minute. After this interval, the system will again return to the sleep state for 9 minutes. If a call is sent during the 1 minute interval, the OnStar® system will receive the call and immediately go into the high power mode to perform any requested functions. If no call is received during the 1 minute interval, the system will go back into the sleep mode for another 9 minutes. This process will continue for up to 48 hours, after which the OnStar® system will turn off until the ignition is turned to the ON or RUN position.

The digital standby power state is entered after the vehicle has been shut off and the retained accessory power has timed out while in a digital cellular area. When in digital standby mode, the OnStar® module is able to perform all remote functions as commanded by an OnStar® advisor at any time, for a continuous 120 hours. After 120 hours, the OnStar® module will go into sleep mode until a wake up signal from the vehicle is seen by the telematics communication interface control module. If the OnStar module loses the digital cellular signal it will revert to analog mode and follow the standard sleep state (9 minutes OFF, 1 minute standby) based on the time of the GPS signals, this will continue until a digital cellular signal is again received.

If the OnStar® system loses battery power while the system is in a standby or sleep mode, the system will remain OFF until battery power is restored and the ignition is turned to the ON or RUN position.

Features

OnStar® Personal Calling

The hands free, OnStar® personal calling cellular phone feature is an additional feature of the OnStar® system. This feature is embedded within the telematics communication interface control module; however it must be activated by an OnStar® advisor. OnStar® personal calling operates similar to most hand held cellular phones in that the availability for its usage is based on minutes or units. The customer must have a current OnStar® subscription, as this feature cannot be utilized without it. To use OnStar® personal calling, the customer must also purchase units (minutes) as outlined in the owners guide provided with the OnStar® system. Units begin to deplete, 1 unit is equal to 1 minute, as the customer makes outbound phone calls, answers inbound phone calls, or while connected to the OnStar® virtual advisor. In addition, units may also have an expiration date, depending upon the type of units purchased.

Customers have the ability to store telephone numbers within the module, referenced by a nametag for the convenience of frequently dialed numbers. After storing a nametag, the user can dial this number by initiating the OnStar® personal calling feature, speaking the word "call," and repeating the nametag assigned.

Turn by Turn Navigation

Turn by Turn Navigation allows the driver to contact OnStar® to obtain directions for driving from a current

location to a desired location. The Turn by Turn Navigation system stores your planned route and continually checks your position along that route, when you deviate from the planned route, the system will recognize this and prompt the driver with verbal prompts for how to proceed. The driver then responds verbally to direct the system to continue the current routing or to recalculate the route because of a missed turn.

Advisor Record Feature

The Advisor Record Feature allows the user to store any information given during a call with an OnStar® Advisor. Recording is activated by pressing the blue OnStar button during a call; pressing the button a second time stops the recording. The stored information can be played back by pressing the phone button on the three button assembly and using the voice command "Advisor Playback".

Deactivated OnStar® Accounts

In the event a customer has not renewed their OnStar® account after expiration or the account was never activated, OnStar® will make a discrete cellular call to the vehicle to deactivate the OnStar® system. Before taking this action, customers are notified that the OnStar® system in their vehicle will be deactivated unless they elect to renew the account. After the OnStar® account has been deactivated, customers will experience the following:

- The OnStar® status LED will not illuminate.
- The OnStar® system will NOT attempt to connect to the OnStar® Call Center in the event of a collision or if the vehicle's front air bags deploy for any other reason.
- An emergency button press will play a demo message indicating the service has been deactivated.
- An OnStar® Call Center button press will connect the customer with a dedicated sales team who can sell an OnStar® subscription and reactivate the vehicle. Depending on the type of OnStar® hardware in the vehicle, the customer may first hear a demonstration message stating there is no current OnStar® subscription for the vehicle, and directing the customer what to do to activate services.
- OnStar® personal calling will not be available, as this feature requires the customer to have a current OnStar® account. Attempts to use this feature may result in cellular connection failure messages and the inability to connect to the number dialed.

Certain vehicles that have never had an active OnStar® account, or that have been deactivated, may be unable to establish a connection with the OnStar® Call Center. When normal published diagnostic procedures do not indicate a possible cause for the no connect concern, the vehicle may have been deactivated. For deactivated vehicles, a no connect response should be considered normal operation. Further diagnosis and subsequent repair is only necessary should the customer elect to become an active OnStar® subscriber or renew the account subscription.

OnStar® Cellular, GPS, and Diagnostic Limitations

The proper operation of the OnStar® System is dependent on several elements outside the components integrated into the vehicle. These include the National Cellular Network Infrastructure, the cellular telephone carriers within the network, and the GPS.

The cellular operation of the OnStar® system may be inhibited by factors such as the users range from an analog or digital cellular tower, the state of the cellular carrier's equipment, and the location where the call is

placed. Making an OnStar® key press in areas that lack sufficient cellular coverage or have a temporary equipment failure will result in either the inability of a call to complete with a data transfer or the complete inability to connect to the OnStar® Call Center. The OnStar® system may also experience connection issues if the identification numbers for the module, station identification number, electronic serial number or manufacturers electronic ID, are not recognized by the cellular carriers local signal receiving towers.

The satellites that orbit earth providing the OnStar system with GPS data have almost no failures associated with them. In the event of a no GPS concern, the failure will likely lie with the inability of the system to gain GPS signals because of its location, i.e. in a parking structure, hardware failure, or being mistaken with an OnStar® call which has reached the Call Center without vehicle data.

During diagnostic testing of the OnStar® system, the technician should ensure the vehicle is located in an area that has a clear unobstructed view of the open sky, and preferably, an area where analog or digital cellular calls have been successfully placed. These areas can be found by successfully making an OnStar® keypress in a known good OnStar® equipped vehicle and confirming success with the OnStar® Call Center advisor. Such places can be used as a permanent reference for future OnStar® testing.

Mobile Identification Number and Mobile Directory Number

The telematics communication interface control module utilizes 2 numbers for cellular device identification, call routing and connection, a mobile identification number and a mobile directory number. The mobile identification number represents the number used by the cellular carrier for call routing purposes while the mobile directory number represents the number dialed to reach the cellular device.

Operation of the OnStar® Speech Recognition Systems

OnStar® users communicate with 2 speech recognition systems. Speech recognition allows the user to speak to one computer in the vehicle, and one reached over a phone line. The computer tries to understand the users command, and responds by speaking back, or by taking the appropriate action, e.g. dialing the phone.

- Personal Calling uses a speech recognition system that resides in the vehicle. When the user presses the phone button, the system states, Ready, and listens for the user's command. The user can speak commands to control the hands-free phone.
- Virtual advisor is a remote speech recognition system that the caller can access by making a phone call. The user connects to virtual advisor by requesting it during personal calling use. The user is then transferred to the virtual advisor server and talks to it via a cellular connection.

The OnStar® speech recognition systems use speech technology that is designed to understand a wide range of American English speakers. Although there is no one right way to speak English, the system will work best when users try to modify their pronunciation should they encounter difficulty. Users who do not obtain good results are advised to try the tips and workarounds found in this section.

General Tips for Better Speech Recognition

Concern	Tip for Better Result
Noise	Noise may confuse the speech recognition system. You usually get better performance from the system in quieter conditions:

	• The HVAC fan creates noise. Turn it down or OFF for better speech system performance. • Driving at high speeds creates louder engine noise and wind noise. You may get better results at lower speeds. • An open window or an open sunroof allows more noise to enter the vehicle. Close all windows for better results. • Noisy rainstorms can also reduce performance. • If passengers are talking while you use the speech system, it may be confused by their speech. You will get better results if all occupants of the vehicle are quiet while the system is listening for commands.
When to Speak	In Personal Calling, the system is only listening after it prompts you to speak with a beep. • When the system prompts you to speak, you have about 5 seconds to respond. If the system does not hear a response, it will prompt you again, or cancel the transaction. • If you begin to speak too soon, try pausing for a half second before speaking after the beep. • In the Virtual Advisor, the system is always listening for commands, even while it is speaking.
How to Speak	Speak forcefully, and clearly. • The noisier the environment, the louder you need to speak. If you are in the driver seat, speak facing the front of the car. If you are a passenger, speak facing the rearview mirror. • Speak calmly, and naturally. The system may sometimes fail your repeated attempts to give a command. If your speech is distorted by shouting or frustration, this may cause more errors. • People with high-pitched voices may have better results by speaking in a deeper, lower-pitched voice. However, do not lower the volume of the voice. • Avoid speaking with a rising intonation, like asking a question. Use a flat or falling intonation, like giving an answer.
What to Say	Personal Calling: One-word commands • The Personal Calling system listens for only one word at a time. There are some exceptions, 2-word phrases that are spoken and understood as a single word, e.g. "virtual advisor", "voice feedback", and "my number". You can enter phone numbers only one digit at a time, and the system repeats each digit as it hears it. • Say "Help" at the Ready prompt to hear the list of Personal Calling commands. • Virtual Advisor can understand sentences with more than one word. It also expects to hear a 4-digit number all at once when it asks for

	your PIN. • Say, "What are my choices?" to hear a list of commands that the Virtual Advisor understands.
Entering a phone number	• If you have trouble getting numbers correctly into the system, store your frequently-called number in the directory, so the system will remember them. After you have stored a number with a nametag, then you simply say "call" and the nametag in order to call the number. • If the system cannot understand your numbers, ask another person to help you enter your frequently-called numbers. This person can speak the numbers, then you can speak the nametag.
Storing or dialing a number	When you have finished speaking your phone number, you do not need to say "store" or "dial" to indicate that you are done. If you pause and say nothing, the system will ask you if you want to store or dial. Say "yes".
Creating nametags	• Short nametags that are similar may be easily confused by the system. You may get better recognition of your nametags if you make them longer, for example "George Washington" without pause, instead of "George" only. • If you want to use nametags while driving, it is best to store the nametag with some vehicle noise in the background. If you are in park while you are storing nametags, you can turn the fan on low or open windows in order to create some background noise.
Virtual Advisor 4-digit PIN	Say the 4 digits in a natural way, without pausing between digits.
Interrupting	• When the Virtual Advisor is speaking, you can interrupt it with another command. The first word in your command helps to get its attention. • If the Virtual Advisor has trouble understanding your commands when you interrupt, try speaking the first word loudly and clearly, then pause for an instant, then continue with the rest of the command. For example: "Get... my weather" or "Lookup... a quote for General Motors".

RADIO/AUDIO SYSTEM DESCRIPTION AND OPERATION

The entertainment system on this vehicle may have several different configurations available to it. To determine the specific configuration of the vehicle, please see the Service Parts ID Label, and refer to **RPO Code List** .

Each item in the list below represents topics covered in detail below.

- Radio Circuit Operation
- Antenna System
- Radio Reception
- Digital Radio Receiver (If equipped)
- Speaker Operation

- Theft Deterrent
- OnStar ®
- Auxiliary Audio Input Jack
- USB Port (if equipped)
- Bluetooth ® (If equipped)
- Applications (if equipped)
- Steering Wheel Controls (If equipped)
- Speed Controlled Volume (SCV) (If equipped)

Radio/Audio Block Diagram

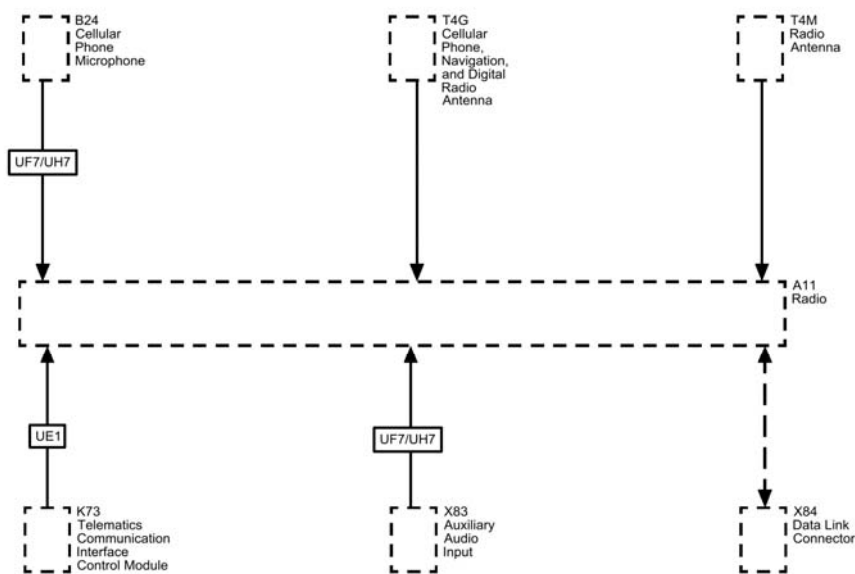


Fig. 14: Radio/Audio Block Diagram
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
HW	Hard-Wired

HW	Hard-Wired
HW	Hard-Wired
UF7	RADIO: AM/FM STEREO, SEEK/SCAN, ETR, CLOCK DSP, MP3/WMA, USB, AUX/IN, WIRELESS INTERFACE
UH7	RADIO: AM/FM STEREO, SEEK/SCAN, CD, ETR, CLOCK DSP, MP3/WMA, USB, AUX/IN, WIRELESS INTERFACE
HW	Hard-Wired
HW	Hard-Wired
DB	Serial Data - GMLAN Low Speed
UE1	COMMUNICATION SYSTEM: VEHICLE, ONSTAR
UF7	RADIO: AM/FM STEREO, SEEK/SCAN, ETR, CLOCK DSP, MP3/WMA, USB, AUX/IN, WIRELESS INTERFACE
UH7	RADIO: AM/FM STEREO, SEEK/SCAN, CD, ETR, CLOCK DSP, MP3/WMA, USB, AUX/IN, WIRELESS INTERFACE
B24	B24 Cellular Phone Microphone
T4G	T4G Cellular Phone, Navigation, and Digital Radio Antenna
T4M	T4M Radio Antenna
A11	A11 Radio
K73	K73 Telematics Communication Interface Control Module
X83	X83 Auxiliary Audio Input
X84	X84 Data Link Connector

Radio Circuit Operation

Radio Power

The radio does not use a discrete ignition feed circuit for power moding. The power mode master provides the system power mode to the radio via serial data messages. The power mode master determines the system power mode by processing power mode information from ignition switch inputs. Serial data power modes supported by the radio are OFF, ACCESSORY, RUN, and CRANK REQUEST.

Radio Grounds

The vehicle harness provides a ground for the radio circuits. The radio may also be case grounded.

Radio Data Link Communication

The radio communicates with other modules via serial data.

Radio Audio Outputs

Each of the audio output channel circuits (+) and (-), at the radio have a DC bias voltage that is approximately one half of battery voltage. The audio being played on the system is produced by a varying AC voltage that is centered around the DC bias voltage on the same circuit. The AC voltage is what causes the speaker cone to move and produce sound. The frequency (Hz) of the AC voltage signal is directly related to the frequency of the

input (audio source playing) to the audio system. Both the DC bias voltage and the AC voltage signals are needed for the audio system to properly produce sound.

Remote Enable Output

The remote enable circuit is a discrete 12 V signal supplied to infotainment system components when the radio is producing audio, needs the front display on, needs video entertainment system components on, or needs to produce chimes. This signal is used to control the power state of the components. There is no output on radio the remote enable circuit when the vehicle is in the CRANK powermode, this is to minimize current consumption from the attached modules and also to avoid audio pops during crank events.

Antenna System

Multi-Band Antenna

The multi-band antenna is located on the roof of the vehicle. Keep this antenna clear of snow and ice build up for clear reception. If the vehicle has a sunroof, the performance of the system may be affected if the sunroof is open. Loading items onto the roof of the vehicle can interfere with the performance of the system, ensure the multi-band antenna is not obstructed.

The radio antenna is enabled when the radio is turned on. The radio provides battery voltage to the antenna using the center conductor of the antenna coaxial cable. This DC voltage does not affect the incoming radio signal. When a 12 V signal is seen by the antenna on the center conductor of the antenna coax, both AM and FM signals are amplified.

Radio Reception

AM/FM Radio Signal

The radio signal is sent from a broadcast station and is then received by an antenna. The strength of the signal received depends on the following:

- The power output (wattage) of the broadcasting station
- The location of the vehicle (or receiver) relative to the broadcast tower.
- Height of the broadcast antenna
- Height of the receiving antenna
- Obstacles between the tower and the receiver
- Atmospheric conditions
- What band (AM or FM) the station is broadcasting
- Type of antenna and the ground plane

Radio Data System (RDS)

The RDS feature is available only on FM stations that broadcast RDS information. This system relies upon receiving specific information from these stations and only works when the information is available. While the radio is tuned to an FM-RDS station, the station name or call letters display. RDS data is carried in what is

known as a "subcarrier". A subcarrier is a frequency that the FM broadcaster is authorized to use to send data that is not audible in the main audio program.

RDS functions will only work with FM broadcast stations that are broadcasting RDS data. Not all FM Broadcast stations broadcast RDS data or offer all of the RDS services.

The information displayed is dependent upon the information broadcast by the particular station. The information may vary greatly between stations. RDS functions may not work properly when reception is weak, reception is of poor quality, or RDS is not implemented properly by the FM Broadcaster. In some cases, a radio station broadcasting incorrect information may cause the RDS features of the radio to appear to work improperly.

With RDS, the radio can do the following:

- Display text information such as: station identification, type of programming, and general information (artist and song title, station messages, call in phone numbers, etc.).
- Seek to stations broadcasting the selected type of programming
- Receive announcements concerning local and national emergencies
- Receive alert warnings of local or national emergencies. When an alert announcement comes on the current radio station, ALERT! displays. You will hear the announcement, even if the volume is low or a CD is playing. If a CD is playing, play stops during the announcement. Alert announcements cannot be turned off. ALERT! is not affected by tests of the emergency broadcast system. This feature is not supported by all RDS stations.

Digital Radio Receiver (if equipped)

The XM satellite radio is integrated into the radio. XM satellite radio provides digital radio reception. The XM signal is broadcast from two satellites and, where necessary, terrestrial repeaters. The high power satellites allow the antenna to receive the XM signal even when foliage and other partial obstructions block the antennas view of the satellite. Terrestrial repeaters are used in dense urban areas. These repeaters will receive the satellite signal and re-broadcast them at much higher power levels in order to ensure reception in areas with densely packed tall buildings. A service fee is required in order to receive the XM service.

Speaker Operation

Speakers turn electrical energy into mechanical energy to move air, using a permanent magnet and an electromagnet. The electromagnet is energized when the radio or amplifier (if equipped) delivers current to the voice coil on the speaker. The voice coil will form a north and south pole that will cause the voice coil and the speaker cone to move in relation to the permanent magnet. The current delivered to the speaker is rapidly changing alternating current (A/C). This causes the speaker cone to move in two directions producing sound.

Theft Deterrent

The radio theft deterrent system is intended to disable or limit radio functionality if incorrect vehicle information is received by the radio. The radio disables functionality if the VIN information received by the radio does not match the VIN information that has been learned by the radio. The radio receives this information via serial data. A possible cause of incorrect VIN info could be the radio was originally installed in

another vehicle.

The radio has the following theft operating modes as part of the theft deterrent system:

- Normal Mode: The radio has learned a correct VIN sequence and the VIN information received via serial data matches the learned VIN sequence. In this mode the radio has full functionality.
- No VIN Mode: The radio has not received or learned a correct VIN sequence. In this mode the radio has limited functionality.
- Theft Detected Mode: The radio has learned a correct VIN sequence and the VIN information received via serial data does NOT match the learned VIN sequence. In this mode the radio may be disabled or have limited functionality. The radio display will indicate that theft protection is active.

OnStar ® (If equipped)

When OnStar is activated, a serial data message is sent to the radio that activates a software program. When the software begins its process, the fade goes to the front, Bass and Treble are set to the mid range, the outputs are mono, and the audio source is OnStar. OnStar takes priority over any other audio source. All of these actions are preset values stored in the radio.

For additional OnStar information, refer to **OnStar Description and Operation**.

Auxiliary Audio Input Jack

The infotainment system has a 3.5mm (1/8 in.) auxiliary audio input jack available on the face of the radio. This input interfaces internally with the radio, no external circuits are involved.

The infotainment system may also have an additional auxiliary audio input jack located in the instrument panel compartment. Audio signals from the device are sent to the radio from the auxiliary jack via the left, right, and common audio signal circuits.

When a portable audio playback device is connected to the auxiliary jack, an internal switch detects the connection and the radio will switch to AUX as the audio source.

- When a device is first connected to the 3.5mm (1/8 in.) input jack the infotainment system automatically switches to that device. If an auxiliary device has already been connected, press the AUX or CD/AUX button to select the device.
- Playback of an audio device that is connected to the 3.5mm jack can only be controlled using the controls on the device.
- The volume control on the device may need to be adjusted to ensure sufficient playback volume through the infotainment system.

USB Port (if equipped)

The infotainment system may have a USB connector located in the instrument panel compartment. The USB connector interfaces directly with the radio. The USB connector supports both USB standards 1.1 and 2.0.

USB supported devices:

- USB Flash Sticks (Thumb Drives)
- Portable USB Hard Drives
- Portable Digital Media Players (iPOD®, ZUNE®, etc.)

Depending on the USB device, some devices may not be recognized, or some features/functions may not be able to be controlled with the radio controls. USB HUB devices are not supported.

Bluetooth ® (If Equipped)

Bluetooth ® wireless technology is a short-range communications technology intended to replace the cables connecting portable and/or fixed devices while maintaining high levels of security. The operating range of the signal is approximately 30 feet.

The available features and functions are determined by the type of device and the software within the devices being used. For a feature or function to operate, it must be supported in both devices.

The first connection between devices is established through a process called pairing. In order to pair two devices, a password (passkey) has to be exchanged between the two devices. One device will generate the password, the other device accepts the password to complete the process. Once the devices are paired, future connections between the devices will occur automatically when the devices are on and within range of each other.

The Bluetooth ® hardware is internal to the radio. The radio supports streaming of data (music, voice, information) from cellular phones and other mobile devices that support those features. The radio may also be capable of interfacing with cellular phones for hands-free features.

- The device must be paired to the radio to use the available Bluetooth ® feature(s). The pairing process must only be performed once for each device, unless that device's information is deleted.
- Up to five devices can be paired to the system, but only one can be connected at any given time.
- Streaming Audio allows playing music from the mobile device wirelessly. Music stored on the mobile device can be viewed and controlled from the display.
- To stream audio from a mobile device, the device must be unlocked, and any additional applications should be closed.

Refer to the vehicle owners manual, supplements, and the device manufacturers information for pairing instructions.

Applications (If equipped)

When the system is equipped with Bluetooth ®, the system may be capable of using applications, commonly referred to as apps.

The term application refers to any piece of software that works on a system (hardware) that is being operated by it's own software. Applications are typically small software programs which uses the hardware to perform a specific task, as opposed to operating the entire system.

- For an application to be used, it must be installed on both the vehicle infotainment system and a compatible mobile device.
- The device must be connected to the system. this may be done wirelessly via Bluetooth ®, or via the vehicle USB port. Refer to the device manufacturers information for the proper connection method.
- When the device is connected, the application on the radio is used to remotely access and control the application on the mobile device.
- The application must work correctly on the device to work with the vehicle infotainment system.
- The user may be required to log-in to the application on the mobile device before using the application from the vehicle controls.
- Using applications will use the device's data plan.
- The device must be unlocked, and any additional applications should be closed.

Refer to the owner's manual and supplements for information on mobile devices, control, and operation.

Steering Wheel Controls (If equipped)

Some audio functions are available using the steering wheel controls. The steering wheel controls duplicate the function of the primary controls available on the radio.

For additional information on steering wheel controls, refer to **Steering Wheel Controls Description and Operation** .

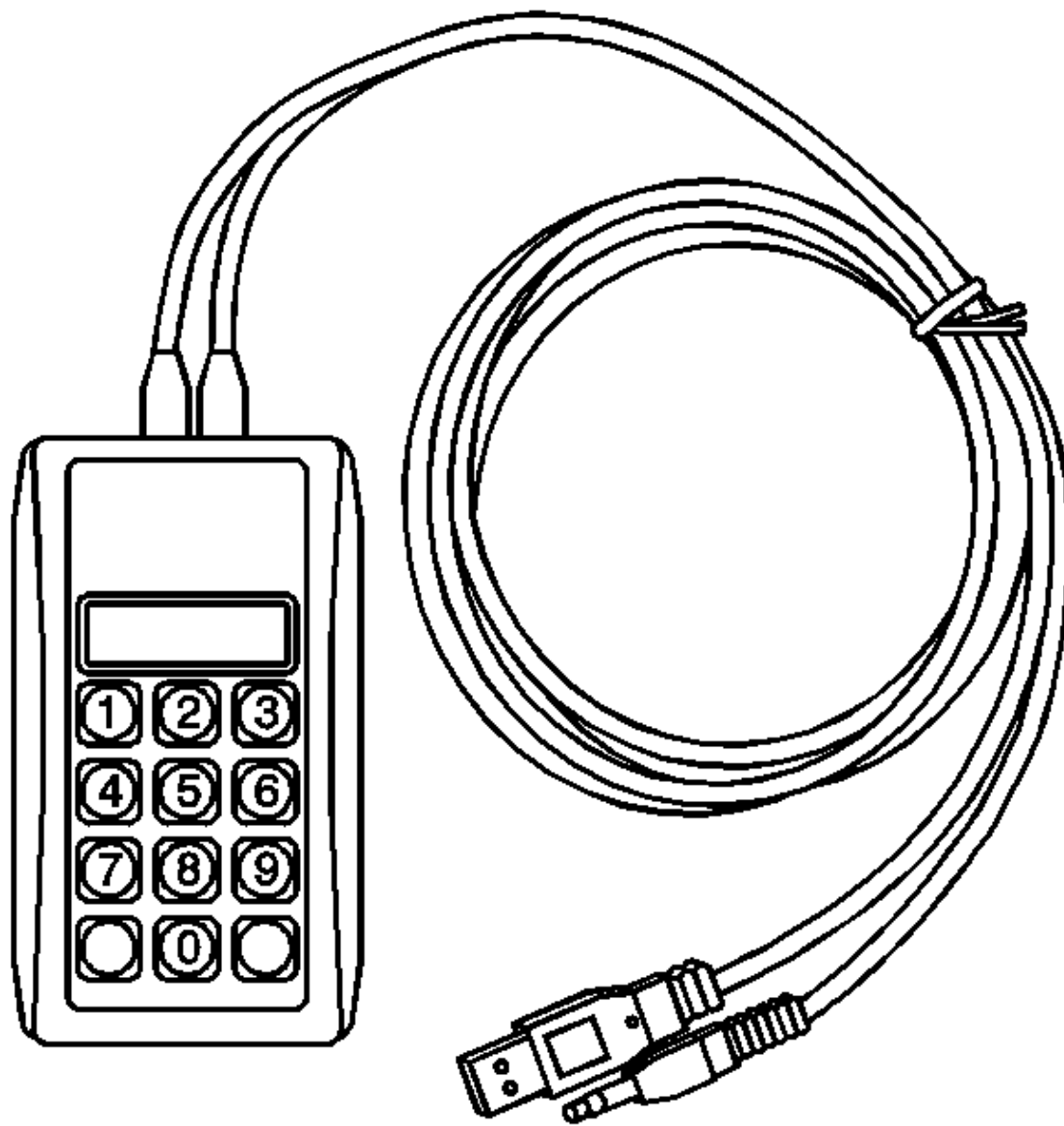
Speed Compensated Volume (If equipped)

With Speed Controlled Volume (SCV), the audio system will adjust automatically to make up for road and wind noise as you drive, by increasing the volume as vehicle speed increases. To use SCV, set the volume at the desired level, and then select either Low, Medium, or High. To turn SCV off, select the Off screen button.

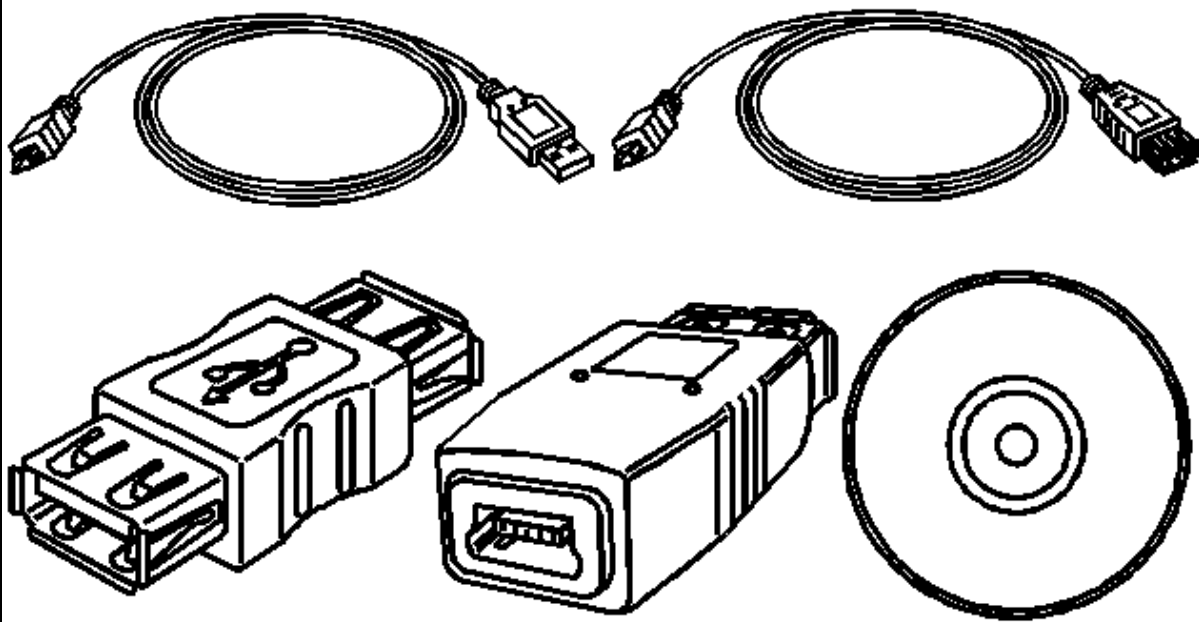
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Descrip

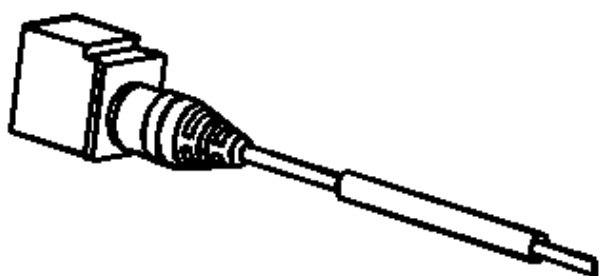


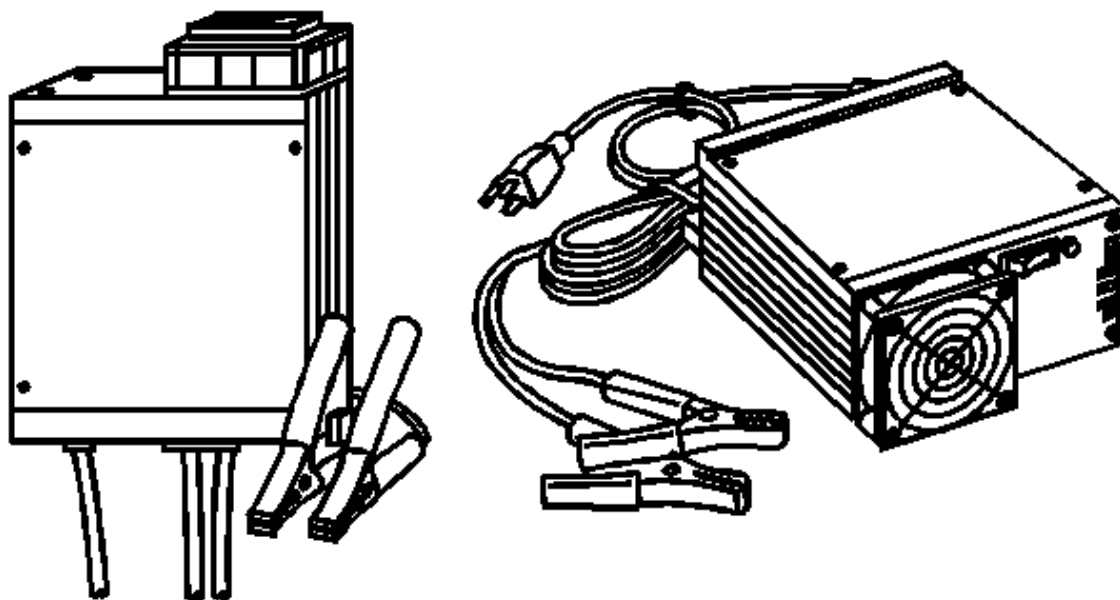
EL-50334-20
Multi-Media
Interface Tester
(MIT)



EL-50334-50
USB Cable and
Adapter Kit

EL-48028
Digital Radio Teletype
Antenna





EL-49903
OnStar Antenn
Diagnostic Tool

SPECIAL TOOLS (MIT TOOL INSTRUCTIONS)

Bluetooth Pairing for Vehicles with Radio RPO: UF7

Either reset the pin code on the radio to 0000, or go under Device Info on the radio and see what the pin code is (to enter it later on the MIT).

1. Turn the BT discoverable ON in the radio Bluetooth settings.
2. Press Pair Device on radio (DO NOT PRESS SEARCH BLUETOOTH DEVICES ON THE RADIO).
3. Press the Pair button on the MIT.
4. When the three LED lights begin flashing on the MIT, enter the pin code (either 0000 if you reset it to that or what the radio pin code was).

5. MIT will then automatically connect with the radio and should show "MIT Connected" message.

Make test call and the audio streaming test.

Holden Radio Bluetooth Pairing Instructions

1. Using the radio controls, place the radio into "Discoverable Mode".
2. Place the MIT into Bluetooth mode by pressing TEST SELECTOR until the Bluetooth LED is illuminated.
3. With the MIT in Bluetooth mode Press and Release the #1 button (the Bluetooth LED will begin to slowly blink).
4. Now Press and release the PAIR/CALL button on the MIT (the Bluetooth LED will begin to blink a little faster).
5. On the radio Enter the PASSKEY when prompted: (press "0000" then Press "OK").
6. The MIT and radio will PAIR and CONNECT (the Bluetooth LED will be Fast Flashing).
7. Use as regular MIT at this point.

For all other Radios

Testing the Bluetooth Function

1. Verify connection of the MIT to the USB port.
2. Press and release the TEST SELECTOR button until the Bluetooth LED illuminates.
3. Disable all other Bluetooth devices present in the vehicle (ie. cell phones, laptops, etc.).

Standard Bluetooth Pairing/Bonding

1. Use the vehicle controls to place the radio into Bluetooth Pairing mode. The vehicle will prompt you with a security code.
2. Press and release the PAIR/CALL button. The Bluetooth LED will blink slowly while preparing to have a security code entered.
3. Wait for the all three LEDs to blink confirming it is ready to have the security code entered.
4. Enter the code with the MIT keypad and hit ENTER.
5. The Bluetooth LED will blink slowly while pairing/bonding and move to a quick flash once paired/bonded.

The vehicle should confirm pairing/bonding is complete.

Streaming Audio

1. Confirm pairing/bonding is complete - the Bluetooth LED will be in a quick flash mode.
2. On some radios the MIT automatically begins streaming audio via A2DP. The audio playback will confirm that the Bluetooth connection using streaming and the audio is working correctly.
3. On other radios you will need to select Bluetooth Audio from the Source menu to verify Audio

Streaming.

4. Audio playback confirms that the Bluetooth connection using Streaming Audio is working correctly.
5. Placing a test call will temporarily stop the streaming audio function, but upon disconnection of that test call,

the streaming audio from the MIT will resume.

To Place a Test Call

1. Confirm pairing/bonding is complete - the Bluetooth LED will be in a quick flash mode. If the vehicle is equipped with streaming audio, and the radio is set to play a Bluetooth audio file, the streaming audio playback will be audible.
2. Press and release PAIR/CALL button to place a test call. Streaming audio will be temporarily turned off.
3. Use the vehicle controls to answer the call.

NOTE: If the call is not answered within several rings, the MIT's audio files will not transmit, even though an active call is occurring.

4. Audio playback confirms that the Bluetooth connectivity is working correctly.

NOTE: The MIT will remain paired/bonded when the call is ended by the vehicle. To re-test the call function, place the MIT in Bluetooth mode and press and release the Pair button to reconnect. When testing is completed, delete MIT from the audio system before returning the vehicle to the customer.

5. Use the vehicle controls to end the call. If applicable, streaming audio will resume.

Testing the AUX/Line-In Function

1. Verify connection of the MIT as stated above.
2. Press and release the TEST SELECTOR button until the MIT AUX LED illuminates.
3. Use the vehicle controls to put the audio system into Audio (Line-In) mode.
4. Audio playback confirms that the audio input is working correctly.

Testing the USB Function

1. Verify connection of the MIT as stated above.
2. Press and release the TEST SELECTOR button until the MIT USB LED illuminates.
3. Use the vehicle controls to put the audio system into USB mode.

NOTE: Volume levels may vary dependent upon vehicle audio system.

4. Audio playback confirms that the USB is working correctly.

Troubleshooting Guide

If the MIT unit is still not working properly after following the below troubleshooting, the unit is malfunctioning and should be repaired or replaced.

Unit not Working

- Verify the MIT is powered on correctly as indicated by the green Power LED.
- If Power LED is not illuminated, verify USB power source is working properly.
- If USB power adapter is being used to power the MIT, check and, if necessary, replace the fuse in adapter.

Problem with Aux/Line-In Test

- Verify Aux/Line- In test cable is inserted properly into the vehicle audio input jack. Verify the MIT is in Aux/Line-In mode as indicated by the red AUX LED.
- Verify the vehicle audio system is in Auxiliary or Line-in mode. Verify the vehicle audio system volume is turned up and not in mute mode.

Problem with USB Test

- Verify MIT is in USB mode as indicated by the red USB LED. Verify the vehicle audio system is in USB mode.
- Verify the vehicle audio system volume is turned up and not in mute mode.

Problem with Bluetooth Pairing

- Delete previous devices stored in the device list of the radio and the pair the MIT
- Remove USB cable, and then reconnect to reset the MIT. Carefully follow the bonding instructions for the correct Passkey procedure.

Problem with Bluetooth Test Call Audio

- Verify the MIT is paired with the vehicle. This is indicated by the quick flashing Bluetooth LED.
- Audio system should have indicated the MIT is bonded.

ACCESSORIES & EQUIPMENT

Collision Repair - Spark

SPECIFICATIONS

DIMENSIONS - BODY

Point-to-point measurements are for reference only. All measurements are given in millimeters. Use these measurements for diagnosing and estimating. Point-to-point measurements are duplicated with tram bar pointers set at equal lengths. All die marks, holes, slots and fasteners are measured to the center. All dimensions are symmetrical unless otherwise specified

Point-to-Point Measurements

Front End

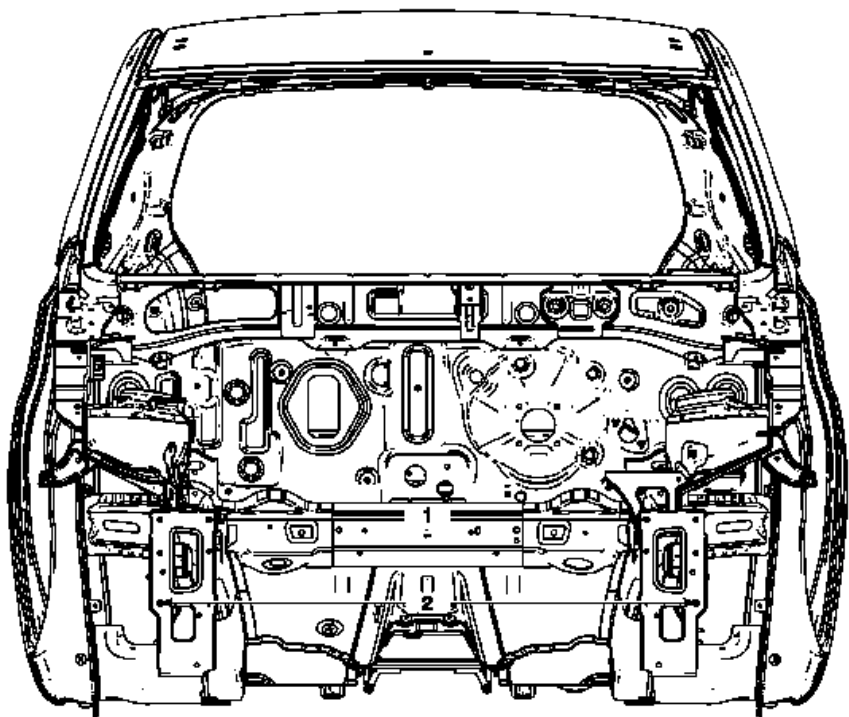


Fig. 1: Front End Measurements
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	833 mm
2	1020 mm

Engine Compartment

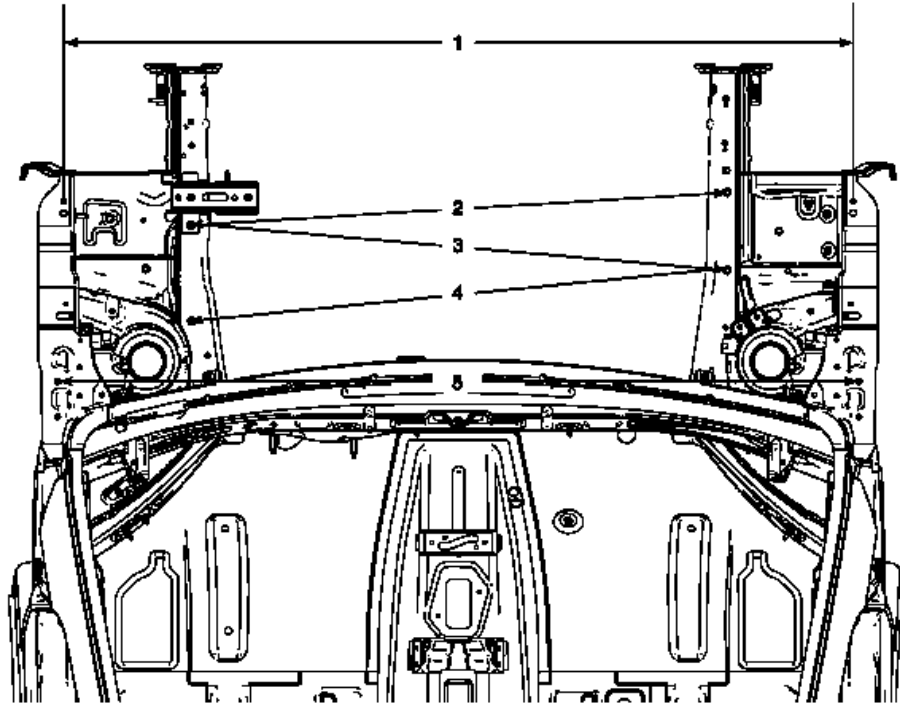


Fig. 2: Engine Compartment Measurements
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	1334 mm
2	908 mm
3	909 mm
4	908 mm
5	1354 mm

Front End Lower

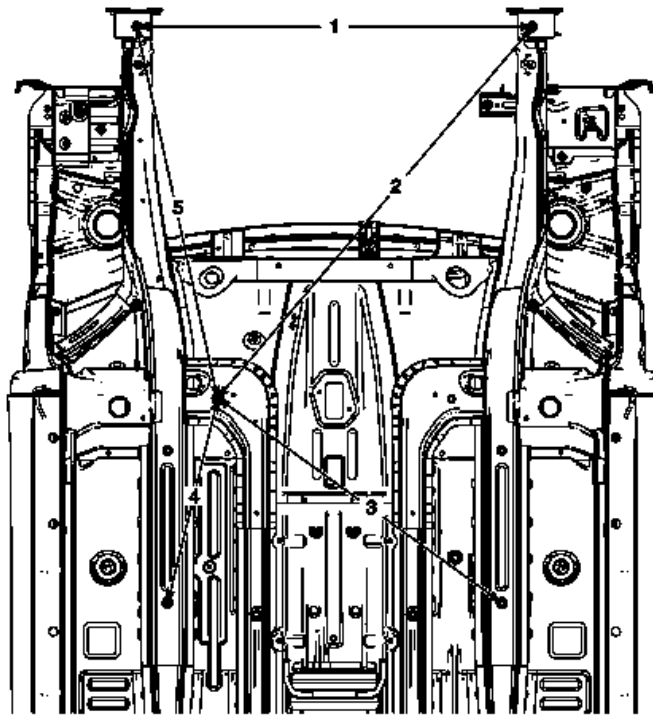


Fig. 3: Front End Lower Measurements
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	918 mm
2	1131 mm
3	812 mm
4	488 mm
5	884 mm

Rear End Lower

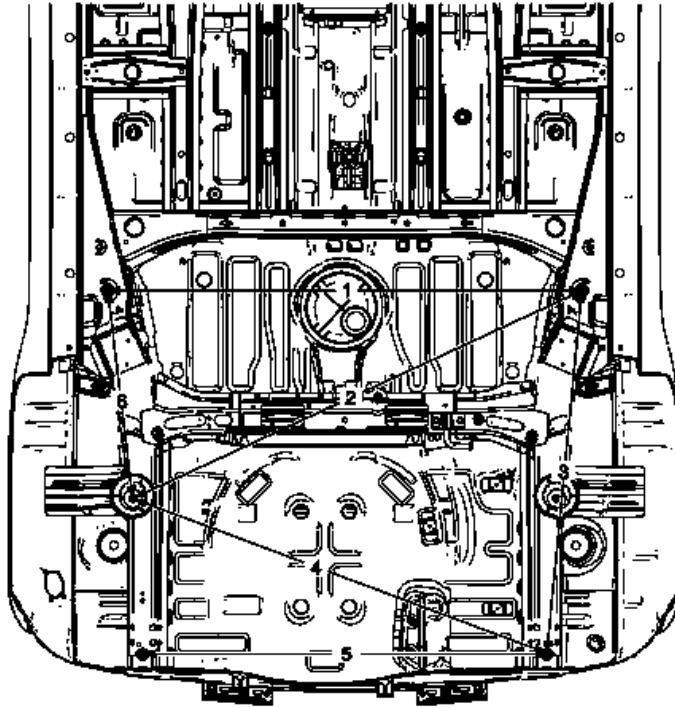


Fig. 4: Rear End Lower Measurements
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	1132 mm
2	1191 mm
3	904 mm
4	1053 mm
5	960 mm
6	528 mm

Rear End

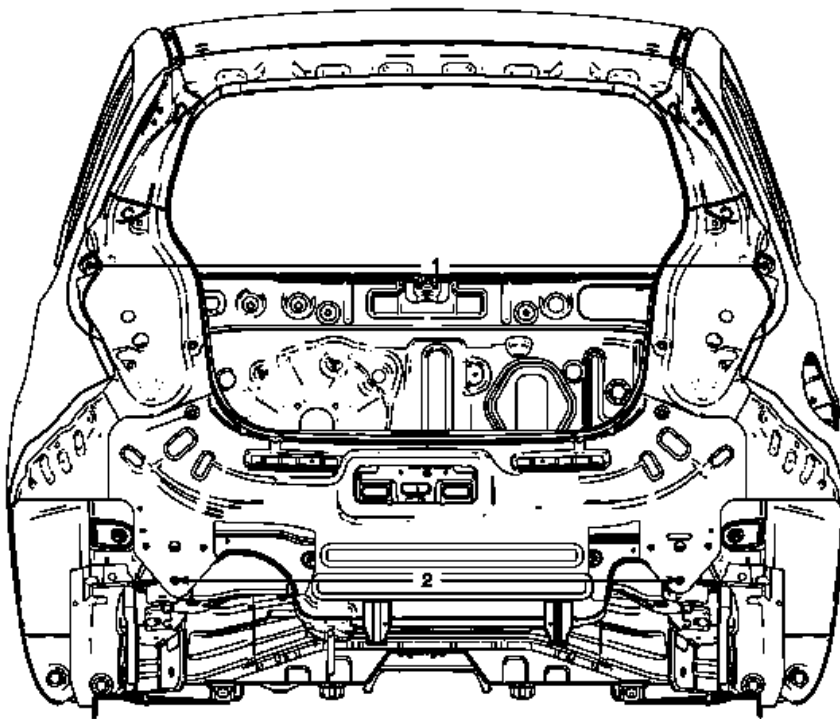


Fig. 5: Rear End Measurements
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	1284 mm
2	910 mm

Side

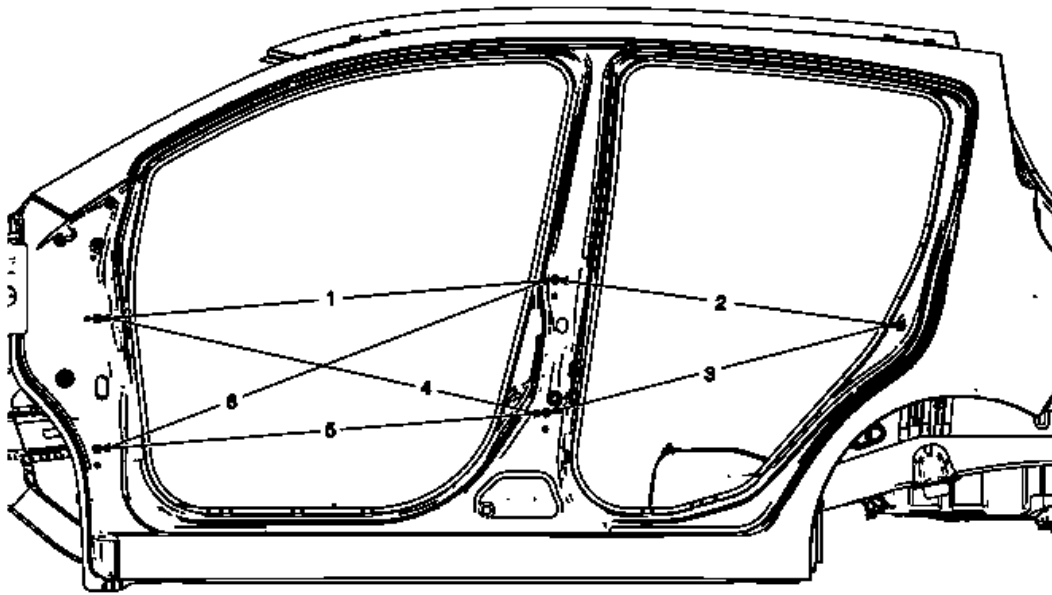


Fig. 6: Side Measurements
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	1060 mm
2	805 mm
3	843 mm
4	1058 mm
5	1039 mm
6	1127 mm

Side Measurements

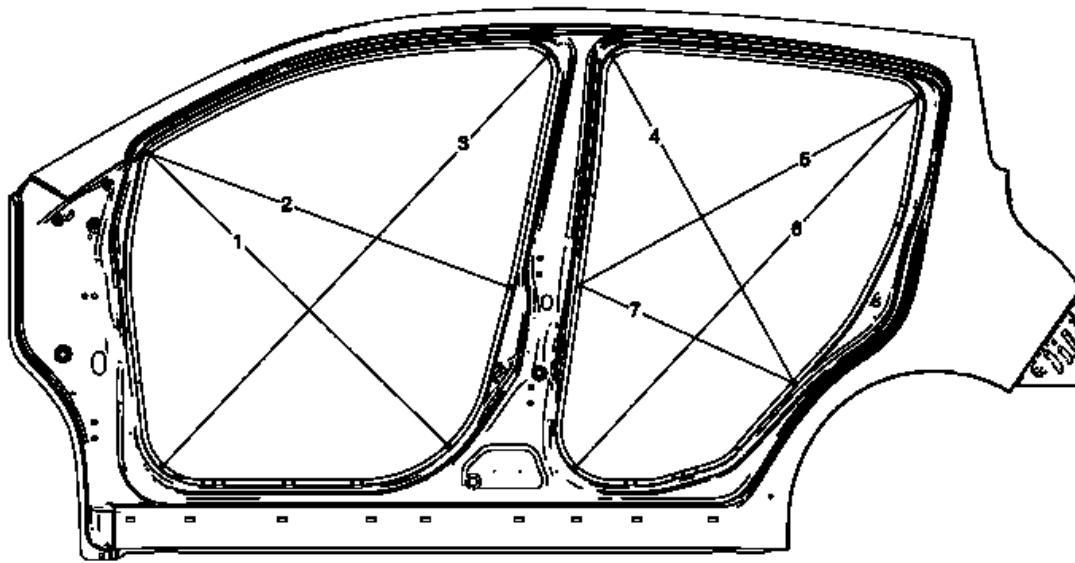


Fig. 7: Side Measurements
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	981 mm
2	916 mm
3	1338 mm
4	896 mm
5	927 mm
6	1199 mm
7	563 mm

VISUAL IDENTIFICATION

STRUCTURE IDENTIFICATION

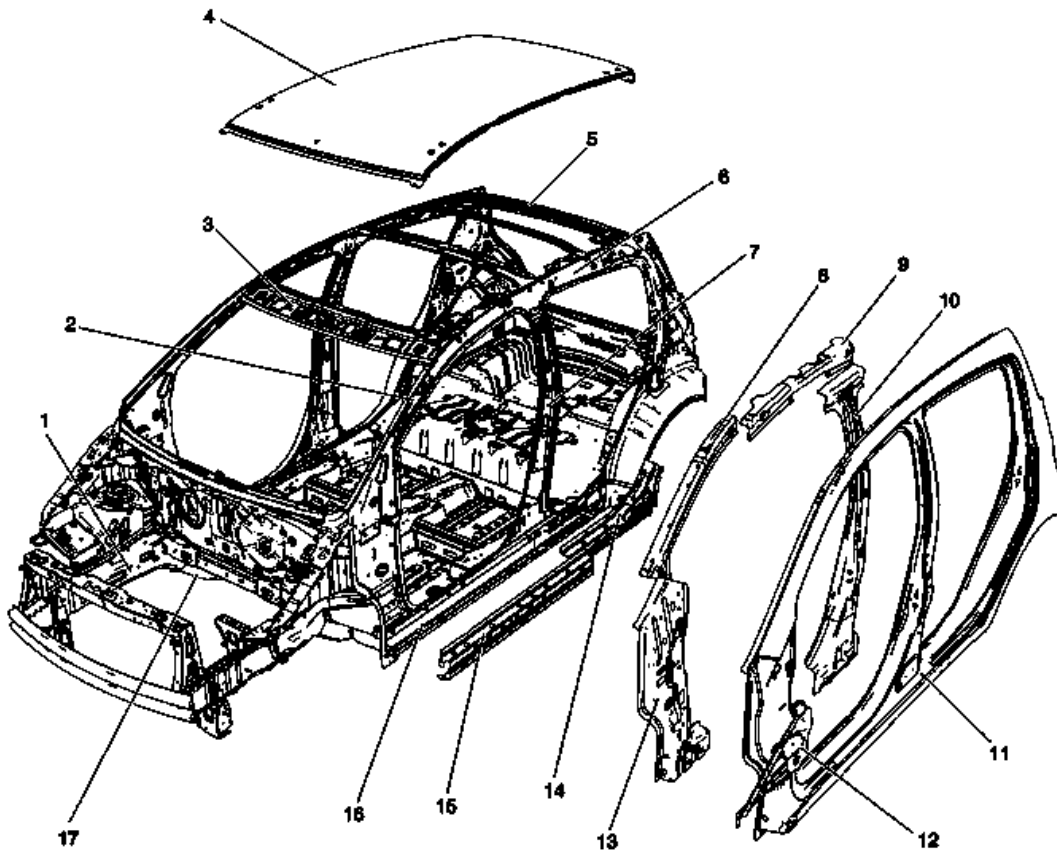


Fig. 8: Front View Of Structure Identification
 Courtesy of GENERAL MOTORS COMPANY

Front View

Number	Description	Material	Procedure
1	Front Compartment Side Rail (Front)	<u>High Strength Low Alloy Steel</u>	<u>Front Compartment Side Rail Bracket Replacement</u>
2	Roof Inner Front Side Rail	<u>Dual Phase Steel</u>	-
3	Roof Front Inner Panel	<u>Mild Steel</u>	<u>Roof Front Header Panel Replacement</u>
4	Roof Panel	<u>Mild Steel</u>	<u>Roof Outer Panel Replacement</u>
5	Roof Rear Inner Panel Assembly	<u>Mild Steel</u>	<u>Roof Rear Header Panel Replacement</u>
6	Roof Inner Rear Side Rail	<u>Dual Phase Steel</u>	-
7	Center Pillar Inner Panel	<u>Dual Phase Steel</u>	<u>Body Lock Pillar Inner Panel Replacement</u>

8	Roof Outer Front Side Rail	<u>Dual Phase Steel</u>	-
9	Roof Outer Rear Side Rail	<u>Dual Phase Steel</u>	-
10	Center Pillar Reinforcement	<u>High Strength Low Alloy Steel</u>	<u>Body Lock Pillar Outer Panel Reinforcement Replacement</u>
11	Body Side Outer Panel	<u>Mild Steel</u>	<u>Front Hinge Pillar Body Sectioning</u>
12	Front Compartment Upper Side Rail	<u>High Strength Low Alloy Steel</u>	<u>Front Compartment Upper Side Rail Replacement</u>
13	Hinge Pillar Outer Lower Reinforcement	<u>Dual Phase Steel</u>	<u>Body Hinge Pillar Lower Reinforcement Replacement</u>
14	Rocker Outer Panel Center Pillar Reinforcement Assembly	<u>Dual Phase Steel</u>	<u>Body Side Outer Panel Reinforcement Replacement</u>
15	Rocker Front Outer Panel Reinforcement	<u>Ultra High Strength Dual Phase Steel</u>	<u>Body Side Outer Panel Reinforcement Replacement</u>
16	Rocker Inner Panel	<u>Dual Phase Steel</u>	-
17	Floor Panel #2 Cross Bar	<u>Ultra High Strength Dual Phase Steel</u>	-
18	Floor Panel #1 Cross Bar	<u>Ultra High Strength Dual Phase Steel</u>	-
19	Front Compartment Side Rail (Rear)	<u>Mild Steel</u>	<u>Front Compartment Side Rail Bracket Replacement</u>
20	Front Wheelhouse Rear Panel	<u>High Strength Low Alloy Steel</u>	<u>Front Wheelhouse Panel Replacement</u>

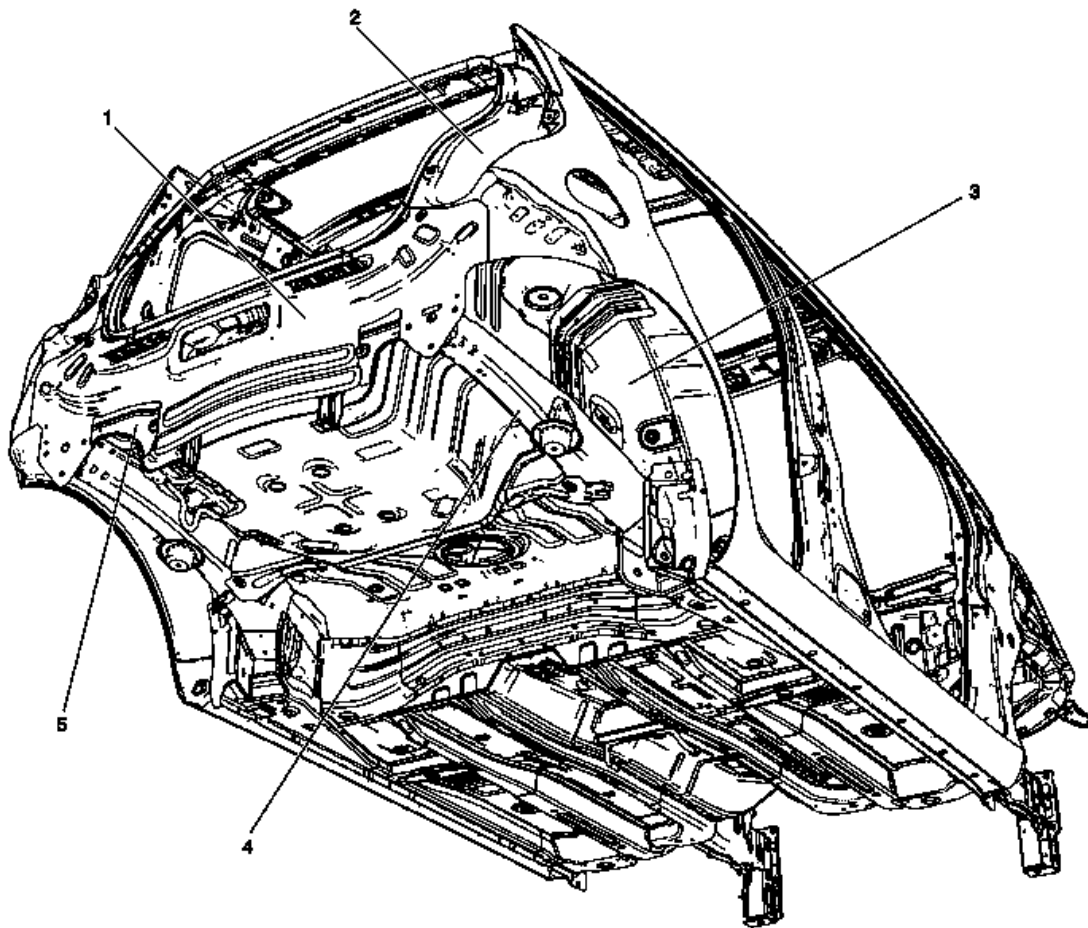


Fig. 9: Rear View Of Structure Identification
 Courtesy of GENERAL MOTORS COMPANY

Rear View

Number	Description	Material	Procedure
1	Rear End Lower Panel	<u>High Strength Low Alloy Steel</u>	<u>Rear End Panel Replacement</u>
2	Body Tail Lamp Fill Panel	<u>Mild Steel</u>	<u>Tail Lamp Pocket Replacement</u>
3	Rear Wheelhouse Inner Panel	<u>High Strength Low Alloy Steel</u>	<u>Quarter Inner Panel Replacement</u>
4	Underbody Rear Side Rear Rail	<u>High Strength Low Alloy Steel</u>	<u>Rear Rail Sectioning</u>
5	Rear End Lower Panel Reinforcement	<u>High Strength Low Alloy Steel</u>	<u>Rear End Panel Replacement</u>

REPAIR INSTRUCTIONS

OVERLAP/BACKING PLATE SECTIONING

WARNING: Refer to Approved Equipment for Collision Repair Warning .

1. Fit the service panel to the vehicle to ensure a proper fit.
2. Measure and mark a line at the sail panel 120 mm (4 3/4 in) from the back glass opening and 70 mm (2 3/4 in) rearward from the rocker panel locating hole edge of the service panel.
3. Cut along the line to trim the service panel.
4. Fabricate a 50 mm (2 in) backer plate so that the panel will fit behind the sectioning joint at the sail panel.
5. Fabricate a 100 mm (4 in) backer plate for the rocker panel.
6. Drill 8 mm (5/16 in) plug weld holes as necessary in the locations noted from the original panel.
7. Bevel the sail panel and service panel edges at the sectioned area to approximately 10 degrees.
8. Grind a 50 mm (2 in) area of the outer surface on the vehicle to remove any corrosion, E-coat, primers, coatings and galvanizing that may be present.
9. At the section area on the service panel, grind a 50 mm (2 in) area of the back side to remove any corrosion, E-coat, primers, coatings and galvanizing that may be present.
10. Drill plug weld holes approximately 13 mm (1/2 in) from the edge of the cuts the sectioning areas of the service panel and the original panel.
11. Prepare all mating surfaces as necessary.
12. Apply GM-approved weld-thru coating or equivalent to all mating surfaces. Refer to Anti-Corrosion Treatment and Repair .
13. Position and clamp or screw the backer plate with half of the backer plate exposed at the sectioning joint.

NOTE: Leave a gap of 1 1/2 times the thickness of the metal at the sectioning joint to the original panel.

14. Position the service panel to overlap the backer plate and 1 1/2 times the thickness up to the original panel.
15. Check for proper fit and alignment to the vehicle. Clamp the panels together.
16. Plug weld the backer plate accordingly.
17. Stitch weld along the entire sectioning joint, make 25 mm (1 in) welds along the seam with 25 mm (1 in) gaps between them.
18. Complete the stitch weld.
19. Clean and prepare all welded surfaces of the entire sectioning joint.

NOTE: Always follow the system manufacturer's instructions for application, handling and curing.

20. Apply a lightweight body filler to the backer plate area.

DRIVETRAIN AND FRONT SUSPENSION FRAME FRONT SUPPORT REPLACEMENT

Removal Procedure

WARNING: Refer to Approved Equipment for Collision Repair Warning

WARNING: Refer to Collision Sectioning Warning

WARNING: Refer to Glass and Sheet Metal Handling Warning

1. Disable the SIR System. Refer to SIR Disabling and Enabling
2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to Anti-Corrosion Treatment and Repair

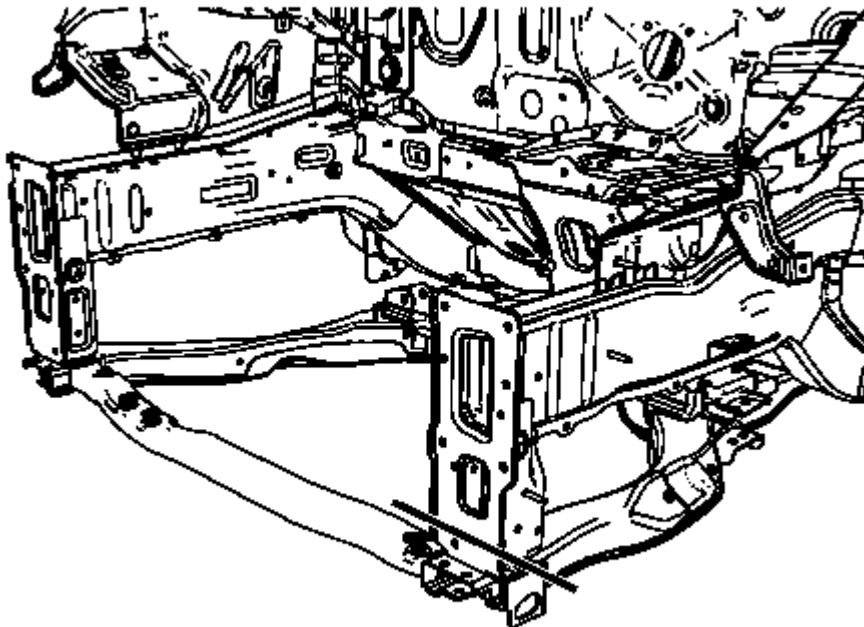


Fig. 10: Drivetrain And Front Suspension Frame
Courtesy of GENERAL MOTORS COMPANY

6. Create cut lines on the drivetrain and front suspension frame front support.

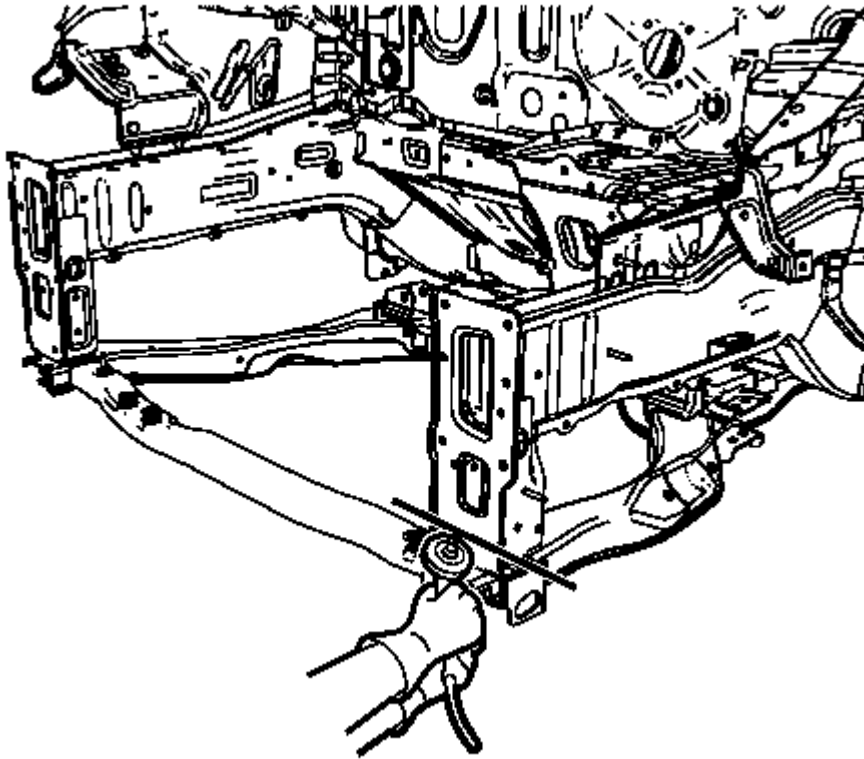


Fig. 11: Inner Panels

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage any inner panels or reinforcements.

7. Cut the panel where sectioning is to be performed.

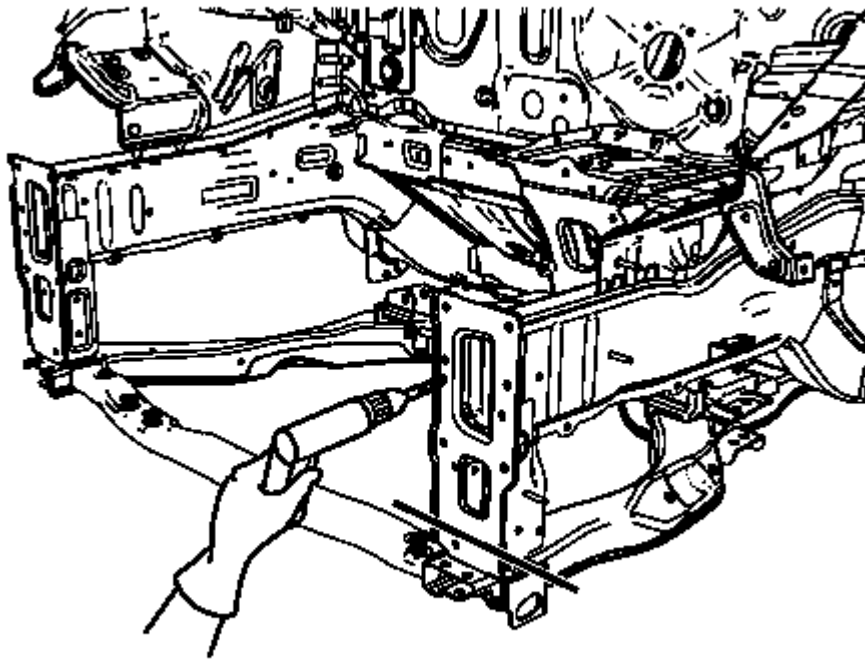


Fig. 12: Drilling all factory welds

Courtesy of GENERAL MOTORS COMPANY

8. Locate and mark all the necessary factory welds of the drivetrain and front suspension frame front support.
9. Drill all factory welds. Note the number and location of welds for installation of the service assembly.

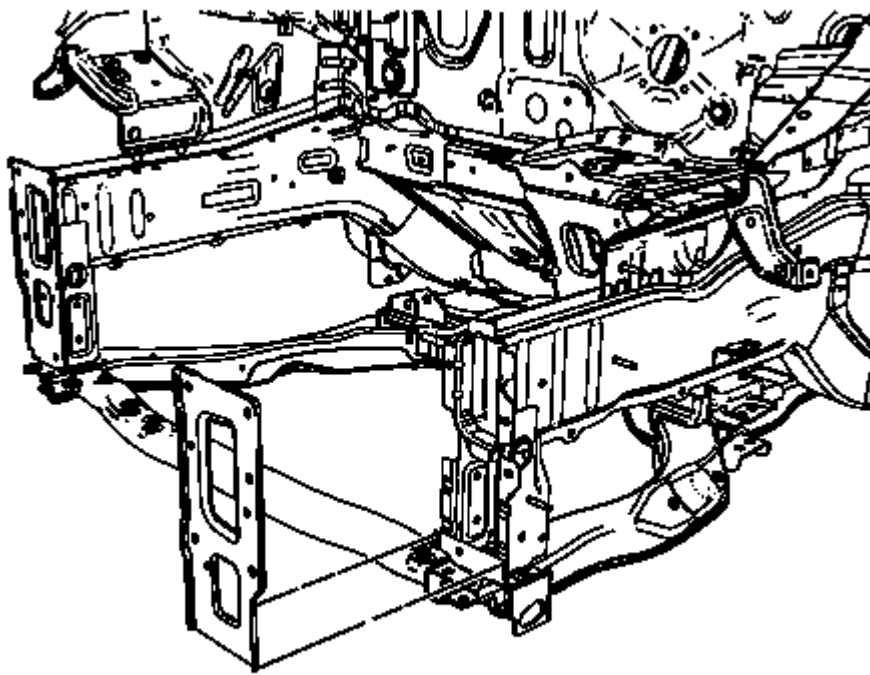


Fig. 13: Drivetrain And Front Suspension Frame
Courtesy of GENERAL MOTORS COMPANY

10. Remove the damaged drivetrain and front suspension frame front support.

Installation Procedure

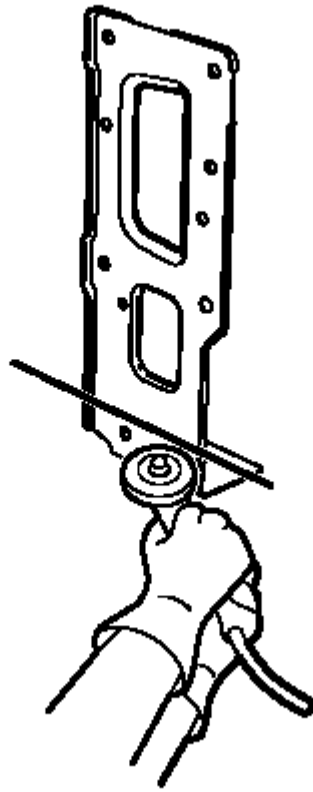


Fig. 14: Cutting Drivetrain And Front Suspension Frame Front Support
Courtesy of GENERAL MOTORS COMPANY

1. Cut the drivetrain and front suspension frame front support in corresponding locations to fit the remaining original panel. The sectioning joint should be trimmed to allow a gap of one-and-one-half-times the metal thickness at the sectioning joint.
2. Create a 50 mm (2 in) backing plate from the unused portion of the service part.
3. Drill 8 mm (5/16 in) along the sectioning cut on the remaining original part. Locate these holes 13 mm (1/2 in) from the edge of part and spaced 40 mm (1 1/2 in) apart.
4. Prepare all mating surfaces as necessary.
5. Fit the backing plates halfway into the sectioning joints, clamp in place and plug weld to the vehicle.
6. Align the drivetrain and front suspension frame front support.

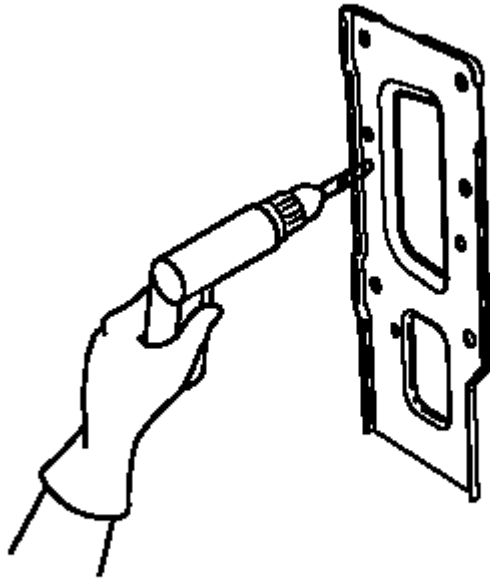


Fig. 15: Drilling For Plug Welding Along Edges Of Front Suspension Frame Front Support
Courtesy of GENERAL MOTORS COMPANY

7. Drill 8 mm (5/16 in) for plug welding along the edges of the front suspension frame front support as noted from the original panel.
8. Clean and prepare the attaching surfaces for welding.
9. Position the front suspension frame front support on the vehicle.
10. Verify the fit of the front suspension frame front support.
11. Clamp the front suspension frame front support into position.

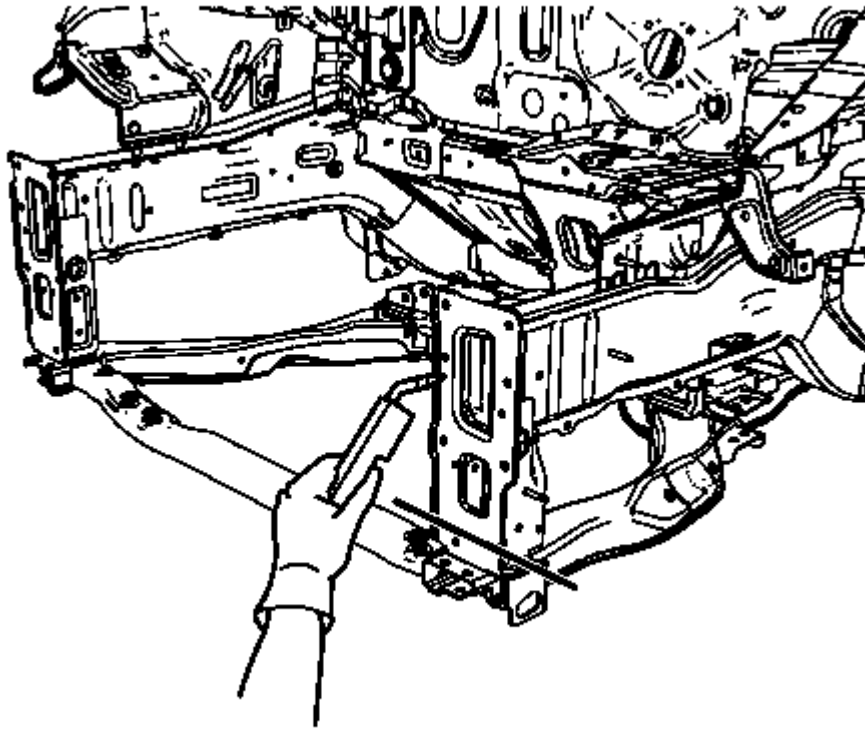


Fig. 16: Suspension Frame Front Support
Courtesy of GENERAL MOTORS COMPANY

12. Plug weld accordingly.
13. To create a solid weld with minimum heat distortion, make 25 mm (1 in) stitch welds along the seam with 25 mm (1 in) gaps between them. Then go back and complete the stitch weld.
14. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .
15. Paint the repaired area. Refer to **Basecoat/Clearcoat Paint Systems** .
16. Install all related panels and components.
17. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
18. Enable the SIR system. Refer to **SIR Disabling and Enabling** .

FRONT COMPARTMENT SIDE RAIL BRACKET REPLACEMENT

Removal Procedure

WARNING: Refer to **Approved Equipment for Collision Repair Warning** .

WARNING: Refer to Glass and Sheet Metal Handling Warning .

NOTE: In the Removal Procedure, steps 6, 7 and 8 are exactly the same except with different graphics.

1. Disable the SIR System. Refer to SIR Disabling and Enabling .
2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection .
3. Remove all the related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to Anti-Corrosion Treatment and Repair .

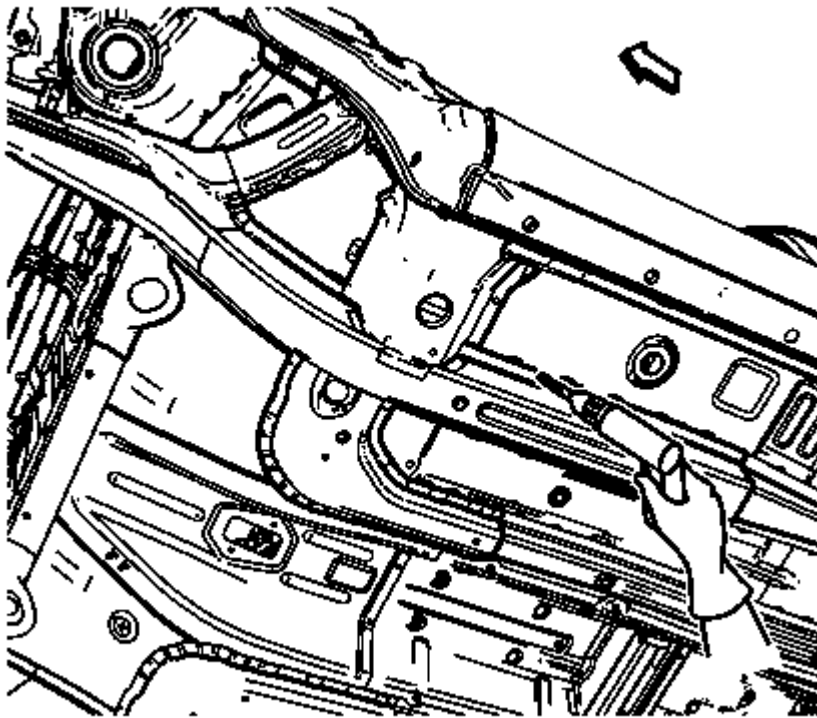


Fig. 17: Locating Necessary Factory Welds
Courtesy of GENERAL MOTORS COMPANY

6. Locate and mark all the necessary factory welds and weld seams of the front compartment side rail.

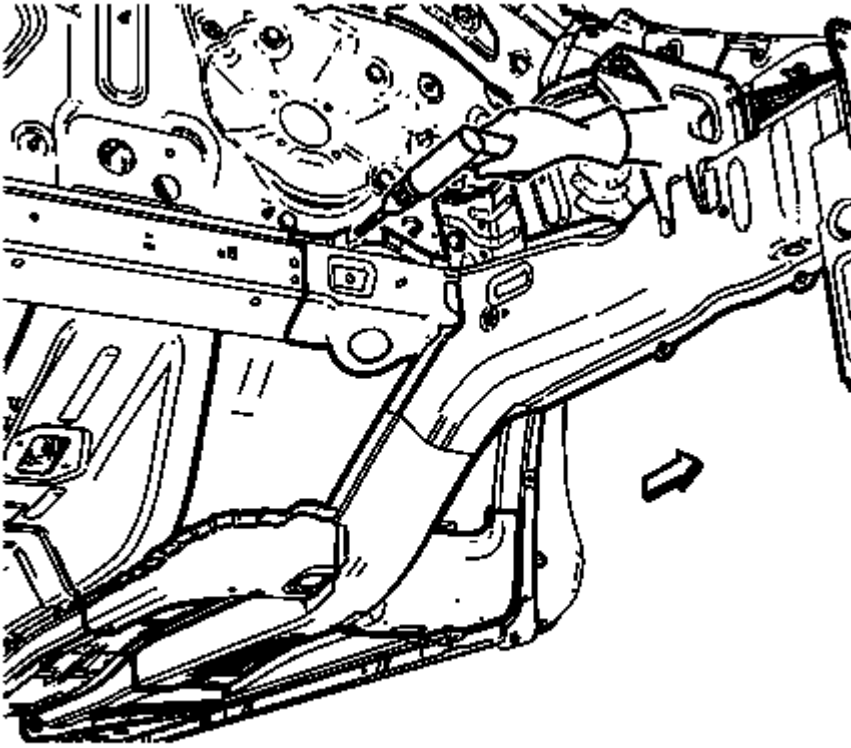


Fig. 18: Locating Necessary Factory Welds
Courtesy of GENERAL MOTORS COMPANY

7. Locate and mark all the necessary factory welds and weld seams of the front compartment side rail.

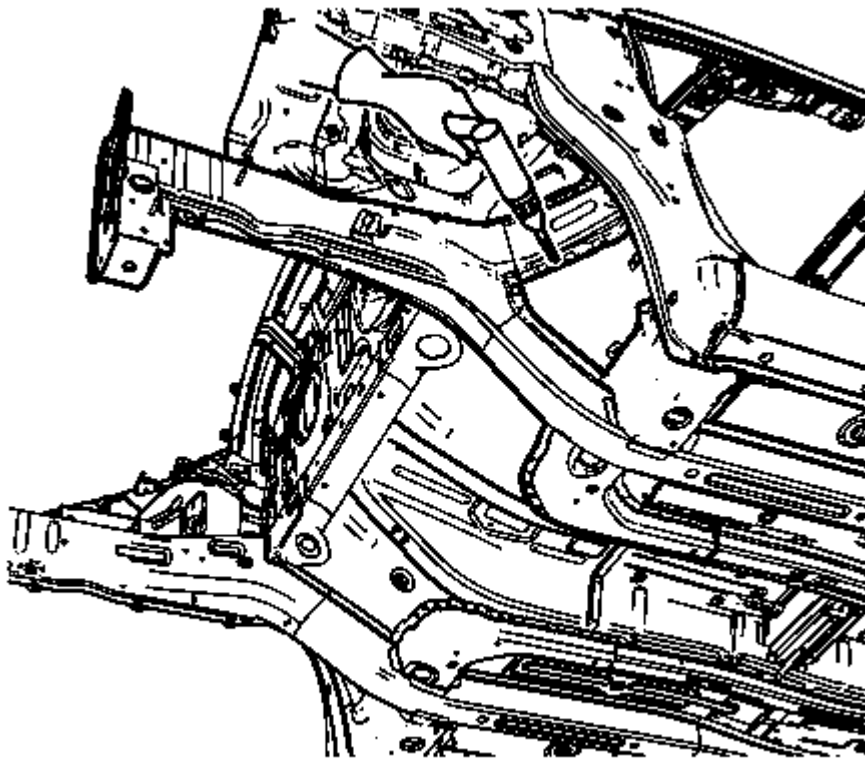


Fig. 19: Locating Necessary Factory Welds
Courtesy of GENERAL MOTORS COMPANY

8. Locate and mark all the necessary factory welds and weld seams of the front compartment side rail.

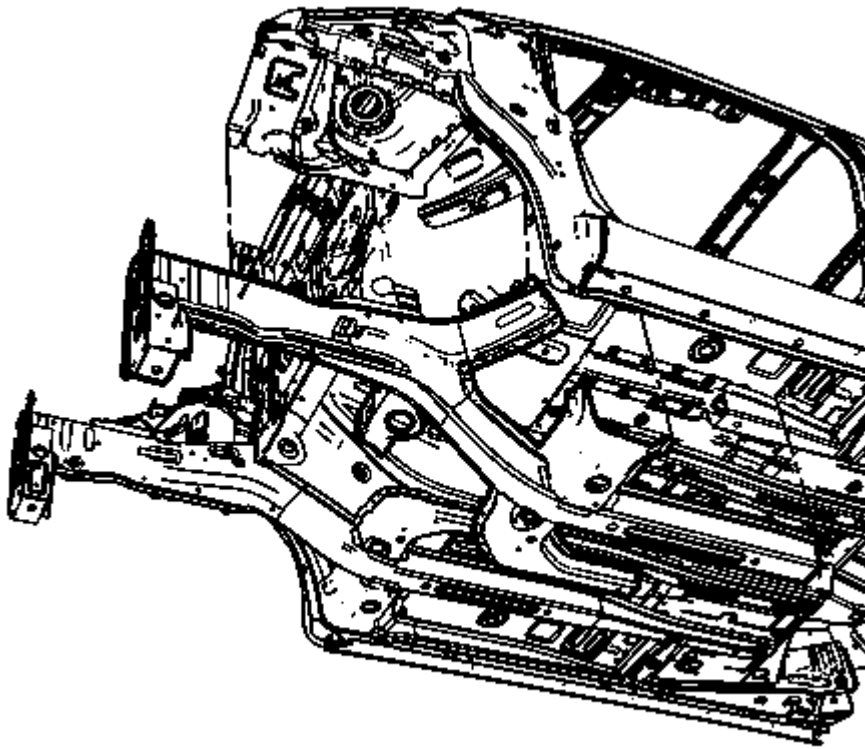


Fig. 20: Front Compartment Side Rail Wheelhouse Panel
Courtesy of GENERAL MOTORS COMPANY

9. Remove the front compartment side rail wheelhouse panel.

Installation Procedure

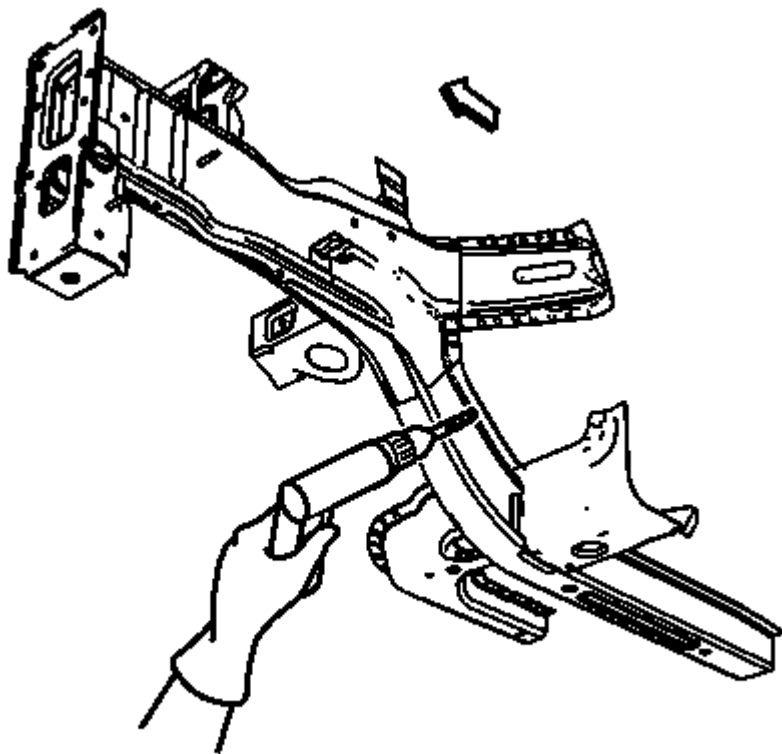


Fig. 21: Drilling 8 mm (5/16 In) For Plug Welding Along Edges Of Front Compartment Side Rail
Courtesy of GENERAL MOTORS COMPANY

1. Drill 8 mm (5/16 in) for plug welding along the edges of the front compartment side rail as noted from the original panel.
2. Clean and prepare the attaching surfaces for welding.

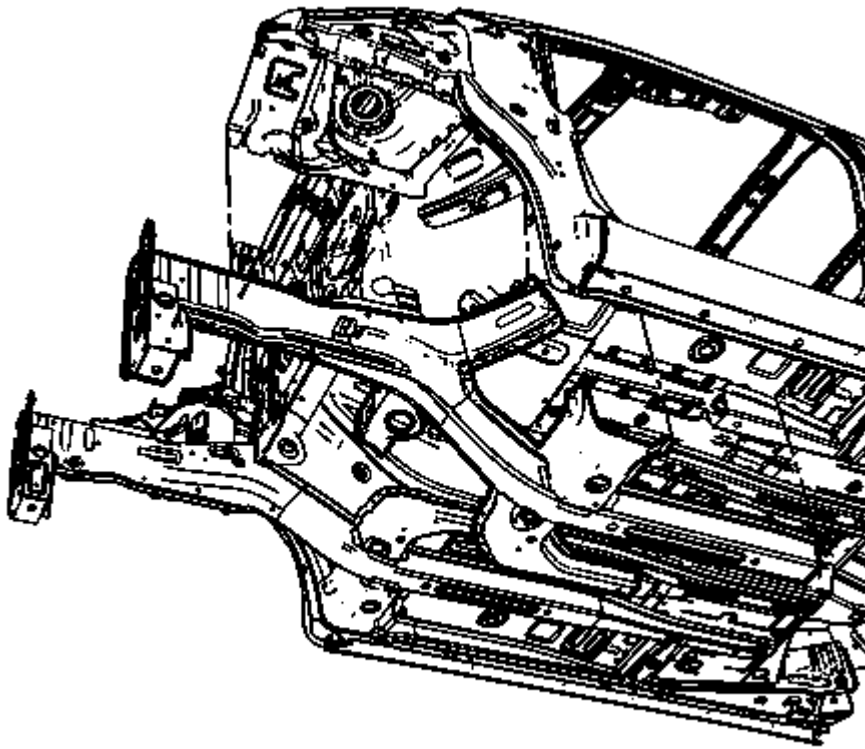


Fig. 22: Front Compartment Side Rail Wheelhouse Panel
Courtesy of GENERAL MOTORS COMPANY

3. Position the front compartment side rail on the vehicle.
4. Verify the fit of the front compartment side rail on the vehicle.
5. Clamp the front compartment side rail into position.

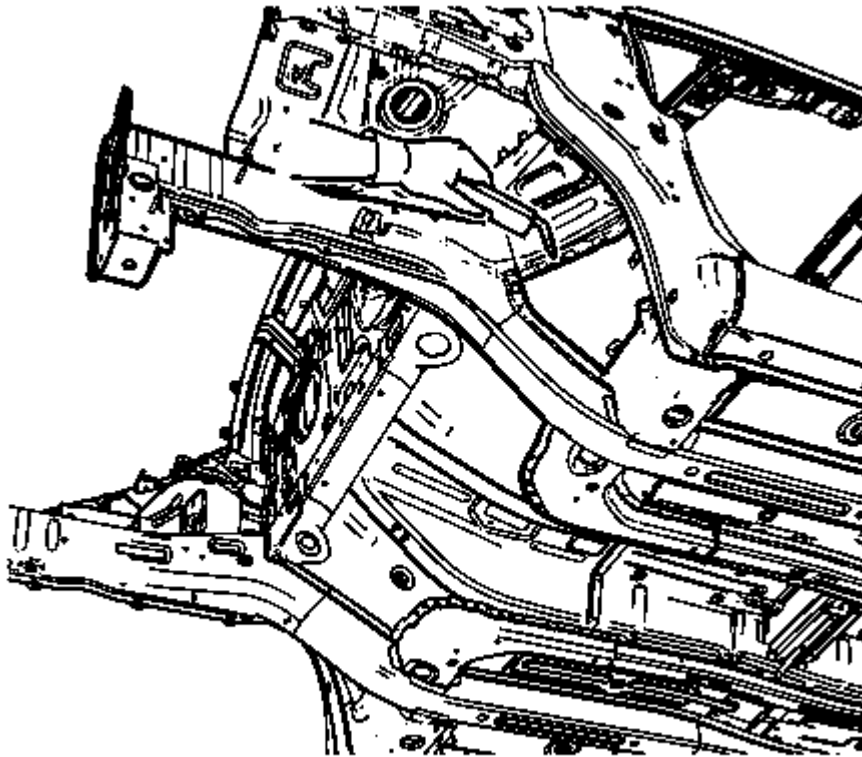


Fig. 23: Applying Sealers And Anti-Corrosion Materials
Courtesy of GENERAL MOTORS COMPANY

6. Plug the weld accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .
8. Paint the repaired area. Refer to **Basecoat/Clearcoat Paint Systems** .
9. Install all the related panels and components.
10. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
11. Enable the SIR system. Refer to **SIR Disabling and Enabling** .

FRONT WHEELHOUSE PANEL REPLACEMENT

Removal Procedure

WARNING: Refer to **Approved Equipment for Collision Repair Warning** .

WARNING: Refer to **Glass and Sheet Metal Handling Warning** .

1. Disable the SIR system. Refer to **SIR Disabling and Enabling** .
2. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .

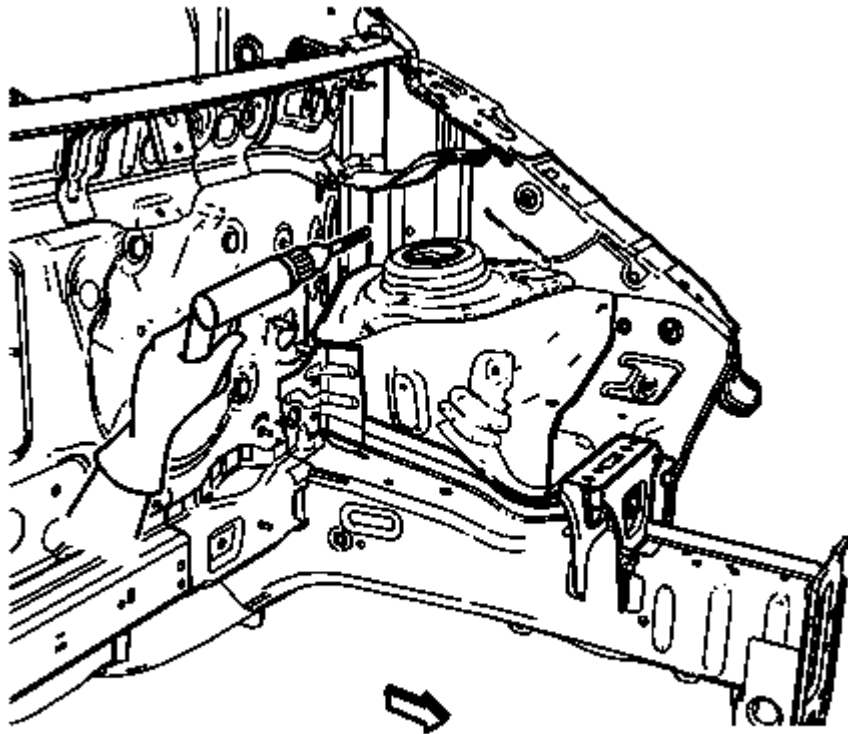


Fig. 24: Removing Sealers And Anti-Corrosion Materials
Courtesy of GENERAL MOTORS COMPANY

6. Locate and mark all the necessary factory welds and weld seams of the front wheelhouse panel.

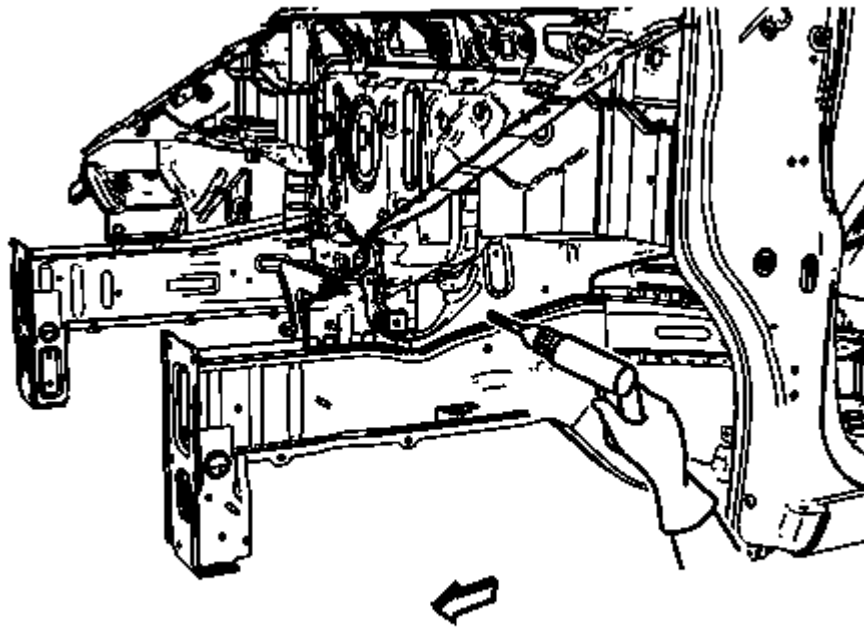


Fig. 25: Drilling All Factory Welds
Courtesy of GENERAL MOTORS COMPANY

7. Drill all factory welds. Note the number and location of welds for installation of the service assembly.
8. Cut the adhesive in the front area and where the front wheelhouse and the front compartment side rail overlap with an appropriate tool.

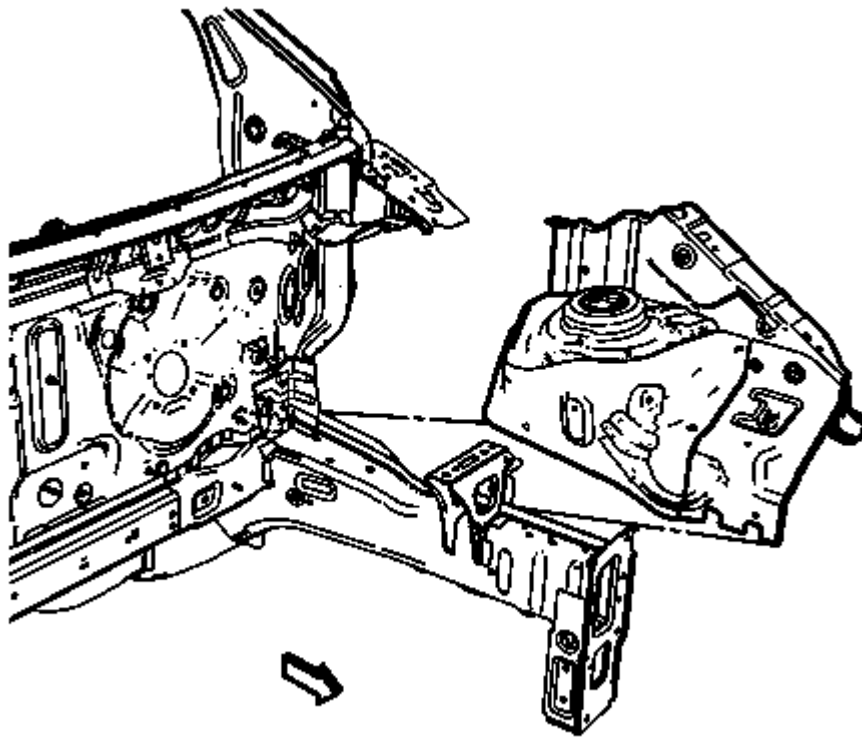


Fig. 26: Front Wheelhouse Panel
Courtesy of GENERAL MOTORS COMPANY

9. Remove the front wheelhouse panel.

Installation Procedure

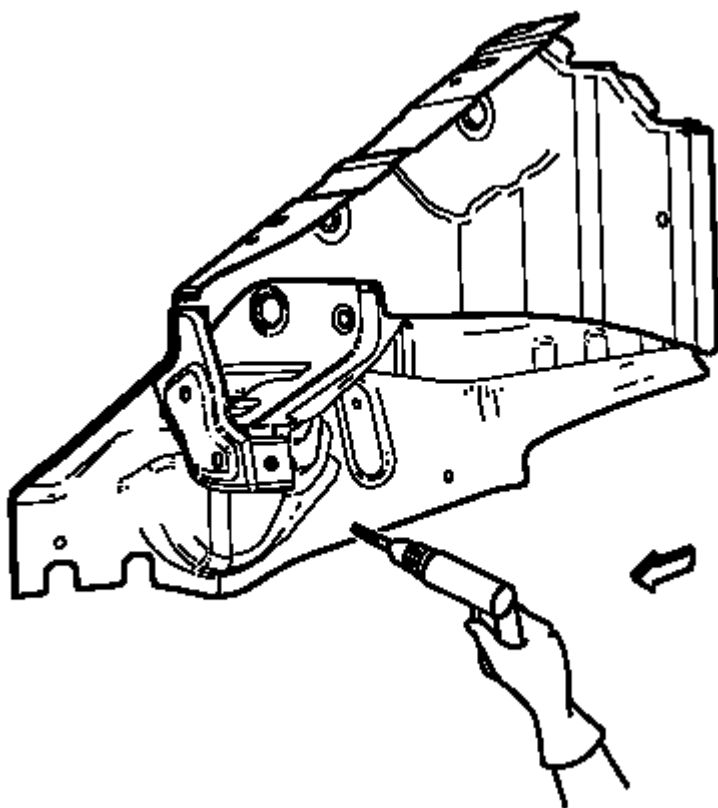


Fig. 27: Drilling 8 Mm (5/16 In) For Plug Welding Along Edges Of Wheelhouse Panel
Courtesy of GENERAL MOTORS COMPANY

NOTE: Double the number of drills at the flange where the front wheelhouse panel and front compartment side rail overlap.

1. Drill 8 mm (5/16 in) for plug welding along the edges of the wheelhouse panel as noted from the original panel.
2. Clean and prepare the attaching surfaces for welding.

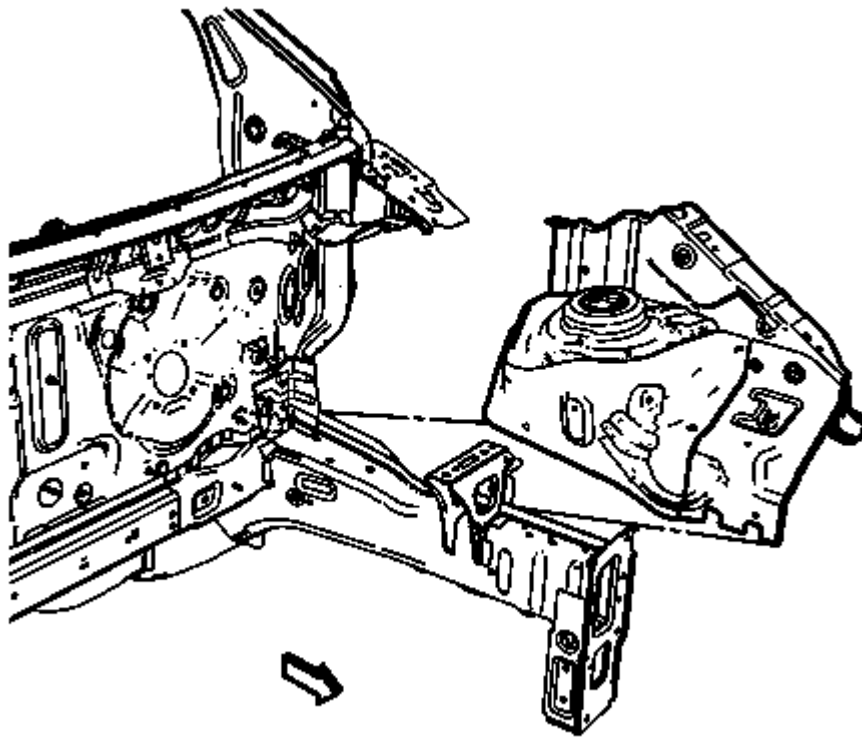


Fig. 28: Front Wheelhouse Panel

Courtesy of GENERAL MOTORS COMPANY

3. Position the wheelhouse panel on the vehicle.
4. Verify the fit of the wheelhouse panel on the vehicle.
5. Clamp the wheelhouse panel into position.

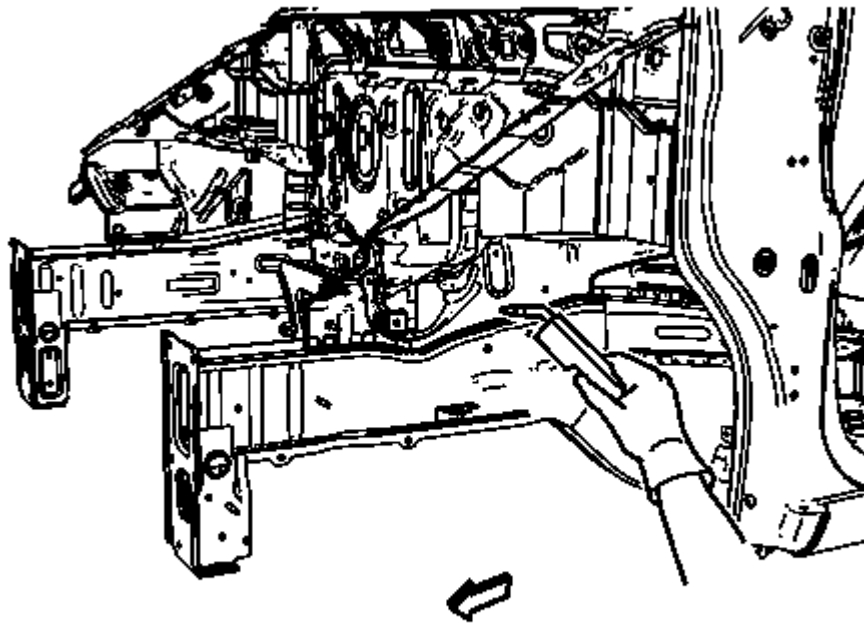


Fig. 29: Applying Sealers And Anti-Corrosion Materials
Courtesy of GENERAL MOTORS COMPANY

6. Plug weld accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .
8. Paint the repaired area. Refer to **Basecoat/Clearcoat Paint Systems** .
9. Install all related panels and components.
10. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
11. Enable the SIR system. Refer to **SIR Disabling and Enabling** .

FRONT COMPARTMENT UPPER SIDE RAIL REPLACEMENT

Removal Procedure

WARNING: Refer to **Approved Equipment for Collision Repair Warning** .

WARNING: Refer to **Glass and Sheet Metal Handling Warning** .

1. Disable the SIR System. Refer to **SIR Disabling and Enabling** .
2. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .

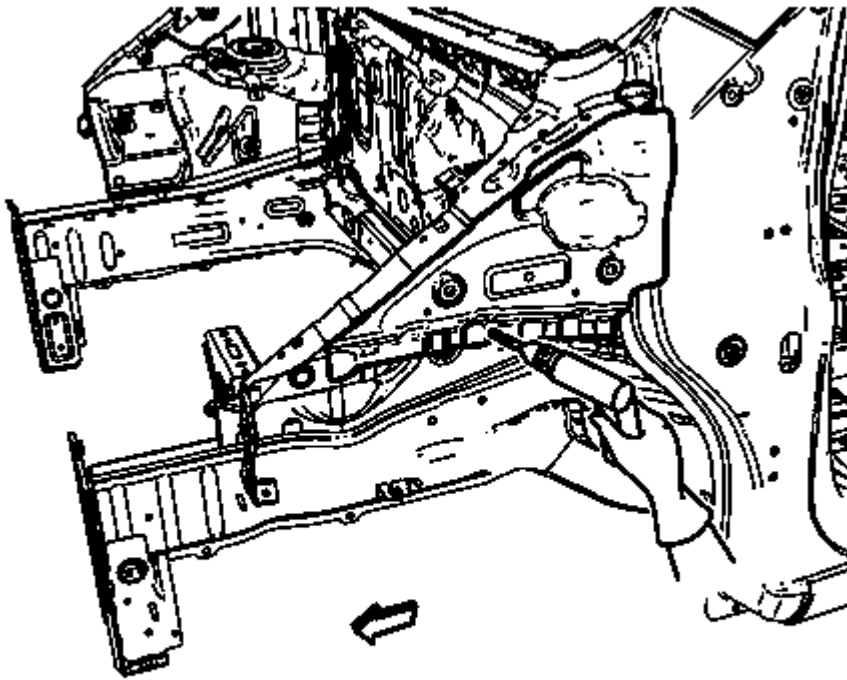


Fig. 30: Marking All Necessary Factory Welds
Courtesy of GENERAL MOTORS COMPANY

6. Locate and mark all the necessary factory welds and weld seams of the front compartment upper side rail.
7. Drill all factory welds. Note the number and location of welds for installation of the service assembly.

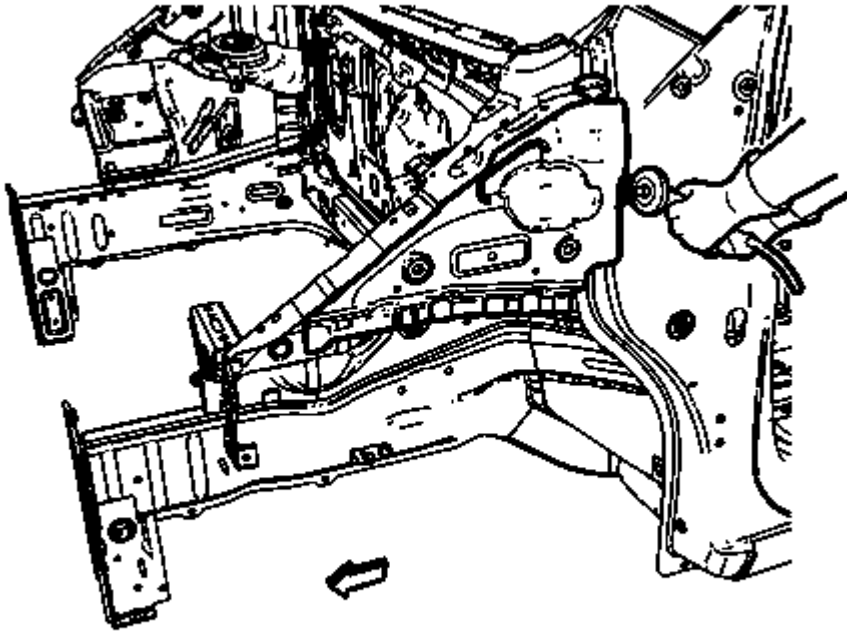


Fig. 31: Grinding Factory Weld Seams
Courtesy of GENERAL MOTORS COMPANY

8. Grind factory weld seams.

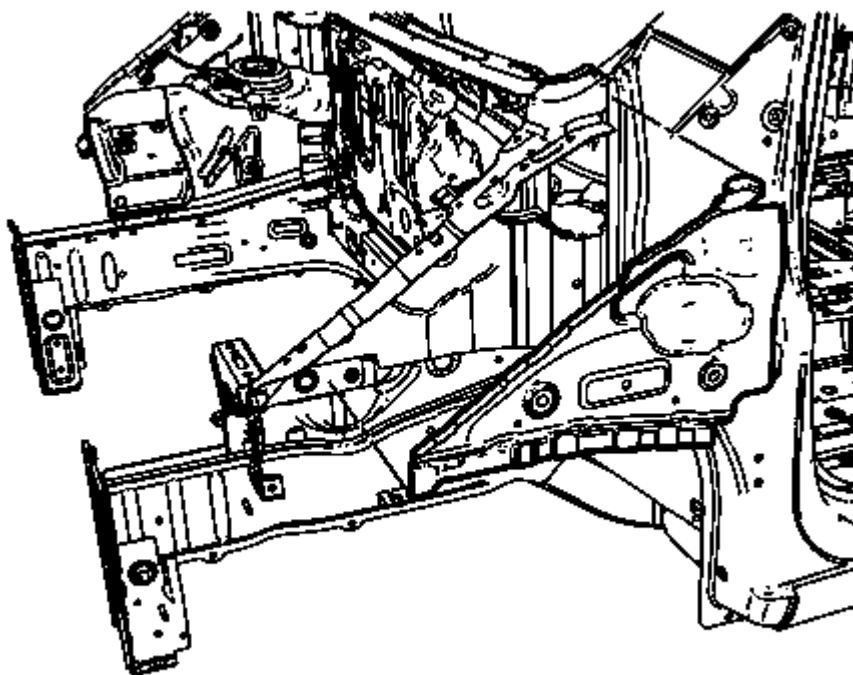


Fig. 32: Removing Front Compartment Upper Side Rail
Courtesy of GENERAL MOTORS COMPANY

9. Remove the front compartment upper side rail.

Installation Procedure

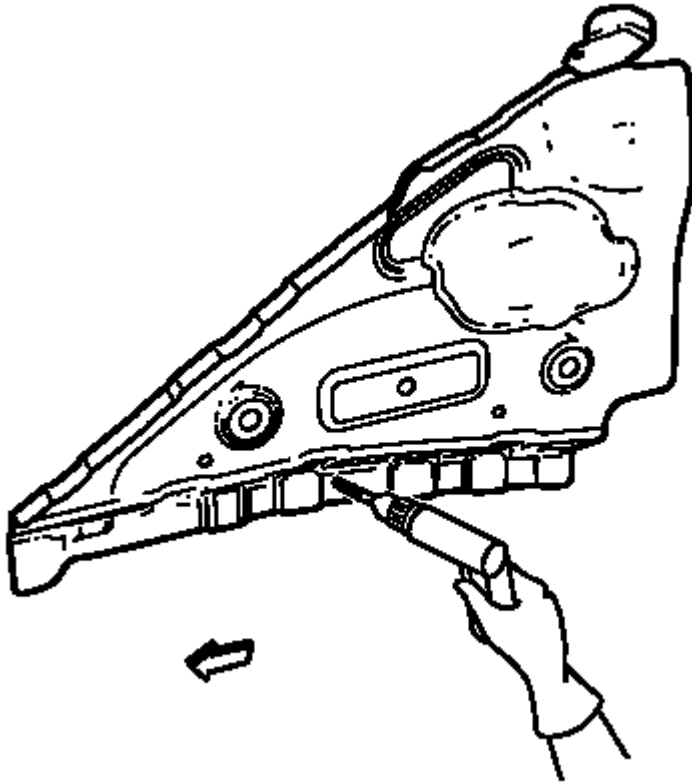


Fig. 33: Drilling 8 Mm (5/16 In) For Plug Welding Along Edges Of Front Compartment Upper Side Rail

Courtesy of GENERAL MOTORS COMPANY

1. Drill 8 mm (5/16 in) for plug welding along the edges of the front compartment upper side rail as noted from the original panel.
2. Clean and prepare the attaching surfaces for welding.
3. Position the front compartment upper side rail on the vehicle.
4. Verify the fit of the front compartment upper side rail.
5. Clamp the front compartment upper side rail into position.

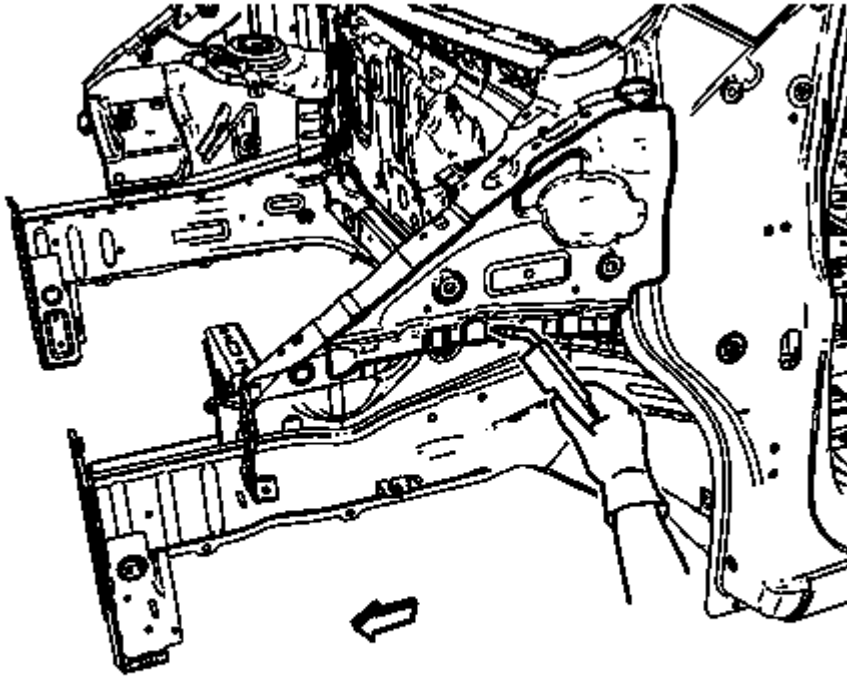


Fig. 34: Front Hinge Pillar Body Area
Courtesy of GENERAL MOTORS COMPANY

NOTE: Plug weld factory slots in the front hinge pillar body area (1) as noted from the original panel.

6. Plug weld accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to Anti-Corrosion Treatment and Repair .
8. Paint the repaired area. Refer to Basecoat/Clearcoat Paint Systems .
9. Install all related panels and components.
10. Connect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection .
11. Enable the SIR system. Refer to SIR Disabling and Enabling .

FRONT HINGE PILLAR BODY SECTIONING

Removal Procedure

WARNING: Refer to Approved Equipment for Collision Repair Warning .

WARNING: Refer to Collision Sectioning Warning .

WARNING: Refer to Glass and Sheet Metal Handling Warning .

1. Disable the SIR system. Refer to SIR Disabling and Enabling .
2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection .
3. Remove all the related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to Anti-Corrosion Treatment and Repair .

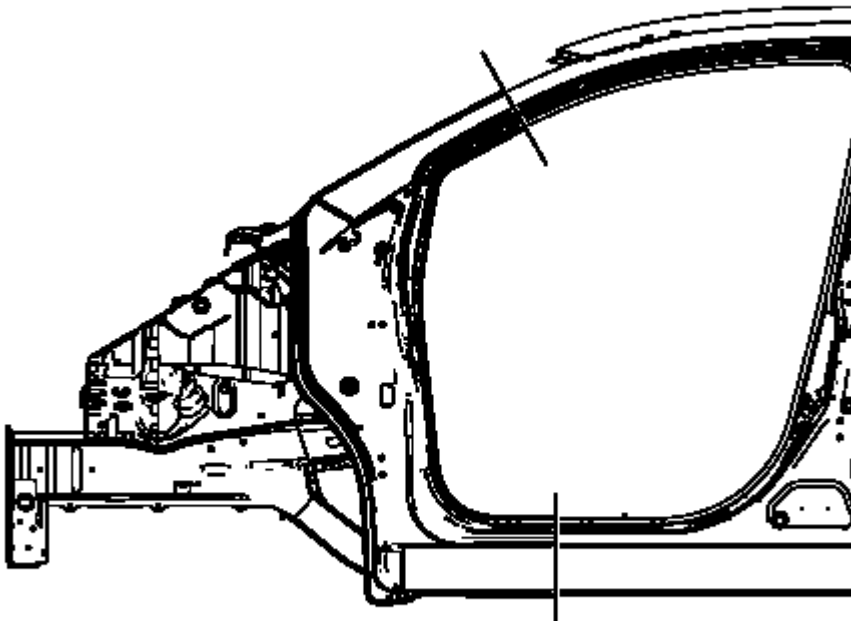


Fig. 35: Front Hinge Pillar Body
Courtesy of GENERAL MOTORS COMPANY

6. Create cut lines on the front hinge pillar body.

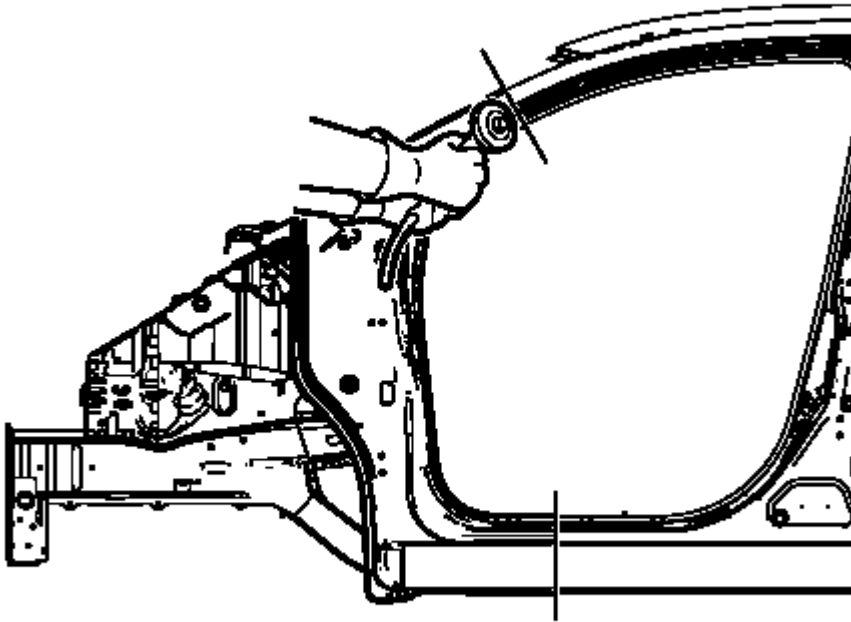


Fig. 36: Cutting Inner Panels

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage any inner panels or reinforcements.

7. Cut the panel where sectioning is to be performed.

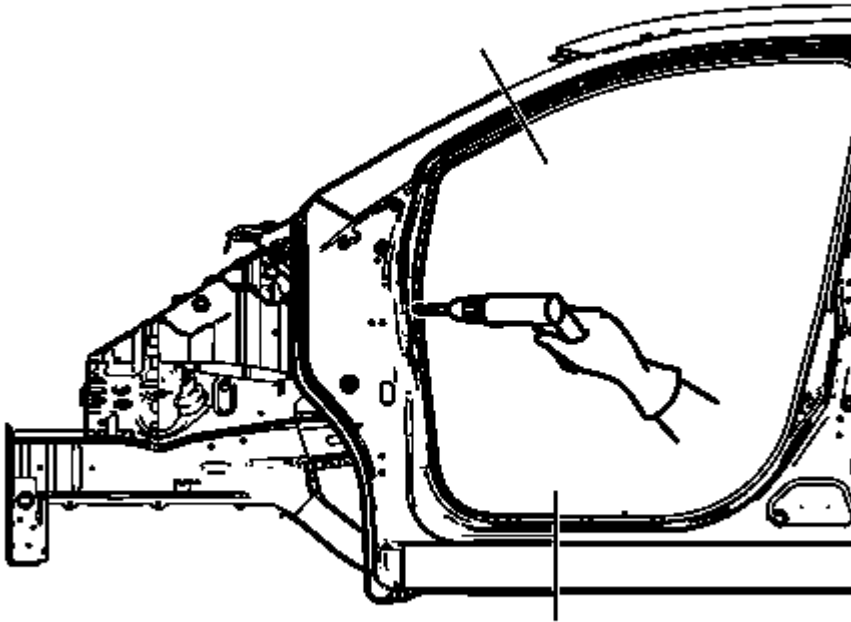


Fig. 37: Drilling All Factory Welds
Courtesy of GENERAL MOTORS COMPANY

8. Locate and mark all the necessary factory welds of the front hinge pillar body.
9. Drill all the factory welds. Note the number and location of welds for installation of the service assembly.

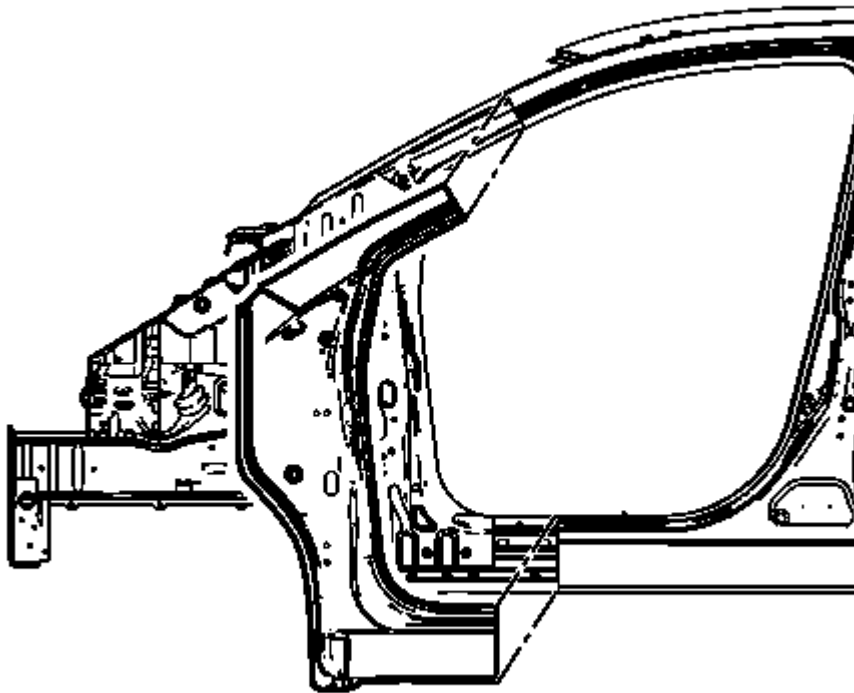


Fig. 38: Removing Damaged Front Hinge Pillar Body
Courtesy of GENERAL MOTORS COMPANY

10. Remove the damaged front hinge pillar body.

Installation Procedure

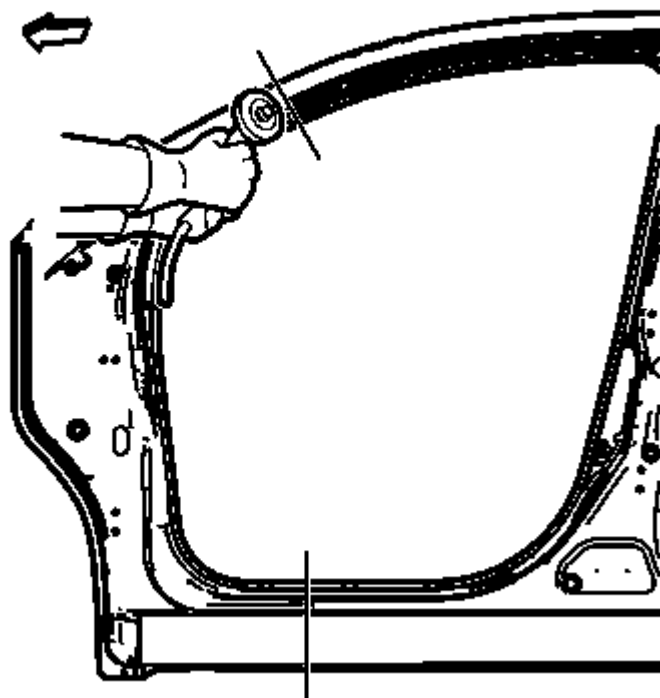


Fig. 39: Cutting Front Hinge Pillar Body In Corresponding Locations
Courtesy of GENERAL MOTORS COMPANY

1. Cut the front hinge pillar body in corresponding locations to fit the remaining original panel. The sectioning joint should be trimmed to allow a gap of one-and-one-half-times the metal thickness at the sectioning joint.
2. Create a 50 mm (2 in) backing plate from the unused portion of the service part.
3. Drill 8 mm (5/16 in) along the sectioning cut on the remaining original part. Locate these holes 13 mm (1/2 in) from the edge of part and spaced 40 mm (1 1/2 in) apart.
4. Prepare all mating surfaces as necessary.
5. Fit the backing plates halfway into the sectioning joints, clamp in place and plug weld to the vehicle.
6. Align the front hinge pillar body.

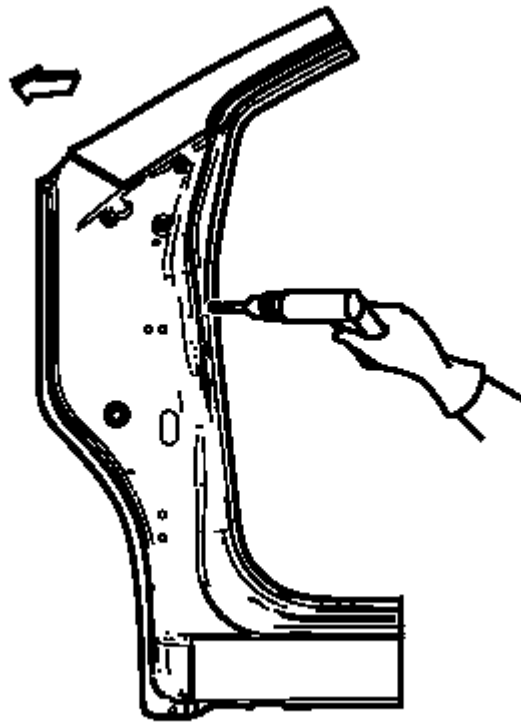


Fig. 40: Drilling for plug welding along edges of front hinge pillar body
Courtesy of GENERAL MOTORS COMPANY

7. Drill 8 mm (5/16 in) for plug welding along the edges of the front hinge pillar body as noted from the original panel.
8. Clean and prepare the attaching surfaces for welding.
9. Position the front hinge pillar body on the vehicle.
10. Verify the fit of the front hinge pillar body.
11. Clamp the front hinge pillar body into position.

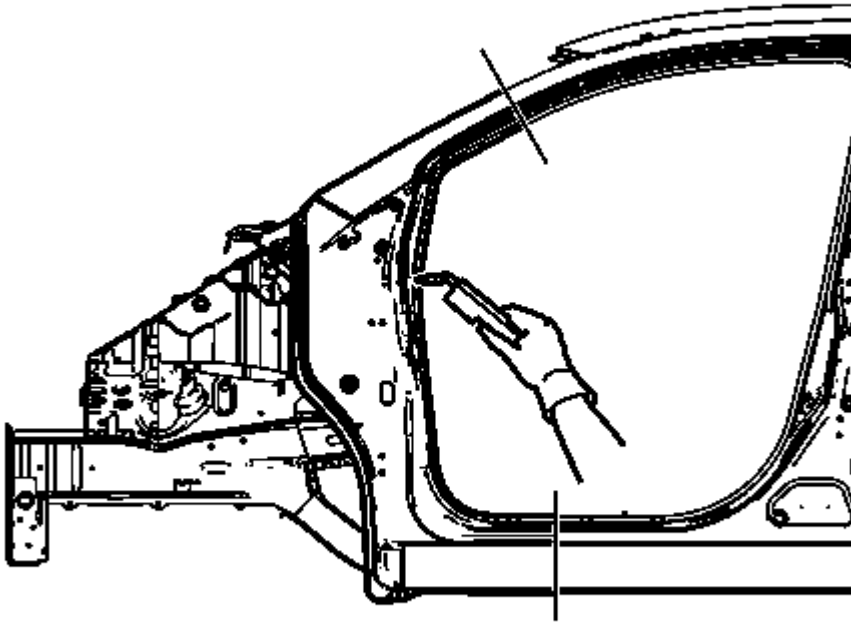


Fig. 41: Applying Sealers And Anti-Corrosion Materials
Courtesy of GENERAL MOTORS COMPANY

12. Plug the weld accordingly.
13. To create a solid weld with minimum heat distortion, make 25 mm (1 in) stitch welds along the seam with 25 mm (1 in) gaps between them. Then go back and complete the stitch weld.
14. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .
15. Paint the repaired area. Refer to **Basecoat/Clearcoat Paint Systems** .
16. Install all the related panels and components.
17. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
18. Enable the SIR system. Refer to **SIR Disabling and Enabling** .

BODY HINGE PILLAR LOWER REINFORCEMENT REPLACEMENT

Removal Procedure

WARNING: Refer to **Approved Equipment for Collision Repair Warning** .

WARNING: Refer to Collision Sectioning Warning .

WARNING: Refer to Glass and Sheet Metal Handling Warning .

1. Disable the SIR system. Refer to SIR Disabling and Enabling .
2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection .
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to Anti-Corrosion Treatment and Repair .

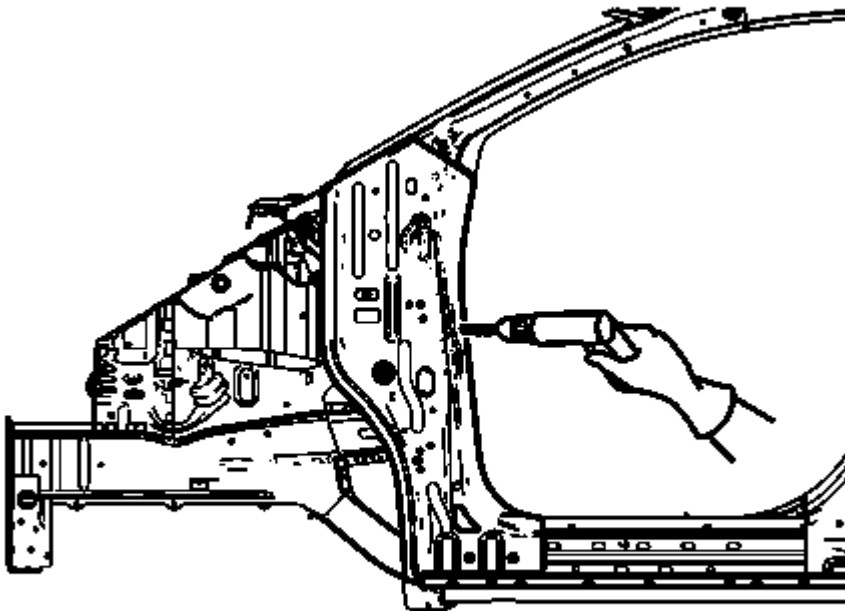


Fig. 42: Marking Factory Welds
Courtesy of GENERAL MOTORS COMPANY

6. Locate and mark all the necessary factory welds and weld seams of the front hinge pillar body.
7. Drill all factory welds. Note the number and location of welds for installation of the service assembly.

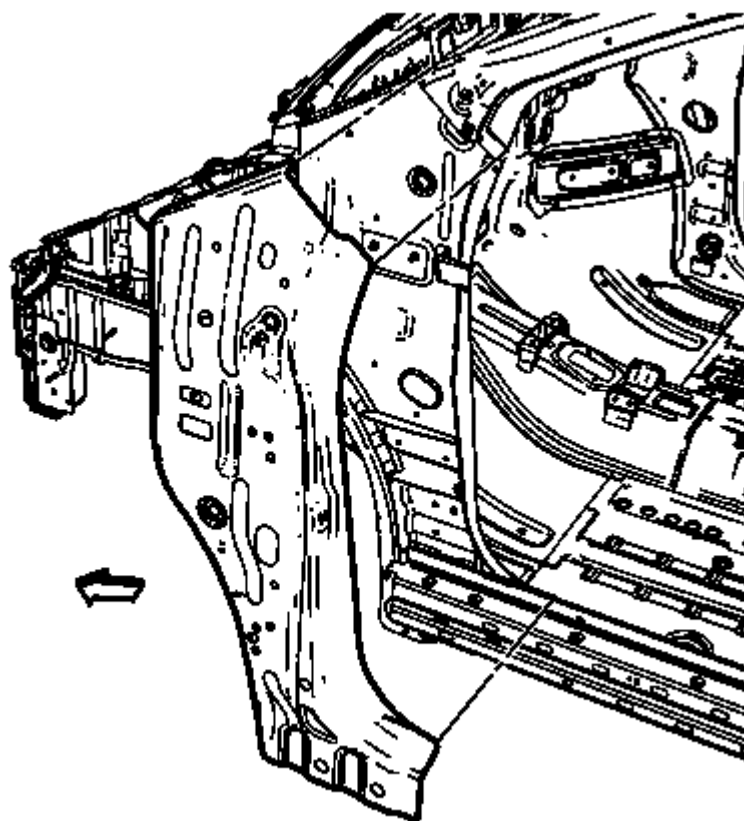


Fig. 43: Front Hinge Pillar Body Reinforcement
Courtesy of GENERAL MOTORS COMPANY

8. Remove the damaged front hinge pillar body reinforcement.

Installation Procedure

1. Prepare all mating surfaces as necessary.
2. Align the front hinge pillar body reinforcement.

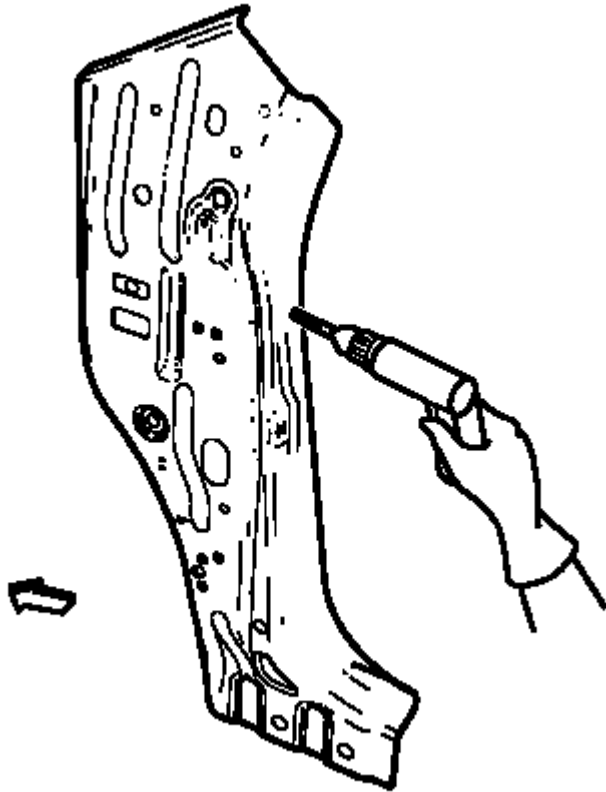


Fig. 44: Drilling 8 Mm (5/16 In) For Plug Welding Along Edges Of Front Hinge Pillar Body
Courtesy of GENERAL MOTORS COMPANY

3. Drill 8 mm (5/16 in) for plug welding along the edges of the front hinge pillar body as noted from the original panel.
4. Clean and prepare the attaching surfaces for welding.
5. Position the front hinge pillar body reinforcement on the vehicle.
6. Verify the fit of the front hinge pillar body reinforcement.
7. Clamp the front hinge pillar body reinforcement into position.

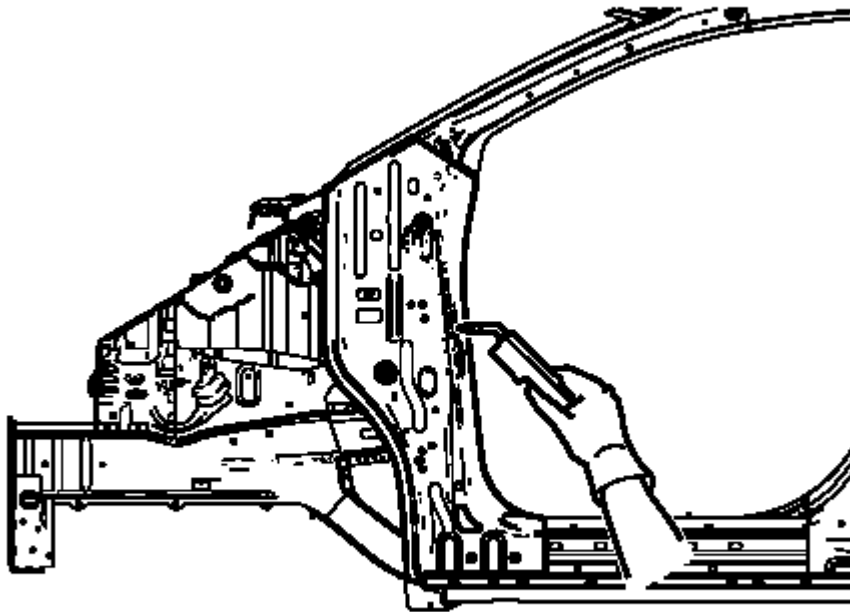


Fig. 45: Applying Sealers And Anti-Corrosion Materials
Courtesy of GENERAL MOTORS COMPANY

8. Plug weld accordingly.
9. To create a solid weld with minimum heat distortion, make 25 mm (1 in) stitch welds along the seam with 25 mm (1 in) gaps between them. Then go back and complete the stitch weld.
10. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .
11. Paint the repaired area. Refer to **Basecoat/Clearcoat Paint Systems** .
12. Install all related panels and components.
13. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
14. Enable the SIR system. Refer to **SIR Disabling and Enabling** .

ROOF OUTER PANEL REPLACEMENT

Removal Procedure

WARNING: Refer to **Approved Equipment for Collision Repair Warning** .

WARNING: Refer to Glass and Sheet Metal Handling Warning .

1. Disable the SIR system. Refer to SIR Disabling and Enabling .
2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection .
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to Anti-Corrosion Treatment and Repair .
6. Locate and mark all factory welds.

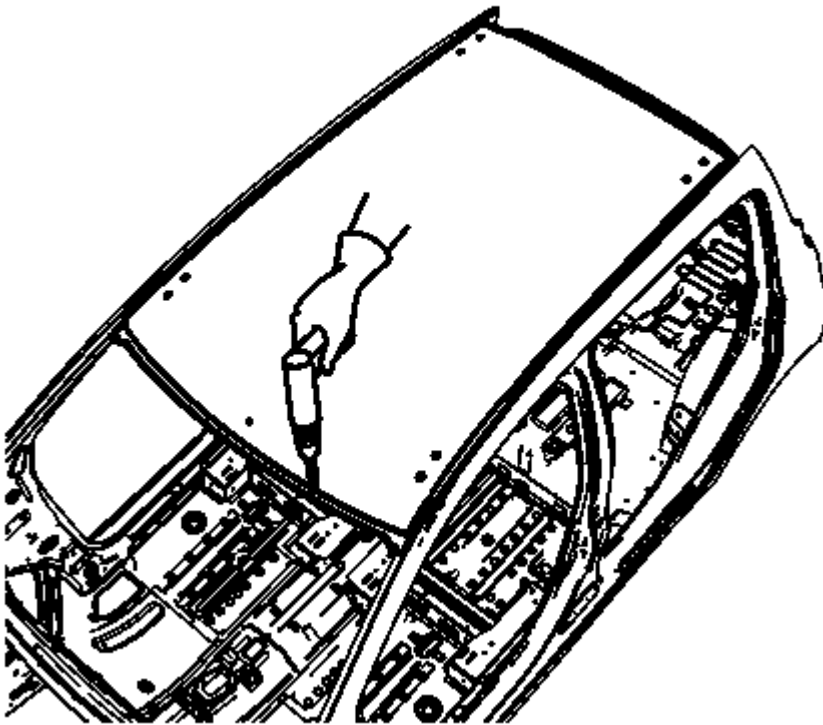


Fig. 46: Drilling All Factory Welds
Courtesy of GENERAL MOTORS COMPANY

7. Drill all factory welds. Note the number and location of welds for installation of the service assembly.
8. Cut the adhesive with an appropriate tool.

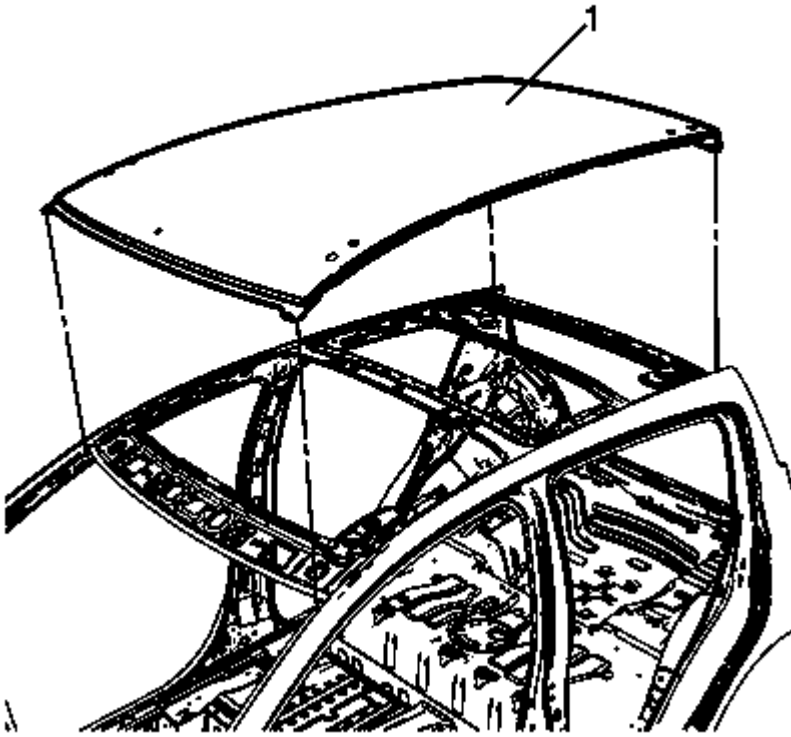


Fig. 47: Damaged Roof Panel

Courtesy of GENERAL MOTORS COMPANY

9. Remove the damaged roof panel (1).

Installation Procedure

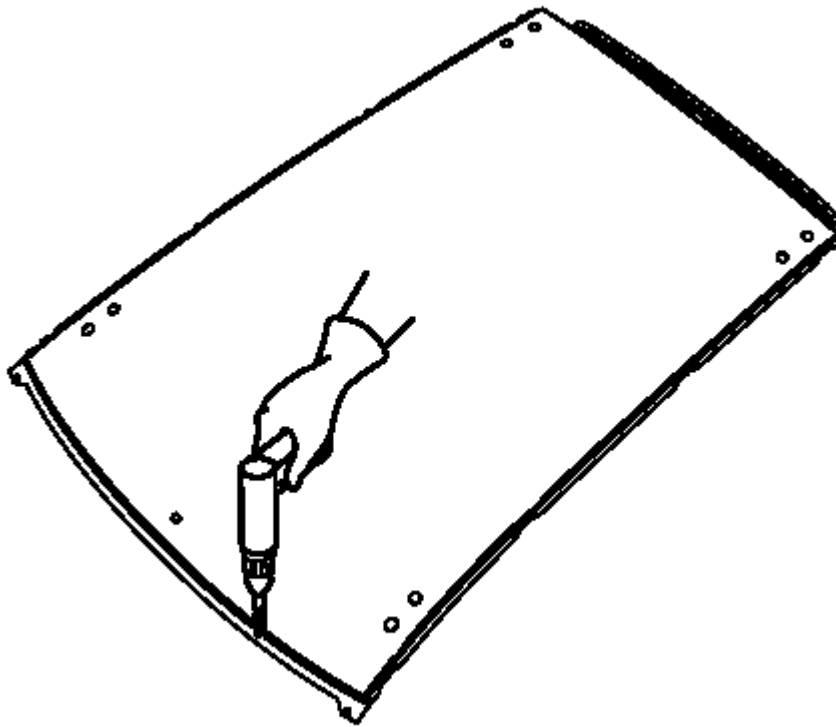


Fig. 48: Drilling 8 mm (5/16 In) For Plug Welding Along Edges Of Service Panel
Courtesy of GENERAL MOTORS COMPANY

1. Drill 8 mm (5/16 in) for plug welding along the edges of the service panel as noted from the original panel.
2. Clean and prepare the attaching surfaces for welding.

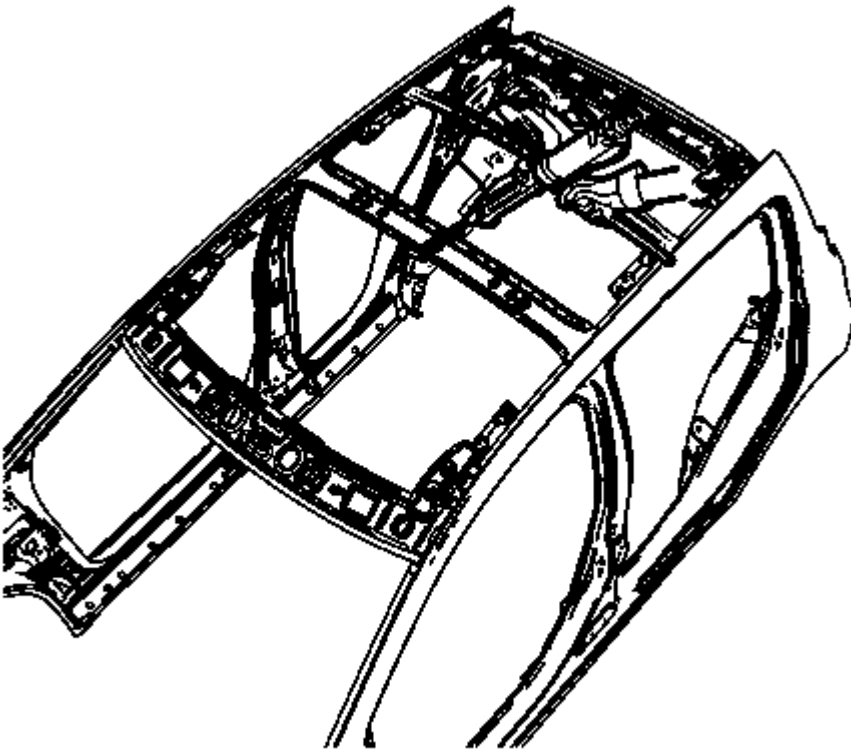


Fig. 49: Applying One-Part Windshield Urethane Adhesive
Courtesy of GENERAL MOTORS COMPANY

3. Apply one-part windshield urethane adhesive as noted from the original panel.
4. Position the roof panel on the vehicle.
5. Verify the fit of the panel.
6. Clamp the panel into position.

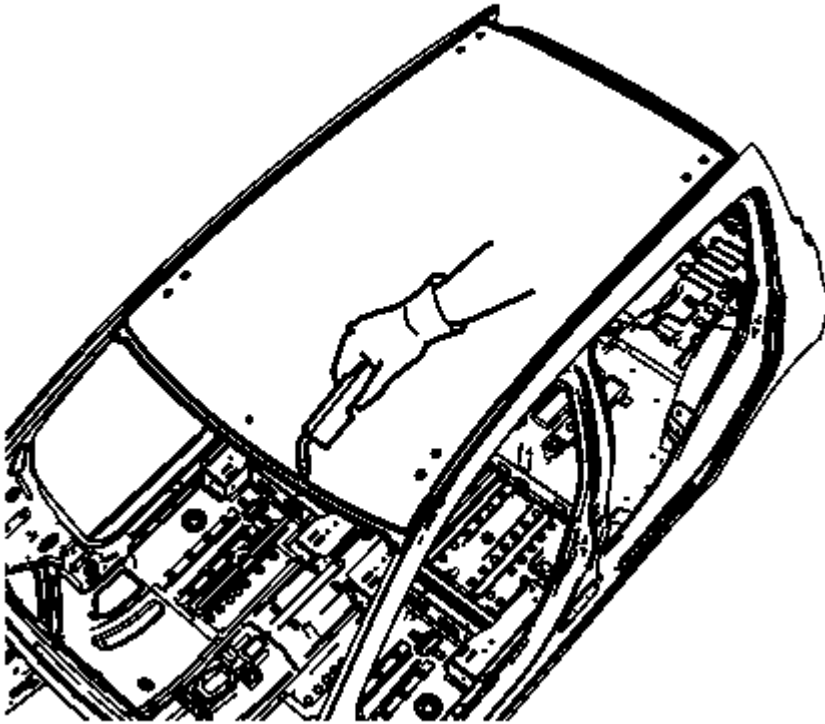


Fig. 50: Applying Sealers And Anti-Corrosion Materials
Courtesy of GENERAL MOTORS COMPANY

7. Plug weld accordingly.
8. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .
9. Paint the repaired area. Refer to **Basecoat/Clearcoat Paint Systems** .
10. Install all related panels and components.
11. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
12. Enable the SIR system. Refer to **SIR Disabling and Enabling** .

ROOF FRONT HEADER PANEL REPLACEMENT

Removal Procedure

WARNING: Refer to **Approved Equipment for Collision Repair Warning** .

WARNING: Refer to **Glass and Sheet Metal Handling Warning** .

1. Disable the SIR system. Refer to **SIR Disabling and Enabling** .
2. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .
6. Locate and mark all factory welds.

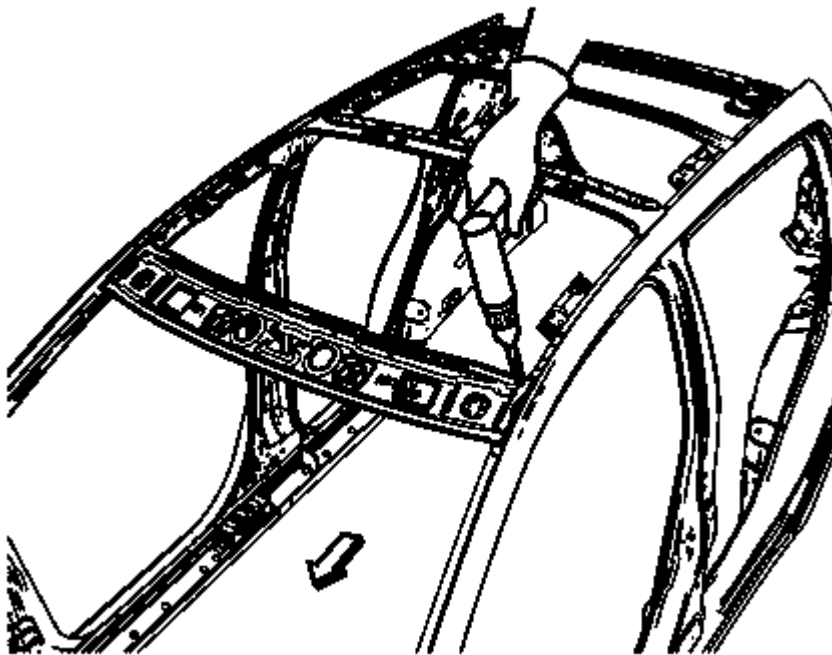


Fig. 51: Drilling All Factory Welds
Courtesy of GENERAL MOTORS COMPANY

7. Drill all factory welds. Note the number and location of welds for installation of the service assembly.

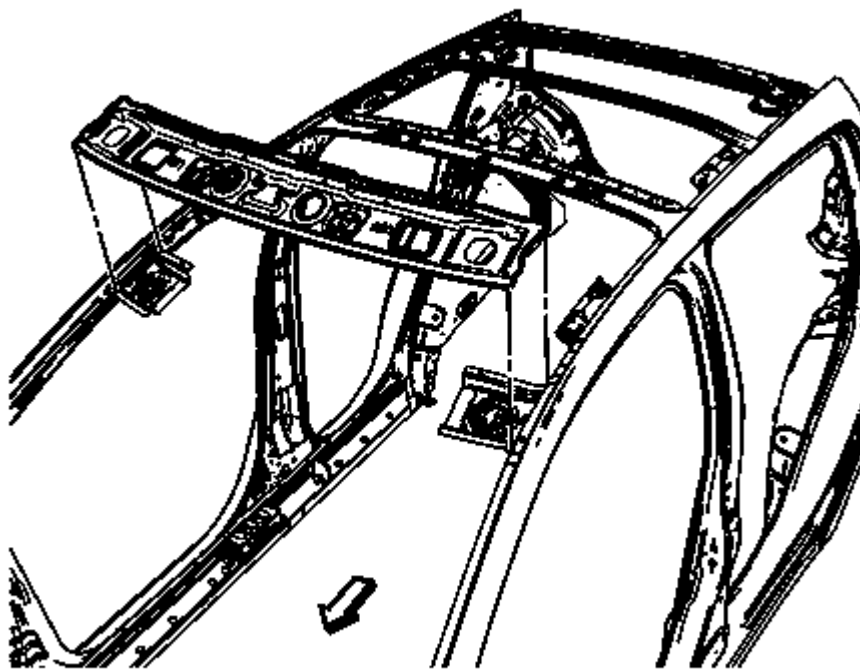


Fig. 52: Roof Front Header Panel
Courtesy of GENERAL MOTORS COMPANY

8. Remove the damaged roof front header panel.

Installation Procedure

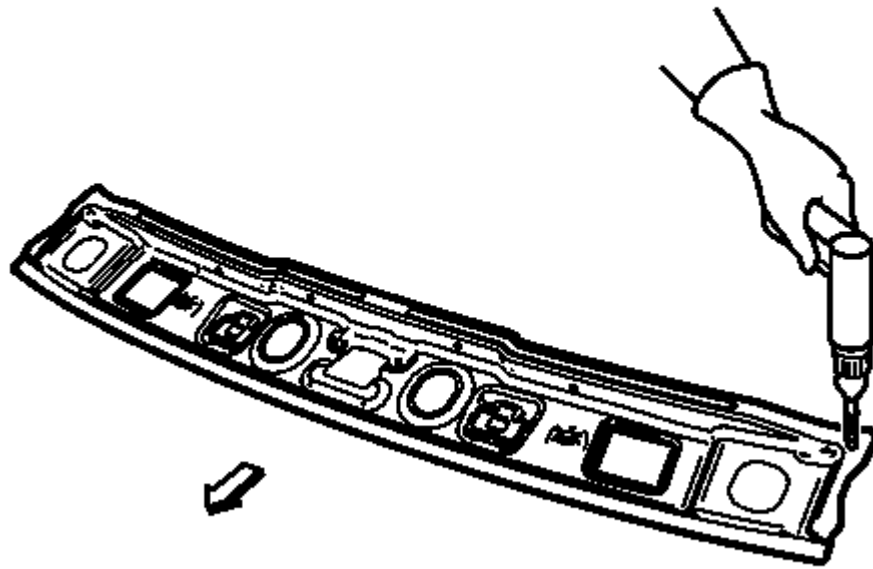


Fig. 53: Drilling 8 mm (5/16 in) For Plug Welding Along Edges Of Service Panel
Courtesy of GENERAL MOTORS COMPANY

1. Drill 8 mm (5/16 in) for plug welding along the edges of the service panel as noted from the original panel.
2. Clean and prepare the attaching surfaces for welding.
3. Position the roof front header panel.
4. Verify the fit of the panel.
5. Clamp the panel into position.

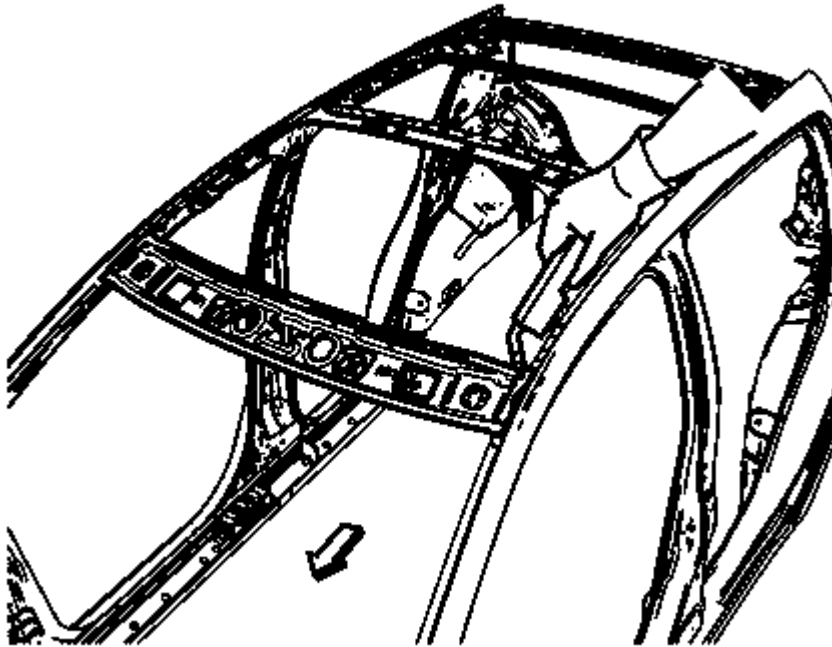


Fig. 54: Applying Sealers And Anti-Corrosion Materials
Courtesy of GENERAL MOTORS COMPANY

6. Plug weld accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .
8. Paint the repaired area. Refer to **Basecoat/Clearcoat Paint Systems** .
9. Install all related panels and components.
10. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
11. Enable the SIR system. Refer to **SIR Disabling and Enabling** .

ROOF REAR HEADER PANEL REPLACEMENT

Removal Procedure

WARNING: Refer to **Approved Equipment for Collision Repair Warning** .

WARNING: Refer to **Glass and Sheet Metal Handling Warning** .

1. Disable the SIR system. Refer to **SIR Disabling and Enabling** .
2. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .
6. Locate and mark all factory welds.

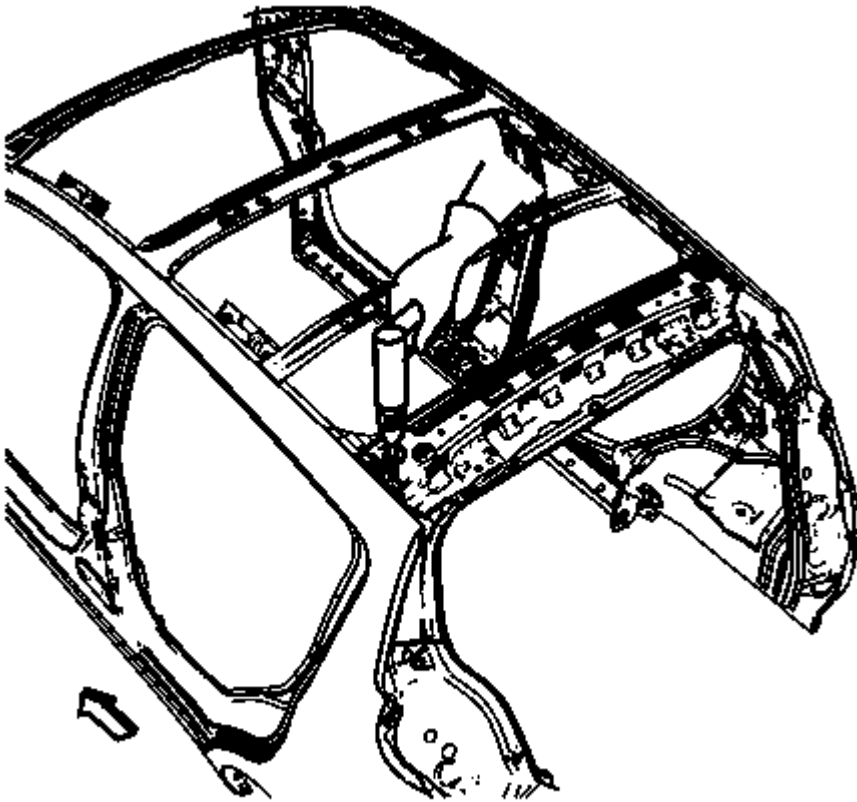


Fig. 55: Drilling All Factory Welds
Courtesy of GENERAL MOTORS COMPANY

7. Drill all factory welds. Note the number and location of welds for installation of the service assembly.

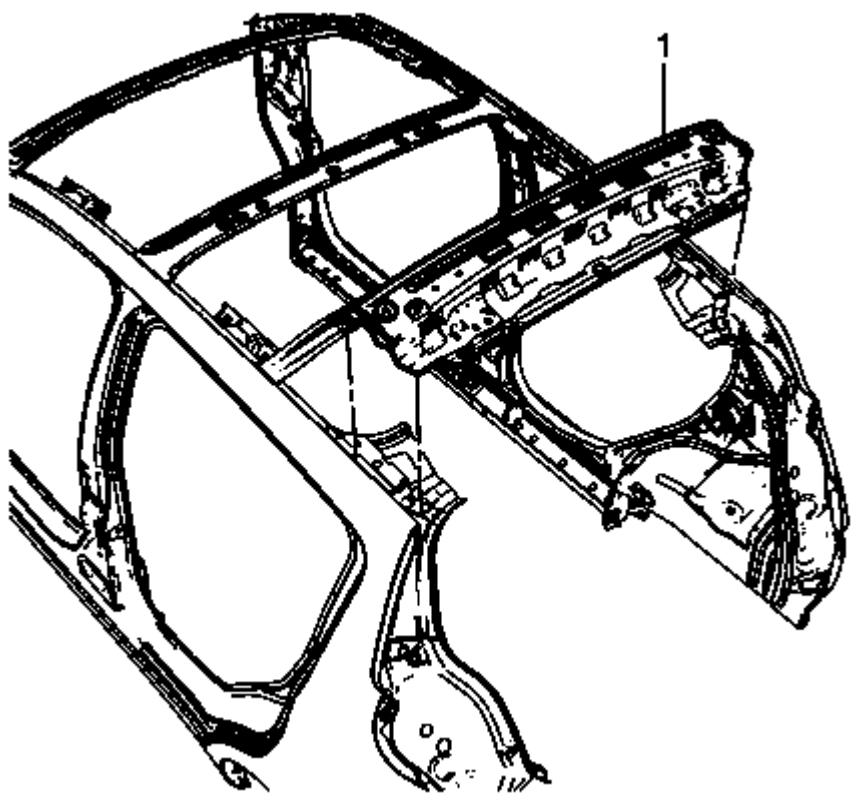


Fig. 56: Rear Header Panel

Courtesy of GENERAL MOTORS COMPANY

8. Remove the damaged rear header panel (1).

Installation Procedure

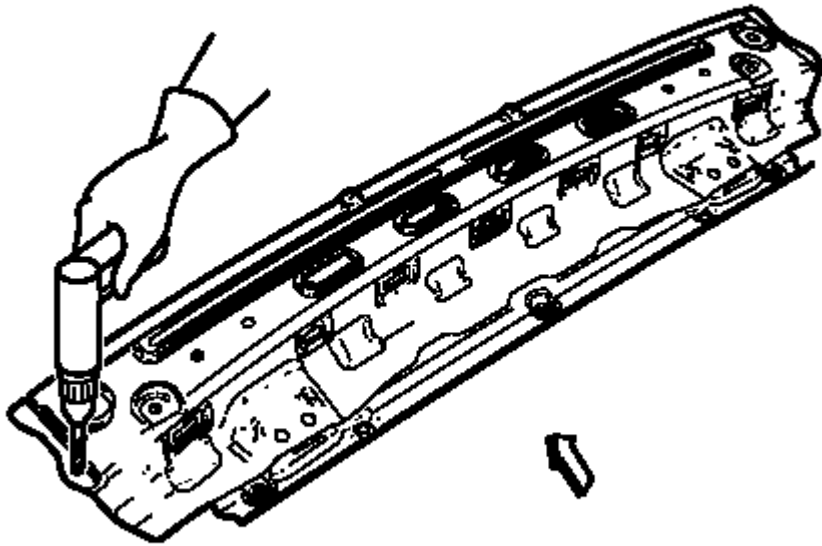


Fig. 57: Drill 8 mm (5/16 in) For Plug Welding Along Edges Of Service Panel
Courtesy of GENERAL MOTORS COMPANY

1. Drill 8 mm (5/16 in) for plug welding along the edges of the service panel as noted from the original panel.
2. Clean and prepare the attaching surfaces for welding.
3. Position the roof rear header panel.
4. Verify the fit of the panel.
5. Clamp the panel into position.

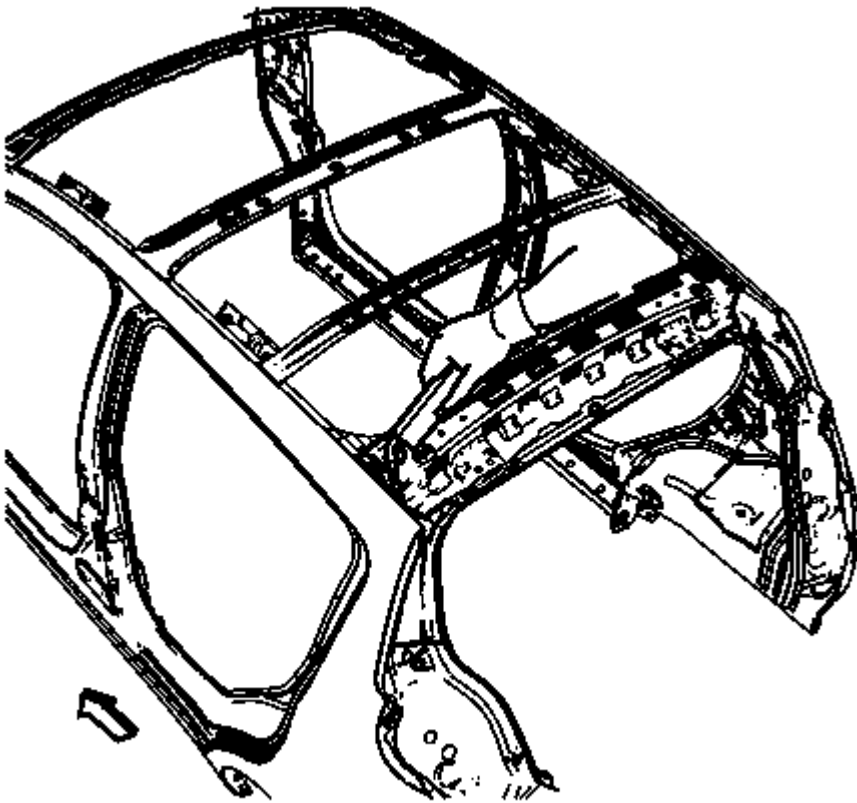


Fig. 58: Applying Sealers And Anti-Corrosion Materials
Courtesy of GENERAL MOTORS COMPANY

6. Plug weld accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .
8. Paint the repaired area. Refer to **Basecoat/Clearcoat Paint Systems** .
9. Install all related panels and components.
10. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
11. Enable the SIR system. Refer to **SIR Disabling and Enabling** .

ROCKER INNER PANEL REPLACEMENT

Removal Procedure

WARNING: Refer to **Approved Equipment for Collision Repair Warning** .

WARNING: Refer to **Glass and Sheet Metal Handling Warning** .

1. Disable the SIR system. Refer to **SIR Disabling and Enabling** .
2. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .
6. Locate and mark all factory welds.

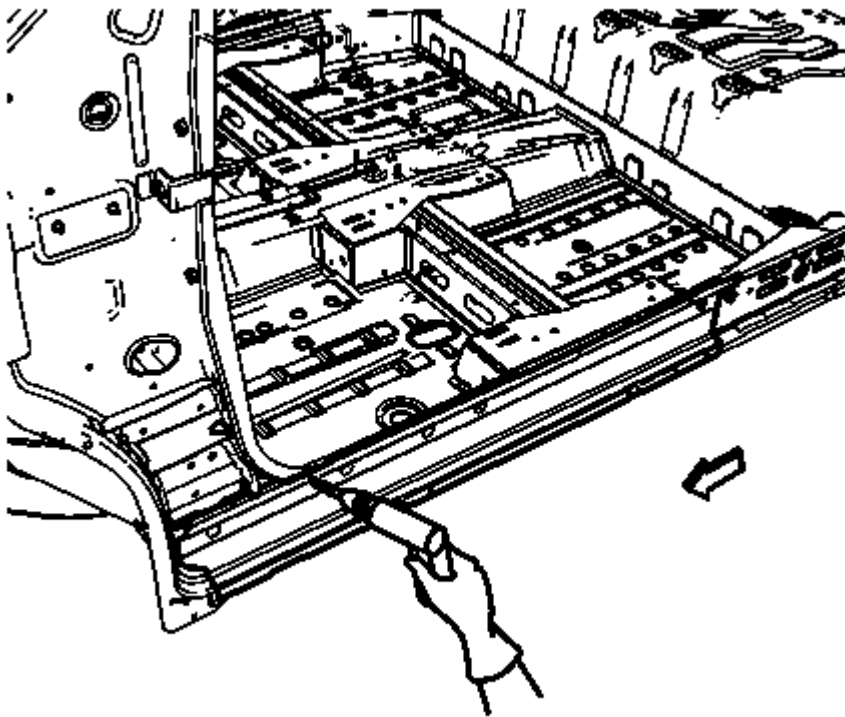


Fig. 59: Drilling All Factory Welds
Courtesy of GENERAL MOTORS COMPANY

7. Drill all factory welds. Note the number and location of welds for installation of the service assembly.

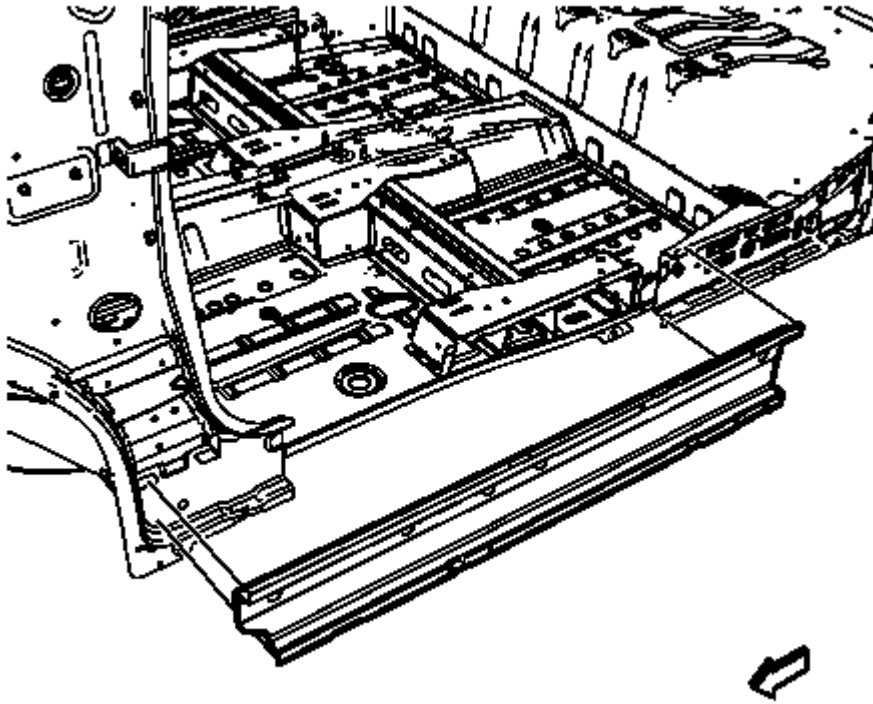


Fig. 60: Rocker Inner Panel

Courtesy of GENERAL MOTORS COMPANY

8. Remove the damaged rocker inner panel.

Installation Procedure

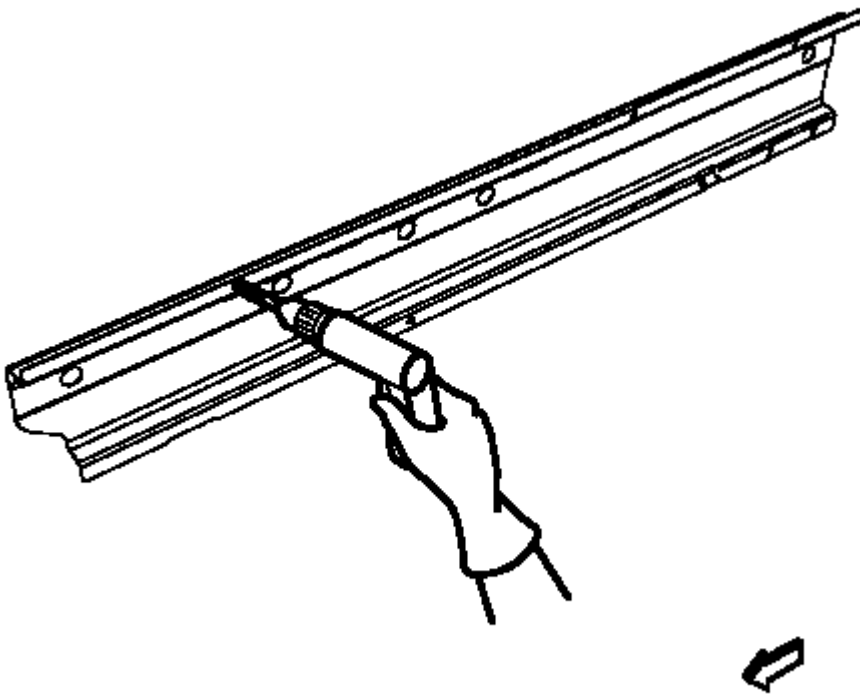


Fig. 61: Drilling 8 Mm (5/16 In) For Plug Welding Along Edges Of Service Panel
Courtesy of GENERAL MOTORS COMPANY

1. Drill 8 mm (5/16 in) for plug welding along the edges of the service panel as noted from the original panel.
2. Clean and prepare the attaching surfaces for welding.
3. Position the rocker inner panel.
4. Verify the fit of the panel.
5. Clamp the panel into position.

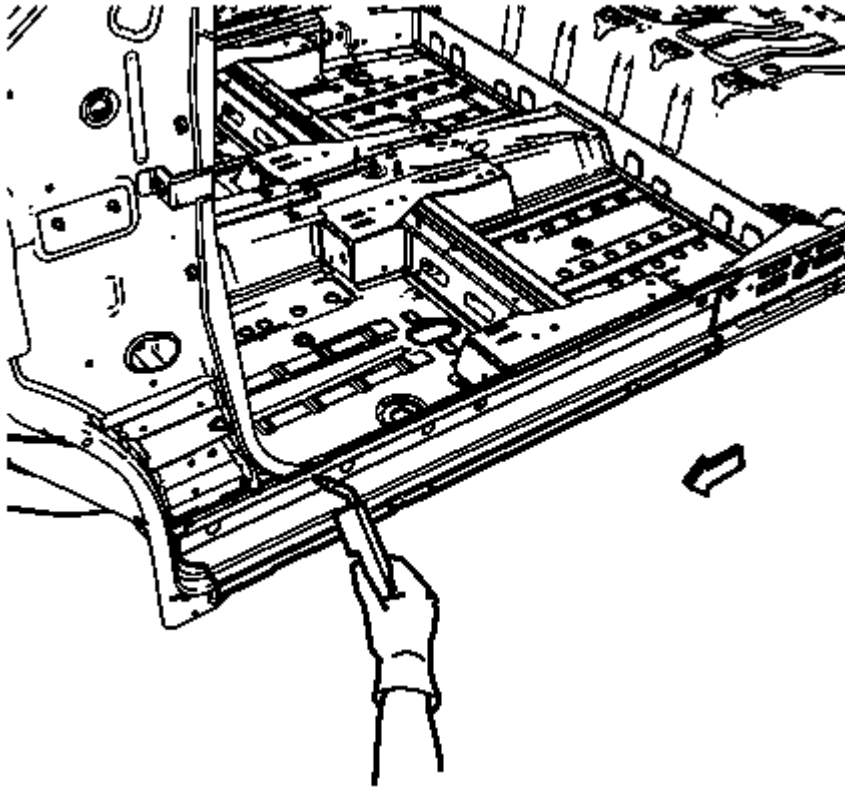


Fig. 62: Applying Sealers And Anti-Corrosion Materials
Courtesy of GENERAL MOTORS COMPANY

6. Plug the weld accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .
8. Paint the repaired area. Refer to **Basecoat/Clearcoat Paint Systems** .
9. Install all related panels and components.
10. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
11. Enable the SIR system. Refer to **SIR Disabling and Enabling** .

BODY LOCK PILLAR OUTER PANEL SECTIONING

Removal Procedure

WARNING: Refer to **Approved Equipment for Collision Repair Warning**

WARNING: Refer to **Collision Sectioning Warning**

WARNING: Refer to Glass and Sheet Metal Handling Warning

1. Disable the SIR system. Refer to SIR Disabling and Enabling .
2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection .
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to Anti-Corrosion Treatment and Repair .

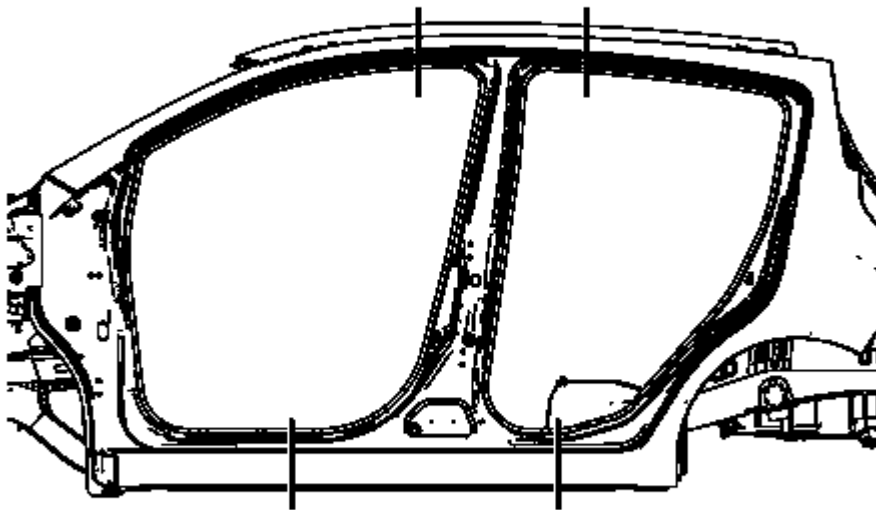


Fig. 63: Cut Lines On Body Lock Pillar Outer Panel
Courtesy of GENERAL MOTORS COMPANY

6. Create cut lines on the body lock pillar outer panel.

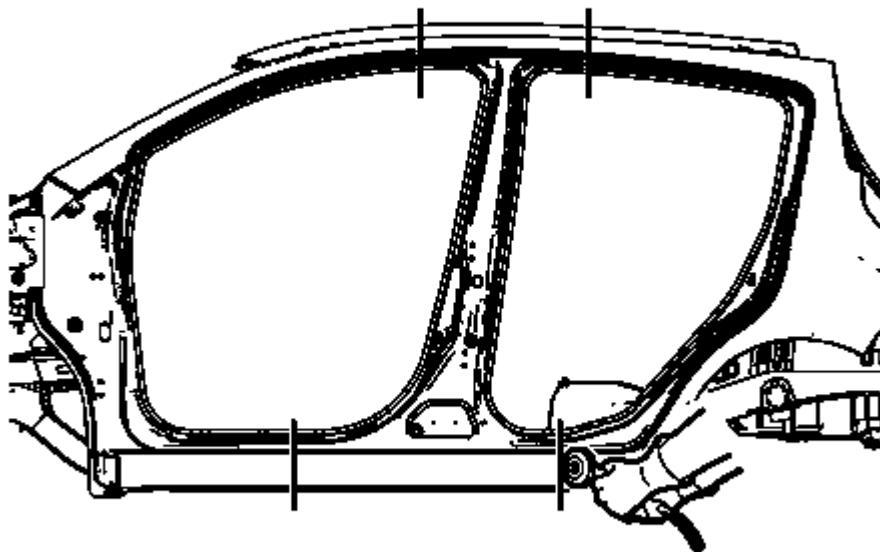


Fig. 64: Cutting Panel
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage any inner panels or reinforcements.

7. Cut the panel where sectioning is to be performed.

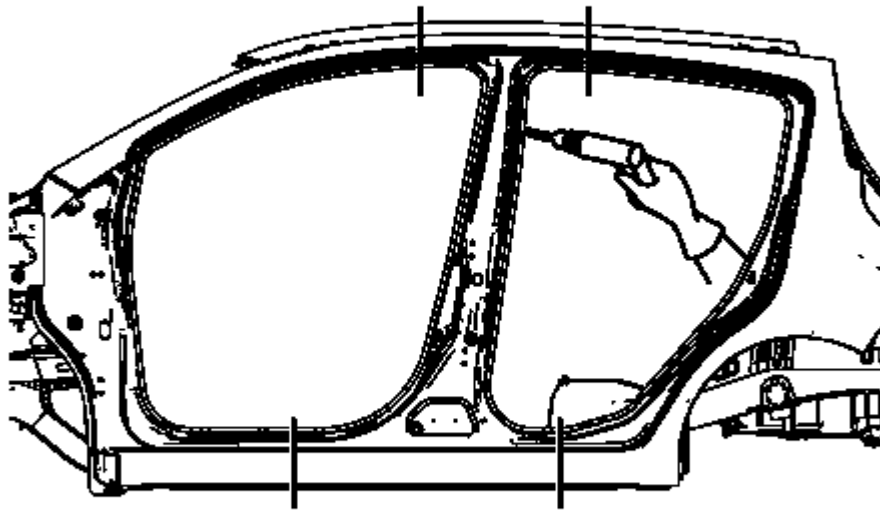


Fig. 65: Marking Necessary Factory Welds
Courtesy of GENERAL MOTORS COMPANY

8. Locate and mark all the necessary factory welds of the body lock pillar outer panel.
9. Drill all factory welds. Note the number and location of welds for installation of the service assembly.

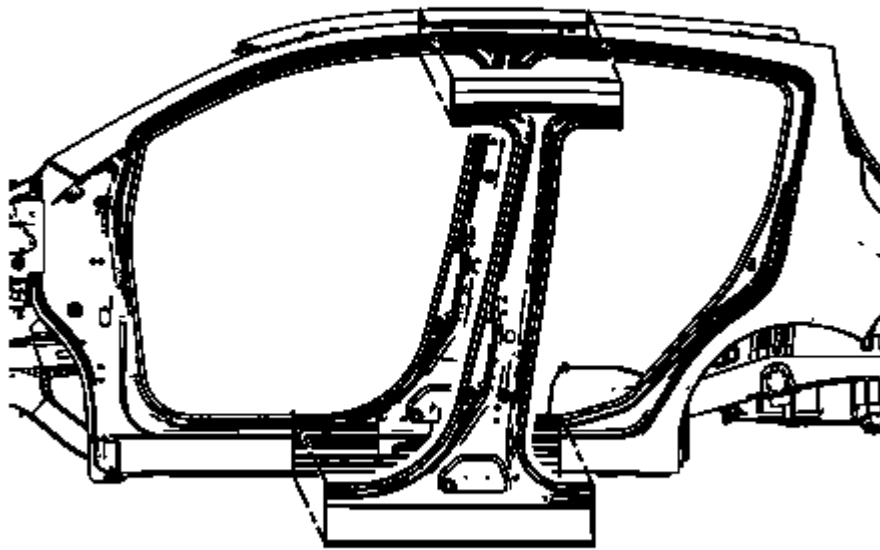


Fig. 66: Body Lock Pillar Outer Panel
Courtesy of GENERAL MOTORS COMPANY

10. Remove the damaged body lock pillar outer panel.

Installation Procedure

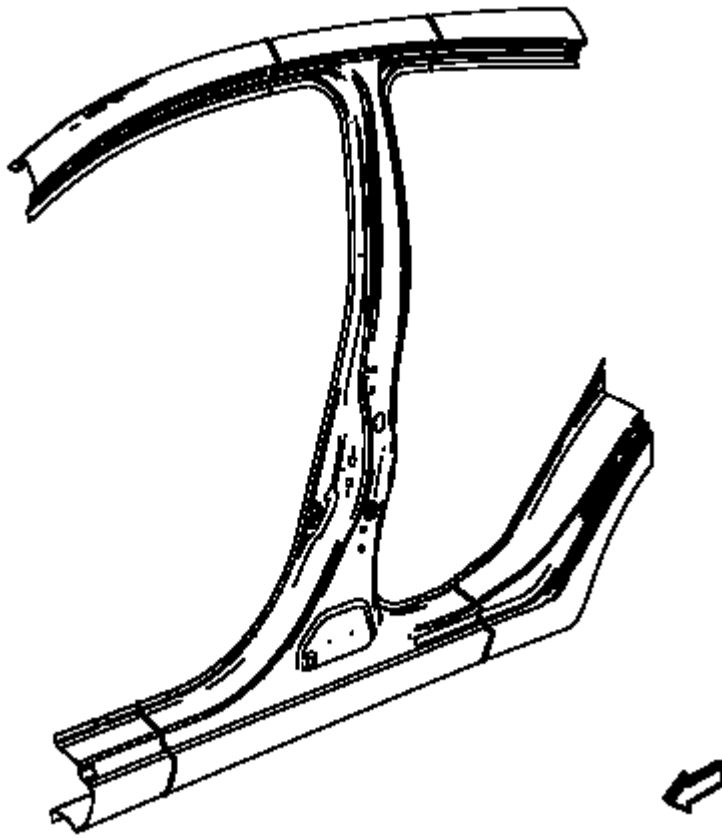


Fig. 67: Cutting Body Lock Pillar Outer Panel
Courtesy of GENERAL MOTORS COMPANY

1. Cut the body lock pillar outer panel in corresponding locations to fit the remaining original panel. The sectioning joint should be trimmed to allow a gap of one-and-one-half-times the metal thickness at the sectioning joint.
2. Create a 50 mm (2 in) backing plate from the unused portion of the service part.
3. Drill a 8 mm (5/16 in) along the sectioning cut on the remaining original part. Locate these holes 13 mm (1/2 in) from the edge of part and spaced 40 mm (1 1/2 in) apart.
4. Prepare all mating surfaces as necessary.
5. Fit the backing plates halfway into the sectioning joints, clamp in place and plug weld to the vehicle.
6. Align the body lock pillar outer panel.

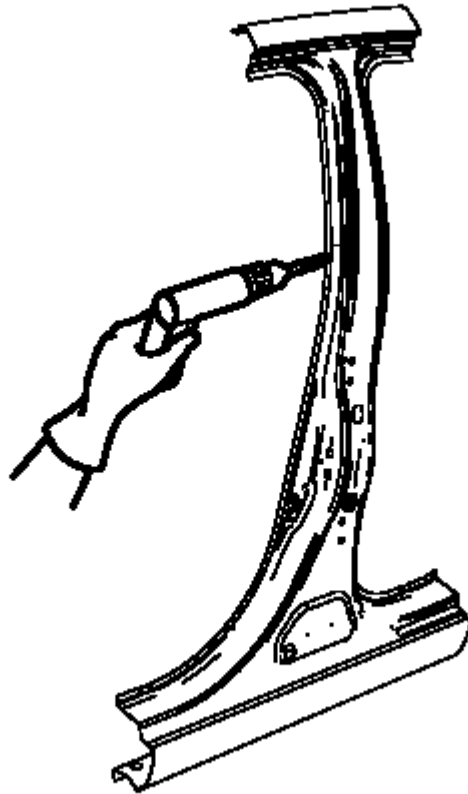


Fig. 68: Drilling 8 Mm (5/16 In) For Plug Welding Along Edges Of Body Lock Pillar Outer Panel
Courtesy of GENERAL MOTORS COMPANY

7. Drill a 8 mm (5/16 in) for plug welding along the edges of the body lock pillar outer panel as noted from the original panel.
8. Clean and prepare the attaching surfaces for welding.
9. Position the body lock pillar outer panel on the vehicle.
10. Verify the fit of the body lock pillar outer panel.
11. Clamp the body lock pillar outer panel into position.

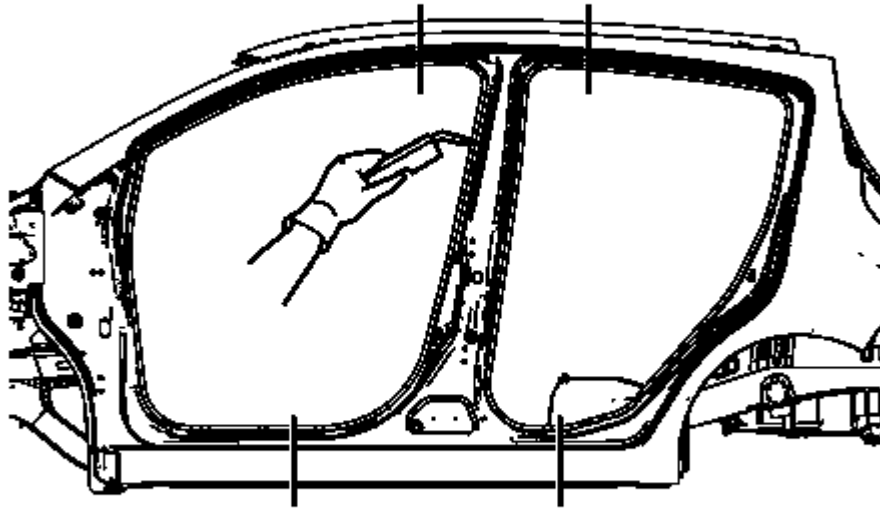


Fig. 69: Applying Sealers And Anti-Corrosion Materials
Courtesy of GENERAL MOTORS COMPANY

12. Plug the weld accordingly.
13. To create a solid weld with minimum heat distortion, make a 25 mm (1 in) stitch welds along the seam with 25 mm (1 in) gaps between them. Then go back and complete the stitch weld.
14. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .
15. Paint the repaired area. Refer to **Basecoat/Clearcoat Paint Systems** .
16. Install all related panels and components.
17. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
18. Enable the SIR system. Refer to **SIR Disabling and Enabling** .

BODY LOCK PILLAR OUTER PANEL REINFORCEMENT REPLACEMENT

Removal Procedure

WARNING: Refer to Approved Equipment for Collision Repair Warning .

WARNING: Refer to Glass and Sheet Metal Handling Warning .

1. Disable the SIR system. Refer to SIR Disabling and Enabling .
2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection .
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to Anti-Corrosion Treatment and Repair .

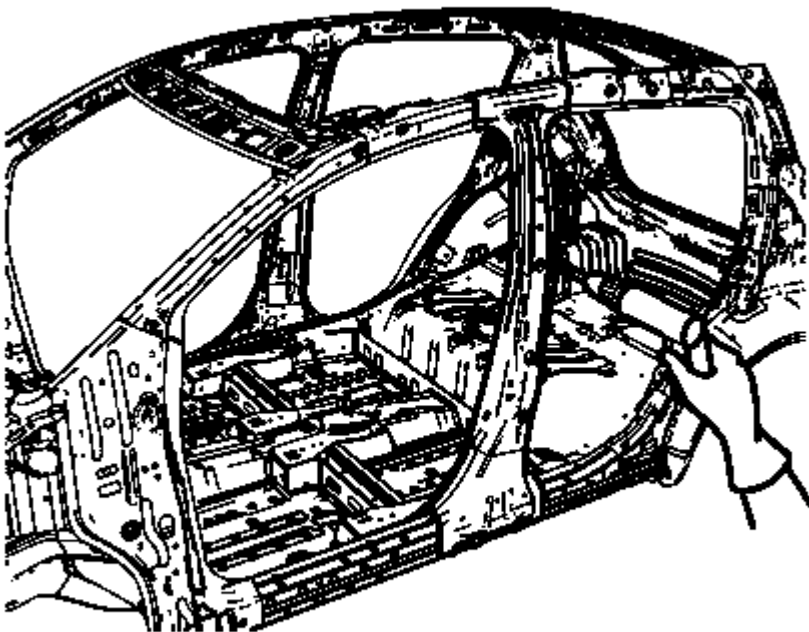


Fig. 70: Drilling All Factory Welds
Courtesy of GENERAL MOTORS COMPANY

6. Locate and mark all the necessary factory welds of the body lock pillar outer panel reinforcement.
7. Drill all factory welds. Note the number and location of welds for installation of the service assembly.

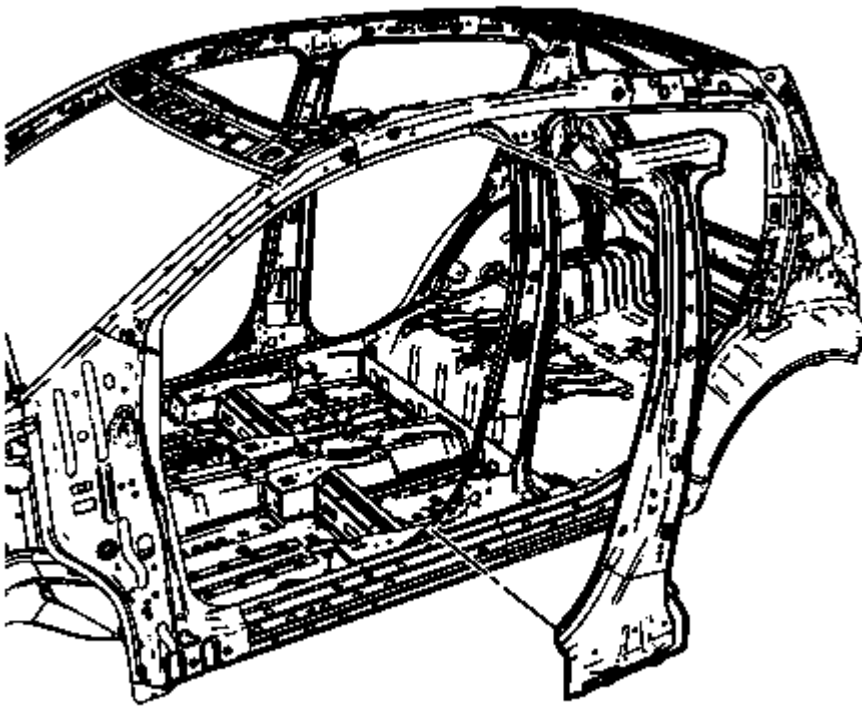


Fig. 71: Removing Damaged Body Lock Pillar Outer Panel Reinforcement
Courtesy of GENERAL MOTORS COMPANY

8. Remove the damaged body lock pillar outer panel reinforcement.

Installation Procedure

1. Prepare all mating surfaces as necessary.
2. Align the body lock pillar outer panel reinforcement.

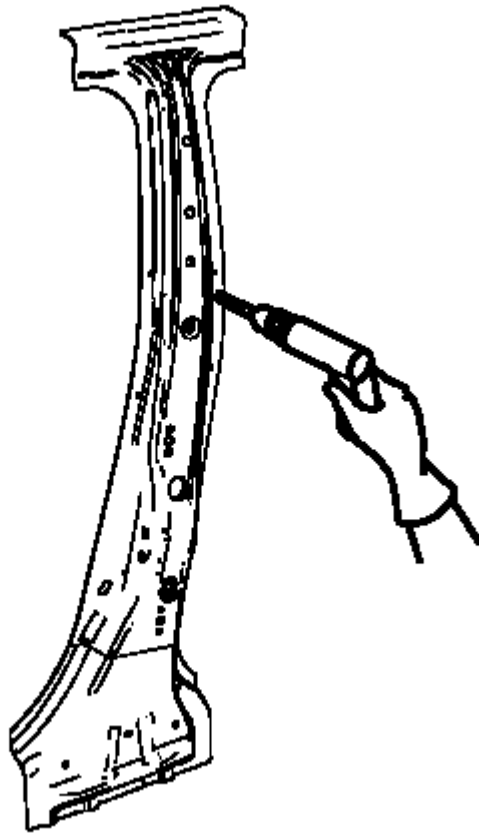


Fig. 72: Drilling 8 mm (5/16 in) For Plug Welding Along Edges Of Body Lock Pillar Outer Panel Reinforcement

Courtesy of GENERAL MOTORS COMPANY

3. Drill a 8 mm (5/16 in) for plug welding along the edges of the body lock pillar outer panel reinforcement as noted from the original panel.
4. Clean and prepare the attaching surfaces for welding.
5. Position the body lock pillar outer panel reinforcement on the vehicle.
6. Verify the fit of the body lock pillar outer panel reinforcement.
7. Clamp the body lock pillar outer panel reinforcement into position.

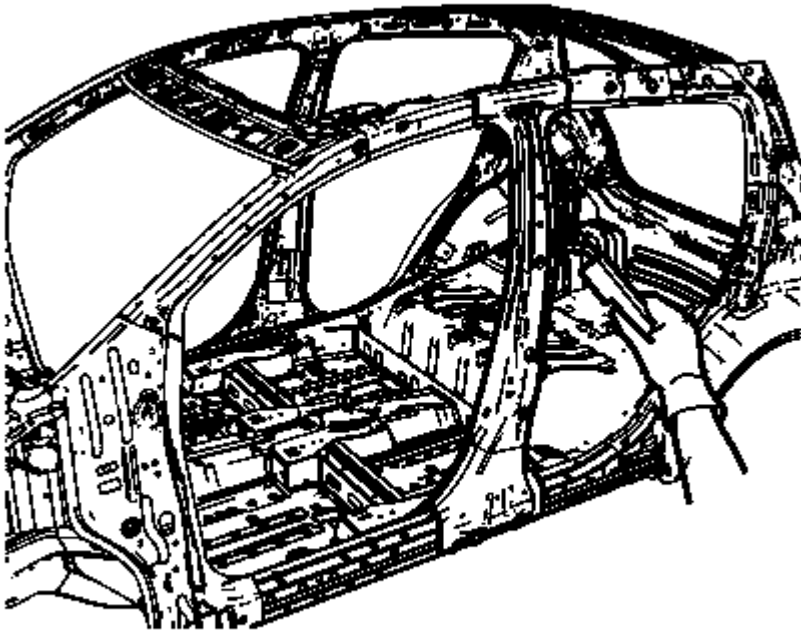


Fig. 73: Applying Sealers And Anti-Corrosion Materials
Courtesy of GENERAL MOTORS COMPANY

8. Plug the weld accordingly.
9. To create a solid weld with minimum heat distortion, make a 25 mm (1 in) stitch welds along the seam with a 25 mm (1 in) gaps between them. Then go back and complete the stitch weld.
10. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .
11. Paint the repaired area. Refer to **Basecoat/Clearcoat Paint Systems** .
12. Install all related panels and components.
13. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
14. Enable the SIR system. Refer to **SIR Disabling and Enabling** .

BODY LOCK PILLAR INNER PANEL REPLACEMENT

Removal Procedure

WARNING: Refer to **Approved Equipment for Collision Repair Warning** .

WARNING: Refer to Glass and Sheet Metal Handling Warning .

1. Disable the SIR system. Refer to SIR Disabling and Enabling .
2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection .
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to Anti-Corrosion Treatment and Repair .
6. Locate and mark all factory welds.

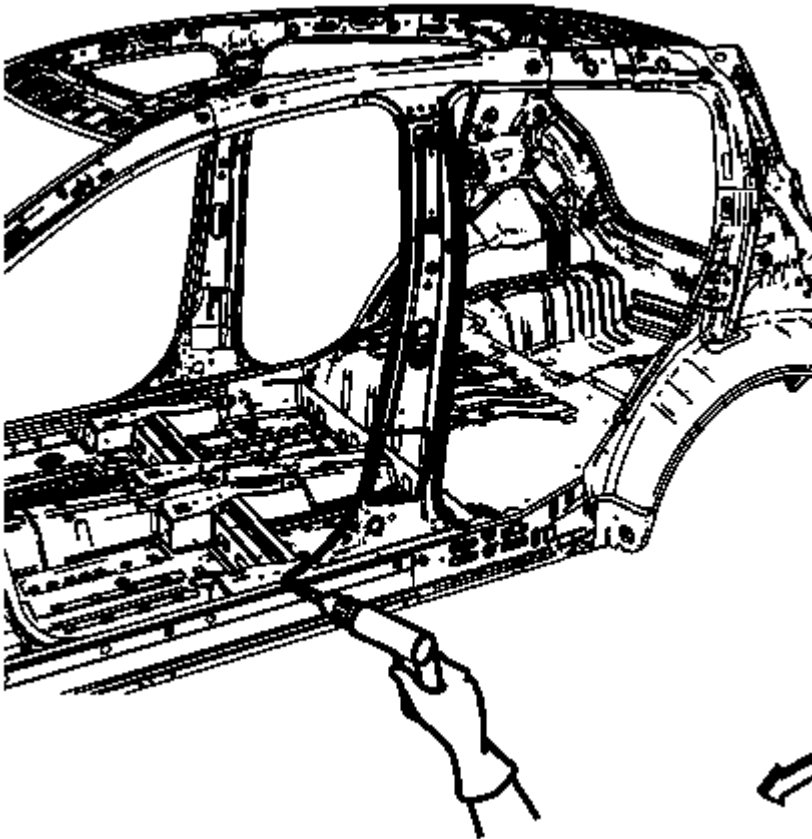


Fig. 74: Drilling All Factory Lower Welds
Courtesy of GENERAL MOTORS COMPANY

7. Drill all factory lower welds. Note the number and location of welds for installation of the service assembly.

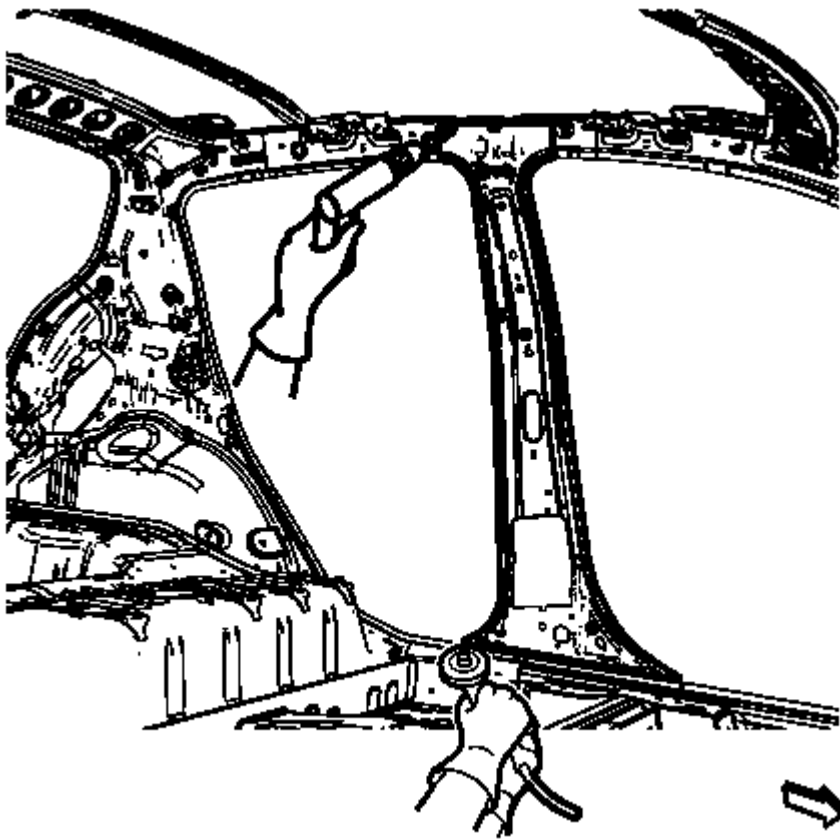


Fig. 75: Drilling All Factory Upper Welds
Courtesy of GENERAL MOTORS COMPANY

8. Drill all factory upper welds. Note the number and location of welds for installation of the service assembly.
9. Grind the factory weld seams lower.

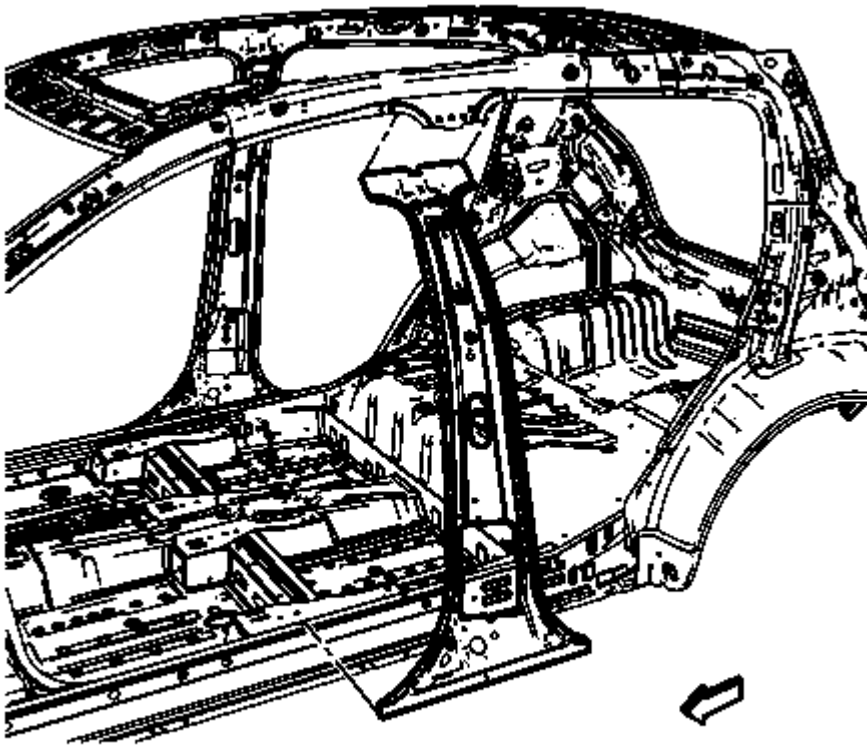


Fig. 76: Removing Damaged Body Lock Pillar Inner Panel
Courtesy of GENERAL MOTORS COMPANY

10. Remove the damaged body lock pillar inner panel.

Installation Procedure

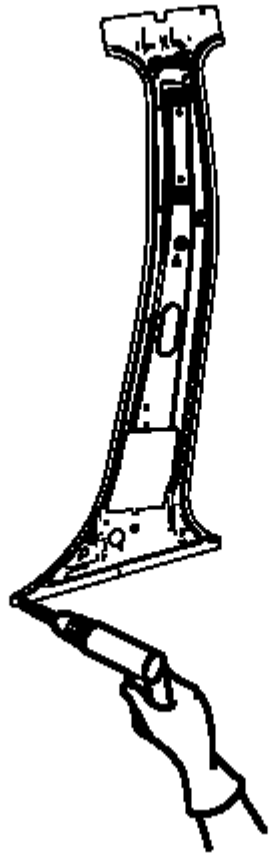


Fig. 77: Drilling 8 Mm (5/16 In) For Plug Welding Along Edges Of Service Panel
Courtesy of GENERAL MOTORS COMPANY

1. Drill a 8 mm (5/16 in) for plug welding along the edges of the service panel as noted from the original panel.
2. Clean and prepare the attaching surfaces for welding.

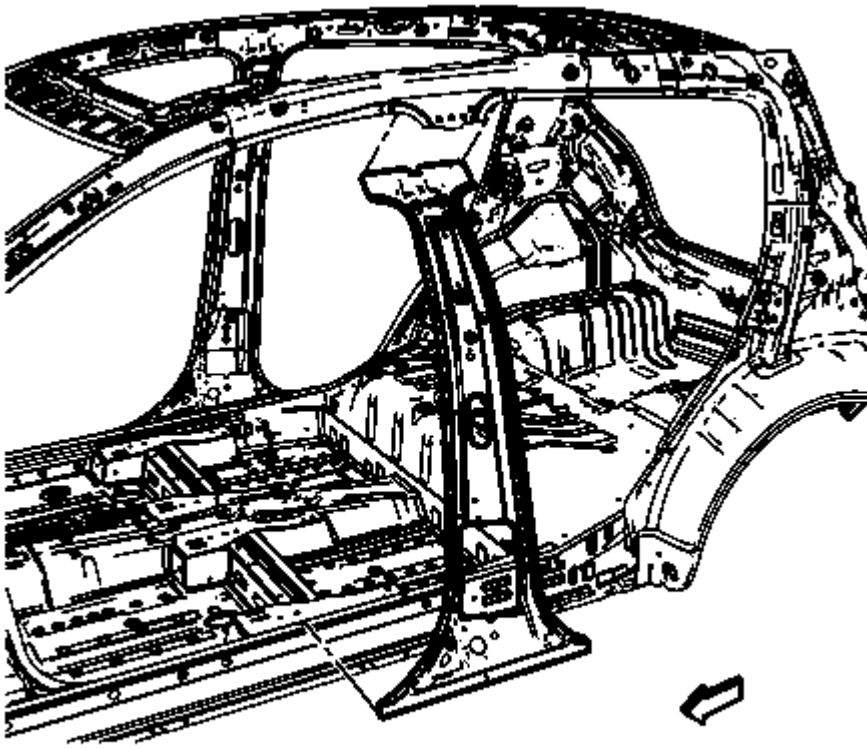


Fig. 78: Removing Damaged Body Lock Pillar Inner Panel
Courtesy of GENERAL MOTORS COMPANY

3. Position the body lock pillar inner panel on the vehicle.
4. Verify the fit of the panel.
5. Clamp the body lock pillar inner panel into position.

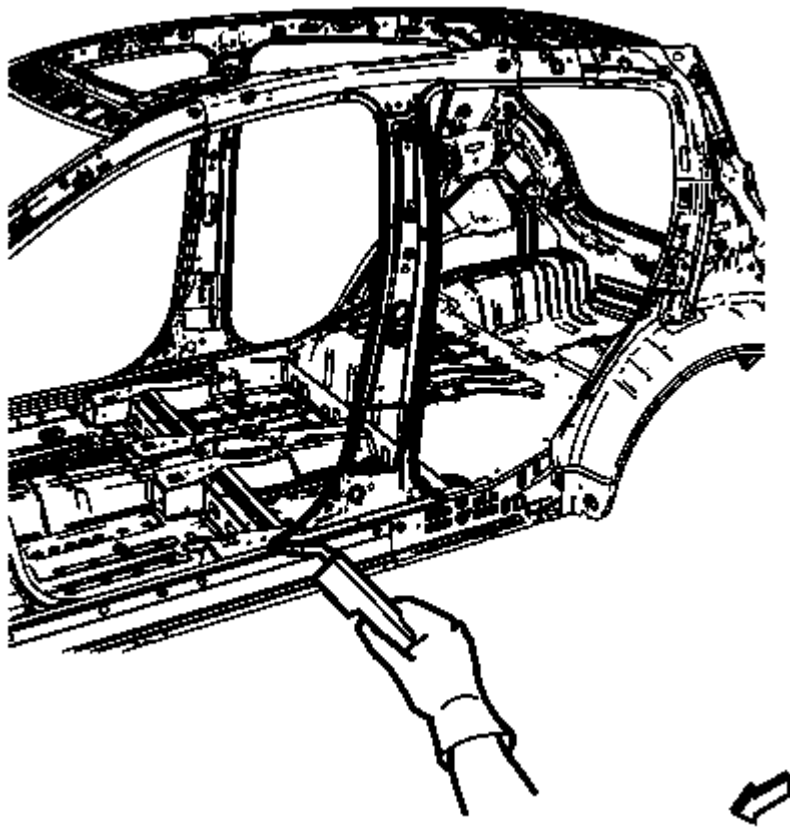


Fig. 79: Applying Sealers And Anti-Corrosion Materials
Courtesy of GENERAL MOTORS COMPANY

6. Plug the weld accordingly body lock pillar inner panel upper and lower.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .
8. Paint the repaired area. Refer to **Basecoat/Clearcoat Paint Systems** .
9. Install all related panels and components.
10. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
11. Enable the SIR system. Refer to **SIR Disabling and Enabling** .

ROCKER OUTER PANEL SECTIONING

Removal Procedure

WARNING: Refer to **Approved Equipment for Collision Repair Warning** .

WARNING: Refer to **Collision Sectioning Warning** .

WARNING: Refer to Glass and Sheet Metal Handling Warning .

1. Disable the SIR system. Refer to SIR Disabling and Enabling .
2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection .
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to Anti-Corrosion Treatment and Repair .

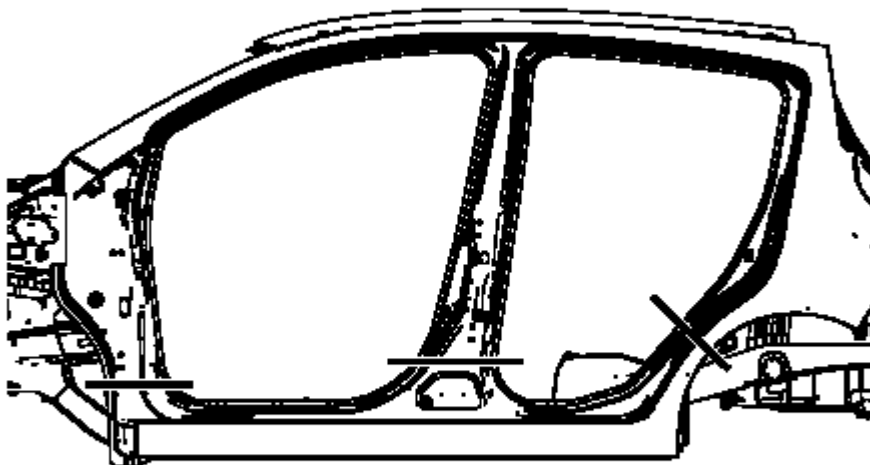


Fig. 80: Creating Cut Lines On Rocker Outer Panel
Courtesy of GENERAL MOTORS COMPANY

6. Create cut lines on the rocker outer panel.

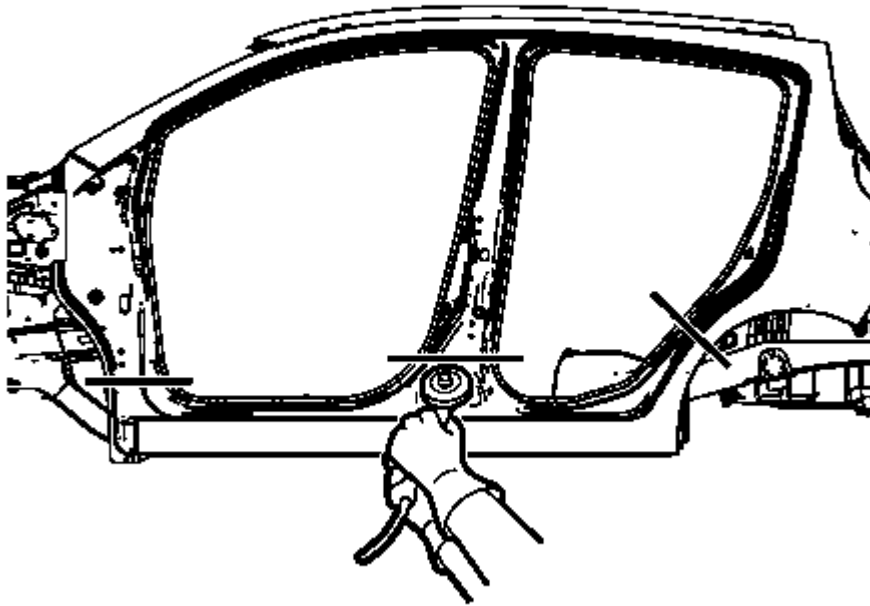


Fig. 81: Cutting panels

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage any inner panels or reinforcements.

7. Cut the panel where sectioning is to be performed.

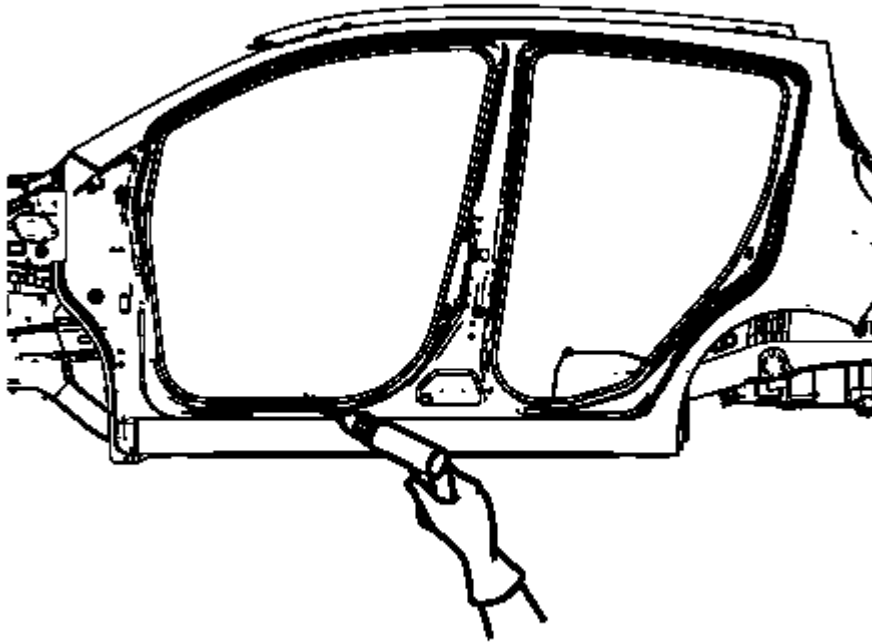


Fig. 82: Drilling Factory Welds
Courtesy of GENERAL MOTORS COMPANY

8. Locate and mark all the necessary factory welds of the rocker outer panel.
9. Drill all factory welds. Note the number and location of welds for installation of the service assembly.

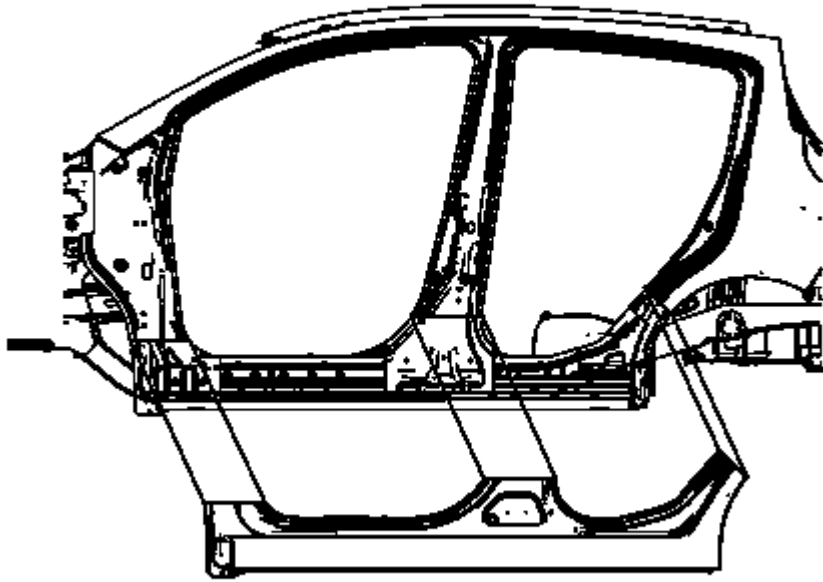


Fig. 83: Removing Damaged Rocker Outer Panel
Courtesy of GENERAL MOTORS COMPANY

10. Remove the damaged rocker outer panel.

Installation Procedure

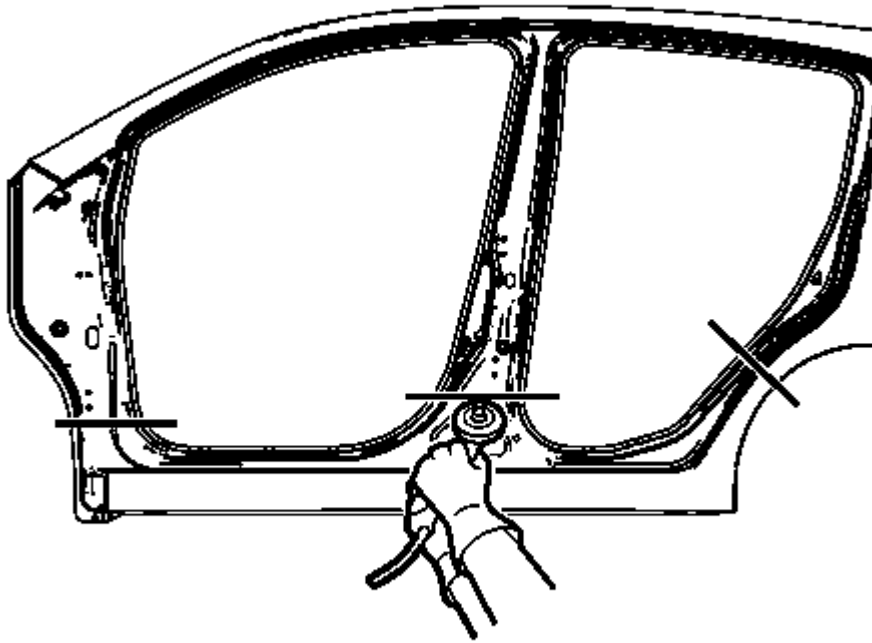


Fig. 84: Cutting Rocker Outer Panel
Courtesy of GENERAL MOTORS COMPANY

1. Cut the rocker outer panel in corresponding locations to fit the remaining original panel. The sectioning joint should be trimmed to allow a gap of one-and-one-half-times the metal thickness at the sectioning joint.
2. Create a 50 mm (2 in) backing plate from the unused portion of the service part.
3. Drill a 8 mm (5/16 in) along the sectioning cut on the remaining original part. Locate these holes 13 mm (1/2 in) from the edge of part and spaced 40 mm (1 1/2 in) apart.
4. Prepare all mating surfaces as necessary.
5. Fit the backing plates halfway into the sectioning joints, clamp in place and plug weld to the vehicle.
6. Align the rocker outer panel.

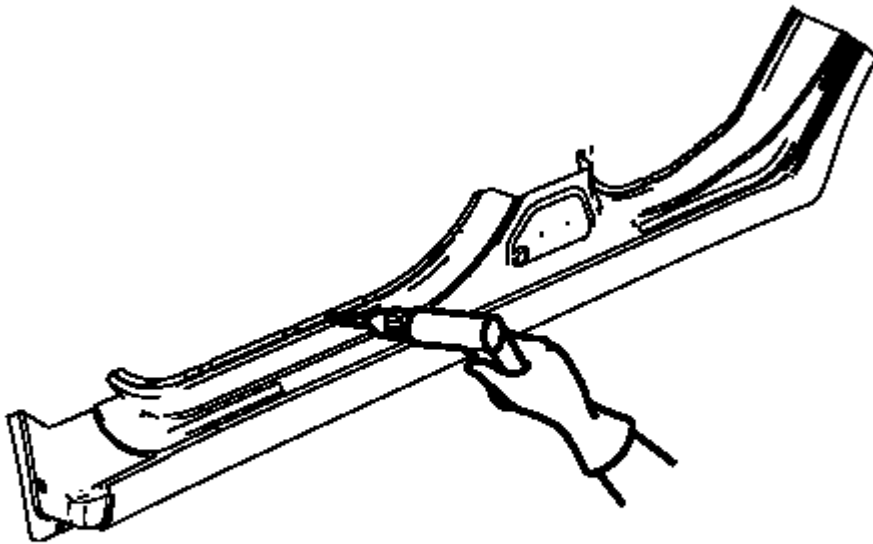


Fig. 85: Drill 8 Mm (5/16 In) For Plug Welding Along Edges Of Rocker Outer Panel
Courtesy of GENERAL MOTORS COMPANY

7. Drill a 8 mm (5/16 in) for plug welding along the edges of the rocker outer panel as noted from the original panel.
8. Clean and prepare the attaching surfaces for welding.
9. Position the rocker outer panel on the vehicle.
10. Verify the fit of the rocker outer panel.
11. Clamp the rocker outer panel into position.

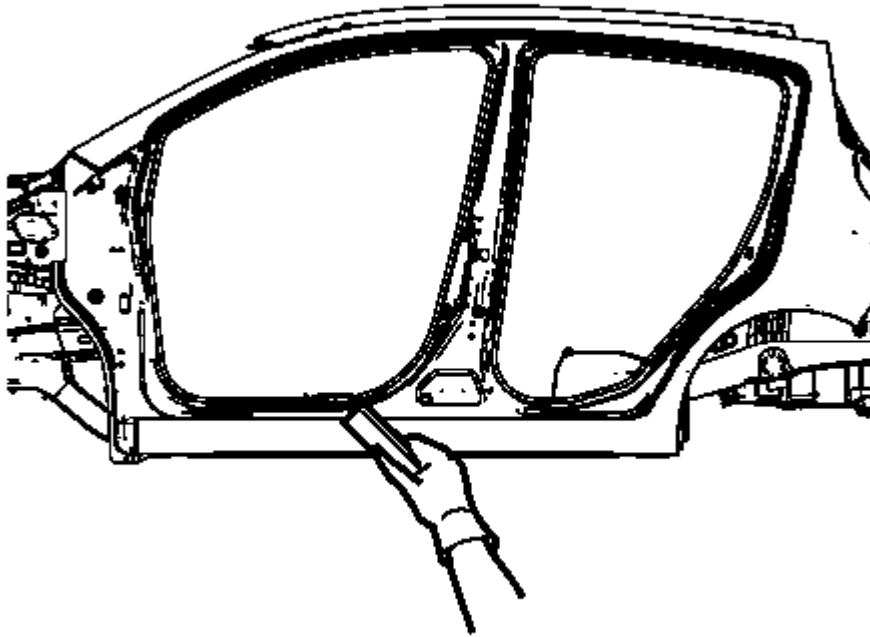


Fig. 86: Applying Sealers And Anti-Corrosion Materials
Courtesy of GENERAL MOTORS COMPANY

12. Plug the weld accordingly.
13. To create a solid weld with minimum heat distortion, make a 25 mm (1 in) stitch weld along the seam with 25 mm (1 in) gaps between them. Then go back and complete the stitch weld.
14. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .
15. Paint the repaired area. Refer to **Basecoat/Clearcoat Paint Systems** .
16. Install all related panels and components.
17. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
18. Enable the SIR system. Refer to **SIR Disabling and Enabling** .

BODY SIDE OUTER PANEL REINFORCEMENT REPLACEMENT

Removal Procedure

WARNING: Refer to **Approved Equipment for Collision Repair Warning** .

WARNING: Refer to Glass and Sheet Metal Handling Warning .

1. Disable the SIR system. Refer to SIR Disabling and Enabling .
2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection .
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to Anti-Corrosion Treatment and Repair .

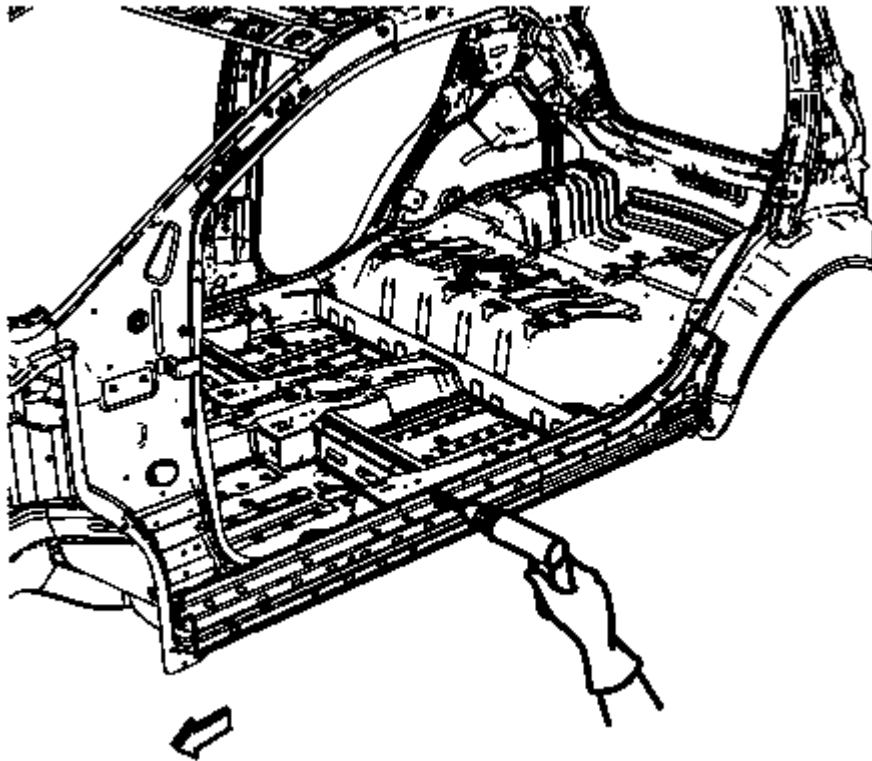


Fig. 87: Drilling All Factory Welds
Courtesy of GENERAL MOTORS COMPANY

6. Locate and mark all the necessary factory welds of the body side outer panel reinforcement.
7. Drill all factory welds. Note the number and location of welds for installation of the service assembly.

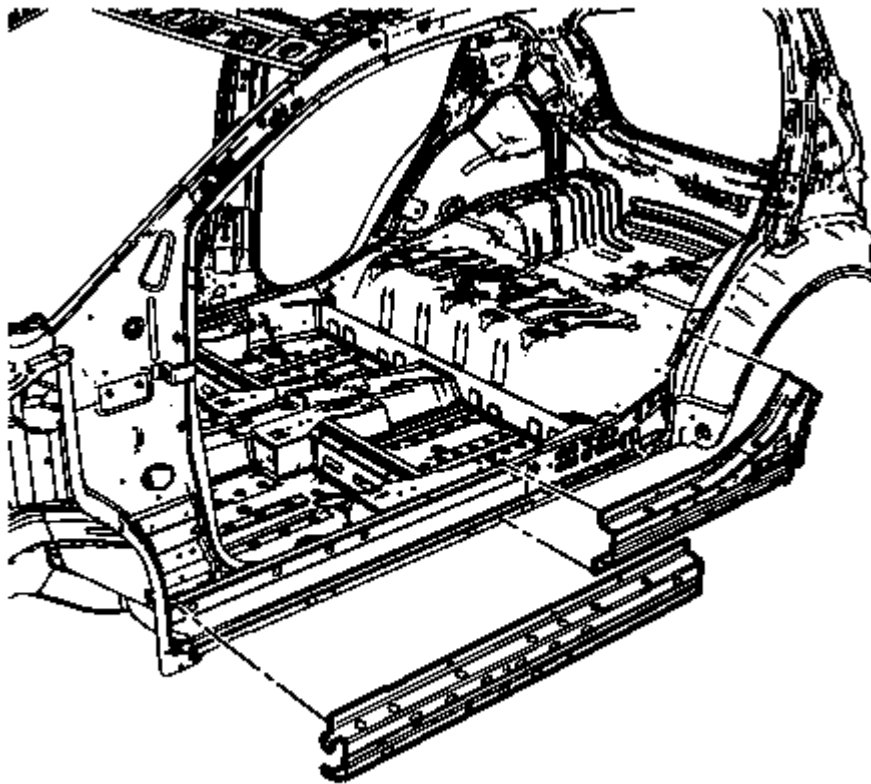


Fig. 88: Removing Damaged Body Side Outer Panel Reinforcement
Courtesy of GENERAL MOTORS COMPANY

8. Remove the damaged body side outer panel reinforcement.

Installation Procedure

1. Align the body side outer panel reinforcement.

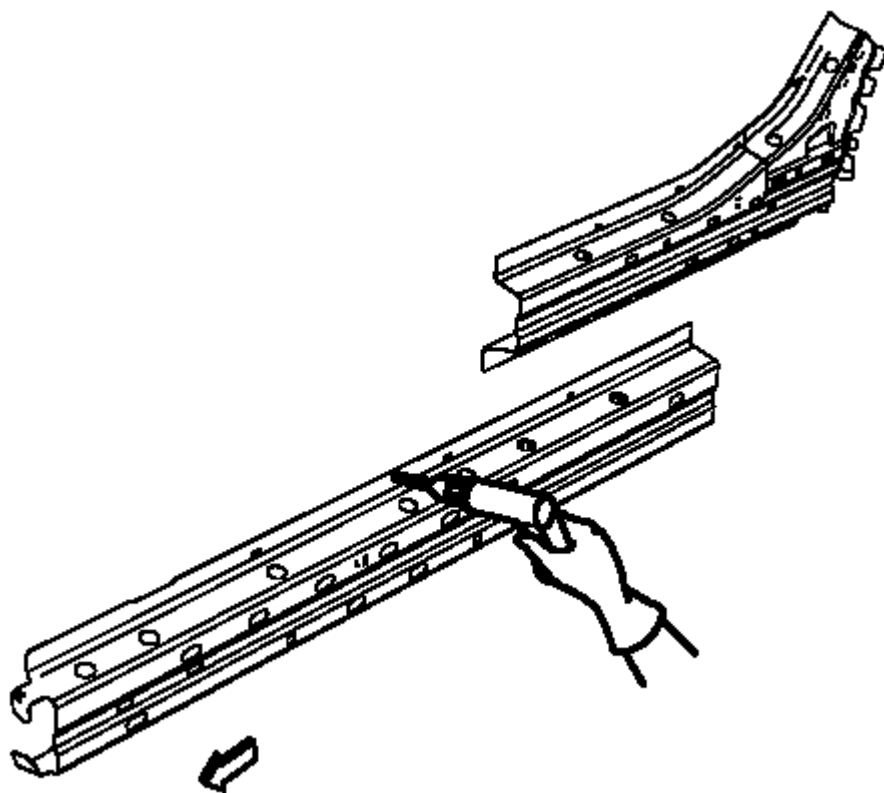


Fig. 89: Drilling 8 Mm (5/16 In) For Plug Welding Along Edges Of Body Side Outer Panel Reinforcement

Courtesy of GENERAL MOTORS COMPANY

2. Drill a 8 mm (5/16 in) for plug welding along the edges of the body side outer panel reinforcement as noted from the original panel.
3. Clean and prepare the attaching surfaces for welding.

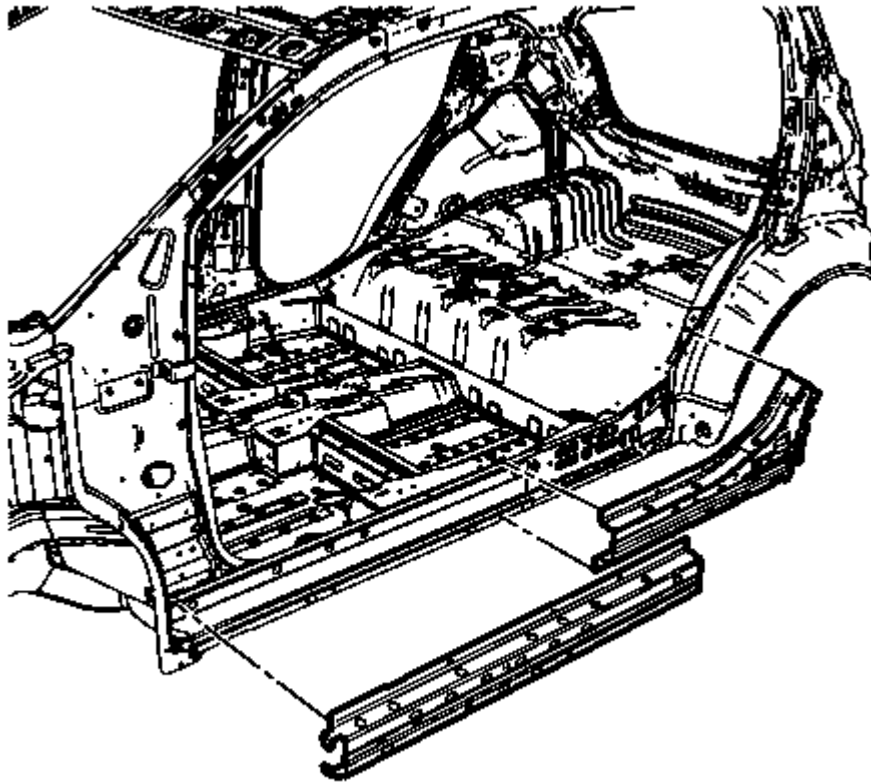


Fig. 90: Removing Damaged Body Side Outer Panel Reinforcement
Courtesy of GENERAL MOTORS COMPANY

4. Position the body side outer panel reinforcement on the vehicle.
5. Verify the fit of the body side outer panel reinforcement.
6. Clamp the body side outer panel reinforcement into position.

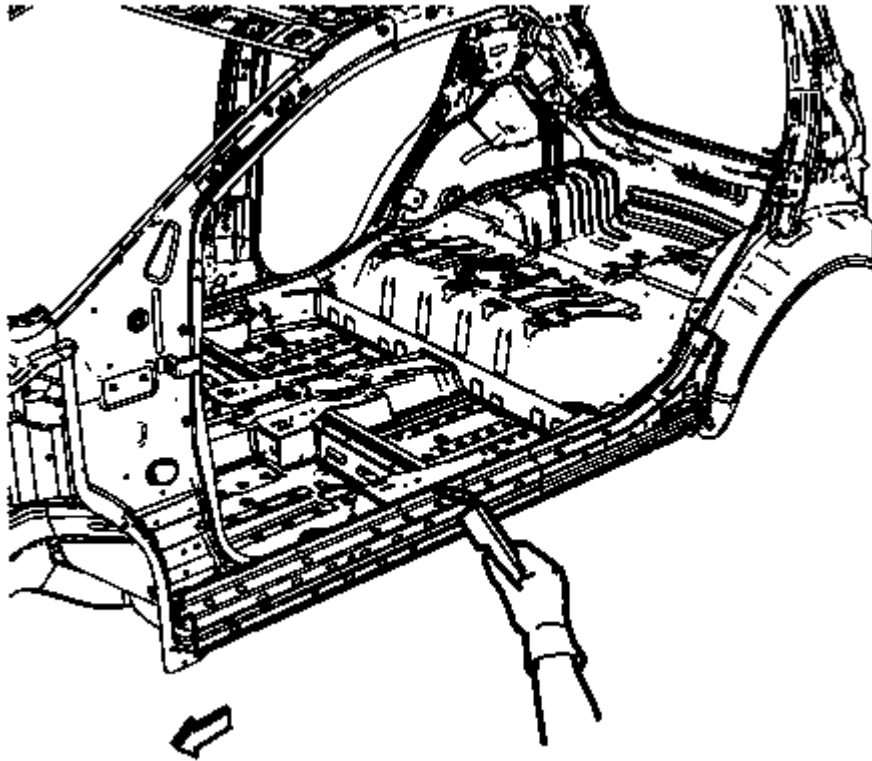


Fig. 91: Applying Sealers And Anti-Corrosion Materials
Courtesy of GENERAL MOTORS COMPANY

7. Plug the weld accordingly.
8. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .
9. Paint the repaired area. Refer to **Basecoat/Clearcoat Paint Systems** .
10. Install all related panels and components.
11. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
12. Enable the SIR system. Refer to **SIR Disabling and Enabling** .

REAR COMPARTMENT FLOOR PANEL REPLACEMENT

Removal Procedure

WARNING: Refer to **Approved Equipment for Collision Repair Warning** .

WARNING: Refer to **Glass and Sheet Metal Handling Warning** .

1. Disable the SIR system. Refer to **SIR Disabling and Enabling** .
2. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .

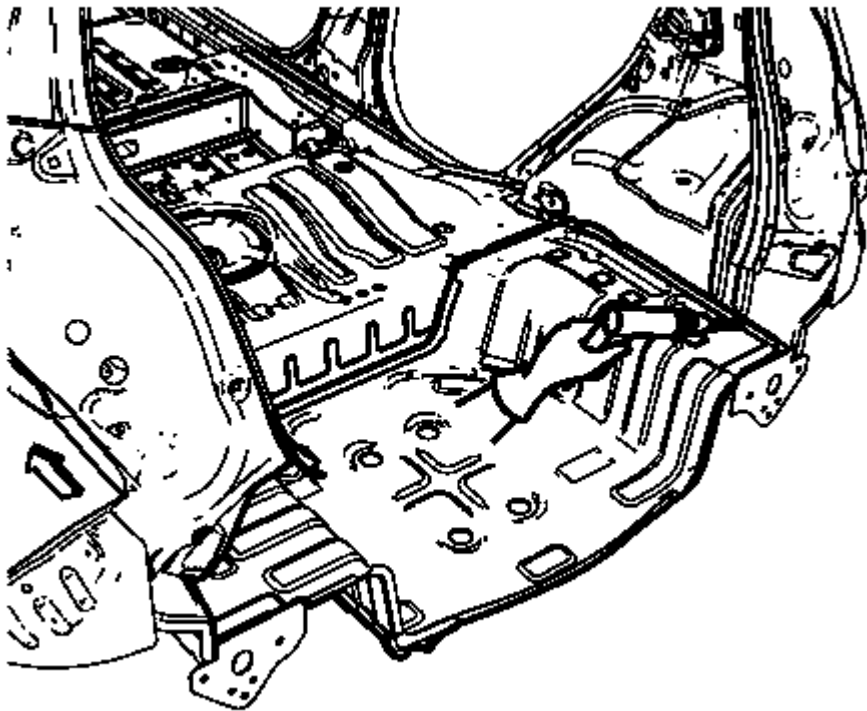


Fig. 92: Drilling All Factory Welds
Courtesy of GENERAL MOTORS COMPANY

6. Locate and mark all the necessary factory welds of the rear compartment floor panel.
7. Note the number and location of weld studs for installation of the service assembly.
8. Drill all factory welds. Note the number and location of welds for installation of the service assembly.

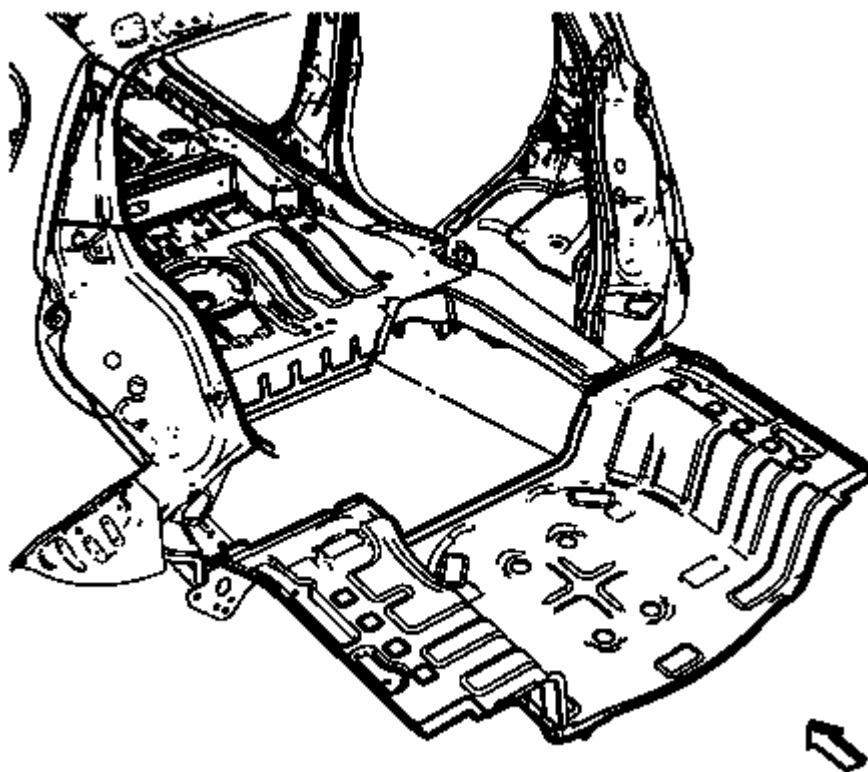


Fig. 93: Removing Damaged Rear Compartment Floor Panel
Courtesy of GENERAL MOTORS COMPANY

9. Remove the damaged rear compartment floor panel.

Installation Procedure

1. Align the rear compartment floor panel.

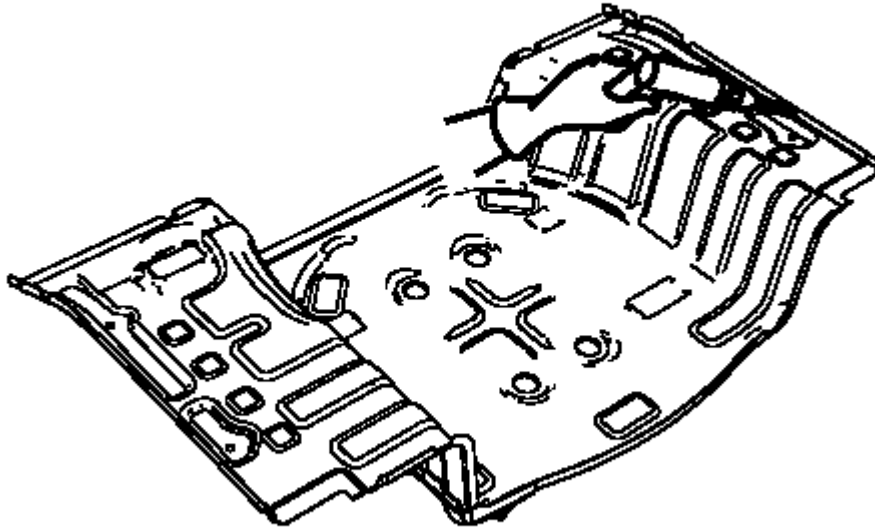


Fig. 94: Drilling 8 Mm (5/16 In) For Plug Welding Along Edges Of Rear Compartment Floor Panel
Courtesy of GENERAL MOTORS COMPANY

2. Drill a 8 mm (5/16 in) for plug welding along the edges of the rear compartment floor panel as noted from the original panel.
3. Clean and prepare the attaching surfaces for welding.
4. Position the rear compartment floor panel on the vehicle.
5. Verify the fit of the rear compartment floor panel.
6. Clamp the rear compartment floor panel into position.

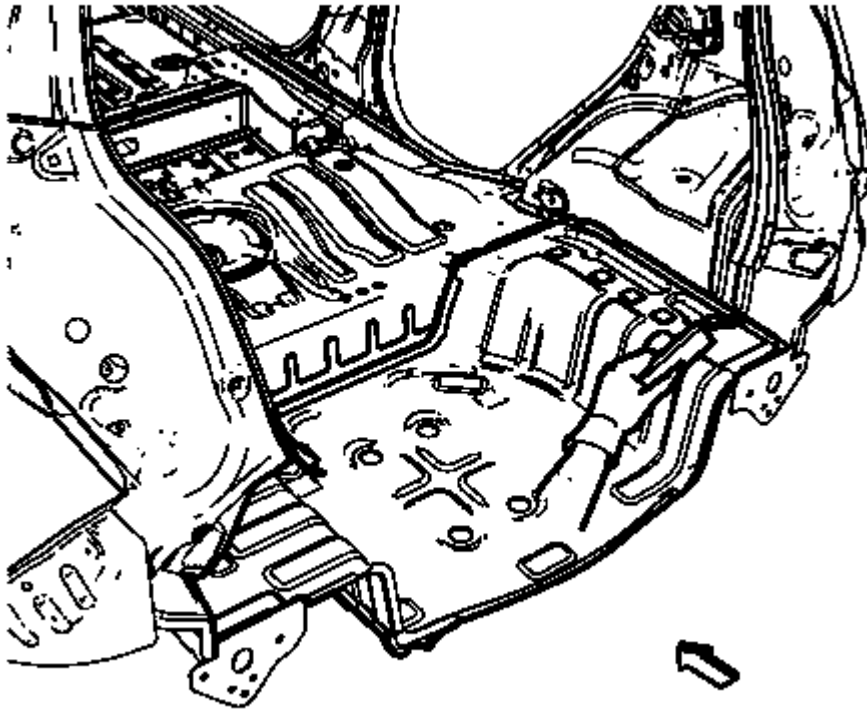


Fig. 95: Applying Sealers And Anti-Corrosion Materials
Courtesy of GENERAL MOTORS COMPANY

7. Plug the weld accordingly.
8. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .
9. Paint the repaired area. Refer to **Basecoat/Clearcoat Paint Systems** .
10. Install all related panels and components.
11. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
12. Enable the SIR system. Refer to **SIR Disabling and Enabling** .

QUARTER OUTER PANEL SECTIONING

Special Tools

- **BO-6392** Flanging Tool Kit
- **BO-6396** Bonding Pliers

For equivalent regional tools, refer to **Special Tools**.

Removal Procedure

WARNING: Refer to Approved Equipment for Collision Repair Warning .

WARNING: Refer to Collision Sectioning Warning .

WARNING: Refer to Glass and Sheet Metal Handling Warning .

1. Disable the SIR system. Refer to SIR Disabling and Enabling .
2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection .
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to Anti-Corrosion Treatment and Repair .

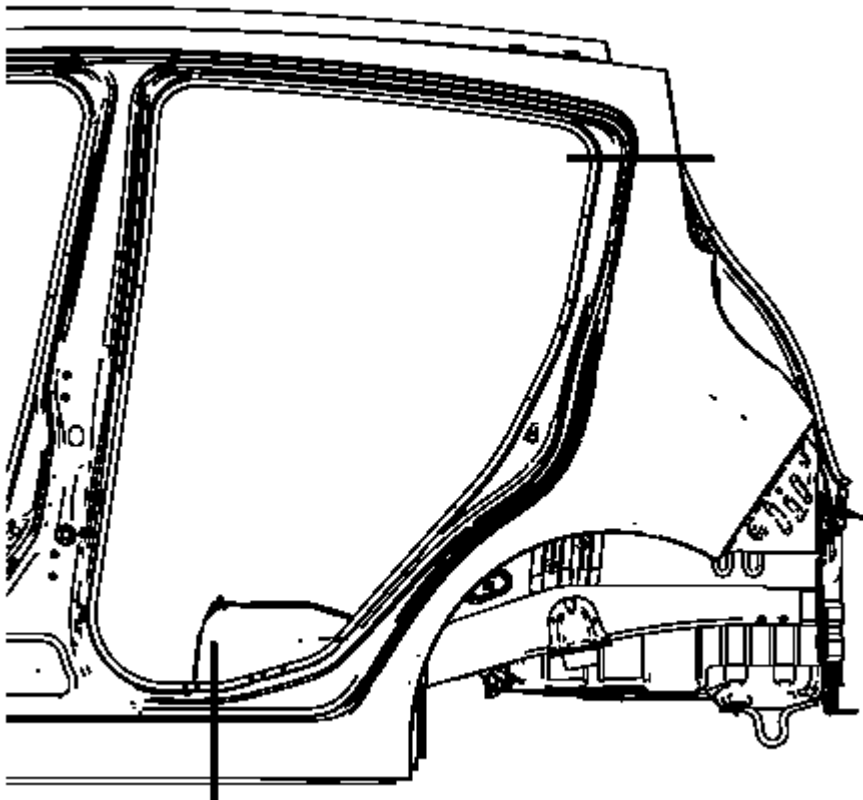


Fig. 96: Creating Cutting Lines On Quarter Outer Panel
Courtesy of GENERAL MOTORS COMPANY

6. Create cut lines on the quarter outer panel.

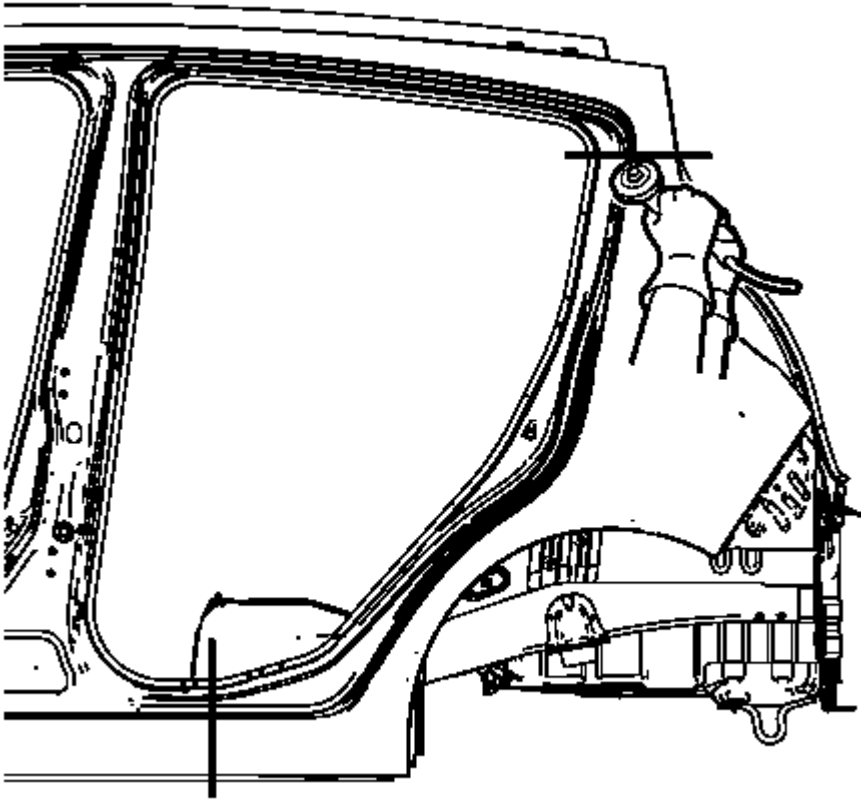


Fig. 97: Cutting panel
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage any inner panels or reinforcements.

7. Cut the panel where sectioning is to be performed.

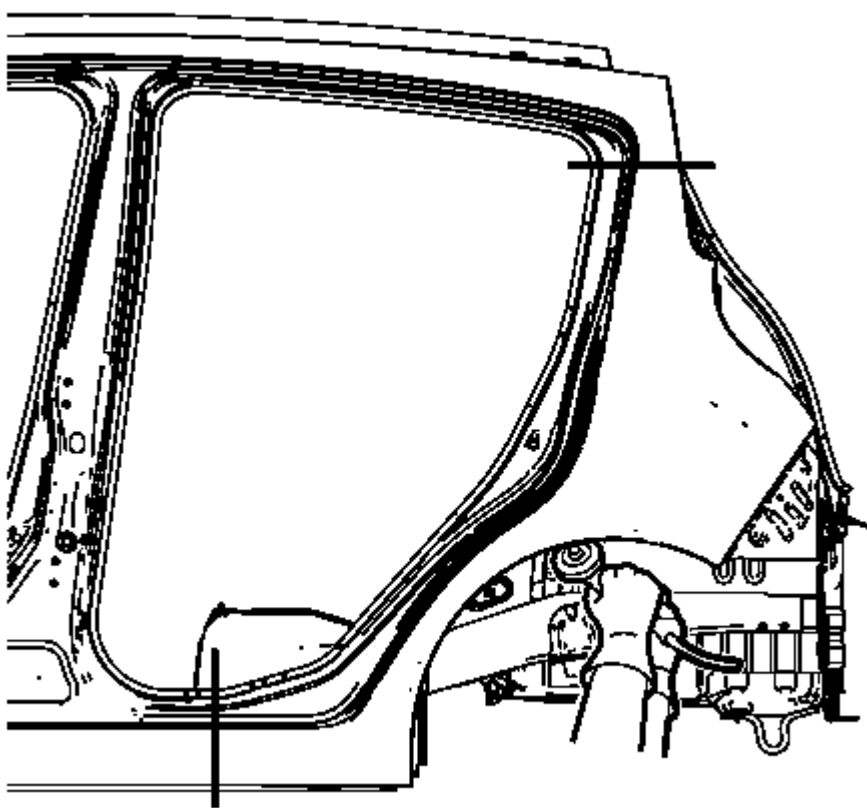


Fig. 98: Opening Wheelhouse Flanging
Courtesy of GENERAL MOTORS COMPANY

8. Open the wheelhouse flanging.

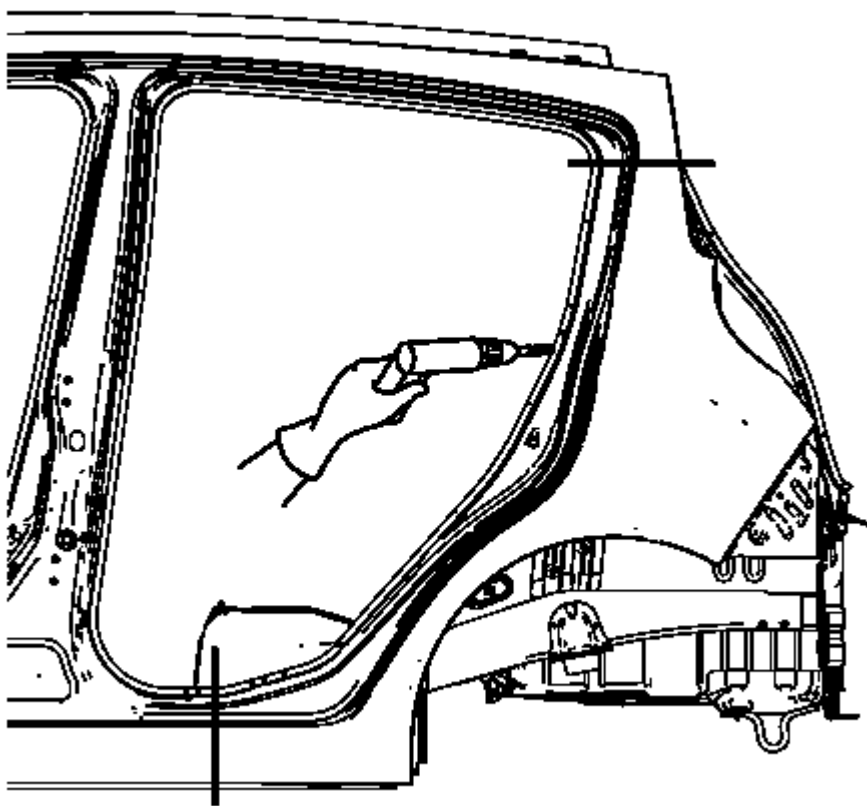


Fig. 99: Drilling All Factory Welds
Courtesy of GENERAL MOTORS COMPANY

9. Locate and mark all the necessary factory welds of the quarter outer panel.
10. Drill all factory welds. Note the number and location of welds for installation of the service assembly.

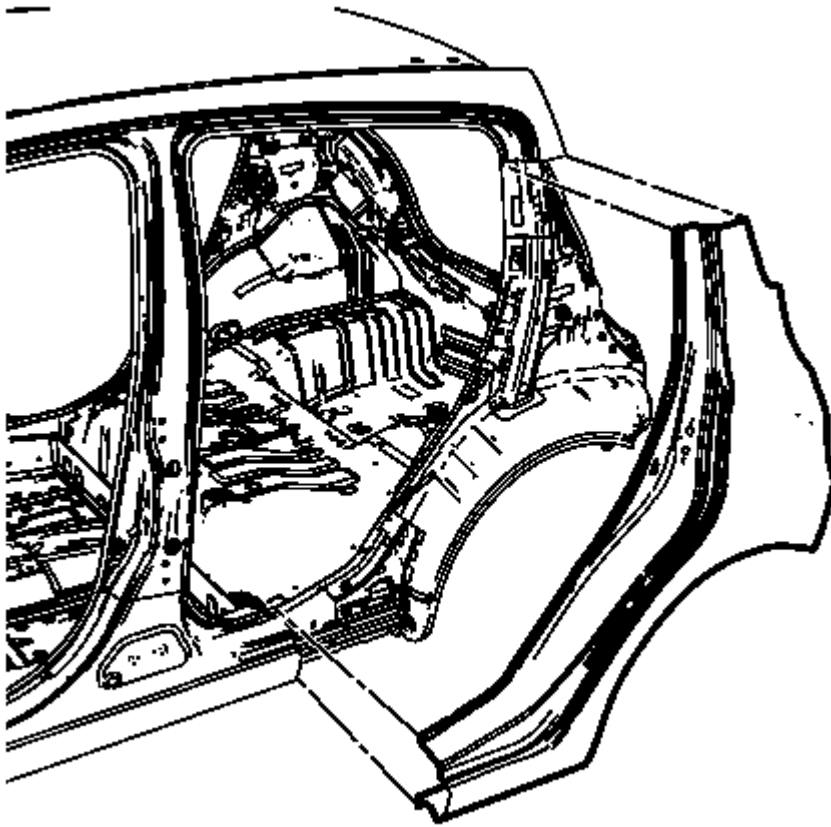


Fig. 100: Removing Damaged Quarter Outer Panel
Courtesy of GENERAL MOTORS COMPANY

11. Remove the damaged quarter outer panel.

Installation Procedure

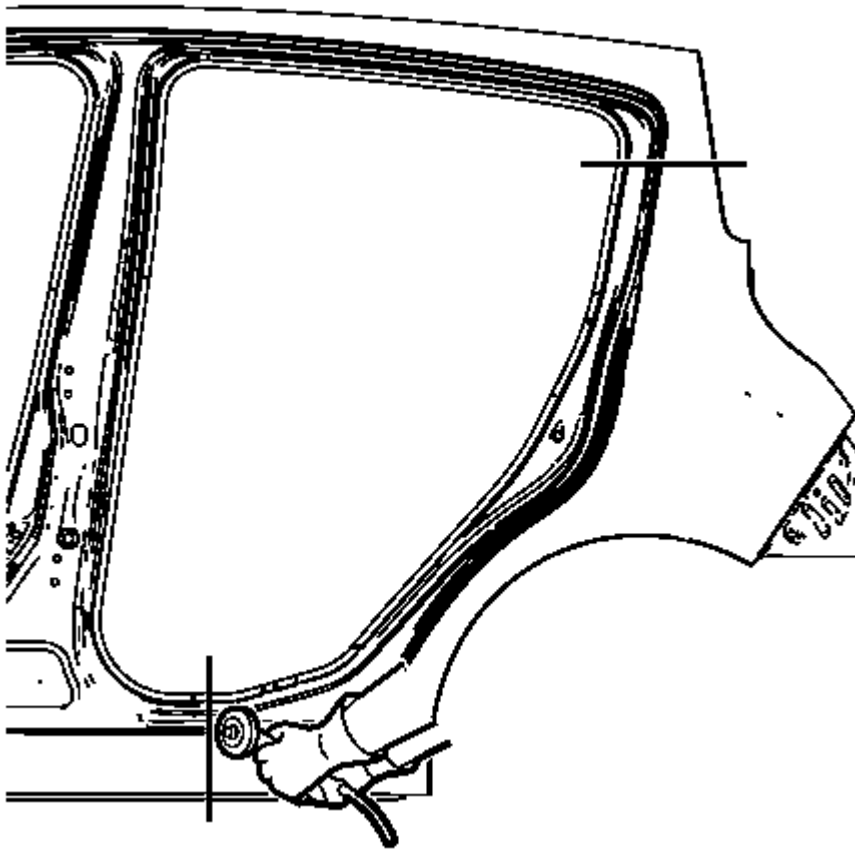


Fig. 101: Cutting Quarter Outer Panel
Courtesy of GENERAL MOTORS COMPANY

1. Cut the quarter outer panel in corresponding locations to fit the remaining original panel. The sectioning joint should be trimmed to allow a gap of one-and-one-half-times the metal thickness at the sectioning joint.
2. Create a 50 mm (2 in) backing plate from the unused portion of the service part.
3. Drill a 8 mm (5/16 in) along the sectioning cut on the remaining original part. Locate these holes 13 mm (1/2 in) from the edge of part and spaced 40 mm (1 1/2 in) apart.
4. Prepare all mating surfaces as necessary.
5. Fit the backing plates halfway into the sectioning joints, clamp in place and plug weld to the vehicle.
6. Align the quarter outer panel.

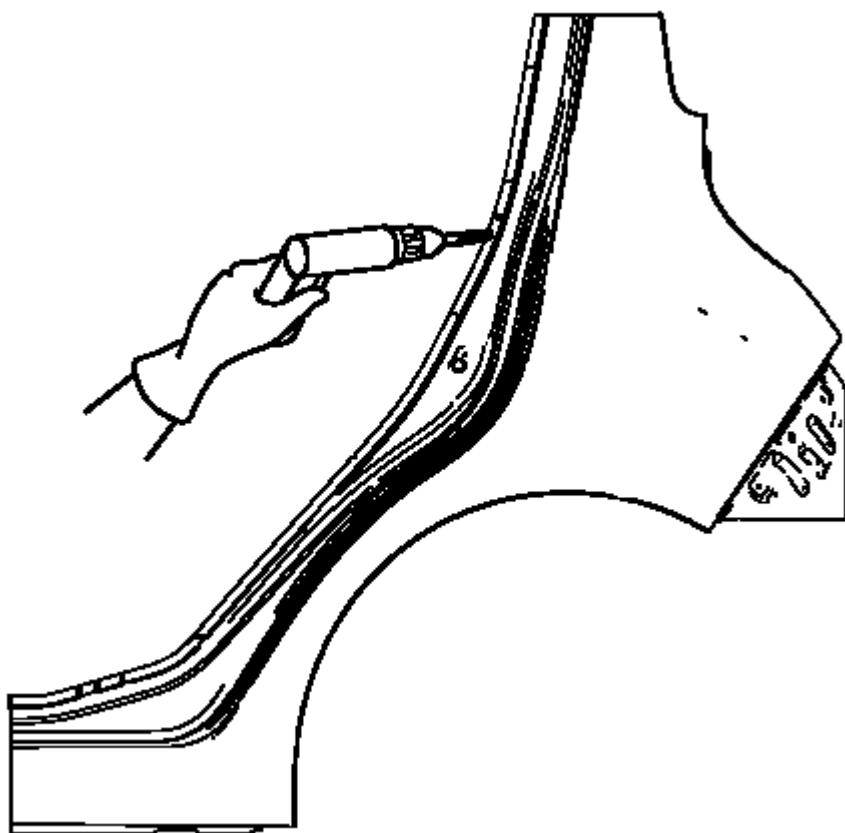


Fig. 102: Drilling 8 mm (5/16 in) For Plug Welding Along Edges Of Quarter Outer Panel
Courtesy of GENERAL MOTORS COMPANY

7. Drill a 8 mm (5/16 in) for plug welding along the edges of the quarter outer panel as noted from the original panel.
8. Clean and prepare the attaching surfaces for welding.

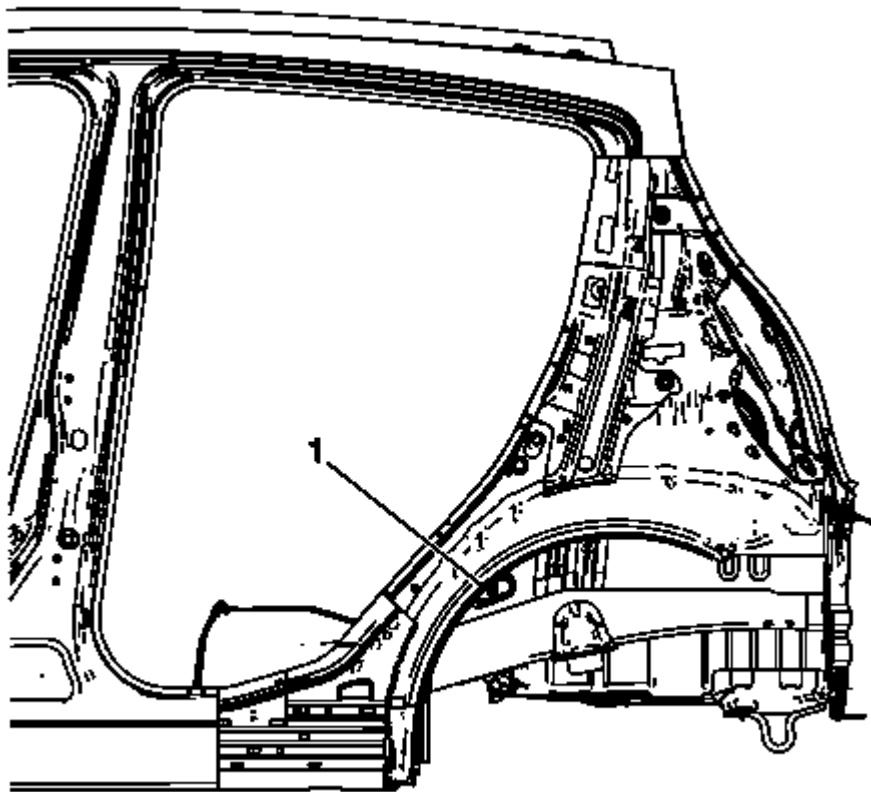


Fig. 103: Applying Structural Adhesive
Courtesy of GENERAL MOTORS COMPANY

9. Apply structural adhesive (1) as noted from the original panel.
10. Position the quarter outer panel on the vehicle.
11. Verify the fit of the quarter outer panel.
12. Clamp the quarter outer panel into position.

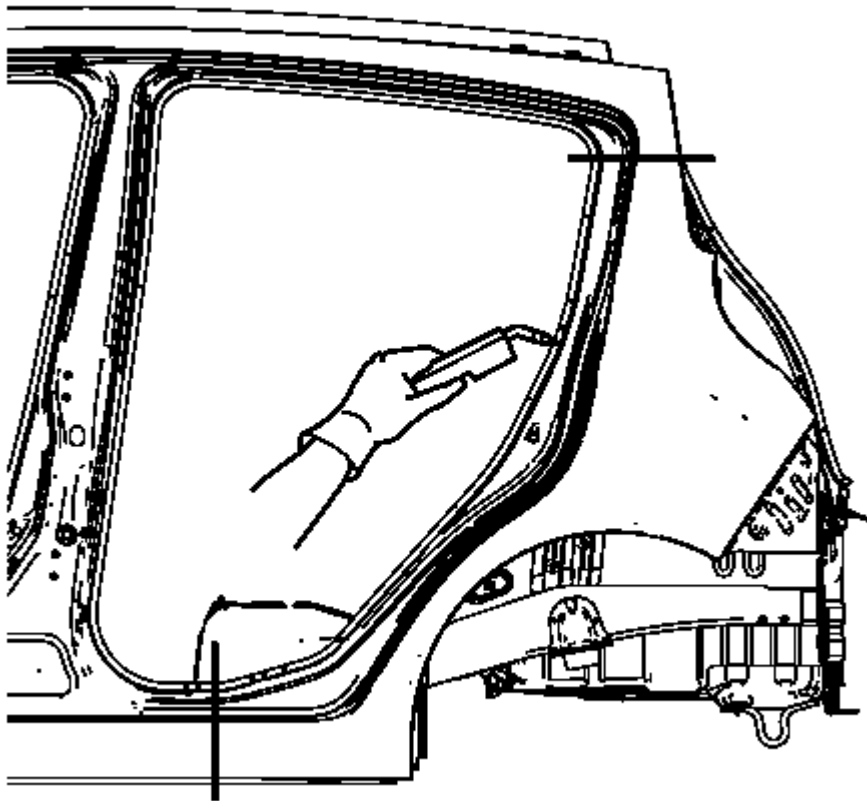


Fig. 104: Identifying BO-6396 Pliers And BO-6392 Tool Kit
Courtesy of GENERAL MOTORS COMPANY

13. Plug the weld accordingly.
14. To create a solid weld with minimum heat distortion, make 25 mm (1 in) stitch welds along the seam with 25 mm (1 in) gaps between them. Then go back and complete the stitch weld.
15. Pre-flang the flange with **BO-6396** pliers and **BO-6392** tool kit.

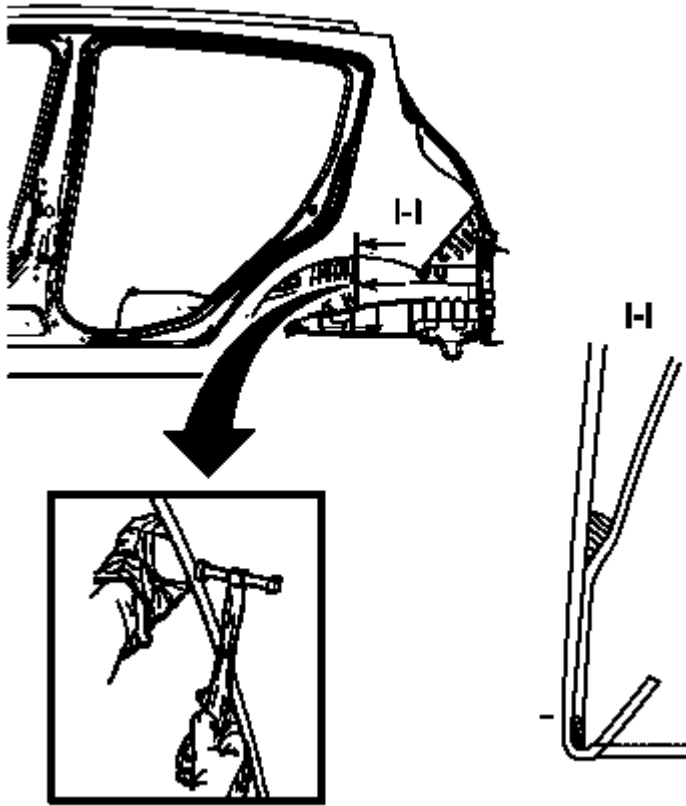


Fig. 105: Closing Wheelhouse Flanging
Courtesy of GENERAL MOTORS COMPANY

16. Finish closing the wheelhouse flanging.
17. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .
18. Paint the repaired area. Refer to **Basecoat/Clearcoat Paint Systems** .
19. Install all related panels and components.
20. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
21. Enable the SIR system. Refer to **SIR Disabling and Enabling** .

QUARTER INNER PANEL REPLACEMENT

Removal Procedure

WARNING: Refer to **Approved Equipment for Collision Repair Warning** .

WARNING: Refer to **Glass and Sheet Metal Handling Warning** .

1. Disable the SIR system. Refer to **SIR Disabling and Enabling** .
2. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .

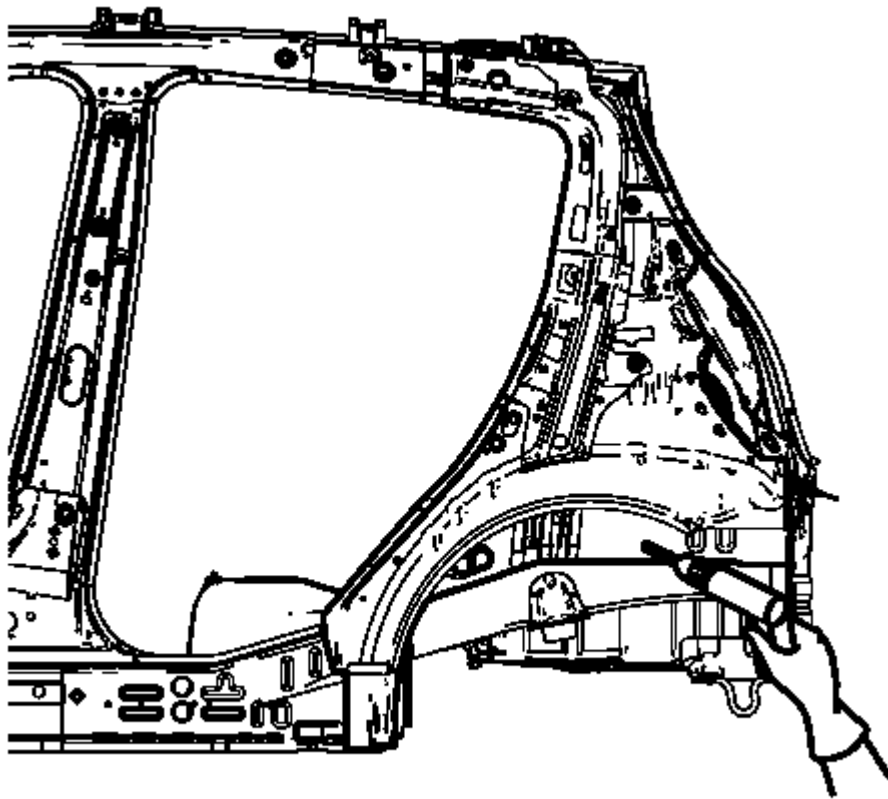


Fig. 106: Drilling Factory Welds
Courtesy of GENERAL MOTORS COMPANY

6. Locate and mark all factory welds.
7. Drill all factory welds. Note the number and location of welds for installation of the service assembly.

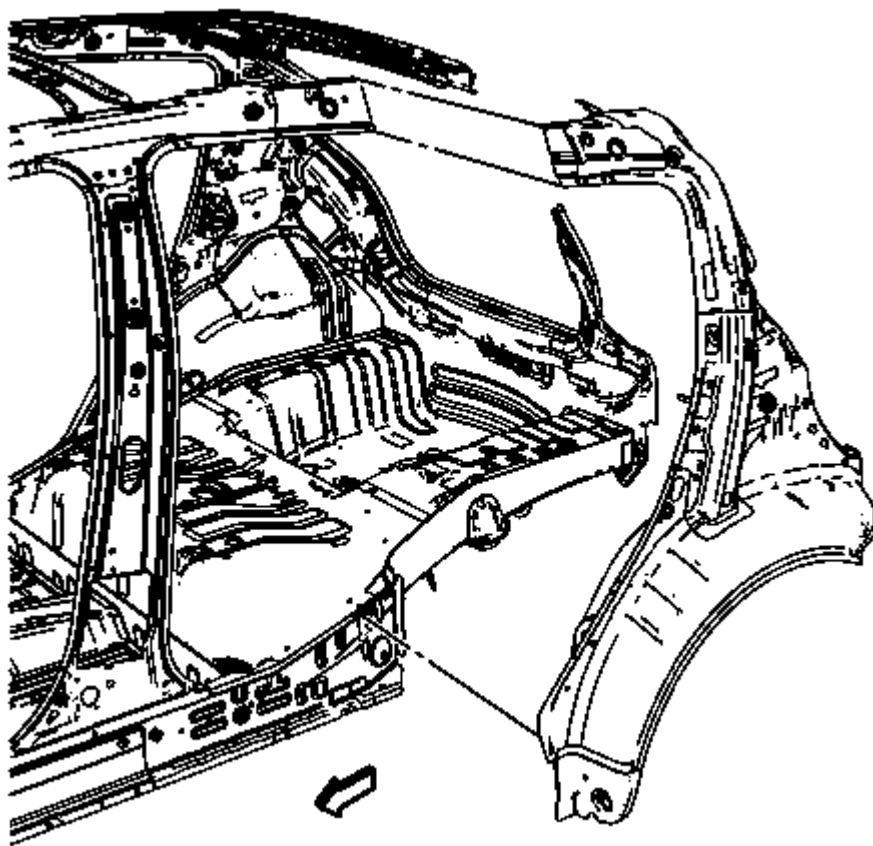


Fig. 107: Removing Damaged Quarter Inner Panel
Courtesy of GENERAL MOTORS COMPANY

8. Remove the damaged quarter inner panel.

Installation Procedure

1. Align the quarter inner panel.

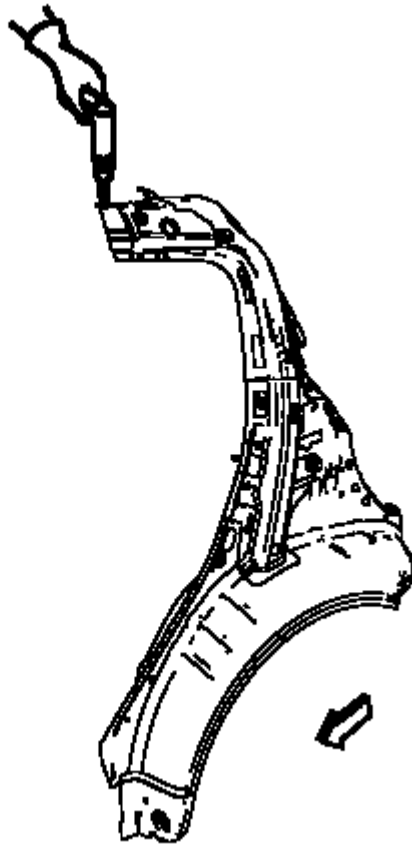


Fig. 108: Drilling 8 Mm (5/16 In) For Plug Welding Along Edges Of Service Panel
Courtesy of GENERAL MOTORS COMPANY

2. Drill a 8 mm (5/16 in) for plug welding along the edges of the service panel as noted from the original panel.
3. Clean and prepare the attaching surfaces for welding.

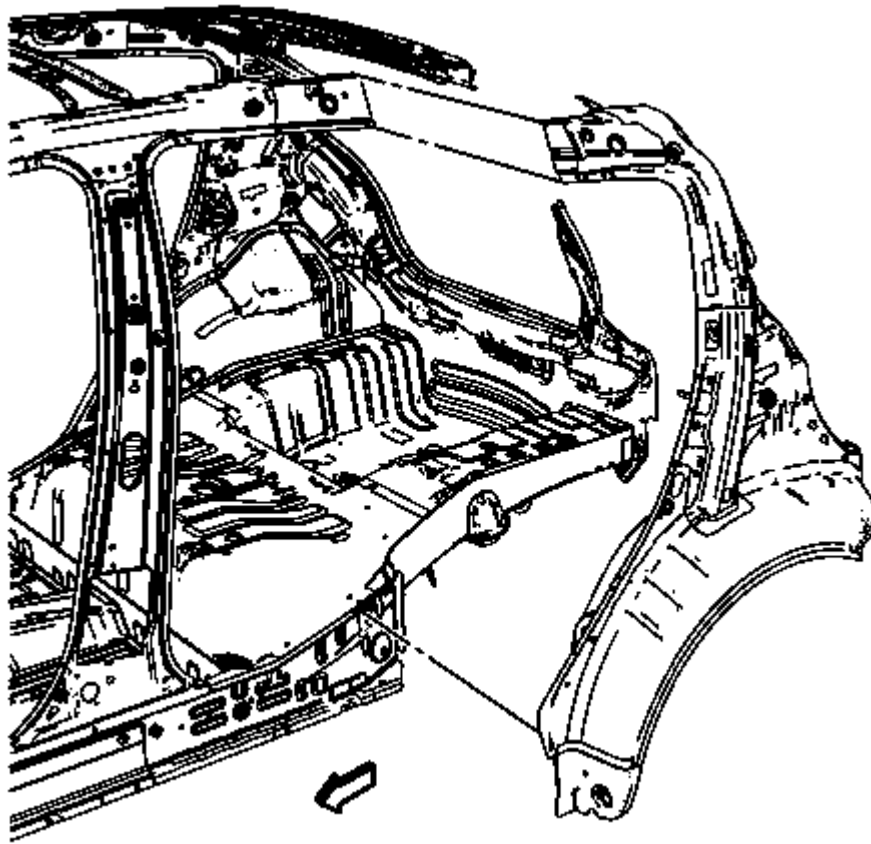


Fig. 109: Removing Damaged Quarter Inner Panel
Courtesy of GENERAL MOTORS COMPANY

4. Position the quarter inner panel.
5. Verify the fit of the panel.
6. Clamp the panel into position.

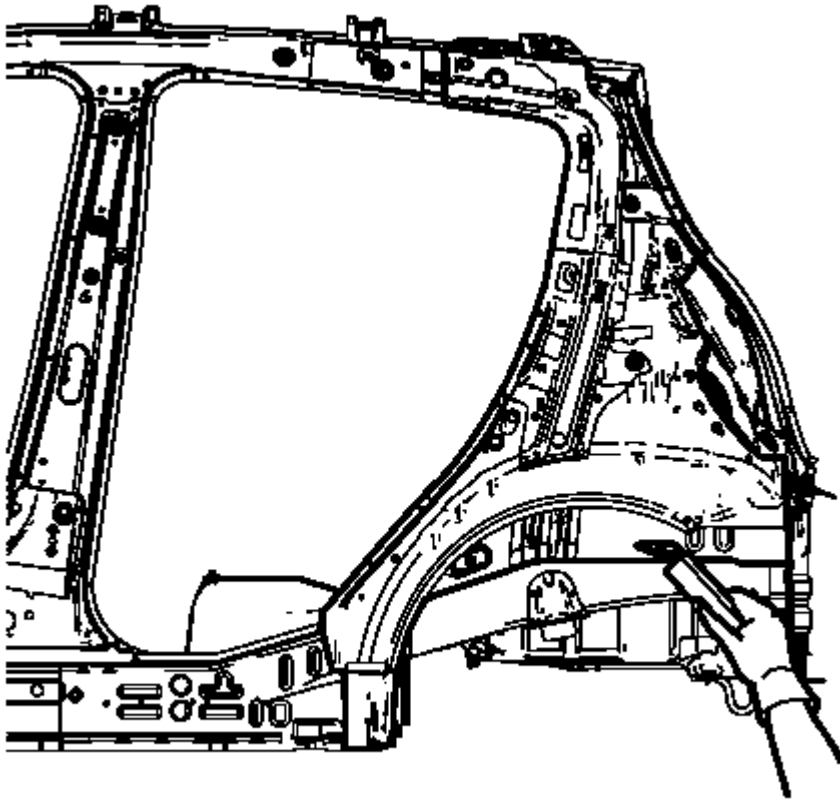


Fig. 110: Applying Sealers And Anti-Corrosion Materials
Courtesy of GENERAL MOTORS COMPANY

7. Plug weld accordingly.
8. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .
9. Paint the repaired area. Refer to **Basecoat/Clearcoat Paint Systems** .
10. Install all related panels and components.
11. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
12. Enable the SIR system. Refer to **SIR Disabling and Enabling** .

REAR RAIL SECTIONING

Removal Procedure

WARNING: Refer to **Approved Equipment for Collision Repair Warning** .

WARNING: Refer to **Glass and Sheet Metal Handling Warning** .

1. Disable the SIR system. Refer to **SIR Disabling and Enabling** .
2. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .

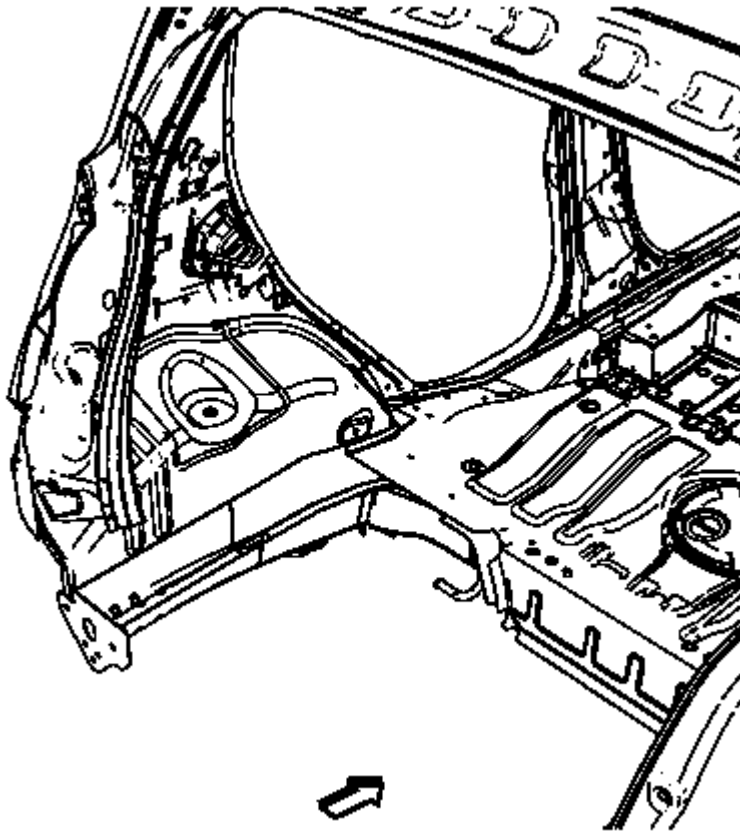


Fig. 111: Creating Cut Lines On Rear Side Rail
Courtesy of GENERAL MOTORS COMPANY

6. Create cut lines on the rear side rail.

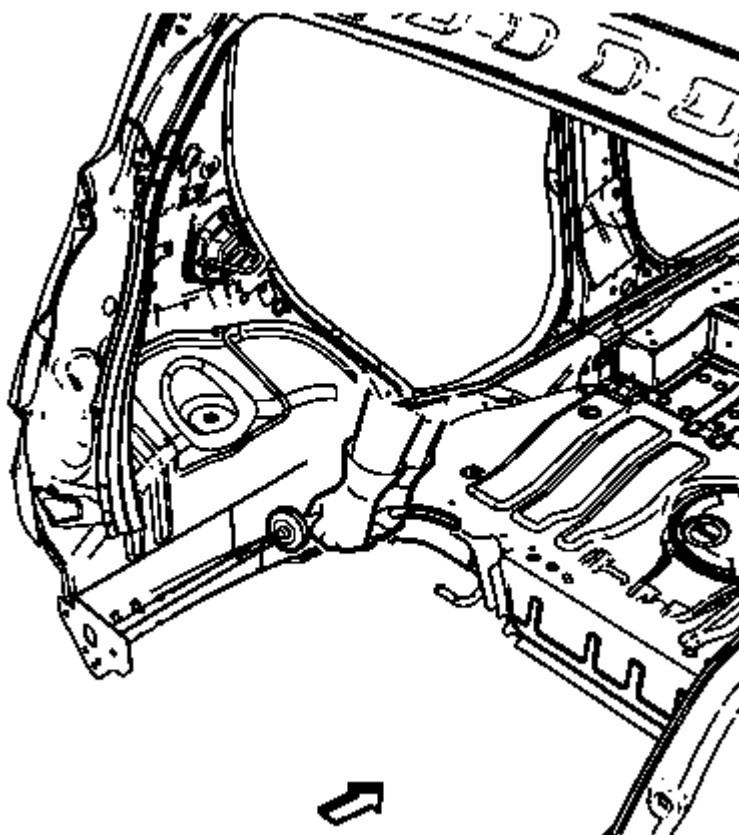


Fig. 112: Cutting Panel

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage any other panels or reinforcements.

7. Cut the panel where sectioning is to be performed.

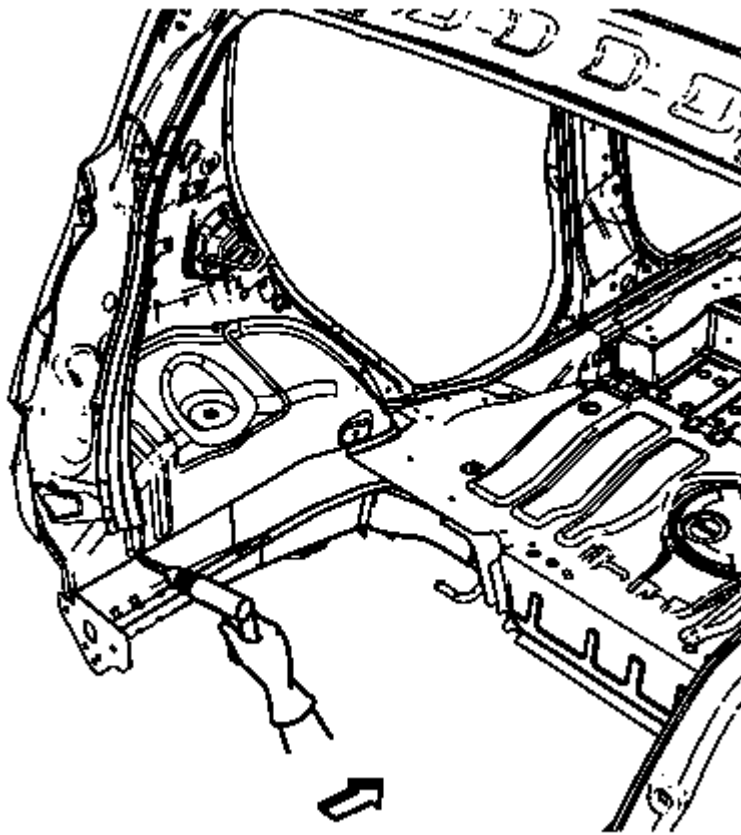


Fig. 113: Drilling Factory Welds

Courtesy of GENERAL MOTORS COMPANY

8. Locate and mark all the necessary factory welds of the rear side rail.
9. Drill all factory welds. Note the number and location of welds for installation of the service assembly.

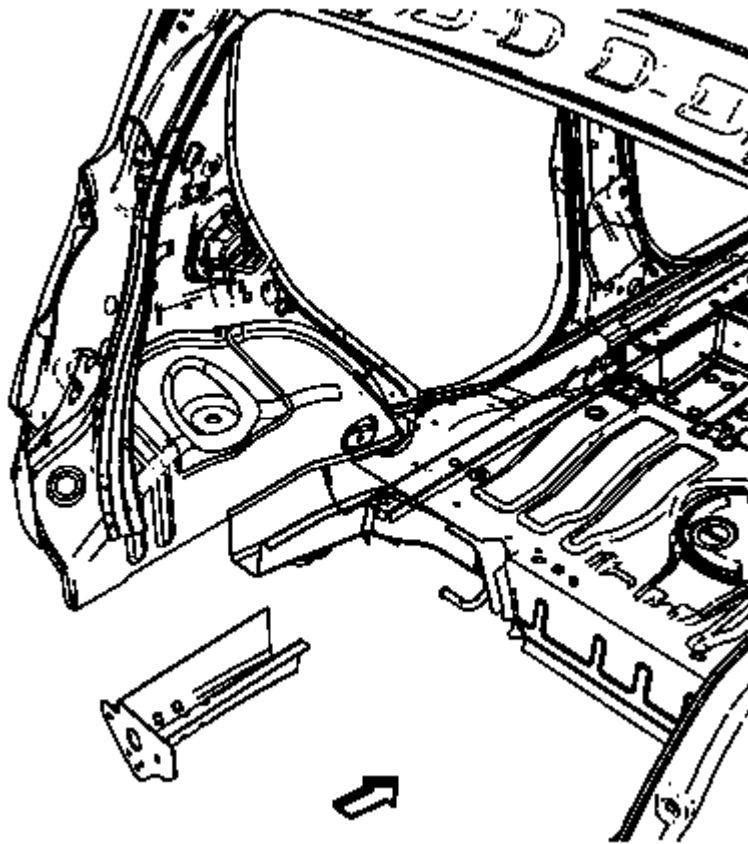


Fig. 114: Damaged Rear Side Rail
Courtesy of GENERAL MOTORS COMPANY

10. Remove the damaged rear side rail.

Installation Procedure

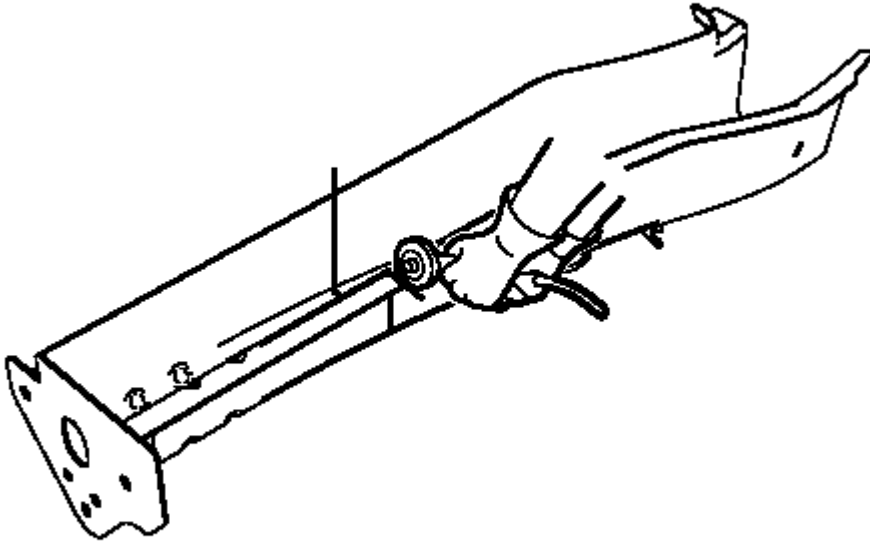


Fig. 115: Cutting Rear Side Rail In Corresponding Locations
Courtesy of GENERAL MOTORS COMPANY

1. Cut the rear side rail in corresponding locations to fit the remaining original panel. The sectioning joint should be trimmed to allow a gap of one-and-one-half-times the metal thickness at the sectioning joint.
2. Create a 50 mm (2 in) backing plate from the unused portion of the service part.
3. Drill 8 mm (5/16 in) along the sectioning cut on the remaining original part. Locate these holes 13 mm (1/2 in) from the edge of part and spaced 40 mm (1 1/2 in) apart.
4. Prepare all mating surfaces as necessary.
5. Fit the backing plates halfway into the sectioning joints, clamp in place and plug weld to the vehicle.
6. Align the rear side rail.

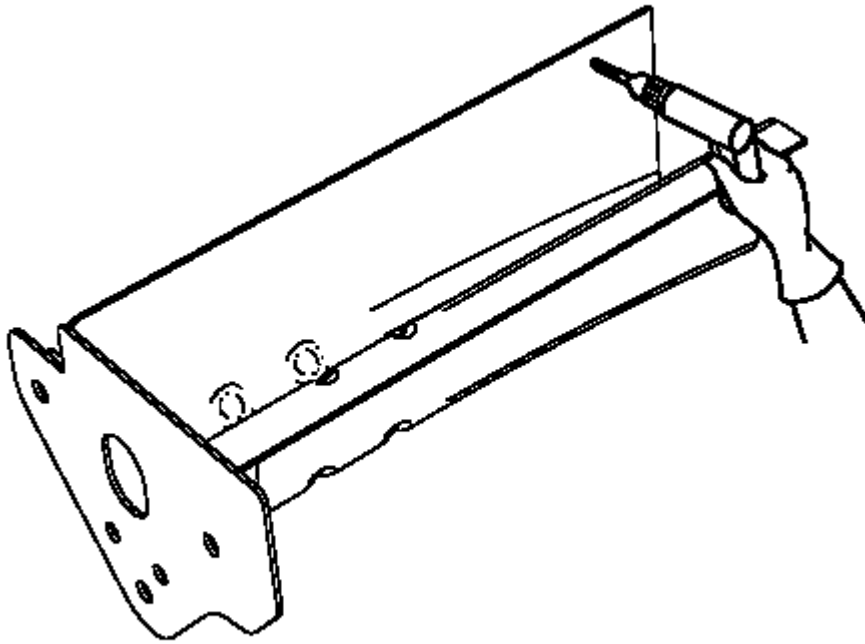


Fig. 116: Drilling 8 mm (5/16 in) For Plug Welding Along Edges Of Rear Side Rail
Courtesy of GENERAL MOTORS COMPANY

7. Drill 8 mm (5/16 in) for plug welding along the edges of the rear side rail as noted from the original panel.
8. Clean and prepare the attaching surfaces for welding.

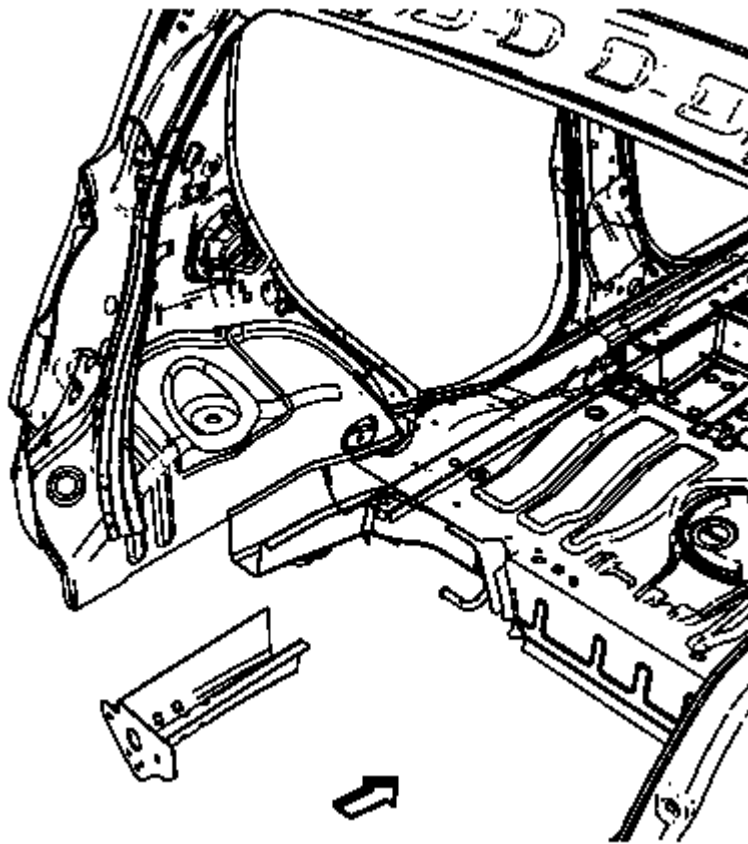


Fig. 117: Damaged Rear Side Rail
Courtesy of GENERAL MOTORS COMPANY

9. Position the rear side rail on the vehicle.
10. Verify the fit of the rear side rail.
11. Clamp the rear side rail into position.

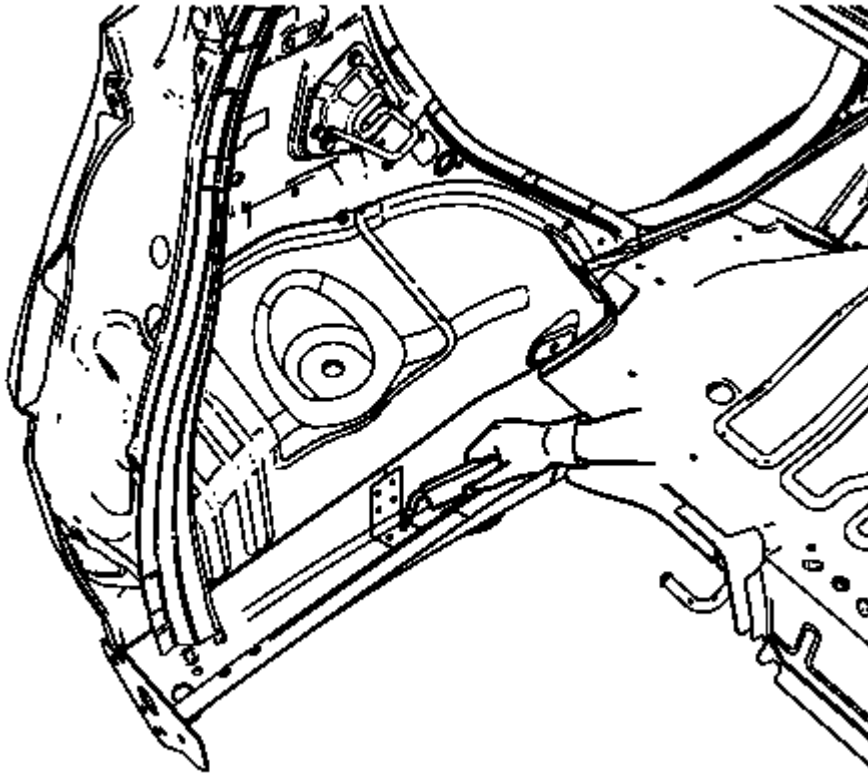


Fig. 118: Applying Sealers And Anti-Corrosion Materials
Courtesy of GENERAL MOTORS COMPANY

12. Plug the weld accordingly.
13. To create a solid weld with minimum heat distortion, make a 25 mm (1 in) stitch weld along the seam with 25 mm (1 in) gaps between them. Then go back and complete the stitch weld.
14. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .
15. Paint the repaired area. Refer to **Basecoat/Clearcoat Paint Systems** .
16. Install all related panels and components.
17. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
18. Enable the SIR system. Refer to **SIR Disabling and Enabling** .

REAR END PANEL REPLACEMENT

Removal Procedure

WARNING: Refer to **Approved Equipment for Collision Repair Warning** .

WARNING: Refer to Glass and Sheet Metal Handling Warning .

1. Disable the SIR system. Refer to SIR Disabling and Enabling .
2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection .
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to Anti-Corrosion Treatment and Repair .

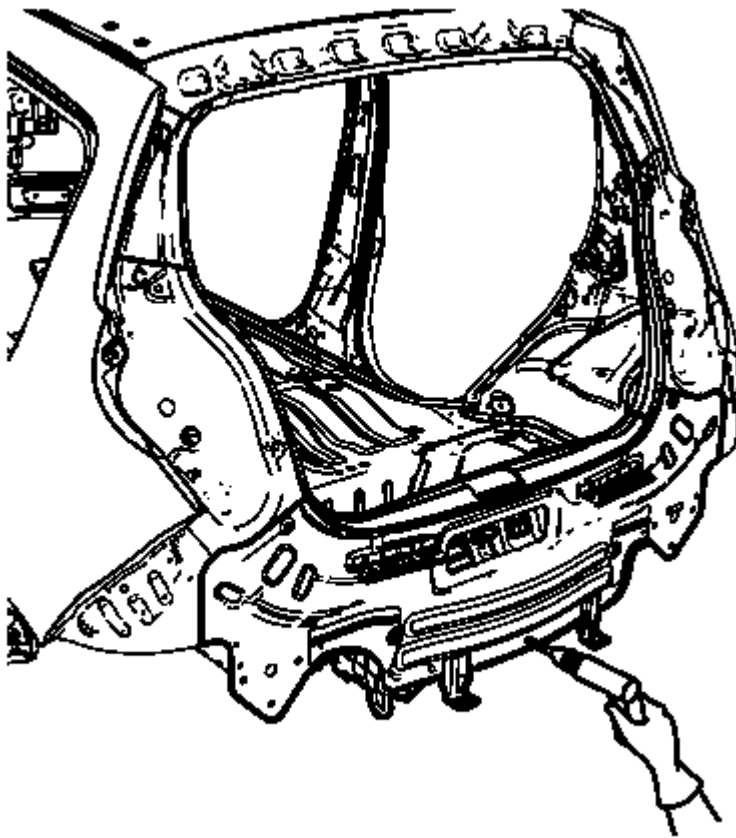


Fig. 119: Drilling Factory Welds
Courtesy of GENERAL MOTORS COMPANY

NOTE: Note the number and location of welds for installation of the service assembly.

6. Locate and mark all the necessary factory welds of the body rear end panel.
7. Drill all factory welds.

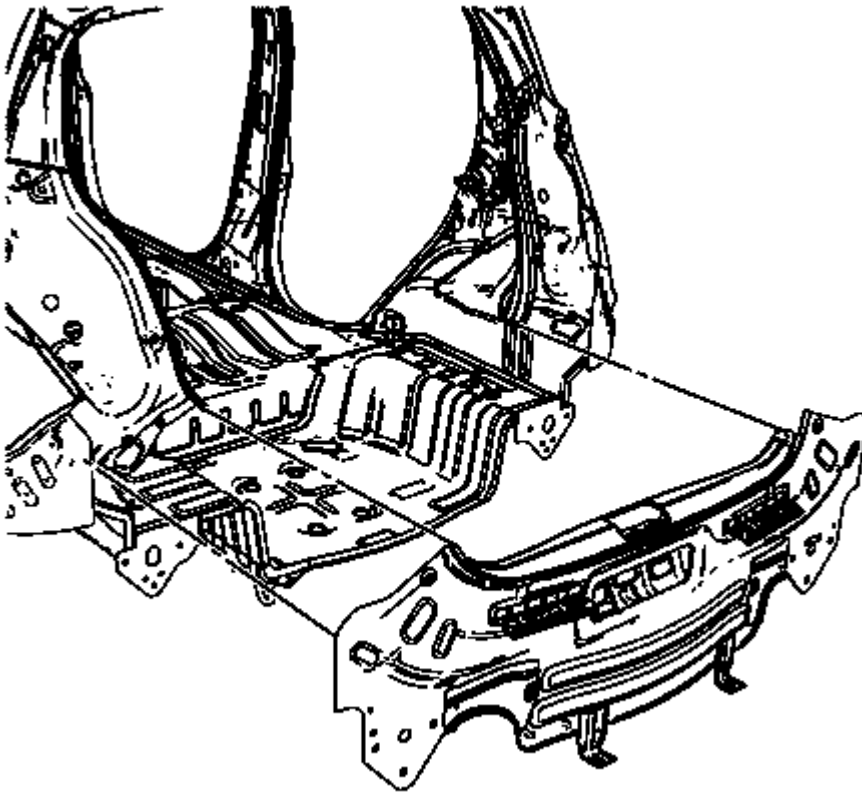


Fig. 120: Body Rear End Panel
Courtesy of GENERAL MOTORS COMPANY

8. Remove the body rear end panel.

Installation Procedure

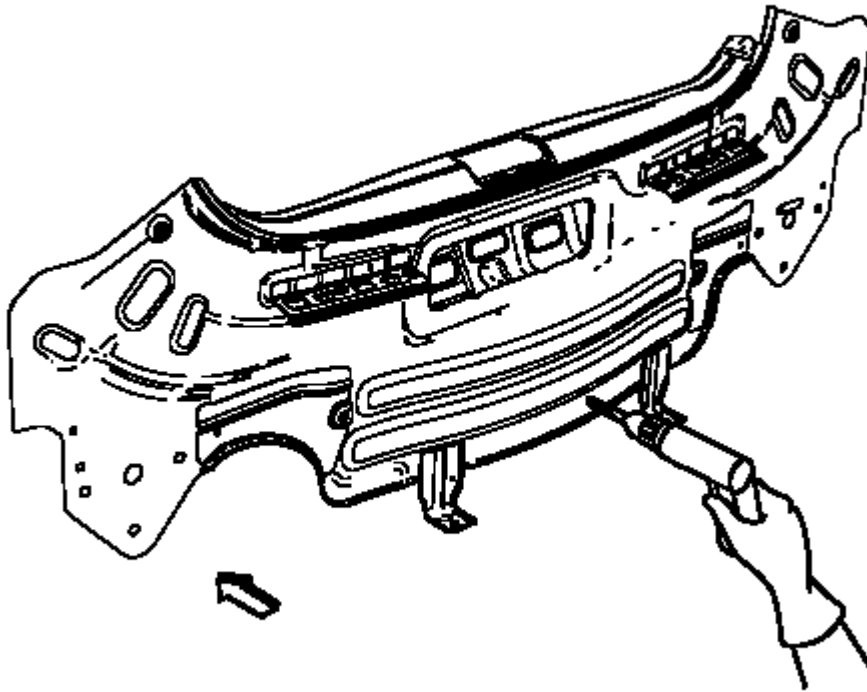


Fig. 121: Drilling 8 mm (5/16 in) For Plug Welding Along Edges Of Body Rear End Panel
Courtesy of GENERAL MOTORS COMPANY

NOTE: If the location of the original plug weld holes can not be determined, space the plug weld holes every 40 mm (1 1/2 in).

1. Drill 8 mm (5/16 in) for plug welding along the edges of the body rear end panel as noted from the original panel.
2. Clean and prepare the attaching surfaces for welding.

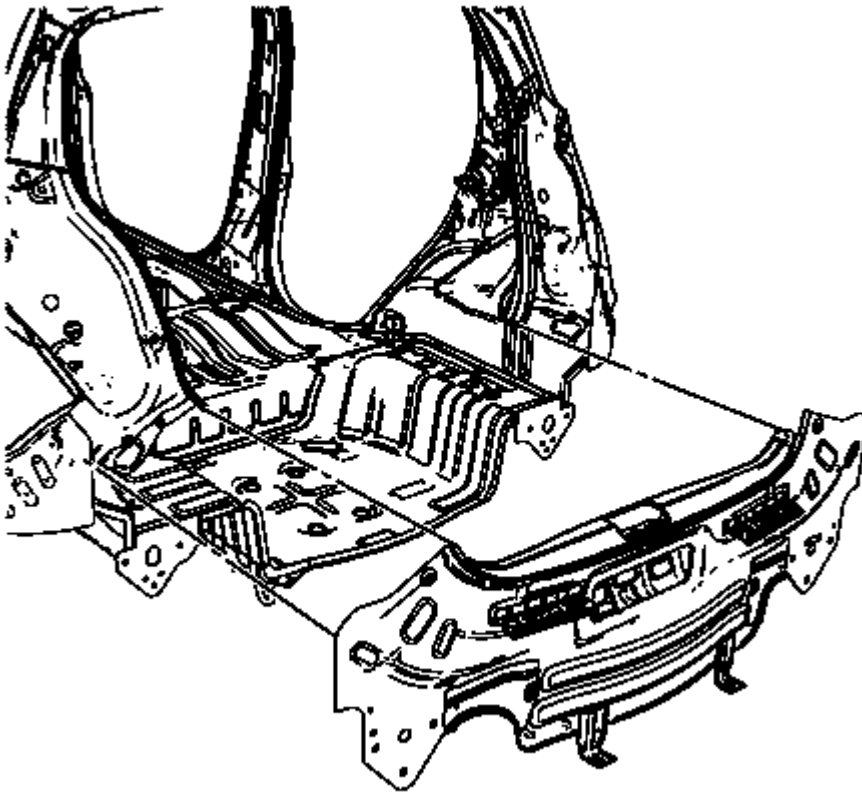


Fig. 122: Body Rear End Panel

Courtesy of GENERAL MOTORS COMPANY

3. Position the body rear end panel on the vehicle.
4. Verify the fit of the body rear end panel.
5. Clamp the body rear end panel into position.

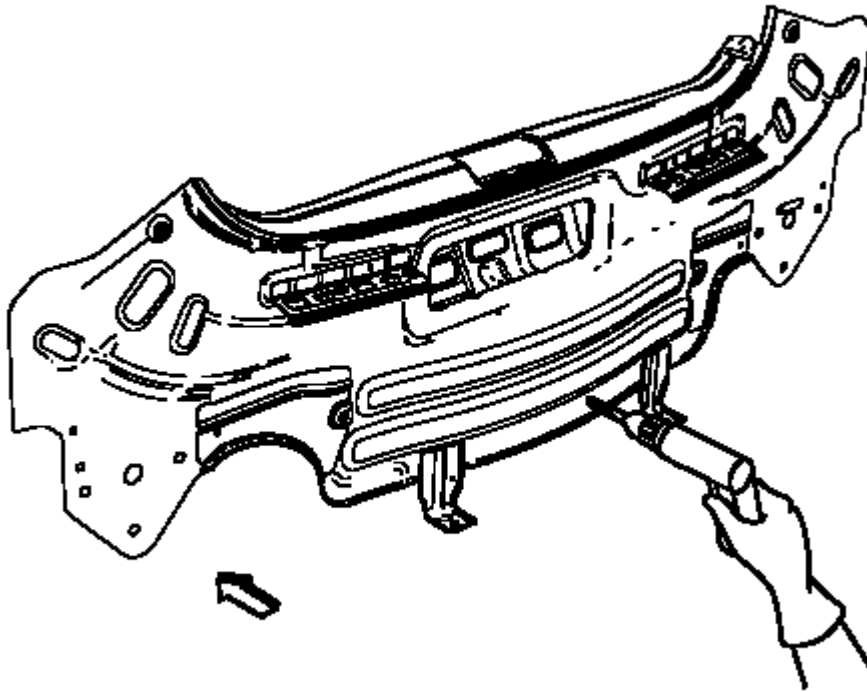


Fig. 123: Drilling 8 mm (5/16 in) For Plug Welding Along Edges Of Body Rear End Panel
Courtesy of GENERAL MOTORS COMPANY

6. Plug the weld accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .
8. Paint the repaired area. Refer to **Basecoat/Clearcoat Paint Systems** .
9. Install all related panels and components.
10. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
11. Enable the SIR system. Refer to **SIR Disabling and Enabling** .

TAIL LAMP POCKET REPLACEMENT

Removal Procedure

WARNING: Refer to **Approved Equipment for Collision Repair Warning** .

WARNING: Refer to **Glass and Sheet Metal Handling Warning** .

1. Disable the SIR system. Refer to **SIR Disabling and Enabling** .
2. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .
6. Locate and mark all factory welds.

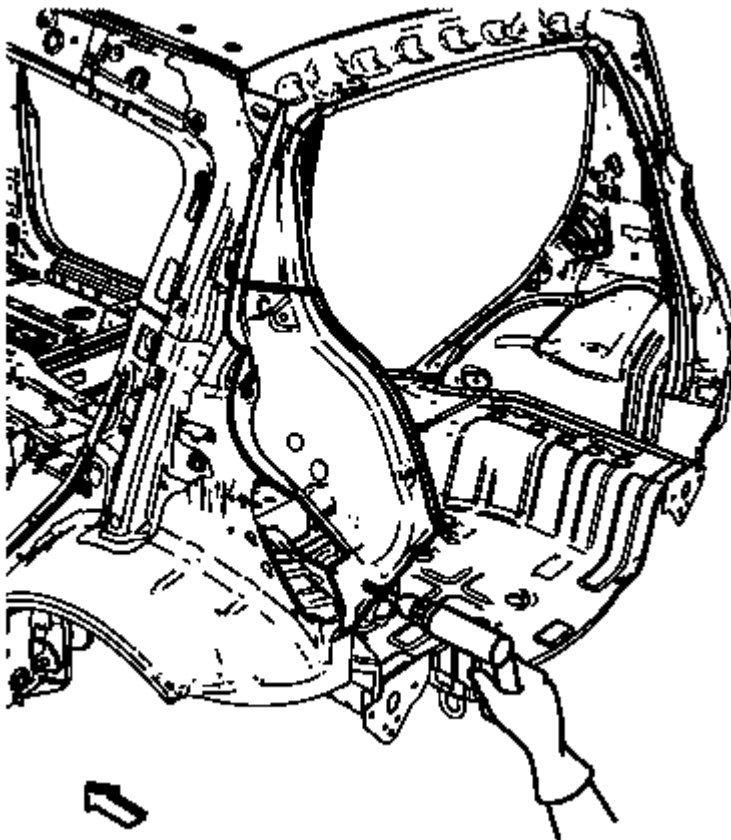


Fig. 124: Drilling All Factory Welds
Courtesy of GENERAL MOTORS COMPANY

7. Locate and mark all the necessary factory welds of the body rear end panel.

NOTE: **Note the number and location of welds for installation of the service assembly.**

8. Drill all factory welds.

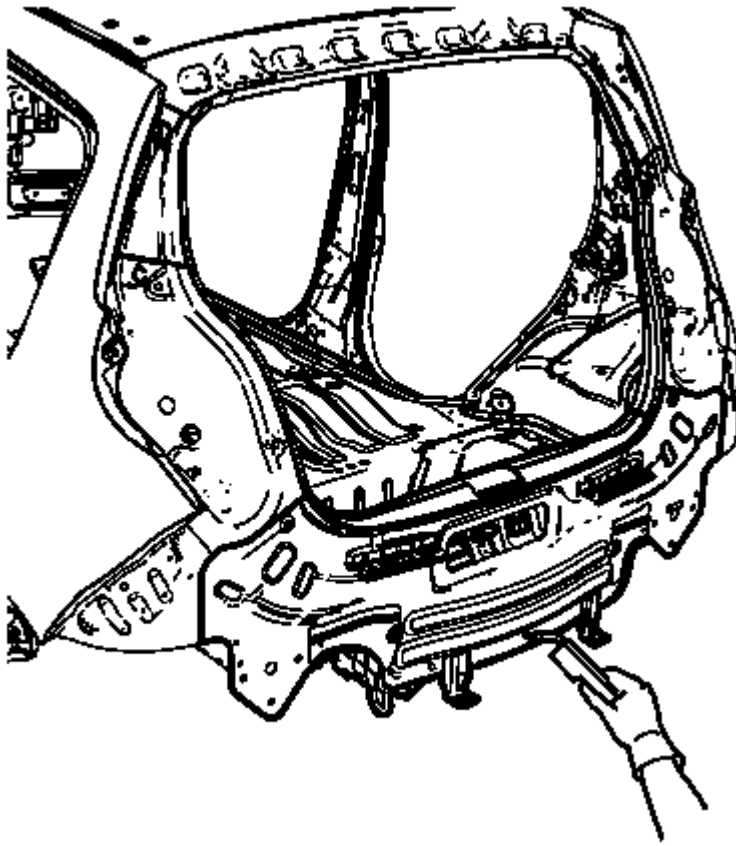


Fig. 125: Removing Tail Lamp Pocket
Courtesy of GENERAL MOTORS COMPANY

9. Remove the tail lamp pocket.

Installation Procedure

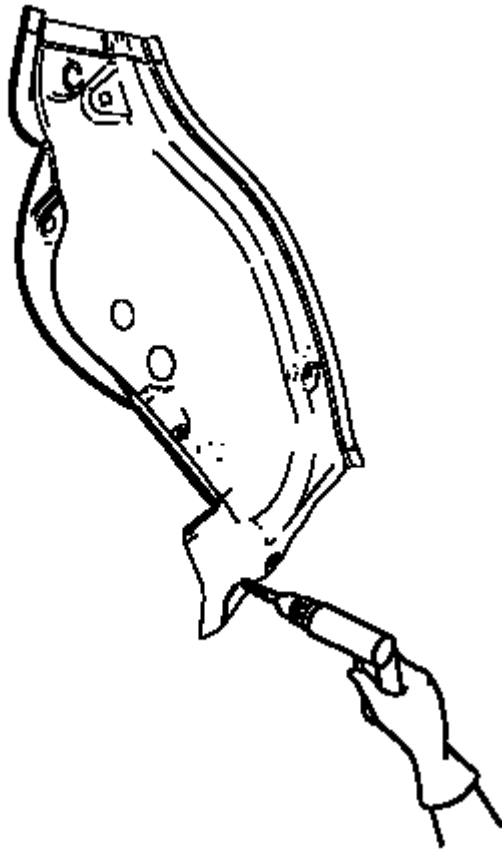


Fig. 126: Drilling 8 mm (5/16 in) For Plug Welding Along Edges Of Tail Lamp Pocket
Courtesy of GENERAL MOTORS COMPANY

1. Drill 8 mm (5/16 in) for plug welding along the edges of the tail lamp pocket as noted from the original panel.
2. Clean and prepare the attaching surfaces for welding.

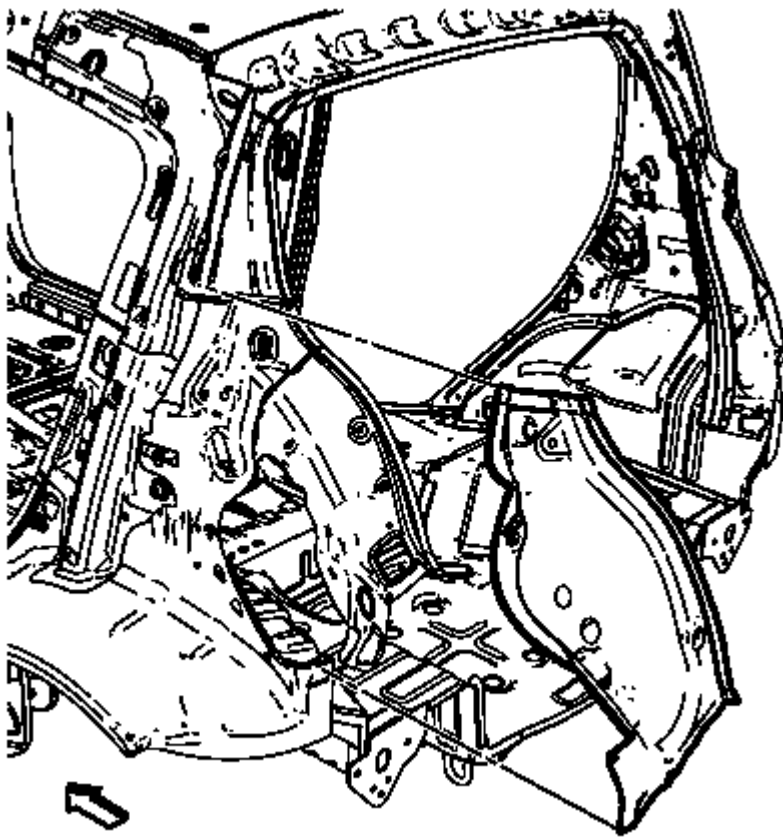


Fig. 127: Tail Lamp Pocket

Courtesy of GENERAL MOTORS COMPANY

3. Position the tail lamp pocket on the vehicle.
4. Verify the fit of the tail lamp pocket.
5. Clamp the tail lamp pocket into position.

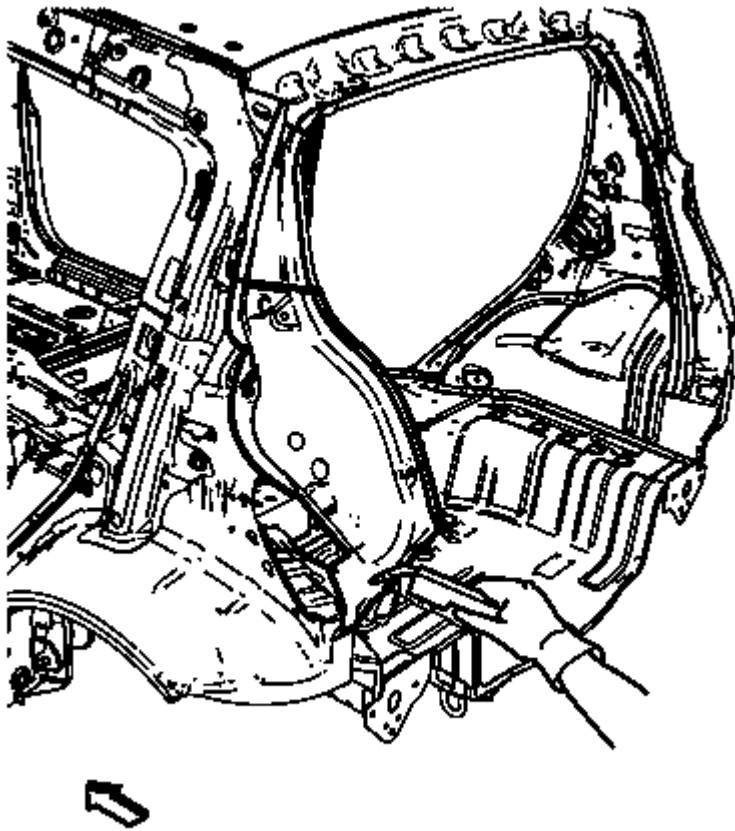


Fig. 128: Applying Sealers And Anti-Corrosion Materials
Courtesy of GENERAL MOTORS COMPANY

6. Plug the weld accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to **Anti-Corrosion Treatment and Repair** .
8. Paint the repaired area. Refer to **Basecoat/Clearcoat Paint Systems** .
9. Install all related panels and components.
10. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
11. Enable the SIR system. Refer to **SIR Disabling and Enabling** .

DESCRIPTION AND OPERATION

DUAL PHASE STEEL

This information provides repair recommendations and general guidelines for steel classified as Dual Phase Steel with a tensile strength up to and including 800 MPa, also known as DP.

General Motors recommends the following when repairing or replacing this type of steel during collision repair.

NOTE: **The use of heat to repair damage is not recommended for this classification of**

steel.

Recommended Repairs

- Cold repairs can be performed on this type of steel, unless the damage includes kinks. If the damage includes kinks, the part should be replaced.
- Sectioning or partial replacement of this type of steel is recommended only at approved locations, in a specific sectioning procedure.
- This type of steel can be used as a sleeve or backer plate, when recommended in a specific sectioning procedure.
- Squeeze resistance spot welding can be used to replace factory spot welds, where applicable.
- MIG plug welding and MIG stitch welding can be used on this type of steel.
- MIG brazing can be used on this type of steel.

HIGH STRENGTH LOW ALLOY STEEL

This information provides repair recommendations and general guidelines for steel classified as High Strength Low Alloy Steel, also known as HSLA. This type of steel normally has a tensile strength range from 300-700 MPa.

General Motors recommends the following when repairing or replacing this type of steel during collision repair.

Recommended Repairs

- Cold repairs can be performed on this type of steel, unless the damage includes kinks. If the damage includes kinks, the part should be replaced.
- Controlled use of heat can be used to repair damage, if the heat does not exceed 650° C (1200° F). The heat should be applied a maximum of 2 times, for up to 90 seconds.
- Sectioning or partial replacement of this type of steel is recommended only at approved locations, in a specific sectioning procedure.
- This type of steel can be used as a sleeve or backer plate, during sectioning procedures.
- Squeeze resistance spot welding can be used to replace factory spot welds, where applicable.
- MIG plug welding and MIG stitch welding can be used on this type of steel.
- MIG Brazing can be used on this type of steel.

MILD STEEL

This information provides repair recommendations and general guidelines for steel classified as Mild Steel. This type of steel normally has a tensile strength less than 270 MPa. This includes the common steel names of:

- Mild Steel
- Bake Hardenable Steel (BH)
- Solid Solution Strengthened Steel

General Motors recommends the following when repairing or replacing this type of steel during collision repair.

Recommended Repairs

- Cold repairs can be performed on this type of steel, unless the damage includes kinks. If the damage includes kinks, the part should be replaced.
- Controlled use of heat can be used to repair damage, if the heat does not exceed 650° C (1200° F). The heat should be applied a maximum of 2 times, for up to 90 seconds.
- Sectioning or partial replacement of this type of steel is recommended only at approved locations, in a specific sectioning procedure.
- This type of steel can be used as a sleeve or backer plate, when recommended in a specific sectioning procedure.
- Squeeze resistance spot welding can be used to replace factory spot welds, where applicable
- MIG plug welding and MIG stitch welding can be used on this type of steel.
- MIG Brazing can be used on this type of steel.

ULTRA HIGH STRENGTH DUAL PHASE STEEL

This information provides repair recommendations and general guidelines for steel classified as Ultra High Strength Dual Phase Steel (Dual Phase Steel with a tensile strength greater than 800 MPa), also known as DPX.

General Motors recommends the following when repairing or replacing this type of steel during collision repair.

NOTE:

- **Repair of this type of steel is not recommended.**
- **This type of steel should be replaced at factory joints only. Sectioning or partial replacement is not recommended.**
- **The use of heat to repair damage is not recommended for this type of steel.**
- **Stitch welding is not recommended for this type of steel.**
- **This classification of steel can not be used as a backing reinforcement or a sleeve for a sectioning joint, unless a specific procedure is available.**

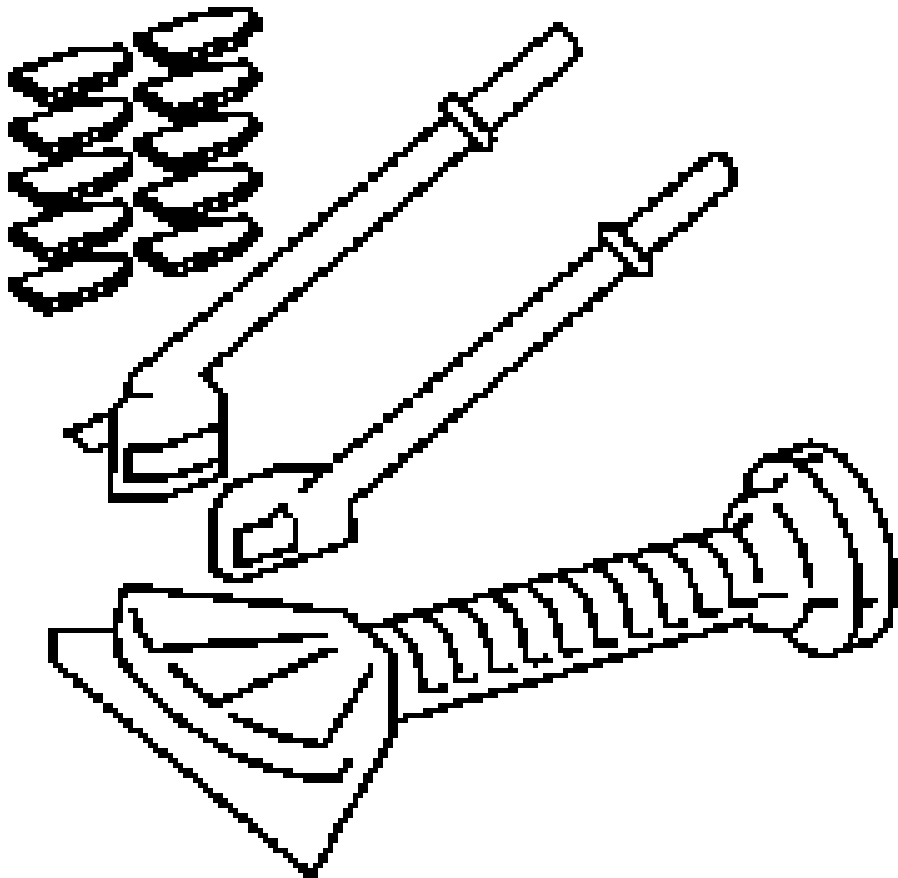
Recommended Repairs

- Squeeze resistance spot welding can be used to replace factory spot welds, where applicable.
- MIG plug welding can be used to replace factory spot welds.
- MIG brazing can be used to replace factory spot welds.

SPECIAL TOOLS AND EQUIPMENT

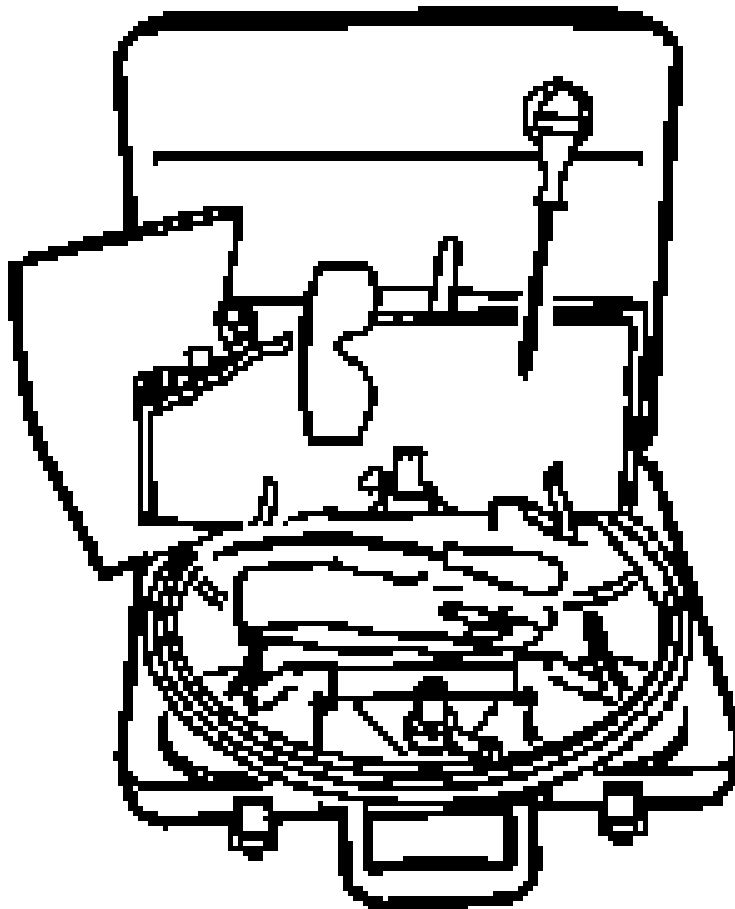
SPECIAL TOOLS

	Tool
--	-------------

Illustration	Number/ Description
	BO-6392 MKM-6392 Flanging Tool Kit



BO-6396
KM-6396
Bonding
Pliers



BO-642-A
MKM-642-
A
Telescope
Measuring
Instrument

COMMON SPECS & PROCEDURES

Spark

COMMON SPECS & PROCEDURES INDEX

(SPARK) COMMON SPECS & PROCEDURES

System	Specification/Procedure
Air Conditioning	
Service	<u>REFRIGERANT SYSTEM SPECIFICATIONS (1.2L LL0)</u>
Torque	<u>FASTENER TIGHTENING SPECIFICATIONS</u>
Axle Nut/Hub Nut	
Front	177 lb ft (240 N.m)
Battery	<u>BATTERY USAGE</u>
Brakes	
Bleeding Sequence	RR, LF, LR, RF See <u>HYDRAULIC BRAKE SYSTEM BLEEDING (MANUAL)</u> or <u>HYDRAULIC BRAKE SYSTEM BLEEDING (PRESSURE)</u>
Disc Brakes	
Service Specifications	<u>DISC BRAKE COMPONENT SPECIFICATIONS</u>
Torque	<u>FASTENER TIGHTENING SPECIFICATIONS</u>
Drum Brakes	
Service Specifications	<u>DRUM BRAKE COMPONENT SPECIFICATIONS</u>
Torque	<u>FASTENER TIGHTENING SPECIFICATIONS</u>
Charging	
Generator	<u>GENERATOR USAGE</u>
Torque	<u>FASTENER TIGHTENING SPECIFICATIONS</u>
Drive Belts	
Adjustment	Non-Adjustable Serpentine Belt
Drive Belt Routing	See routing illustration under <u>INSTALLATION PROCEDURE</u>
Engine Cooling	
General Service Specifications	N/A
Radiator Cap Pressure	Pressure is stamped on pressure cap
Thermostat R & I	
1.2L	<u>ENGINE COOLANT THERMOSTAT REPLACEMENT</u>
Water Pump R & I	
1.2L	<u>WATER PUMP REPLACEMENT</u>
Engine Mechanical	
1.2L	

Compression	<u>ENGINE COMPRESSION TEST</u>
Oil Pressure	idling oil temperature less than or equal to 120°C (170°F), at least 110 kPa (15.95 psi)
Overhaul	<u>ENGINE MECHANICAL SPECIFICATIONS (LL0)</u>
Torque	<u>FASTENER TIGHTENING SPECIFICATIONS (LL0)</u>
Fluid Specifications	See FLUIDS under MAINTENANCE/FLUIDS tab. From within Manager or Service Writer, click the "30/60/90 Interval" or "Maint." button.
Flywheel/Flex Plate/Drive Plate Torque	15 lb ft + 25° (20 N.m + 25°)
Fuel System	
Pressure Specification (Commanded with Scan Tool)	KOEO 276-345 kPa (40-50 psi)
Fuel Pressure Test Procedure	<u>CIRCUIT/SYSTEM VERIFICATION</u>
Fuel Filter Location	fuel filter is contained in the fuel sender assembly inside the fuel tank
Fuel Filter R & I	<u>FUEL TANK FUEL PUMP MODULE REPLACEMENT (LL0)</u>
Ignition	
Firing Order & Cylinder Identification	<u>FIRING ORDER & CYLINDER IDENTIFICATION</u>
Ignition Wires (Resistance)	Coil On Plug
Ignition Wires (Routing)	
1.2L	Coil On Plug
Spark Plug	
1.2L (Type = Refer to Electronic Parts Catalogue)	
Gap	0.8-0.9 mm (0.031-0.035 in)
Torque	15 lb ft (20 N.m)
Starting	
Starter	<u>STARTER USAGE</u>
Torque	<u>FASTENER TIGHTENING SPECIFICATIONS</u>
Wheel Alignment	
Adjustment Specifications	<u>WHEEL ALIGNMENT SPECIFICATIONS</u>
Torque	<u>FASTENER TIGHTENING SPECIFICATIONS</u>
Wheel & Tire	
Wheel Lug Nut Torque	140 N.m (103 lb ft) See tightening sequence illustration under <u>INSTALLATION PROCEDURE</u>

GENERAL INFORMATION

Commonly Used Abbreviations

*** PLEASE READ THIS FIRST ***

NOTE: This article is intended for general information purposes only. This information may not apply to all makes and models. Not all abbreviations are covered as manufacturers add new ones every day.

"A"

A

Amperes

ABS

Anti-Lock Brakes

ABRS

Air Bag Restraint System

AC

Alternating Current

A/C

Air Conditioning

ACCS

A/C Cycling Switch

ACCUM

Accumulator

ACCY

Accessory

ACT

Air Charge Temperature Sensor

ADJ

Adjust or Adjustable

ADV

Advance

AFS

Airflow Sensor

AI

Air Injection

AIR or A.I.R.

Air Injection Reactor

AIS

Air Injection System

Alt.

Alternator or Altitude

Amp./amp/amps

Ampere

ASCS

Air Suction Control Solenoid

ASD

Auto Shutdown

ASDM

Air Bag System Diagnostic Module

ASV

Air Suction Valve

A/T

Automatic Transmission/Transaxle

ATC

Automatic Temperature Control

ATDC

After Top Dead Center

ATF

Automatic Transmission Fluid

ATS

Air Temperature Sensor

Aux.

Auxiliary

Avg.

Average

AXOD

Automatic Transaxle Overdrive (Ford Models Only)

"B"

BAC

By-Pass Air Control

BAP

Barometric Absolute Pressure Sensor

BARO

Barometric

Batt.

Battery

Bbl.

Barrel (Example: 4-Bbl.)

BCM

Body Control Module

BHP

Brake Horsepower

BMAP

Barometric and Manifold Absolute Pressure Sensor

BOO

Brake On-Off Switch

B/P

Backpressure

BPS

Barometric Pressure Sensor

BPT

Backpressure Transducer

BTDC

Before Top Dead Center

BTSI

Brake Transmission Shift Interlock

BTU

British Thermal Unit

BVSV

Bimetallic Vacuum Switching Valve

"C"**° C**

Celsius (Degrees)

Calif.

California

CANP

Canister Purge

CARB

California Air Resources Board

CAT

Catalytic Converter

CB

Circuit Breaker

CBD

Closed Bowl Distributor

cc

cubic centimeter

CCC

Close Coupled Catalyst

CCC

Computer Command Control

CCD

Computer Controlled Dwell

CCOT

Cycling Clutch Orifice Tube

CCW

Counterclockwise

CDI

Capacitor Discharge Ignition

CEC

Computerized Engine Control

CID

Cubic Inch Displacement

cm

Centimeter

CMP

Camshaft Position Sensor

CO

Carbon Monoxide

CO₂

Carbon Dioxide

Cont.

Continued

CONV

Convertible

CP

Canister Purge

CKP

Crankshaft Position Sensor

CTS

Coolant Temperature Sensor

Cu. In.

Cubic Inch

CVC

Constant Vacuum Control

CV

Check Valve or Constant Velocity

CW

Clockwise

CYL or Cyl.

Cylinder

C³ I

Computer Controlled Coil Ignition

C⁴

Computer Controlled Catalytic Converter

"D"

"D"

Drive

DC

Direct Current Or Discharge

DDD

Dual Diaphragm Distributor

Def.

Defrost

Defog.

Defogger

DERM

Diagnostic Energy Reserve Module

DFI

Digital Fuel Injection

Diag.

Diagnostic

DTC

Diagnostic Trouble Code

DIC

Driver Information Center

DIS

Distributorless Ignition System

DIST

Distribution

DLC

Data Link Connector

DOC

Diesel Oxidation Catalyst

DOHC

Double Overhead Cam

DOT

Department of Transportation

DPF

Diesel Particulate Filter

DRB-II

Diagnostic Readout Box

DVOM

Digital Volt-Ohmmeter

"E"

EACV

Electric Air Control Valve

EATX

Electronic Automatic Transaxle

EBCM

Electronic Brake Control Module

EBL

Electronic Back Light

ECM

Engine Control Module

ECT

Engine Coolant Temperature Sensor

EDIS

Electronic Distributorless Ignition System

EEC

Electronic Engine Control

EECS

Evaporative Emission Control System

EEPROM

Electronically Erasable PROM

EFE

Early Fuel Evaporation

EGO

Exhaust Gas Oxygen Sensor

EGR

Exhaust Gas Recirculation

EOT

Engine Oil Temperature

ESA

Electronic Spark Advance

ESC

Electronic Spark Control

EST

Electronic Spark Timing

EVAP

Fuel Evaporative System

EVIC

Electronic Vehicle Information Center

EVP

EGR Valve Position Sensor

EWMA

Exponentially Weighted Moving Average (MODE 6)

Exc.

Except

"F"**° F**

Fahrenheit (Degrees)

F/B

Fuse Block

Fed.

Federal

FI

Fuel Injection

FICU

Fuel Injection Control Unit

FIPL

Fuel Injector Pump Lever

FLI

Fuel Level Indicator

FPR-VSV

Fuel Pressure Regulator Vacuum Switching Valve

Ft. Lbs.

Foot Pounds

FWD

Front Wheel Drive

"G"

g

grams

Gals.

gallons

GND or GRND

Ground

"H"

HAC

High Altitude Compensation

HC

Hydrocarbons

H/D

Heavy Duty

HO2S

Heated Exhaust Gas Oxygen Sensor

Hg

Mercury

Hgt.

Height

HLDT

Headlight

HO

High Output

HO2S

Heated Oxygen Sensor

HP

High Performance

HSC

High Swirl Combustion

HSO

High Specific Output

HTR

Heater

Hz

Hertz (Cycles Per Second)

"I"

IAC

Idle Air Control

IACV

Idle Air Control Valve

IAT

Intake Air Temperature

IC

Integrated Circuit

ID

Identification

I.D.

Inside Diameter

IFS

Independant Front Suspension

IFS

Inertia Fuel Shutoff (Ford)

Ign.

Ignition

IMRC

Intake Manifold Runner Control

In.

Inches

INCH Lbs.

Inch Pounds

in. Hg

Inches of Mercury

Inj.

Injector

IP

Instrument Panel

IRS

Independant Rear Suspension

ISC

Idle Speed Control

IVD

Interactive Vehicle Dynamics (Ford)

IVSV

Idle Vacuum Switching Valve

"J"**J/B**

Junction Block

"K"**KAPWR**

Keep Alive Power

k/ohms

kilo-ohms (1000 ohms)

kg

Kilograms (weight)

kg/cm²

Kilograms Per Square Centimeter

KM/H

Kilometers Per Hour

KOEO

Key On, Engine Off

KOER

Key On, Engine Running

KS

Knock Sensor

kW

Kilowatt

kV

Kilovolt

"L"

L

Liter

lbs. (Lbs. when used in table)

Pounds

LCD

Liquid Crystal Display

L/D

Light Duty

LDP

Leak Detection Pump (Part of EVAP system.)

LED

Light Emitting Diode

LH

Left Hand

"M"

mA

Milliamps

MA or MAF

Mass Airflow

MAFS

Mass Airflow Sensor

MAP

Manifold Absolute Pressure

MAT

Manifold Air Temperature

Mem.

Memory

MEM-CAL

Memory Calibration Chip

mfd.

Microfarads

MFI

Multiport Fuel Injection

MICU

Multiplex Integrated Control Unit (Acura/Honda)

MIL

Malfunction Indicator Light

MPI

Multi-Point (Fuel) Injection

mm

Millimeters

MPH

Miles Per Hour

mV

Millivolts

"N"

NA

Not Available

NAC

NOx Adsorber Catalyst

NCA

No Color Available (Wiring Diagrams)

NGS

New Generation Star

N.m

Newton Meter

No.

Number

Nos.

Numbers

NOx

Oxides of Nitrogen

"O"

O₂

Oxygen

OBD

On-Board Diagnostics

OC

Oxidation Catalyst

OD

Overdrive

O.D.

Outside Diameter

OHC

Overhead Camshaft

OSS

Output Speed Sensor

O/S

Oversize

oz.

Ounce

ozs.

Ounces

"P"

"P"

Park

P/C

Printed Circuit

PCM

Powertrain Control Module

PCS

Purge Control Solenoid

PC-SOL

Purge Control Solenoid

PCV

Positive Crankcase Ventilation

PFI

Port Fuel Injection

PGM-FI

Programmed Fuel Injection

PID

Parameter Identification

PIP

Profile Ignition Pick-up

PNP

Park Neutral Position Switch

P/N

Park/Neutral

PRNDL

Park Reverse Neutral Drive Low

PROM

Programmable Read-Only Memory

psi

Pounds Per Square Inch

P/S

Power Steering

PSPS

Power Steering Pressure Switch

PTC

Positive Temperature Coefficient

PTO

Power Take-Off

Pts.

Pints

Pwr.

Power

"Q"

Qts.

Quarts

"R"

RABS

Rear Anti-Lock Brake System

RECIRC

Recirculation

RH

Right Hand

RPM

Revolutions Per Minute

RWAL

Rear Wheel Anti-Lock Brake

RWD

Rear Wheel Drive

"S"

SAS

Steering Angle Sensor

SBC

Single Bed Converter

SBEC

Single Board Engine Controller

SDARS

Satellite Digital Audio Radio Service

SES

Service Engine Soon

SFI

Sequential (Port) Fuel Injection

SIL

Shift Indicator Light

SIR

Supplemental Inflatable Restraint

SOHC

Single Overhead Cam

SOL or Sol.

Solenoid

SPFI

Sequential Port Fuel Injection

SPK

Spark Control

SPOUT

Spark Output

SRI

Service Reminder Indicator

SRS

Supplemental Restraint System (Air Bag)

STAR

Self-Test Automatic Readout

STO

Self-Test Output

SUB-O₂

Sub Oxygen Sensor

Sw.

Switch

Sys.

System

"T"

TAB

Thermactor Air By-Pass

TAC

Throttle Actuator Module

TAD

Thermactor Air Diverter

TBC

Body Control Module (General Motors)

TBI

Throttle Body Injection

TCC

Torque Converter Clutch

TDC

Top Dead Center

Temp.

Temperature

TFI

Thick Film Ignition

THERMAC

Thermostatic Air Cleaner

TPM

Tire Pressure Monitor

TPMS

Tire Pressure Monitor System

TPS

Throttle Position Sensor/Switch

TS

Temperature Sensor

TV

Therموالve

TWC

Three-Way Catalyst

"V"

V

Valve

Vac.

Vacuum

VAF

Vane Airflow

VAPS

Variable Assist Power Steering

VCC

Viscous Converter Clutch

VCRM

Variable Control Relay Module

VIN

Vehicle Identification Number

VM

Vacuum Modulator

Volt.

Voltage

VOM

Volt-Ohmmeter (Analog)

VRV

Vacuum Regulator Valve

VSS

Vehicle Speed Sensor

VSV

Vacuum Switching Valve

"W"**W/**

With

W/O

Without

WAC

Wide Open Throttle A/C Switch

WOT

Wide Open Throttle

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Door Component Views - Spark

DOOR COMPONENT VIEWS

DRIVER DOOR COMPONENTS (LEFT HAND DRIVE)

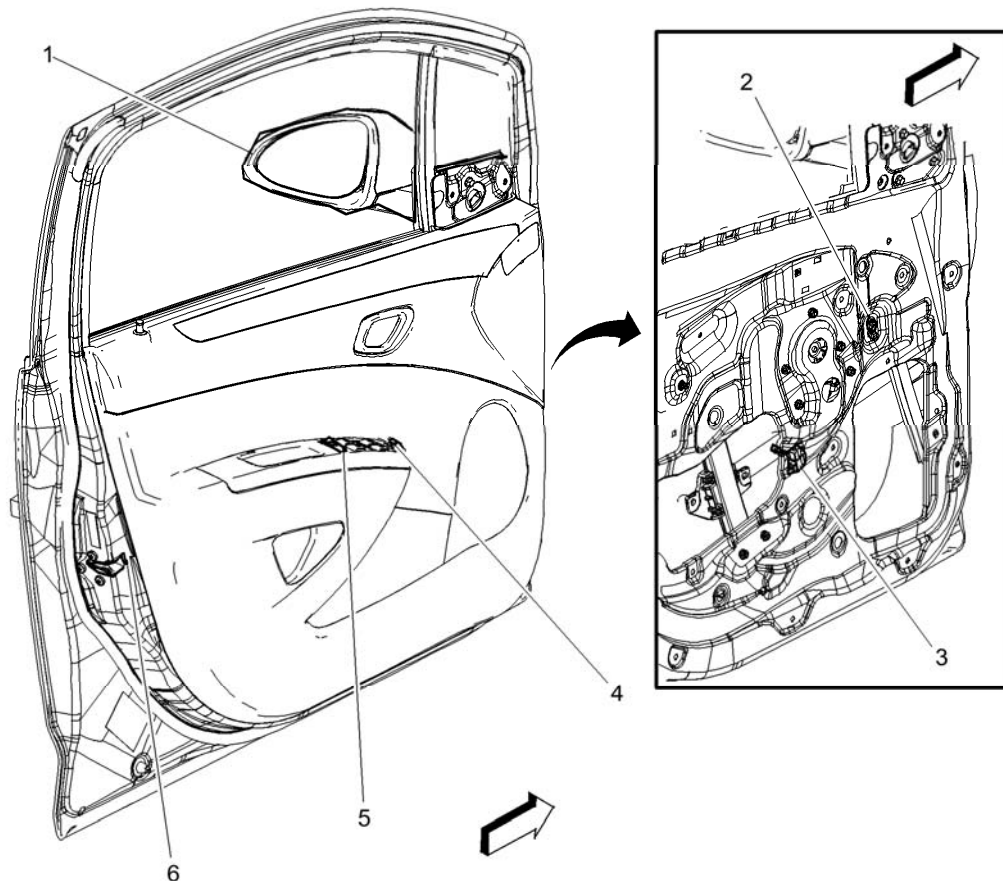


Fig. 1: Driver Door Components (Left Hand Drive)
Courtesy of GENERAL MOTORS COMPANY

Items

- | | |
|--|--|
| 1: A9A Outside Rearview Mirror - Driver | <u>A9A Outside Rearview Mirror - Driver (Left Hand Drive)</u> |
| | <u>A9A Outside Rearview Mirror - Driver (Right Hand Drive)</u> |
| 2: B63LF Side Impact Sensor - Left Front (AYF) | <u>B63LF Side Impact Sensor - Left Front</u> |
| 3: M74D Window Motor - Driver (A32 or AE3) | <u>M74D Window Motor - Driver</u> |

4: S79D Window Switch - Driver (A32 or AE3) S79D Window Switch - Driver (A32) S79D Window Switch - Driver (AE3)

5: S13D Door Lock Switch - Driver (AU3) S13D Door Lock Switch - Driver (Left Hand Drive with AU3)

6: A23D Door Latch Assembly - Driver A23D Door Latch Assembly - Driver X1 A23D Door Latch Assembly - Driver X2

PASSENGER DOOR COMPONENTS (LEFT HAND DRIVE)

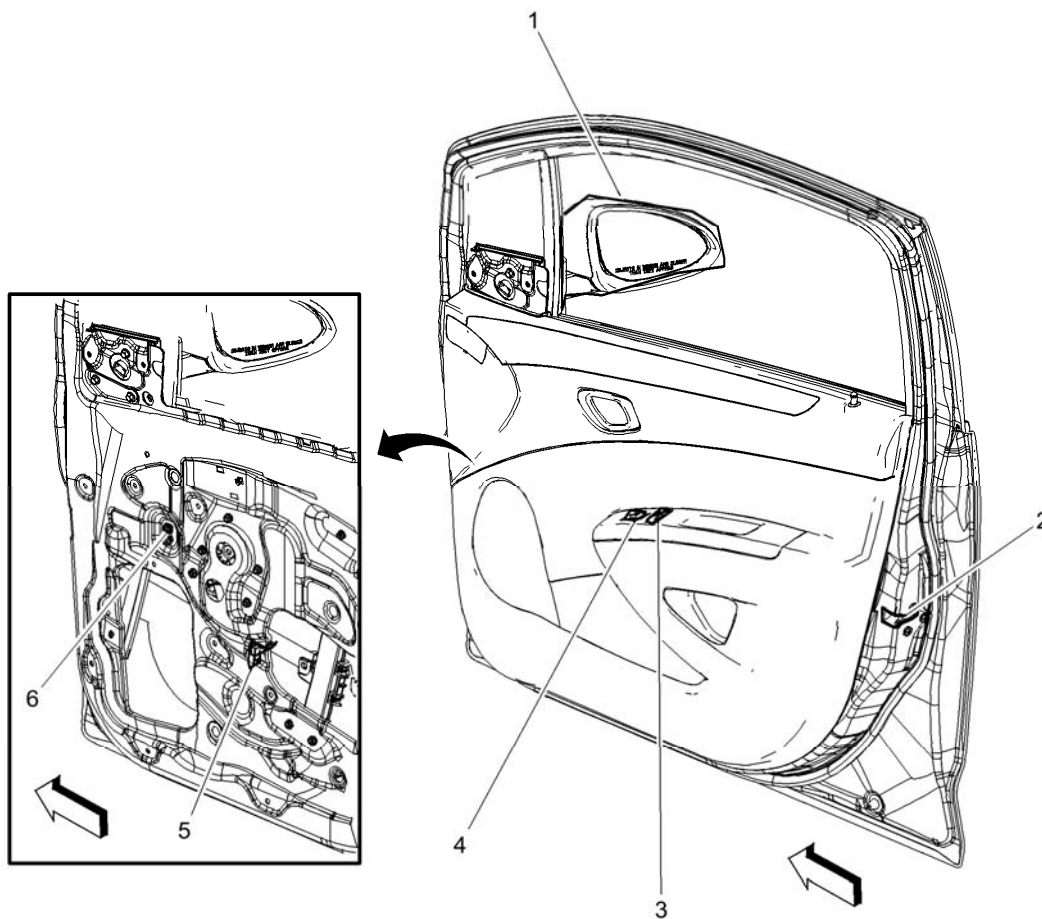


Fig. 2: Passenger Door Components (Left Hand Drive)

Courtesy of GENERAL MOTORS COMPANY

Items

1: A9B Outside Rearview Mirror - Passenger A9B Outside Rearview Mirror - Passenger (Left Hand Drive) A9B Outside Rearview Mirror - Passenger (Right Hand Drive)

2: A23P Door Latch Assembly - Passenger A23P Door Latch Assembly - Passenger

3: S13P Door Lock Switch - Passenger (AU3) S13P Door Lock Switch - Passenger (Left Hand Drive)

with AU3)

4: S79P Window Switch - Passenger (A32 or AE3) S79P Window Switch - Passenger

5: M74P Window Motor - Passenger (A32 or AE3) M74P Window Motor - Passenger

6: B63R Side Impact Sensor - Right (AY0)

DRIVER DOOR COMPONENTS (RIGHT HAND DRIVE)

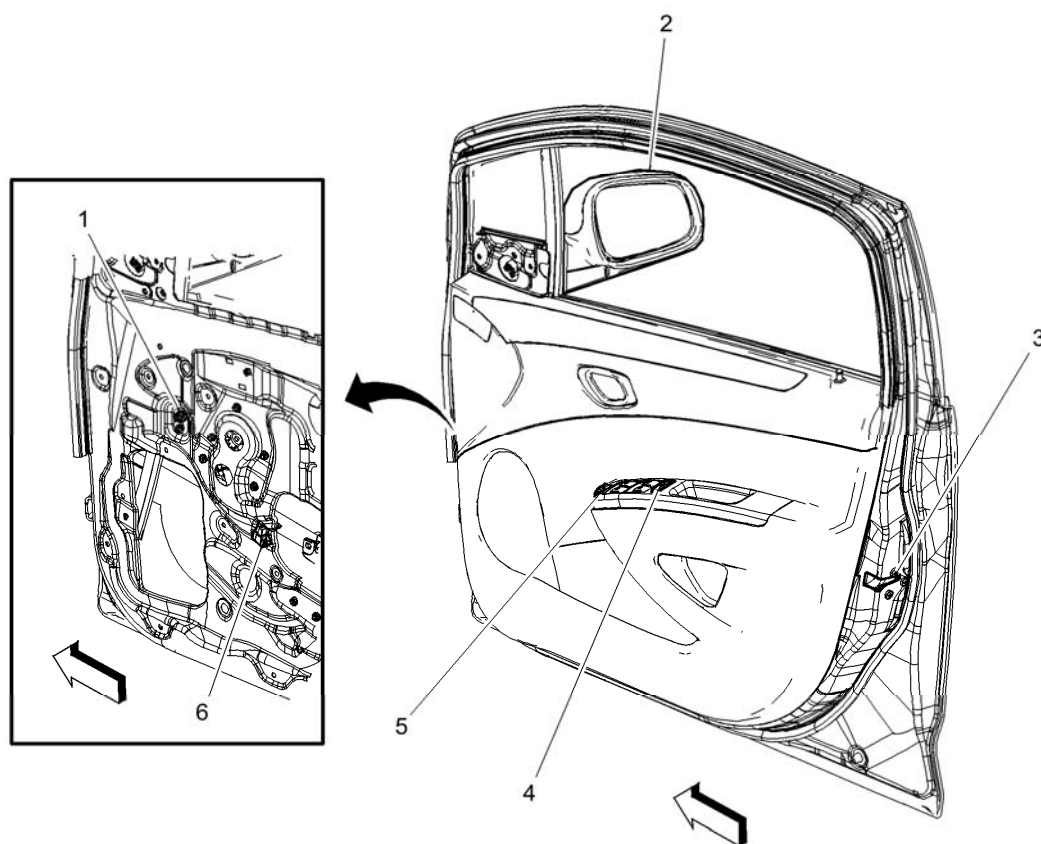


Fig. 3: Driver Door Components (Right Hand Drive)

Courtesy of GENERAL MOTORS COMPANY

Items

1: B63LF Side Impact Sensor - Left Front (AYF) B63LF Side Impact Sensor - Left Front

2: A9A Outside Rearview Mirror - Driver A9A Outside Rearview Mirror - Driver (Left Hand Drive)
A9A Outside Rearview Mirror - Driver (Right Hand Drive)

3: A23D Door Latch Assembly - Driver A23D Door Latch Assembly - Driver X1 A23D Door Latch Assembly - Driver X2

4: S13D Door Lock Switch - Driver (AU3) S13D Door Lock Switch - Driver (Left Hand Drive with

AU3)

5: S79D Window Switch - Driver (A32 or AE3) S79D Window Switch - Driver (A32) S79D Window Switch - Driver (AE3)

6: M74D Window Motor - Driver (A32 or AE3) M74D Window Motor - Driver

PASSENGER DOOR COMPONENTS (RIGHT HAND DRIVE)

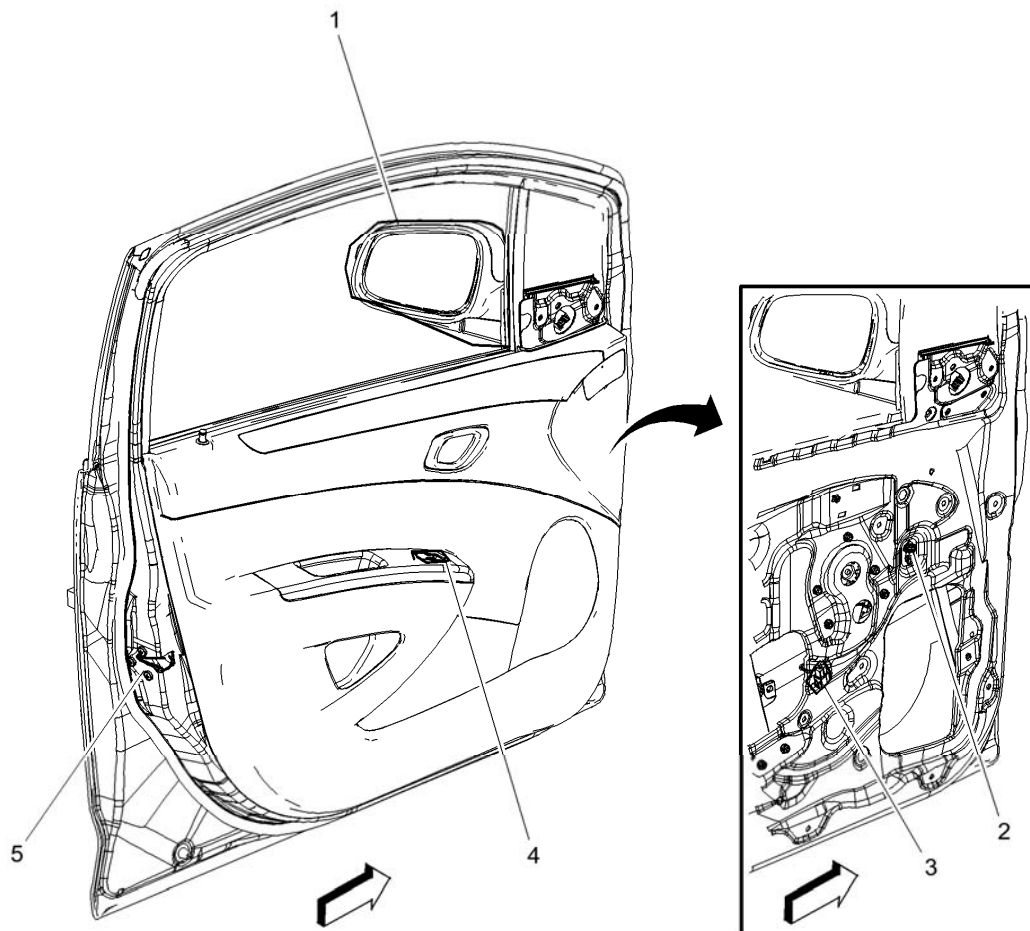


Fig. 4: Passenger Door Components (Right Hand Drive)

Courtesy of GENERAL MOTORS COMPANY

Items

1: A9B Outside Rearview Mirror - Passenger A9B Outside Rearview Mirror - Passenger (Left Hand Drive) A9B Outside Rearview Mirror - Passenger (Right Hand Drive)

2: M74P Window Motor - Passenger (A32 or AE3) M74P Window Motor - Passenger

3: B63L Side Impact Sensor - Left

4: S79P Window Switch - Passenger (A32 or AE3) S79P Window Switch - Passenger

5: A23P Door Latch Assembly - Passenger A23P Door Latch Assembly - Passenger

LEFT REAR DOOR COMPONENTS

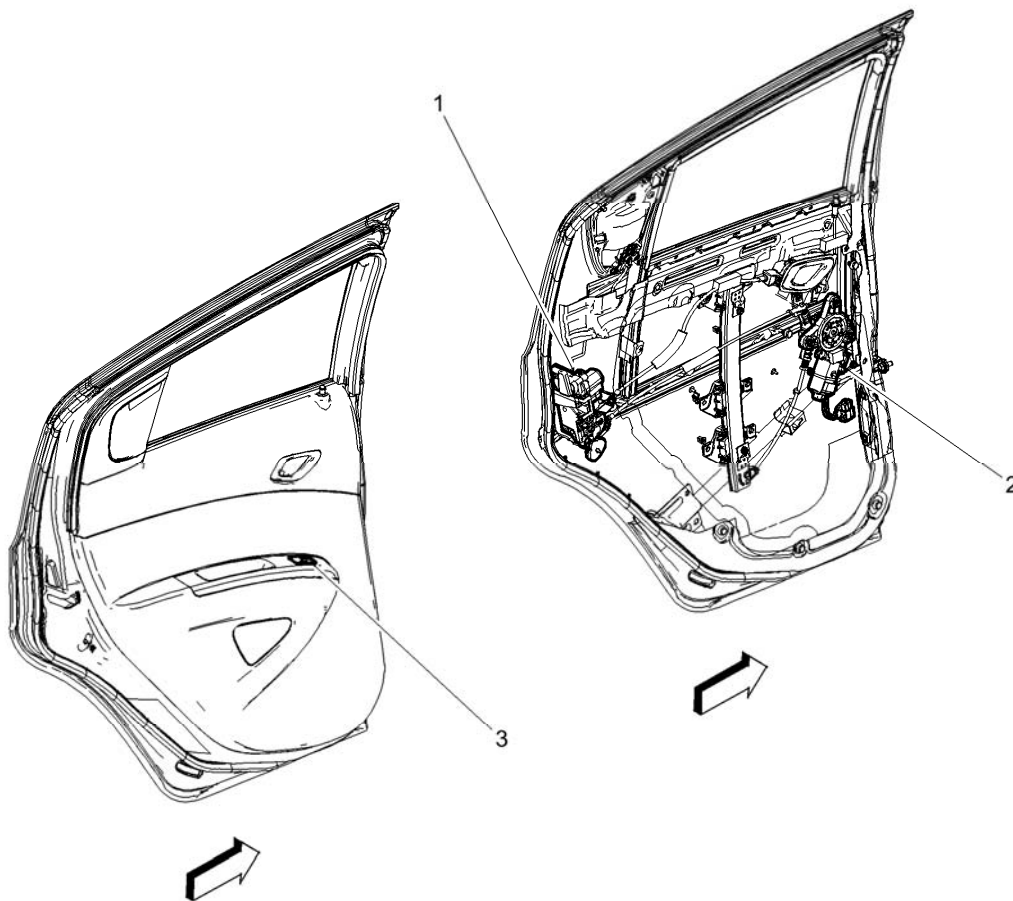


Fig. 5: Left Rear Door Components
Courtesy of GENERAL MOTORS COMPANY

Items

- 1: A23LR Door Latch Assembly - Left Rear A23LR Door Latch Assembly - Left Rear
2: M74LR Window Motor - Left Rear (AE3) M74LR Window Motor - Left Rear
3: S79LR Window Switch - Left Rear (AE3) S79LR Window Switch - Left Rear

RIGHT REAR DOOR COMPONENTS

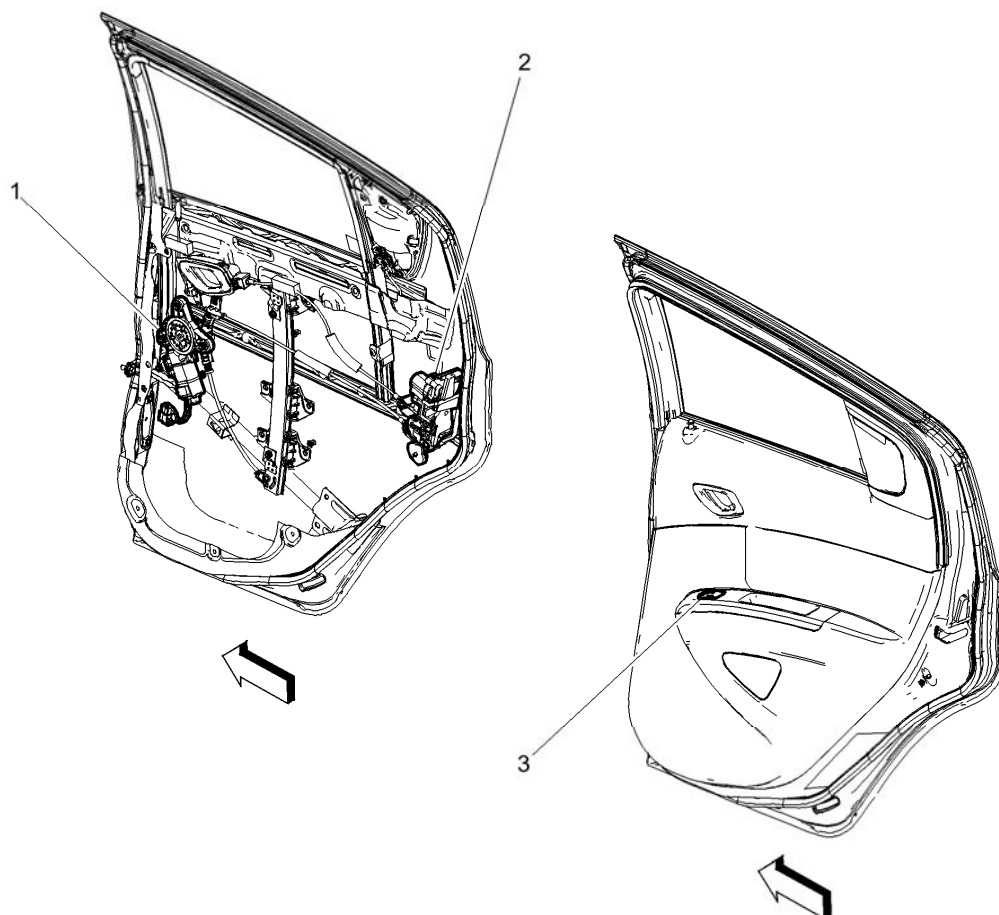


Fig. 6: Right Rear Door Components
Courtesy of GENERAL MOTORS COMPANY

Items

- 1: M74RR Window Motor - Right Rear (AE3) M74RR Window Motor - Right Rear**
2: A23RR Door Latch Assembly - Right Rear A23RR Door Latch Assembly - Right Rear
3: S79RR Window Switch - Right Rear (AE3) S79RR Window Switch - Right Rear

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Electrical Center Identification Views - Spark

ELECTRICAL CENTER IDENTIFICATION VIEWS

X50A FUSE BLOCK - FUSE AND RELAY UNDERHOOD LABEL

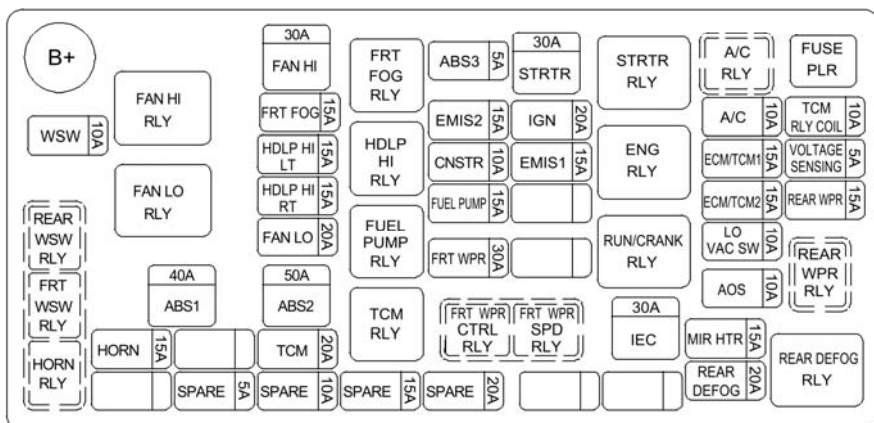


Fig. 1: X50A Fuse Block - Fuse And Relay Underhood Label
Courtesy of GENERAL MOTORS COMPANY

X50A FUSE BLOCK - UNDERHOOD TOP VIEW

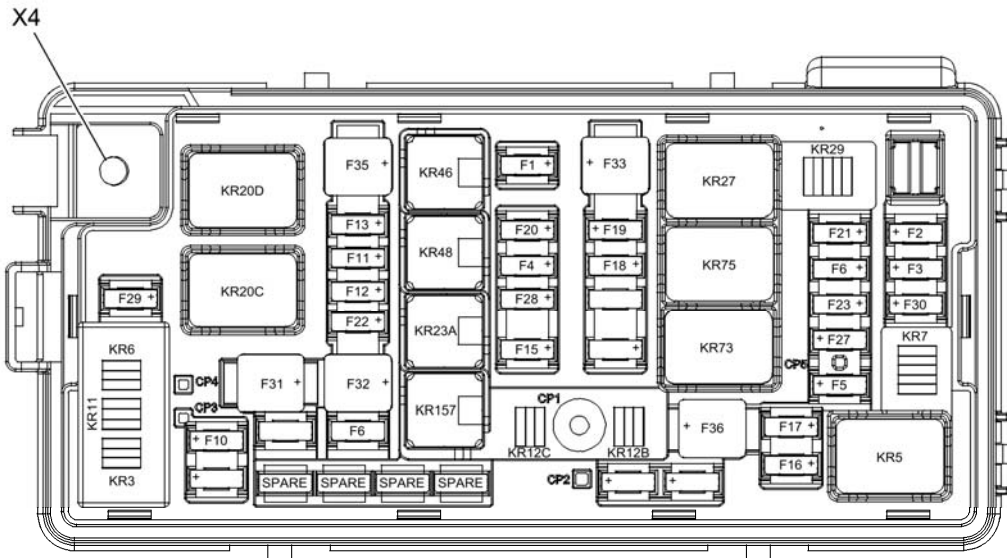


Fig. 2: X50A Fuse Block - Underhood Top View
Courtesy of GENERAL MOTORS COMPANY

X50A Fuse Block - Underhood Usage

No.	Device Label Name	Device Assigned Name	Rating	Description
F1	ABS3	F1UA Fuse	5A	X90 Assembly Plant ABS Data Connector
F2	-	F2UA Fuse	-	Not Used
F3	VOLTAGE SENSING	F3UA Fuse	5A	K9 Body Control Module
F4	CNSTR	F4UA Fuse	10A	Q13 Evaporative Emissions Vent Solenoid Valve
F5	AOS	F5UA Fuse	10A	K85 Passenger Presence Module
F6	ECM/TCM1	F6UA Fuse	15A	K20 Engine Control Module, K71 Transmission Control Module
F7	-	F7UA Fuse	-	Not Used
F8	-	F8UA Fuse	-	Not Used
F9	-	F9UA Fuse	-	Not Used
F10	HORN	F10UA Fuse	15A	P12 Horn
F11	HDLP HI LT	F11UA Fuse	15A	E13L Headlamp - Left
F12	HDLP HI RT	F12UA Fuse	15A	E13R Headlamp - Right
F13	FRT FOG	F13UA Fuse	15A	E29L Fog Lamp - Left Front, E29R

				Fog Lamp - Right Front
F14	-	F14UA Fuse	-	Not Used
F15	FRT WPR	F15UA Fuse	30A	G24 Windshield Washer pump
F16	REAR DEFOG	F16UA Fuse	20A	E18 Rear Defogger Grid
F17	MIR HTR	F17UA Fuse	15A	A9A Outside Rearview Mirror - Driver, A9B Outside Rearview Mirror - Passenger
F18	EMIS 1	F18UA Fuse	15A	Heated Oxygen Sensor 1, B5B Heated Oxygen Sensor 2, B75B Mass Air Flow/Intake Air Temperature Sensor, E41 Engine Coolant Thermostat Heater, Q12 Evaporative Emission Purge Solenoid Valve.
F19	IGN	F19UA Fuse	20A	Q17A Fuel Injector 1, Q17B Fuel Injector 2, Q17C Fuel Injector 3, Q17D Fuel Injector 4, Ignition Coil 1, T8B Ignition Coil 2, T8C Ignition Coil 3, T8D Ignition Coil 4
F20	EMIS2	F20UA Fuse	15A	K20 Engine Control Module, KR20C Low Speed Cooling Fan Relay, KR20D High Speed Cooling Fan Relay
F21	A/C	F21UA Fuse	10A	Q2 A/C Compressor Clutch
F22	FAN LO	F22UA Fuse	20A	KR20C Cooling Fan Low Speed Relay
F23	ECM/TCM 2	F23UA Fuse	15A	K20 Engine Control Module, K71 Transmission Control Module
F24	-	F24UA Fuse	-	Not Used
F25	-	F25UA Fuse	10A	Not Used
F26	-	Fuse F26UA	-	Not Used
F27	LO VAC SW	F27UA Fuse	10A	B19C Brake Booster Vacuum Switch
F28	FUEL PUMP	F28UA Fuse	15A	KR23A Fuel Pump Relay
F29	WSW	F29UA Fuse	10A	KR11 Windshield Washer Pump Relay, KR6 Rear Window Washer Pump Relay
F30	REAR WPR	F30UA Fuse	15A	KR7 Rear Wiper Relay, M45 Rear Wiper Motor
F31	ABS1	F31UA Fuse	40A	K17 Electronic Brake Control Module
F32	ABS2	F32UA Fuse	50A	K17 Electronic Brake Control Module
F33	STRTR	F33UA Fuse	35A	KR27 Starter Relay
F34	-	F34UA Fuse	-	Not Used
F35	-	F35UA Fuse	-	Not Used
F36	IEC	F36UA Fuse	30A	P16 Instrument Cluster, P17 Info Display Module

Relays

KR5	REAR DEFOG RLY	KR5 Rear Defogger Relay	-	F16UA, F17UA
KR20C	FAN LO RLY	KR20C Cooling Fan Low Speed Relay	-	R10 Cooling Fan Resistor
KR20D	FAN HI RLY	KR20D Cooling Fan High Speed Relay	-	G10 Cooling Fan Motor
KR23A	FUEL PUMP RLY	KR23A Fuel Pump Relay	-	G12 Fuel Pump
KR27	STRTR RLY	KR27 Starter Relay	-	M64 Starter Motor
KR46	FRT FOG RLY	KR46 Front Fog Lamp Relay	-	F13UA
KR48	HDLR HI RLY	KR48 Headlamp High Beam Relay	-	F11UA, F12UA
KR73	RUN/CRANK RLY	KR73 Ignition Main Relay	-	F23UA, F24UA, F25UA, F26UA, F27UA, F28UA, F36UA, KR23A, F30DA, F31DA,
KR75	ENG RLY	KR75 Engine Controls Ignition Relay	-	F18UA, F19UA, F20UA
KR157	TCM RLY	KR157 Transmission Control Relay	-	F14UA

NOTE:

Relays listed below are non-serviceable Printed Circuit Board (PCB) relays and are internal to the block.

-	HORN RLY	KR3 Horn Relay	-	F10UA
-	REAR WSW RLY	KR6 Rear Window Washer Pump Relay	-	G19 Rear Window Washer Pump
-	FRT WSW RLY	KR11 Windshield Washer Pump Relay	-	G24 Windshield Washer pump
-	FRT WPR CTRL RLY	KR12B Windshield Wiper Relay	-	M75 Windshield Wiper Motor
-	FRT WPR SPD RLY	KR12C Windshield Wiper Speed Control Relay	-	M75 Windshield Wiper Motor
-	A/C RLY	KR29 A/C Compressor Clutch Relay	-	F21UA
-	REAR WPR RLY	KR7 Rear Wiper Relay	-	F30UA

-	REAR WSW RLY	KR6 Rear Window Washer Pump Relay	-	F29UA
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X50A FUSE BLOCK - UNDERHOOD BOTTOM VIEW

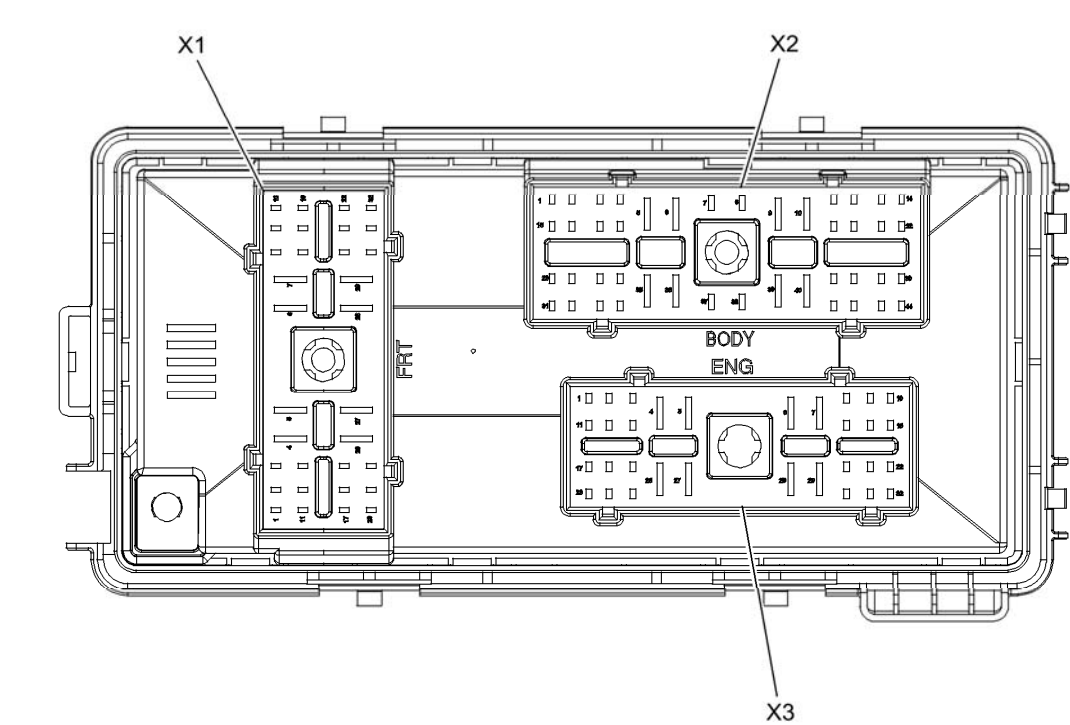
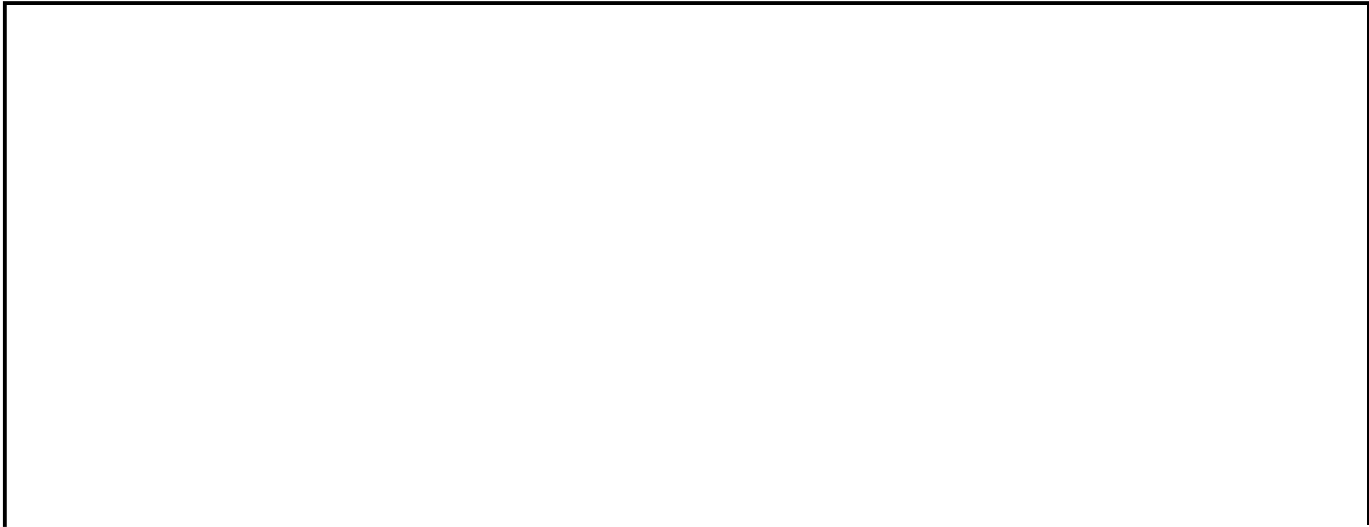
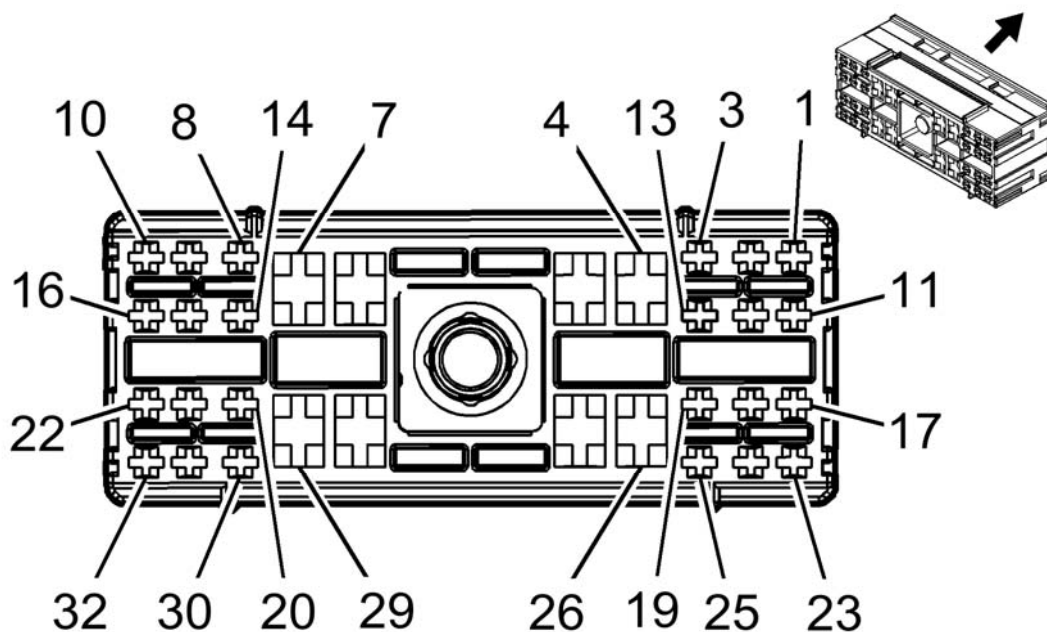


Fig. 3: X50A Fuse Block - Underhood Bottom View
Courtesy of GENERAL MOTORS COMPANY

X50A FUSE BLOCK - UNDERHOOD X1





Connector Part Information

- Harness Type: Forward Lamp
- OEM Connector: 2005333-2
- Service Connector: Not Available
- Description: 32-Way F Mixed Timer Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray	Core Crimp	Insulation Crimp
I	13575531	J-35616-42 (RD)	J-38125-36	964328-1	25	4	B
II	Not Available	J-35616-2A (GY)	J-38125-553	12191819	8	2	1
III	Not Available	J-35616-14 (GN)	J-38125-560	962943-5	16	E	A

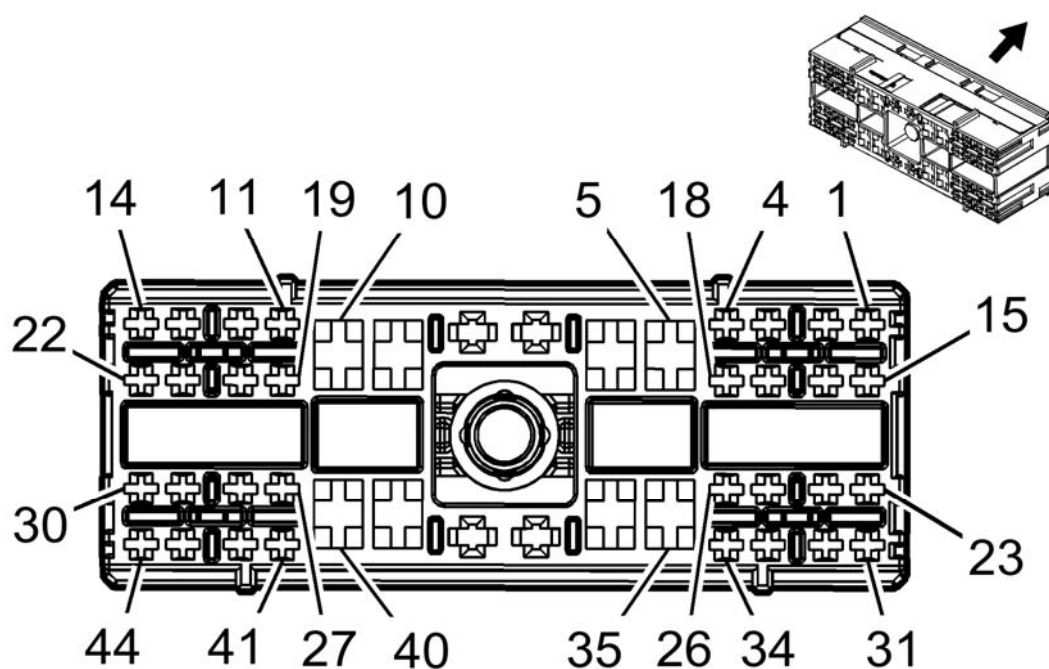
X50A Fuse Block - Underhood X1

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1-3	-	-	-	Not Occupied	-	-
4	2.5	GY	532	Cooling Fan Motor Supply	I	-

				Voltage (2)		
5	2.5	WH/BU	409	Cooling Fan Motor Supply Voltage (1)	I	-
6	2.5	RD/WH	40	Battery Positive Voltage	I	JM4/FX3
7	2.0	L-BU/WH	92	Windshield Wiper Motor High Speed Control	I	RHD
8	0.5	GY/VT	228	Windshield Washer Pump Control	II	-
9	0.75	BN/GY	29	Horn Control	III	-
10-13	-	-	-	Not Occupied	-	-
14	0.5	BU/VT	392	Rear Window Washer Pump Control	II	CD6
15	-	-	-	Not Occupied	-	-
16	0.5	BY/WH	1314	Left Front Turn Signal Lamp Supply Voltage	I	-
17	0.5	RD/WH	340	Battery Positive Voltage	II	JM4/FX3
18-21	-	-	-	Not Occupied	-	-
22	0.5	GN/GY	333	Brake Fluid Level Sensor Signal	II	LHD/JM4/FX3
23	-	-	-	Not Occupied	-	-
24	0.5	BN/YE	189	Headlamp Leveling Motor Supply Voltage	II	TR6
25	0.75	BN/VT	2234	Front Fog Lamp Supply Voltage	III	-
26	0.75	WH	711	Left Headlamp High Beam Supply Voltage	III	-
27	0.75	WH	311	Right Headlamp High Beam Supply Voltage	III	-
28	4	RD/YE	140	Battery Positive Voltage	III	JM4/FX3
29	2.0	YE/BN	95	Windshield Wiper Motor Low Speed Control	I	RHD
30	0.5	BN/GN	196	Windshield Wiper Motor Park Switch Signal	II	RHD
31	0.5	VT/GY	709	Left Park Lamp Supply Voltage	II	-
32	1.0	YE	712	Left Headlamp Low Beam Supply Voltage	III	-

X50A FUSE BLOCK - UNDERHOOD X2





Connector Part Information

- Harness Type: Body
- OEM Connector: 2005336-2
- Service Connector: Not Available
- Description: 44-Way Mixed Timer Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray	Core Crimp	Insulation Crimp
I	13582280	J-35616-14 (GN)	J-38125-560	962943-5	16	E	A
II	13575858	J-35616-42 (RD)	J-38125-36	927837-1	25	C	A

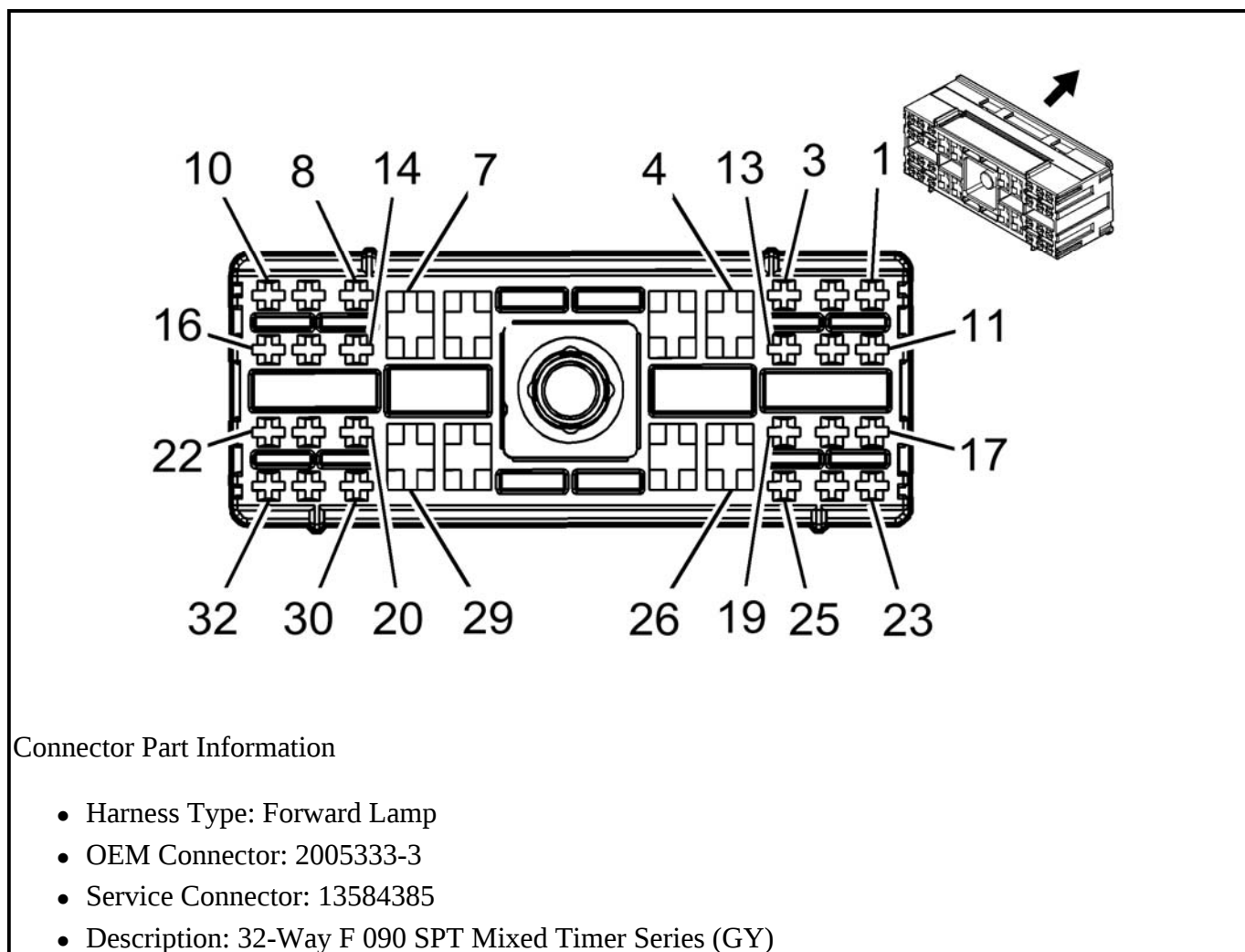
X50A Fuse Block - Underhood X2

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	VT/GY	709	Left Park Lamp Supply Voltage	I	-
2	0.5	BU/WH	1314	Left Front Turn Signal Lamp Supply Voltage	I	-
3	0.5	GN/GY	333	Brake Fluid Level Sensor Signal	I	JM4/FX3

4	0.35	GN/WH	2270	Rear Window Washer Relay Control	I	CD6
5	1.5	YE/BN	95	Windshield Wiper Motor Low Speed Control	II	LHD
6	1.5	WH	92	Windshield Washer Switch Signal	II	LHD
7-9	-	-	-	Not Occupied	-	-
10	1.5	BN/VT	293	Rear Defog Element Supply Voltage	II	C49
11	0.35	GN/VT	5199	Run/Crank Relay Coil Control	I	-
12	-	-	-	Not Occupied	-	-
13	0.5	GN/YE	4297	Transmission Main Relay Output Voltage	I	M4M
14	0.35	RD/WH	440	Battery Positive Voltage	I	-
15	1	YE	712	Left Headlamp Low Beam Supply Voltage	I	-
16	-	-	-	Not Occupied	-	-
17	0.35	BN/WH	28	Horn Relay Control	I	-
18	0.35	BN/GY	2268	Windshield Washer Relay Control	I	-
19	1	BN/YE	2267	Mirror Heating Element Supply Voltage	I	DLW/DLS
20	1	BN/YE	2267	Mirror Heating Element Supply Voltage	I	DLW/DLS
21	0.35	BN/VT	193	Rear Defog Relay Control	I	-
22	-	-	-	Not Occupied	-	-
23	0.5	GN/YE GN/YE	4295 4295	Transmission Main Relay Fused Supply (1) Transmission Main Relay Fused Supply (1)	II	M4M
24	0.5	GN/YE	4297	Battery Positive Voltage	I	M4M
25	0.35	GY	91	Windshield Wiper Motor Relay Coil Supply Voltage	I	-
26	0.35	WH/VT	860	Front Windshield Wiper Switch High Signal	I	-
27	0.35	YE	5420	Rear Wiper Motor Relay Coil Control	I	CD6
28	0.5	RD/WH	740	Battery Positive Voltage	I	AYF
29	1	RD/VT	1640	Battery Positive Voltage	I	CD6
30	1	BU	393	Rear Window Wiper Motor Control	I	CD6
31	0.5	BN/WH	1317	Fog Lamp Relay Control	I	-
32	0.35	BN/VT	1969	Headlamp High Beam Relay Control	I	-
33	0.5	RD/GY	2140	Battery Positive Voltage	I	CW1

34	0.5	VT/BN	841	Run Ignition 3 Voltage	I	UVC
35	2	BK	450	Ground	II	-
36	1.5	GY	120	Fuel Pump Supply Voltage	II	-
37-38	-	-	-	Not Occupied	-	-
39	2.5	BK	450	Ground	II	-
40	2.5	VT/GY	39	Run/Crank Ignition 1 Voltage	II	-
41-44	-	-	-	Not Occupied	-	-

X50A FUSE BLOCK - UNDERHOOD X3



Connector Part Information

- Harness Type: Forward Lamp
- OEM Connector: 2005333-3
- Service Connector: 13584385
- Description: 32-Way F 090 SPT Mixed Timer Series (GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray	Core Crimp	Insulation Crimp
I	13582280	J-35616-14 (GN)	J-38125-560	962943-5	16	E	A

II	Not Available	J-35616-42 (RD)	J-38125-36	962943-6	25	C	A
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X50A Fuse Block - Underhood X3

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK	350	Ground	I	-
2	0.75	VT/BU	5290	Powertrain Main Relay Fused Supply (1)	I	-
3	0.75	VT/BU	5291	Powertrain Main Relay Fused Supply (2)	I	-
4	0.75	VT/BU	5291	Powertrain Main Relay Fused Supply (2)	I	-
5-7	-	-	-	Not Occupied	-	-
8	0.5	RD	6305	Brake Vacuum Switch Signal	I	-
9	-	-	-	Not Occupied	-	-
10	0.75	VT/WH	239	Run/Crank Ignition 1 Voltage	I	-
11	0.5	GN/GY	465	Fuel Pump Primary Relay Control	I	-
12	0.75	VT/BU	5291	Powertrain Main Relay Fused Supply (2)	I	-
13	0.75	VT/BU	5291	Powertrain Main Relay Fused Supply (2)	I	-
14	0.5	BN/WH	5069	Engine Main Relay Coil Control	I	-
15	0.75	RD/BU	840	Battery Positive Voltage	I	-
16	0.5	BN/GN	59	A/C Compressor Clutch Supply Voltage	I	C60
17	-	-	-	Not Occupied	-	-
18	0.75	VT/BU	5290	Powertrain Main Relay Fused Supply (1)	I	-
19	-	-	-	Not Occupied	-	-
20	0.5	BK	350	Ground	I	-
21	0.5	YE	447	Starter Relay Coil Control	I	-
22	0.5	WH/GY	459	A/C Compressor Clutch Relay Control	I	C60
23	-	-	-	Not Occupied	-	-
24	0.5	BN/YE	473	High Speed Cooling Fan Relay Control	I	-
25	0.5	GN/VT	335	Low Speed Cooling Fan Relay Control	I	-
26	1	VT/BU	5290	Powertrain Main Relay Fused Supply (1)	II	-
27	1	VT/BU	5290	Powertrain Main Relay Fused Supply (1)	II	-

28	1.5	YE	6	Starter Solenoid Crank Voltage	II	-
29-32	-	-	-	Not Occupied	-	-

X50A FUSE BLOCK - UNDERHOOD X4

Connector Part Information

- Harness Type: Battery
- OEM Connector: 849619
- Service Connector: Pending
- Description: 1-Way Ring Terminal

Terminal Part Information

- Terminated Lead: Service by Harness - See Part Catalog
- Release Tool: Pending
- Diagnostic Test Probe: Pending
- Terminal/Tray: Not Available
- Core/Insulation Crimp: Not Available

X50A Fuse Block - Underhood X4

Pin	Wire	Circuit	Function
A	10 RD/YE	2	Battery Positive Voltage

X50B FUSE BLOCK - FUSE AND RELAY UNDERHOOD AUXILIARY, LABEL

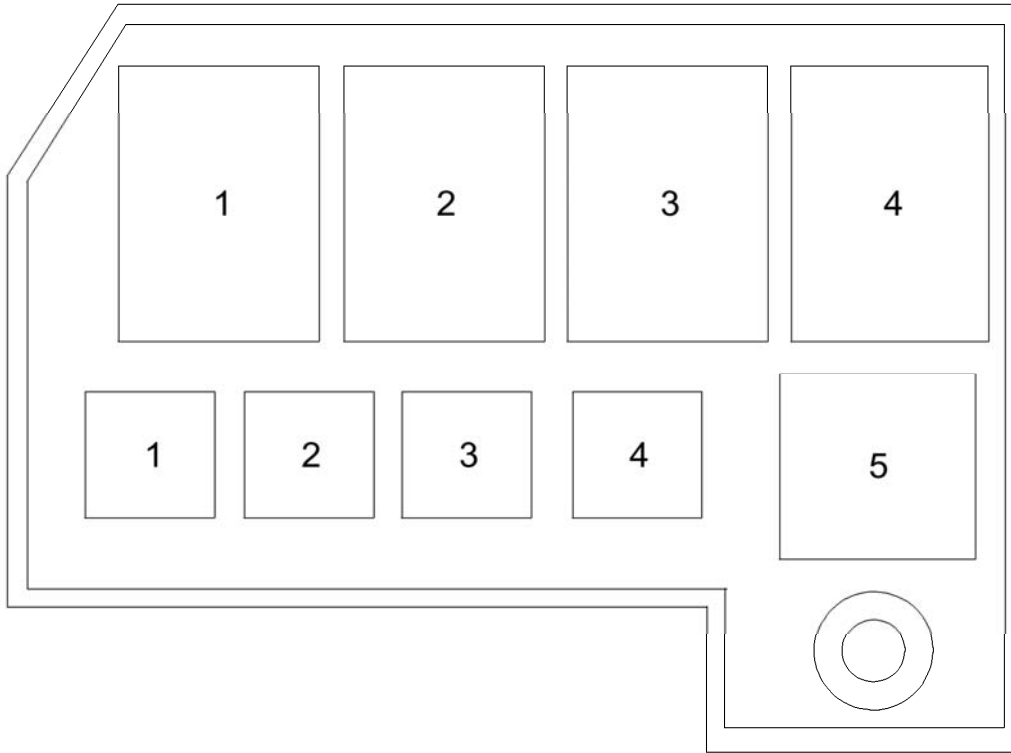


Fig. 4: X50B Fuse Block - Fuse And Relay Underhood Auxiliary, Label
Courtesy of GENERAL MOTORS COMPANY

X50B FUSE BLOCK - UNDERHOOD AUXILIARY, TOP VIEW

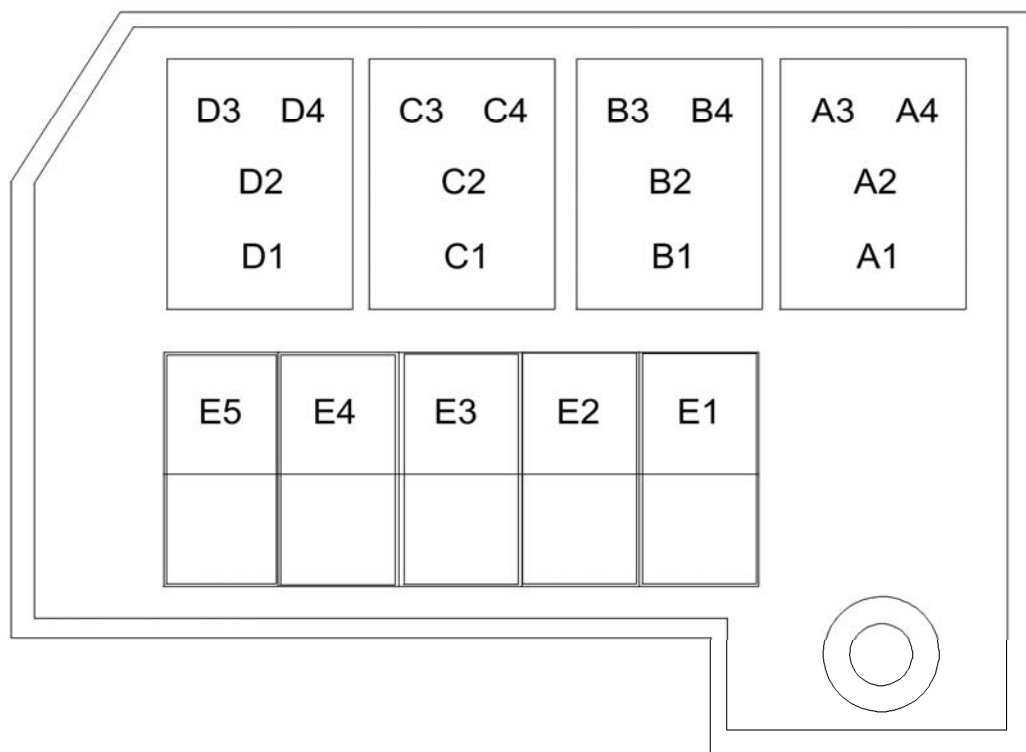


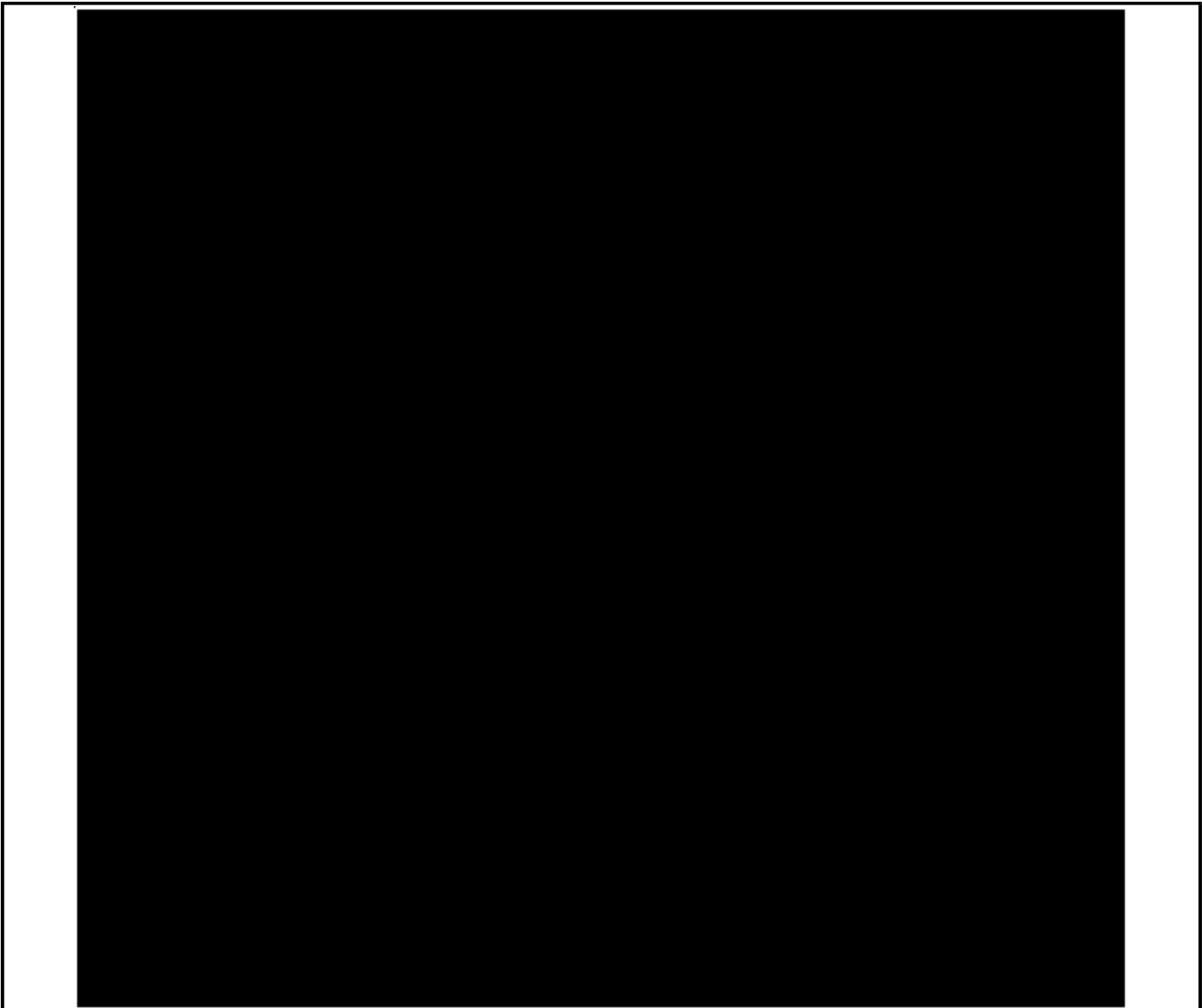
Fig. 5: X50B Fuse Block - Underhood Auxiliary, Top View
 Courtesy of GENERAL MOTORS COMPANY

X50B Fuse Block - Underhood Auxiliary, Top View

No.	Device Label Name	Device Assigned Name	Rating	Description
Fuses				
1	EVP MTR	-	30A	M9 Brake Booster Pump Motor
2	2	-	-	Not Used
3	3	-	-	Not Used
4	4	-	-	Not Used
5	5	-	-	Not Used
Relays				
1	1	KR14 Brake Booster Pump Motor Relay	-	M9 Brake Booster Pump Motor
2	2	-	-	Not Used

3	3	-	-	Not Used
4	4	-	-	Not Used

X50B FUSE BLOCK - UNDERHOOD AUXILIARY, WIRE ENTRY



Connector Part Information

- Harness Type: Not Available
- OEM Connector: 96948708
- Service Connector: Service by Harness - See Part Catalog
- Description: Fuse Block (BK)

Terminal Part Information

			Terminal				
--	--	--	----------	--	--	--	--

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Removal Tool	Service Terminal	Tray	Core Crimp	Insulation Crimp
I	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available

X50B Fuse Block - Underhood Auxiliary, Wire Entry

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A1 - C4	-	-	-	Not Occupied	-	-
D1	2.5	BK/YE	3040	Battery Positive Voltage	I	-
D2	2.5	BK/YE	3040	Battery Positive Voltage	I	-
D3	0.5	BN	6305	Brake Vacuum Switch Signal	I	-
D4	0.5	BK	50	Ground	I	-
E1-E4	-	-	-	Not Occupied	-	-
E5	-	RD/YE	3040	Battery Positive Voltage	I	-

X50B FUSE BLOCK - UNDERHOOD AUXILIARY X1

Connector Part Information • Harness Type: Engine • OEM Connector: YZK7187-1237 • Service Connector: Service by Harness - See Part Catalog • Description: Ring Terminal	Terminal Part Information • Terminated Lead: Service by Harness - See Part Catalog • Release Tool: No Tool Required • Diagnostic Test Probe: No Tool Required
--	---

X50B Fuse Block - Underhood Auxiliary X1

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	10	RD/YE	2	Battery Positive Voltage	-	-

X50D FUSE BLOCK - BATTERY TOP VIEW

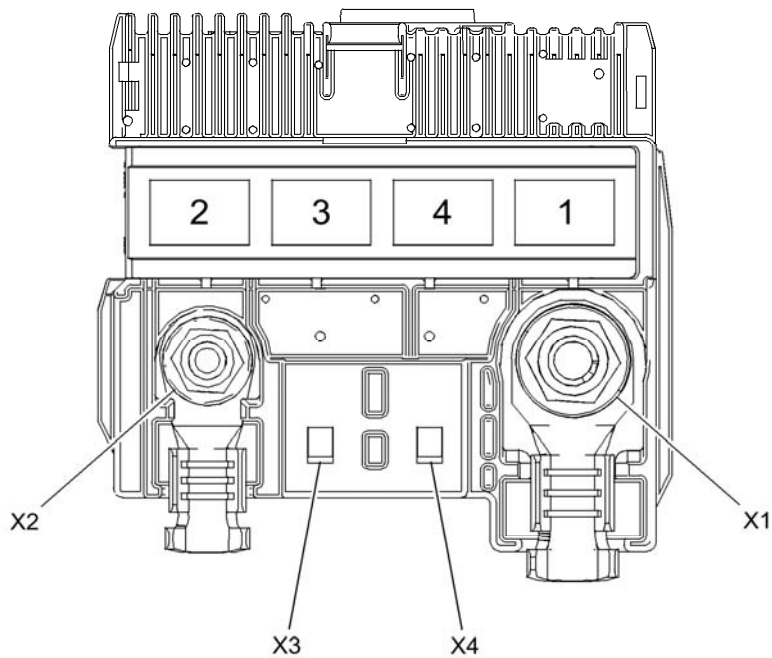
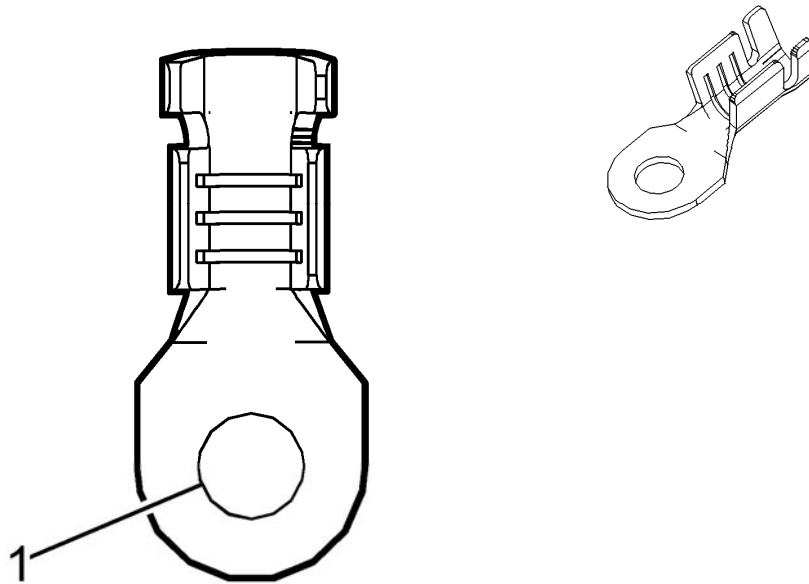


Fig. 6: X50D Fuse Block - Battery Top View
 Courtesy of GENERAL MOTORS COMPANY

X50D Fuse Block - Battery Top View

No.	Device Label Name	Device Assigned Name	Rating	Description
1	STR/ALT	F1BA Fuse	400A	Starter Alternator
2	UEC	F2BA Fuse	150A	X51 Fuse Block - Underhood
3	REC	F3BA Fuse	80A	X51 Fuse Block - Instrument Pane
4	EPS	F4BA Fuse	80A	K43 Power Steering Control Module

X50D FUSE BLOCK - BATTERY X1



Connector Part Information

- Harness Type: Battery
- OEM Connector: 817325
- Service Connector: Service by Harness - See Part Catalog
- Description: 1-Way Ring Terminal

Terminal Part Information

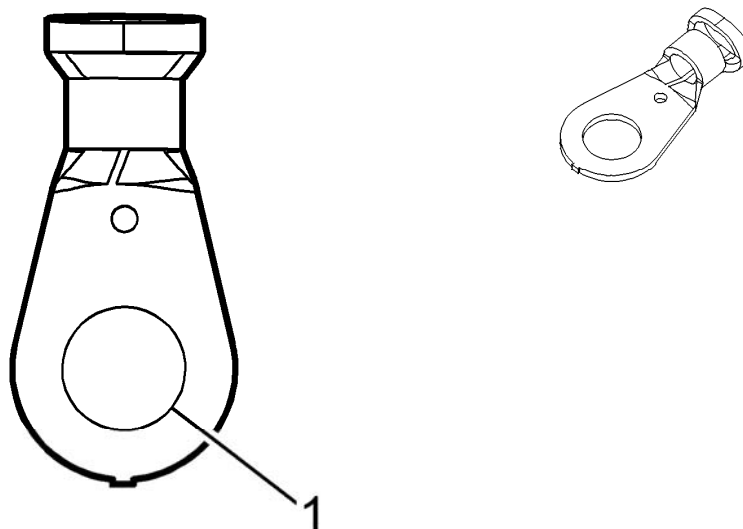
Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool
I	Not Available	No Tool Required	No Tool Required

X50D Fuse Block - Battery X1

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	25	RD	1	Battery Positive Voltage	I	-

X50D FUSE BLOCK - BATTERY X2

--	--	--	--	--	--	--



Connector Part Information

- Harness Type: Battery
- OEM Connector: PTS 120-4
- Service Connector: Service by Harness - See Part Catalog
- Description: 1 Way Ring Terminal

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool
I	Service by Harness - See Part Catalog	Not required	Not required

X50D Fuse Block - Battery X2

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	10	RD/YE	2	Battery Positive Voltage	I	-

X50D FUSE BLOCK - BATTERY X3

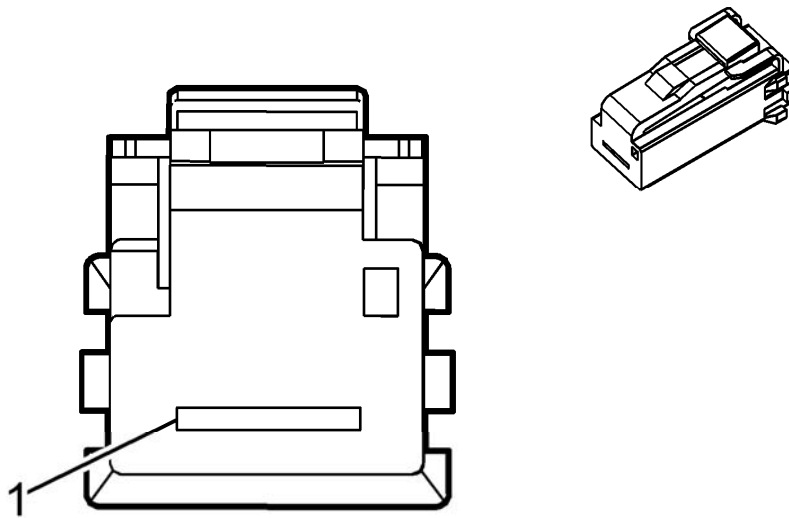


Fig. 7: X50D Fuse Block - Battery X3
Courtesy of GENERAL MOTORS COMPANY

Connector Part Information

- Harness Type: Engine
- OEM Connector: MG610658-5
- Service Connector: Not Available
- Description: 1-Way F 375 Series (BK)

Terminal Part Information

- Terminated Lead: Service by Harness - See Part Catalog
- Release Tool: Service by Harness - See Part Catalog
- Diagnostic Test Probe: Service by Harness - See Part Catalog

X50D Fuse Block - Battery X3

Pin	Wire	Circuit	Function
1	10 RD/WH	2740	Battery Positive Voltage

X50D FUSE BLOCK - BATTERY X4

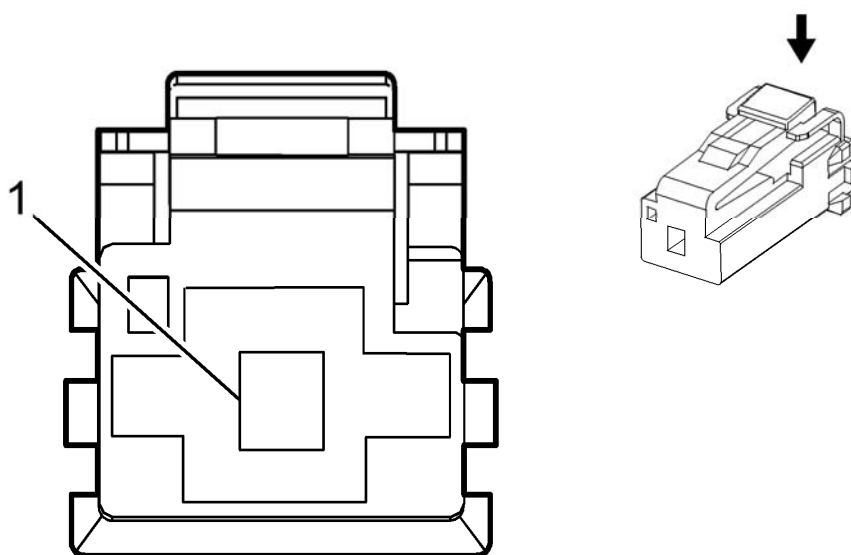


Fig. 8: X50D Fuse Block - Battery X4
Courtesy of GENERAL MOTORS COMPANY

Connector Part Information

- Harness Type: Battery
- OEM Connector: MG613689-1
- Service Connector: Pending
- Description: 375 Series (BK)

Terminal Part Information

- Terminated Lead: Service by Harness - See Part Catalog
- Release Tool: Service by Harness - See Part Catalog
- Diagnostic Test Probe: Service by Harness - See Part Catalog

X50D Fuse Block - Battery X4

Pin	Wire	Circuit	Function
1	10 RD	540	Battery Positive Voltage

X51A FUSE BLOCK - FUSE AND RELAY INSTRUMENT PANEL LABEL

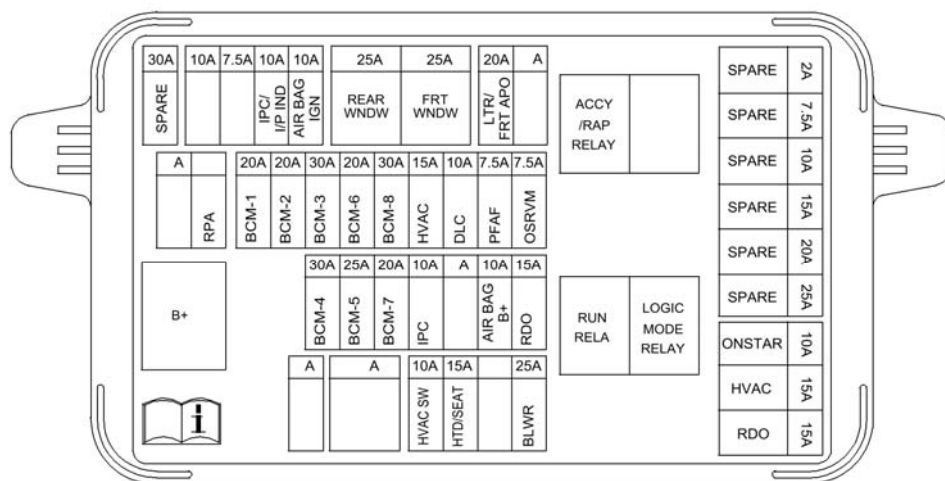


Fig. 9: X51A Fuse Block - Fuse And Relay Instrument Panel Label
Courtesy of GENERAL MOTORS COMPANY

X51A FUSE BLOCK - INSTRUMENT PANEL TOP VIEW

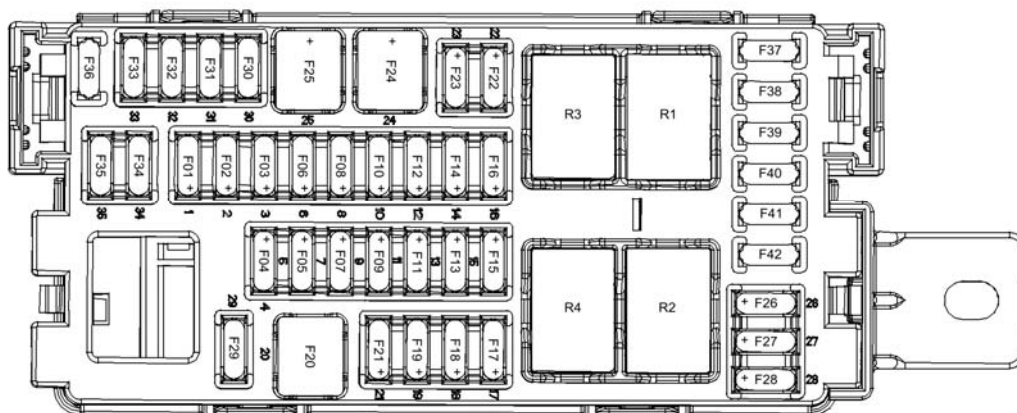


Fig. 10: X51A Fuse Block - Instrument Panel Top View
 Courtesy of GENERAL MOTORS COMPANY

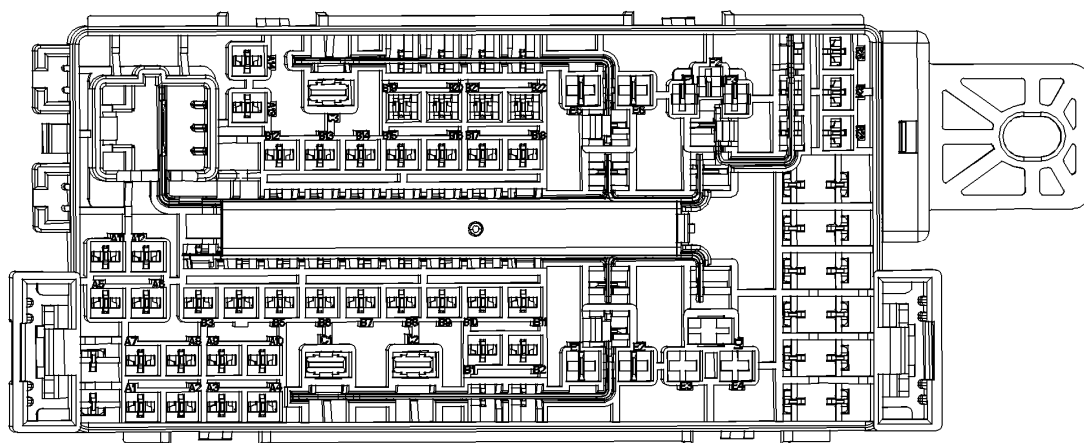
X51A Fuse Block - Instrument Panel Top View

No.	Device Label Name	Device Assigned Name	Rating	Description
F1	BCM1	F1DA Fuse	15A	K9 Body Control Module
F2	BCM2	F2DA Fuse	10A	K9 Body Control Module
F3	BCM3	F3DA Fuse	15A	K9 Body Control Module
F4	BCM4	F4DA Fuse	15A	K9 Body Control Module
F5	BCM5	F5DA Fuse	15A	K9 Body Control Module
F6	BCM6	F6DA Fuse	15A	K9 Body Control Module
F7	BCM7	F7DA Fuse	15A	K9 Body Control Module
F8	BCM8	F8DA Fuse	20A	K9 Body Control Module
F9	IPC	F9DA Fuse	10A	P16 Instrument Cluster
F10	HVAC	F10DA Fuse	-	Not Used

F11	Not Occupied	F11DA Fuse	-	Not Occupied
F12	DLC	F12DA Fuse	30A	X84 Data Link Connector
F13	AIRBAG	F13DA Fuse	10A	K36 Inflatable Restraint Sensing and Diagnostic Module
F14	DILS	F14DA Fuse	2A	S39 Ignition Switch
F15	RADIO	F15DA Fuse	-	Not Occupied
F16	OSRVM	F16DA Fuse	7.5	S52 Outside Rearview Mirror Switch
F17	BLWR	F17DA Fuse	25A	M8 Blower Motor
F18	Not Occupied	F18DA Fuse	-	Not Occupied
F19	HDT/SEAT	F19DA Fuse	15A	S32D Seat Heating Switch-Driver, S32P Seat Heating Switch-Passenger
F20	Not Occupied	F20DA Fuse	-	Not Occupied
F21	HVAC SW	F21DA Fuse	20A	K33 HVAC Control Module
F22	Not Occupied	F22DA Fuse	-	Not Occupied
F23	LTR/APO	F23DA Fuse	10A	Cigarette Lighter Receptacle
F24	FRT WNDW	F24DA Fuse	25A	S79D Window Switch-Driver, Window Switch- Passenger
F25	REAR WNDW	F25DA Fuse	10A	S79D Window Switch - Driver
F26	ONSTAR	F26DA Fuse	10A	K73 Telematics Communication Interface Control Module
F27	HVAC	F27DA Fuse	10A	K33 HVAC Control Module
F28	RADIO	F28DA Fuse	15A	A11 Radio
F29	Not Occupied	F29DA Fuse	-	Not Occupied
F30	AIR BAG IGN	F30DA	10A	K36 Inflatable Restraint Sensing and Diagnostic Module
F31	IPC I/P IND	F31DA Fuse	10A	P16 Instrument Panel Cluster, P17 Info Display Module
F32	Not Occupied	F33DA Fuse	-	Not Occupied
F33	Not Occupied	F33DA Fuse	-	Not Occupied
F34	RPA	F34DA Fuse	-	Not Used
F35	Not Occupied	F35DA Fuse	-	Not Occupied
F36	SPARE	F36DA Fuse	30A	Not Used
F37	SPARE	F37DA Fuse	2A	Not Used
F38	SPARE	F38DA	7.5A	Not Used
F39	SPARE	F39DA Fuse	10A	Not Used
F40	SPARE	F40DA Fuse	15A	Not Used
F41	SPARE	F41DA Fuse	20A	Not Used
F42	SPARE	F42DA	25A	Not Used
Relays				
R1	Not Occupied	-	-	-
R2	LOGIC MODE RELAY	KR104A Battery Saver Relay1	-	F26DA, F27DA, F28DA

R3	ACCY/RAP RELAY	KR76 Retained Accessory Power Relay	-	F22DA, F23DA, F24DA, F25DA
R4	RUN RELA	KR74 Ignition Run Relay	-	F17DA, F18DA, F19DA, F20DA. F21DA

X51A FUSE BLOCK - INSTRUMENT PANEL, WIRE ENTRY



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector:95981339
- Service Connector: Service by Harness - See Part Catalog
- Description: 53-Way F

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray	Core Crimp	Insulation Crimp
I	Not available	J-35616-35 (VT)	J-38125-36	2-964284-1	25	E	A
II	Not available	J-35616-35 (VT)	J-38125-36	4-965999-1	25	4	A

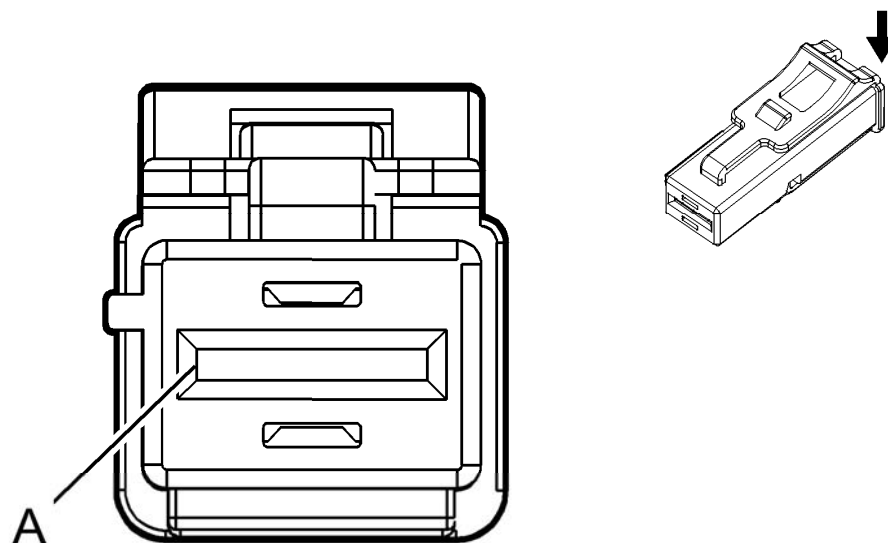
X51A Fuse Block - Instrument Panel, Wire Entry

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A1	0.5	VT/GN	39	Run/Crank Ignition 1 Voltage	I	TR6
A2	-	-	-	Not Occupied	-	-
A3	0.75	VT/GN	39	Run/Crank Ignition 1 Voltage	I	-
A4	0.5	VT/GN	39	Run/Crank Ignition 1 Voltage	I	-
A5	-	-	-	Not Occupied	-	-
A6	0.5	VT/GN	39	Run/Crank Ignition 1 Voltage	I	-
A7	0.5	VT/GN	39	Run/Crank Ignition 1 Voltage	I	TR6
A8	-	-	-	Not Occupied	-	-
A9	0.75	VT/GY	139	Run/Crank Ignition 1 Voltage	I	-
A10	0.5	vt/gn	439	Run/Crank Ignition 1 Voltage	I	AYF
A11	-	-	-	Not Occupied	-	-
A12	0.35	VT/GN	141	Run/Crank Ignition 3 Voltage	I	RHD
A13	0.75	VT/GY	539	Run/Crank Ignition 1 Voltage	I	-
B1	-	-	-	Not Occupied	-	-
B2	1.5	VT	801	Retained Accessory Power Fuse Supply Voltage	II	-
B3	1	RD/BN	1140	Battery Positive Voltage	I	-
B4	1	RD/BU	1240	Battery Positive Voltage	I	-
B5	2.5	RD/WH	1340	Battery Positive Voltage	II	-
B6	1	RD/VT	1640	Battery Positive Voltage	I	-
B7	2	RD/GN	1840	Battery Positive Voltage	I	-
B8	-	-	-	Not Occupied	-	-

B9	0.5	RD/BN	2240	Battery Positive Voltage	I	-
B10	0.35	RD/GN	2440	Battery Positive Voltage	I	-
B11	0.5	RD/VT	2640	Battery Positive Voltage	I	-
B12	2.5	RD/BN	1440	Battery Positive Voltage	II	-
B13	2.5	RD/GN	1540	Battery Positive Voltage	II	-
B14	1	RD/GY	1740	Battery Positive Voltage	I	-
B15	0.5	RD/VT	1940	Battery Positive Voltage	I	-
B16	-	-	-	Not Occupied	-	-
B17	0.75	RD/WH	640	Battery Positive Voltage	I	-
B18	-	-	-	Not Occupied	-	-
B19	0.5	VT/BN	441	Run Ignition 3 Voltage	I	C41/C60
B20	0.75	VT/BN	341	Run Ignition 3 Voltage	I	C37/C38
B21	-	-	-	Not Occupied	-	-
B22	2.5	VT/BN	41	Run Ignition 3 Voltage	II	C41/C60
B23	0.5	RD/YE	2340	Battery Positive Voltage	I	UE1
B24	0.75	RD/WH	2040	Battery Positive Voltage	I	C41/C60
B25	0.75	RD/BU	2540	Run Ignition 3 Voltage	I	UF7/UH7/UM7/UCH
C1	1.5	VT	1701	Retained Accessory Power Fuse Supply Voltage	II	-
C3	-	-	-	Not Occupied	-	-
D1	0.75	VT/GN	39	Run/Crank Ignition 1 Voltage	I	-
E1	0.35	GY/VT	755	RAP Relay Coil Control	I	-
E2	0.35	BK	750	Ground	I	-
E3	0.75	VT/GY	539	Run/Crank Ignition 1 Voltage	I	-
E4	-	-	-	Not Occupied	-	-
E5	0.35	BN/VT	5486	Run Relay Coil Control	I	-
E6	0.35	BK	750	Ground	I	-
F1	0.35	GY/VT	3264	Logistic Mode Relay Close Control	I	-
F2	0.35	BK	750	Ground	I	-
F3	0.35	VT/BU	3263	Logistic Mode Relay Open Control	I	-

X51A FUSE BLOCK - INSTRUMENT PANEL X1





Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 2005400-2
- Service Connector: Service by Harness - See Part Catalog
- Description: 1-Way F 9.5 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray	Core Crimp	Insulation Crimp
I	Not Available	J-35616-21 (RD)	J-38125-221	Not Available	Not Available	Not Available	Not Available

X51A Fuse Block - Instrument Panel X1

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	10	RD/GN	2740	Battery Positive Voltage	I	-

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Front of Vehicle/Engine Compartment Component Views - Spark

FRONT OF VEHICLE/ENGINE COMPARTMENT COMPONENT VIEWS

FRONT OF ENGINE COMPARTMENT COMPONENTS

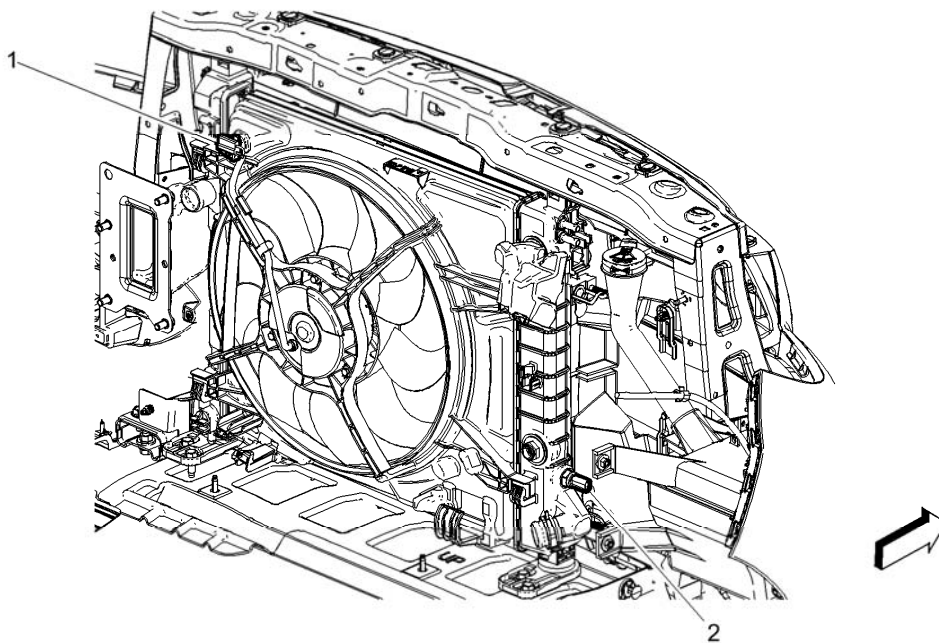


Fig. 1: Front of Engine Compartment Components
Courtesy of GENERAL MOTORS COMPANY

Items

1: G10 Cooling Fan Motor **G10 Cooling Fan Motor**

2: B34B Engine Coolant Temperature Sensor 2 (EVP) **B34B Engine Coolant Temperature Sensor 2**

FRONT OF VEHICLE

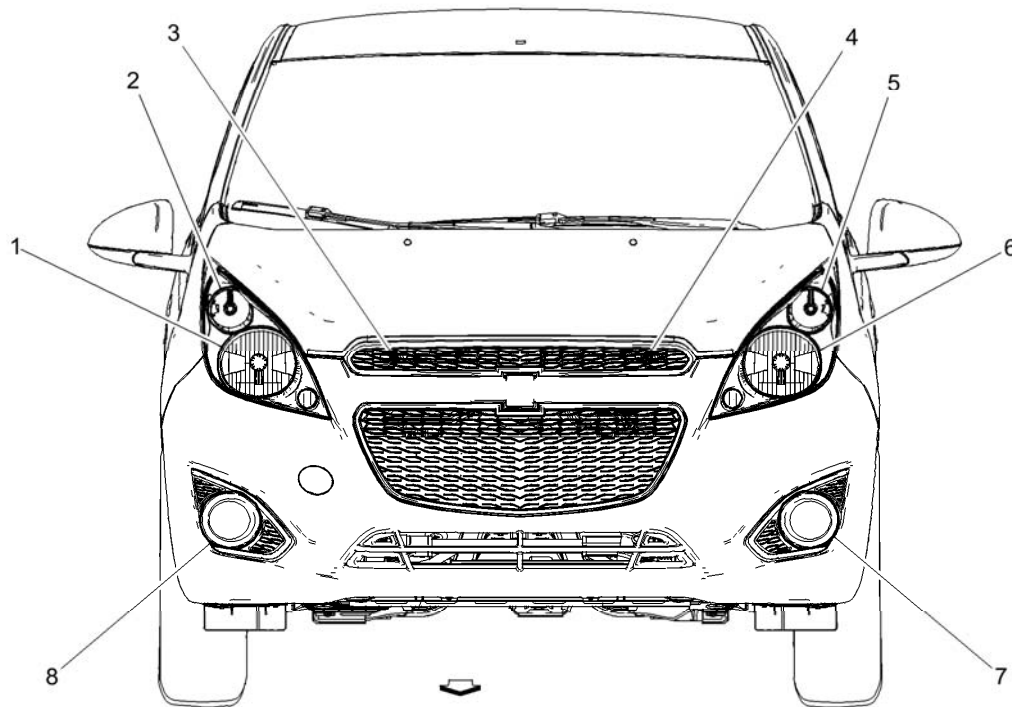


Fig. 2: Front of Vehicle

Courtesy of GENERAL MOTORS COMPANY

Items

- 1: E13R Headlamp - Right E13R Headlamp - Right**
- 2: E4P Park/Turn Signal Lamp - Right (CW1) E4P Park/Turn Signal Lamp - Right**
- 3: B59R Front Impact Sensor - Right (EF7/Z49) B59R Front Impact Sensor - Right**
- 4: B59L Front Impact Sensor - Left (EF7/Z49)**
- 5: E4N Park/Turn Signal Lamp - Left (CW1) E4N Park/Turn Signal Lamp - Left**
- 6: E13L Headlamp - Left E13L Headlamp - Left**
- 7: E29LF Fog Lamp - Left Front (TY3) E29LF Fog Lamp - Left Front (TY3)**
- 8: E29RF Fog Lamp - Right Front (TY3) E29RF Fog Lamp - Right Front (T3Y)**

LEFT SIDE OF ENGINE COMPARTMENT COMPONENTS

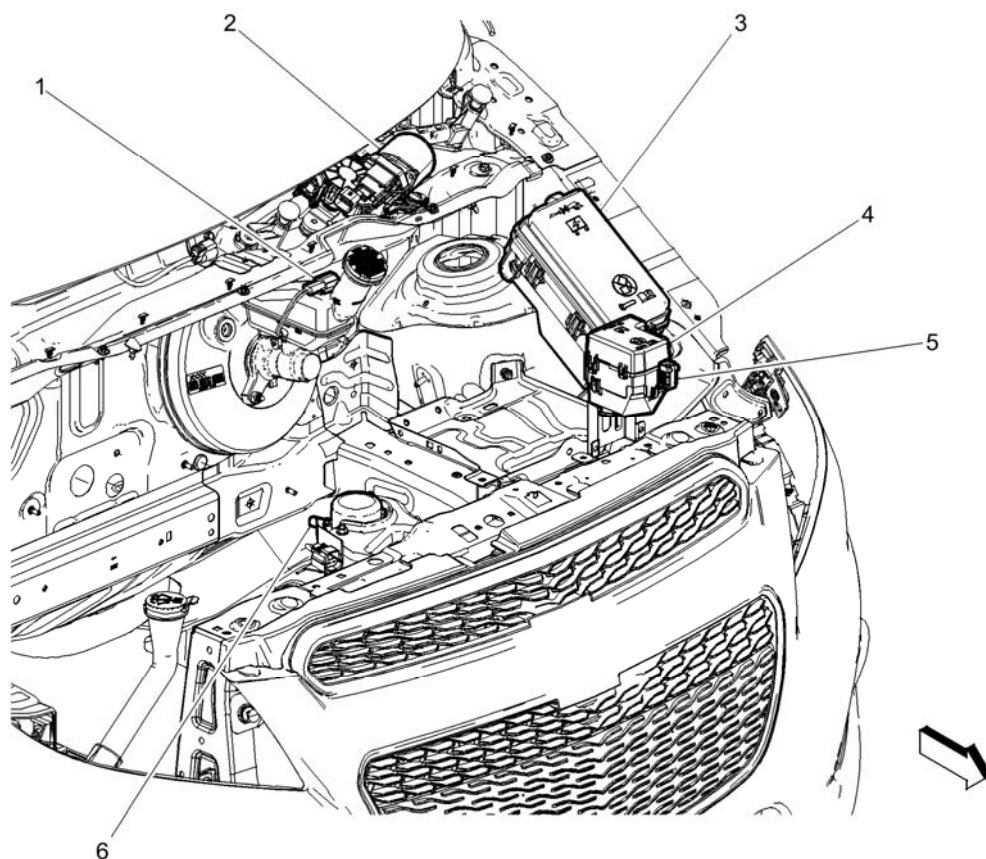


Fig. 3: Left Side of Engine Compartment Components
 Courtesy of GENERAL MOTORS COMPANY

Items
1: B20 Brake Fluid Level Switch <u>B20 Brake Fluid Level Switch (LHD) B20 Brake Fluid Level Switch (RHD)</u>
2: M75 Windshield Wiper Motor <u>M75 Windshield Wiper Motor</u>
3: X50A Fuse Block - Underhood <u>X50A Fuse Block - Underhood X1 X50A Fuse Block - Underhood X2 X50A Fuse Block - Underhood X3 X50A Fuse Block - Underhood X4</u>
4: X50B Fuse Block - Underhood Auxiliary <u>X50B Fuse Block - Underhood Auxiliary X1 X50B Fuse Block - Underhood Auxiliary, Wire Entry</u>
5: X90 Assembly Plant ABS Data Connector (FX3) <u>X90 Assembly Plant ABS Data Connector</u>
6: M9 Brake Booster Pump Motor <u>M9 Brake Booster Pump Motor</u>

RIGHT SIDE OF ENGINE COMPARTMENT COMPONENTS

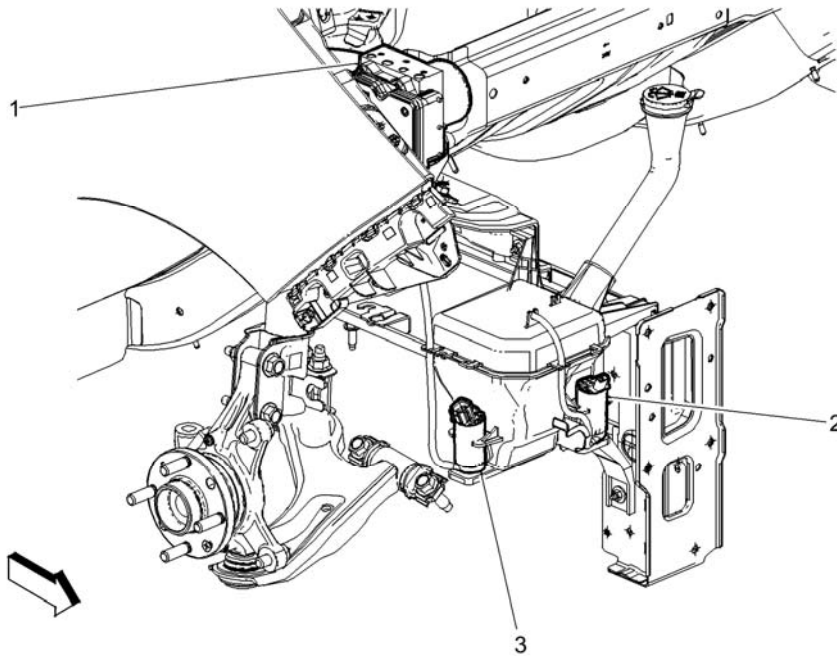


Fig. 4: Right Side of Engine Compartment Components
Courtesy of GENERAL MOTORS COMPANY

Items

- 1: K17 Electronic Brake Control Module (JM4/FX3) K17 Electronic Brake Control Module**
2: G19 Rear Window Washer Pump (CD6) G19 Rear Window Washer Pump
3: G24 Windshield Washer Pump

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Ground Views - Spark

GROUND VIEWS

G101

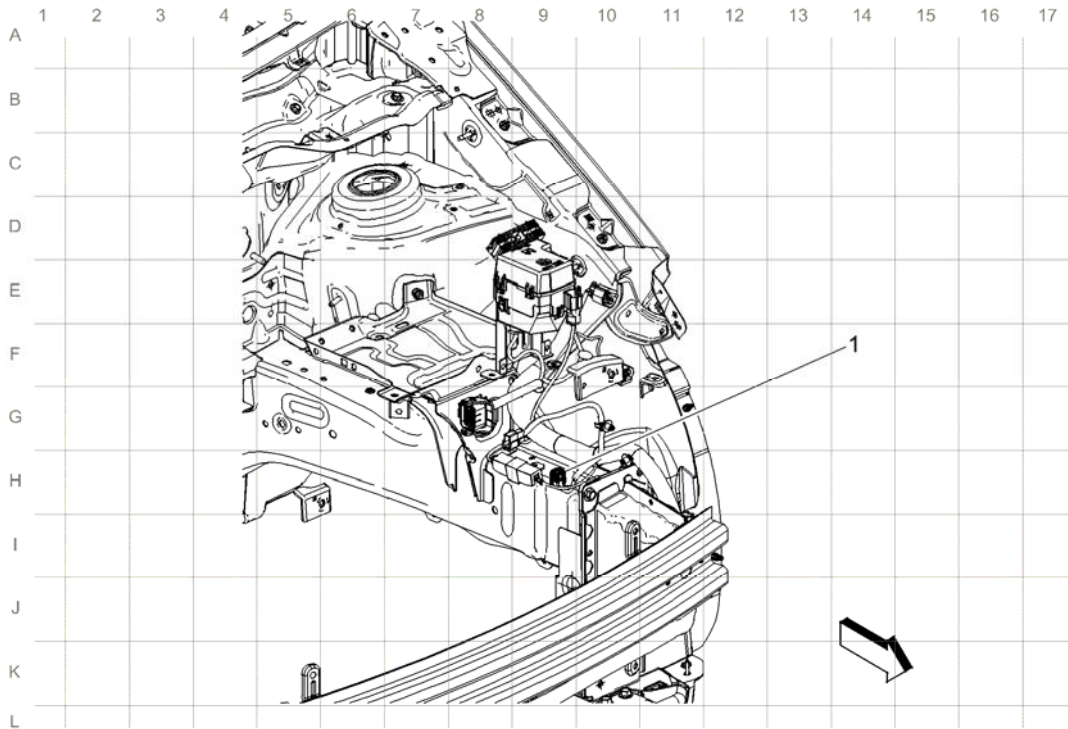


Fig. 1: G101

Courtesy of GENERAL MOTORS COMPANY

Items	
1:	G101

G102 AND G106

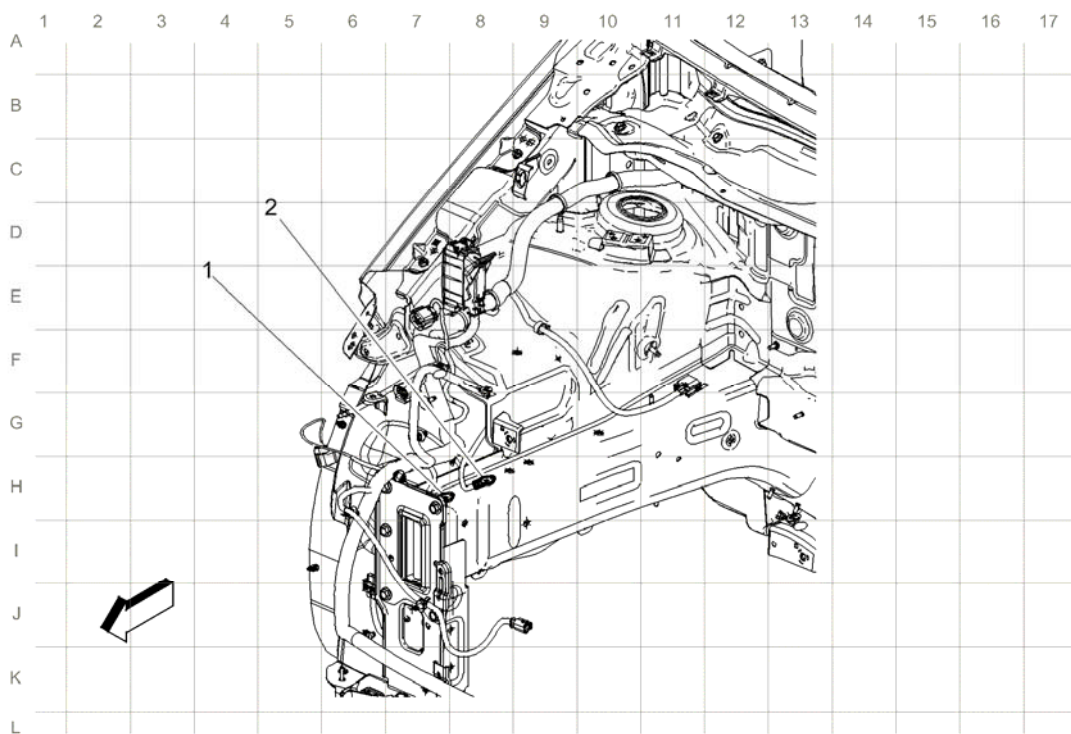


Fig. 2: G102 and G106

Courtesy of GENERAL MOTORS COMPANY

Items	
1:	G106
2:	G102

G103

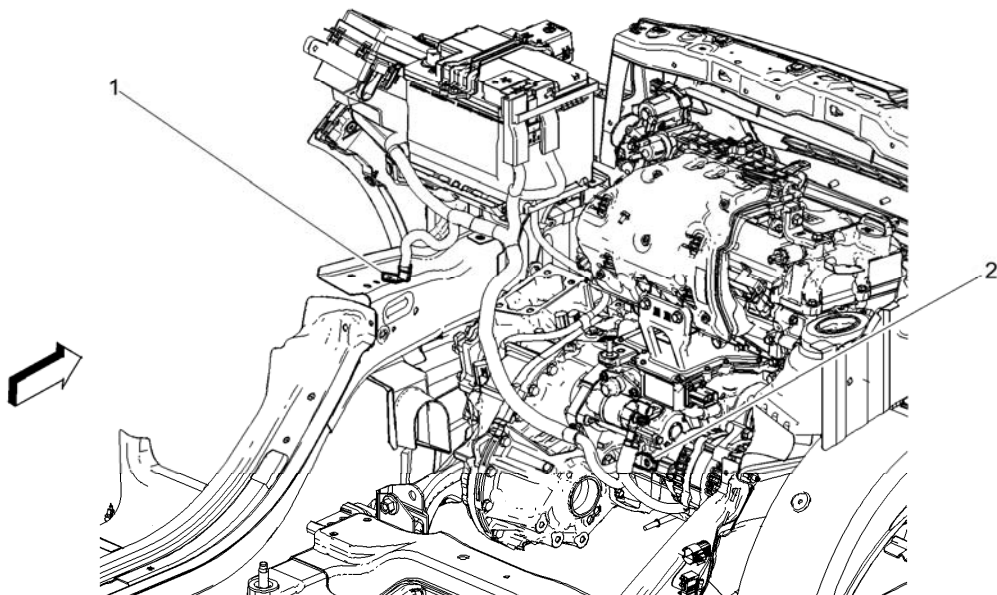


Fig. 3: G103

Courtesy of GENERAL MOTORS COMPANY

Items
1: G103
2: G104

G104 AND G107

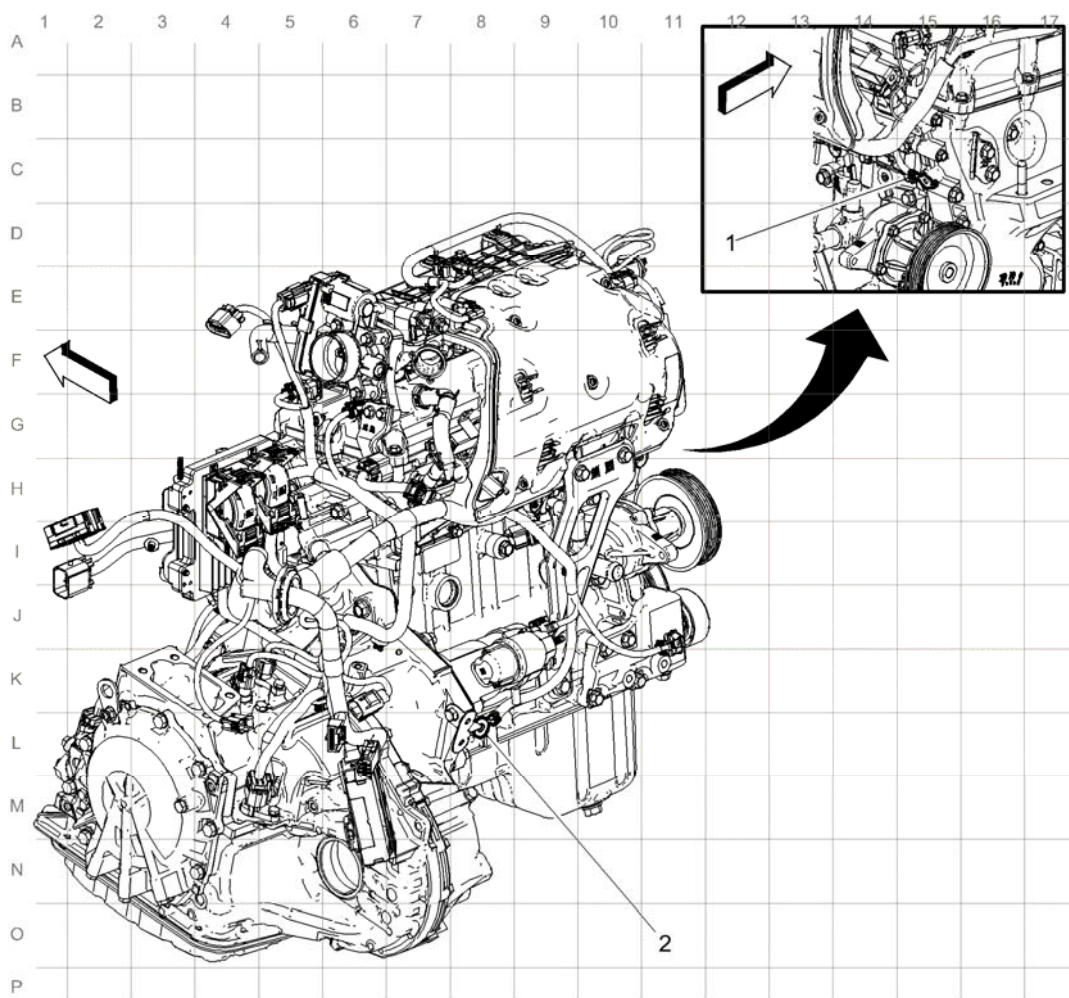


Fig. 4: G104 and G107
Courtesy of GENERAL MOTORS COMPANY

Items

1: G107

2: G104

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Instrument Panel/Center Console Component Views - Spark

INSTRUMENT PANEL/CENTER CONSOLE COMPONENT VIEWS

INSTRUMENT PANEL AND CENTER CONSOLE COMPONENTS

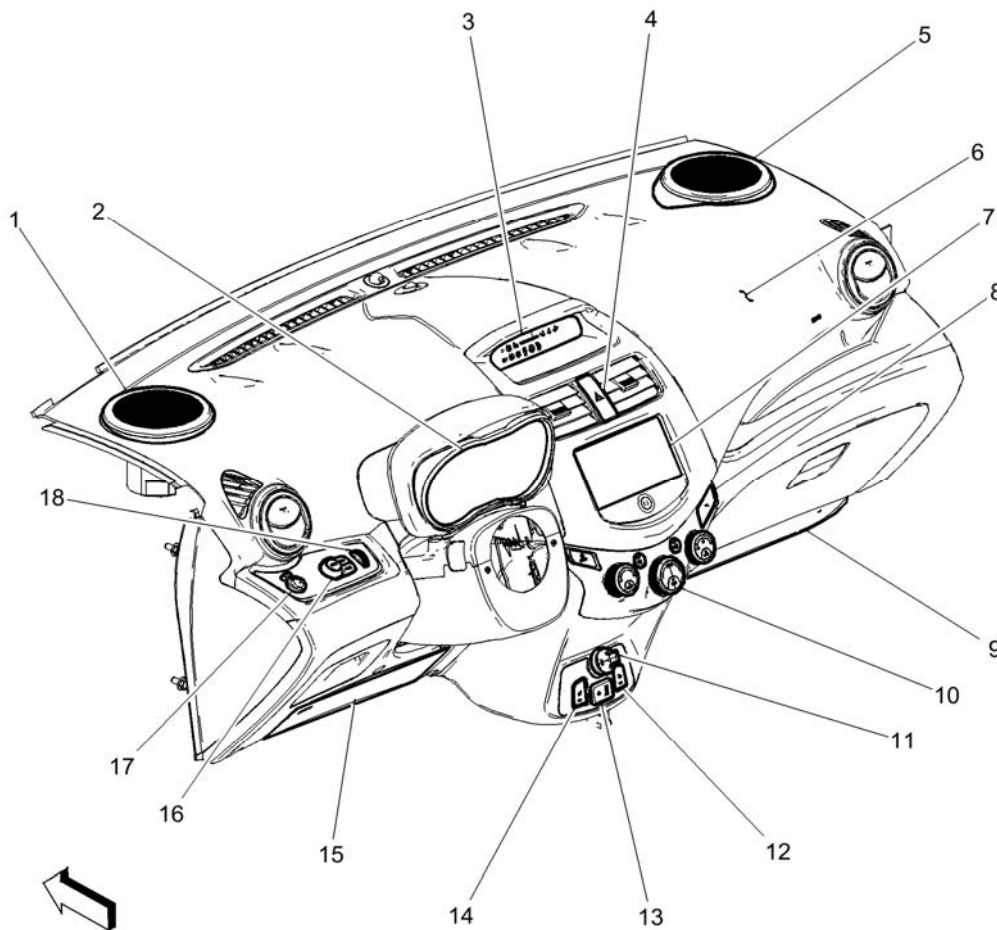


Fig. 1: Instrument Panel and Center Console Components
Courtesy of GENERAL MOTORS COMPANY

Items

- 1: P19J Speaker - Left Instrument Panel (UF7/UH7/UM7/UCH) **P19J Speaker - Left Instrument Panel**
- 2: P16 Instrument Cluster **P16 Instrument Cluster**
- 3: P17 Info Display Module **P17 Info Display Module**
- 4: S26 Hazard Warning Switch **S26 Hazard Warning Switch**

5: P19W Speaker - Right Instrument Panel (UF7/UH7/UM7/UCH) **P19W Speaker - Right Instrument Panel**
6: F101 Passenger Instrument Panel Air Bag (AYF) **F101 Passenger Instrument Panel Air Bag**
7: A11 Radio **A11 Radio X1 A11 Radio X2 A11 Radio X3 A11 Radio X4**
8: S75 Traction Control Switch (FX3) **S75 Traction Control Switch**
9: F114P Knee Air Bag - Passenger (AYF) **F114P Knee Air Bag - Passenger**
10: K33 HVAC Control Module **K33 HVAC Control Module**
11: X80G Accessory Power Receptacle - Instrument Panel **X80G Accessory Power Receptacle - Instrument Panel**
12: S32P Seat Heating Switch - Passenger (C37/C38) **S32P Seat Heating Switch - Passenger**
13: X83 Auxiliary Audio Input **X83 Auxiliary Audio Input X1 X83 Auxiliary Audio Input X2**
14: S32D Seat Heating Switch - Driver (C37/C38) **S32D Seat Heating Switch - Driver**
15: F114D Knee Air Bag - Driver (AYF) **F114D Knee Air Bag - Driver**
16: S36 Instrument Panel Dimmer Switch (WU5) **S36 Instrument Panel Dimmer Switch**
17: S52 Outside Rearview Mirror Switch (LHD + (DLW/D71/DLS)) **S52 Outside Rearview Mirror Switch**
18: S46B Liftgate Unlatch Switch (AU3) **S46B Liftgate Unlatch Switch (Without AU3)**

HVAC ASSEMBLY COMPONENTS

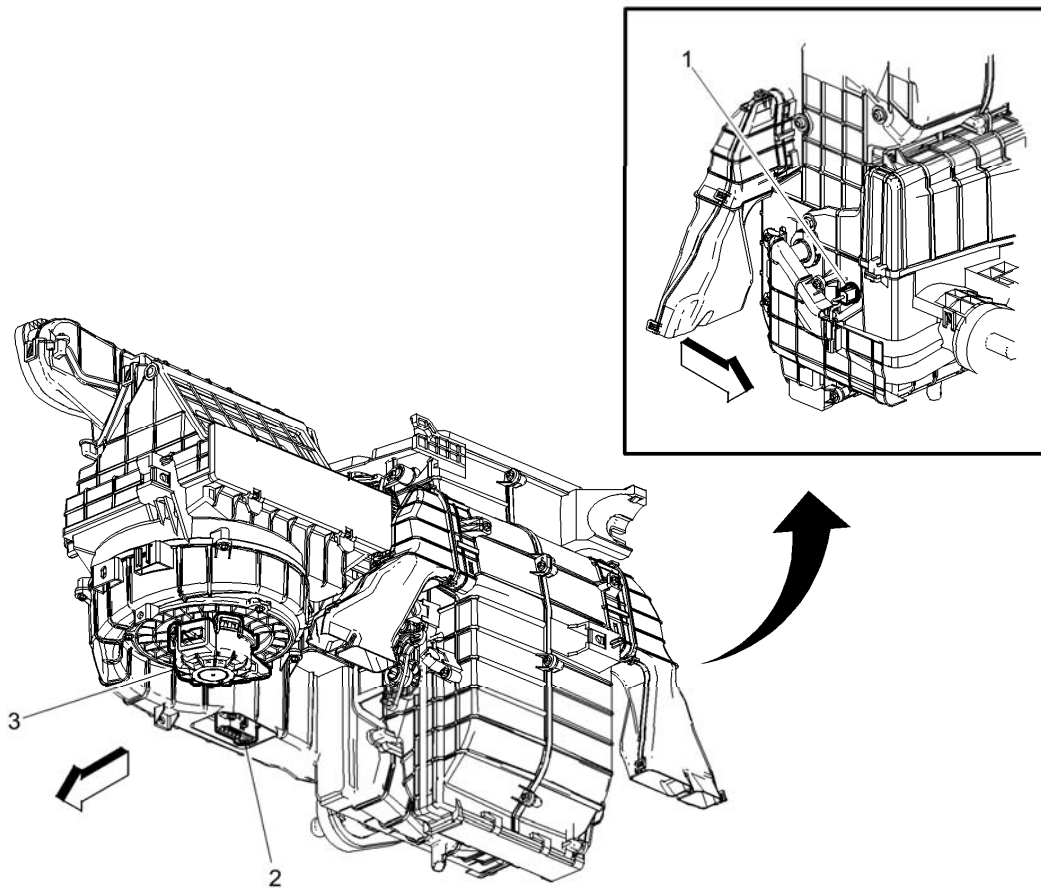


Fig. 2: HVAC Assembly Components
Courtesy of GENERAL MOTORS COMPANY

Items

- 1: B39 A/C Evaporator Temperature Sensor (C60) B39 A/C Evaporator Temperature Sensor**
2: R3 Blower Motor Resistor (C41/C60) R3 Blower Motor Resistor
3: M8 Blower Motor M8 Blower Motor

STEERING COLUMN COMPONENTS (LEFT HAND DRIVE)

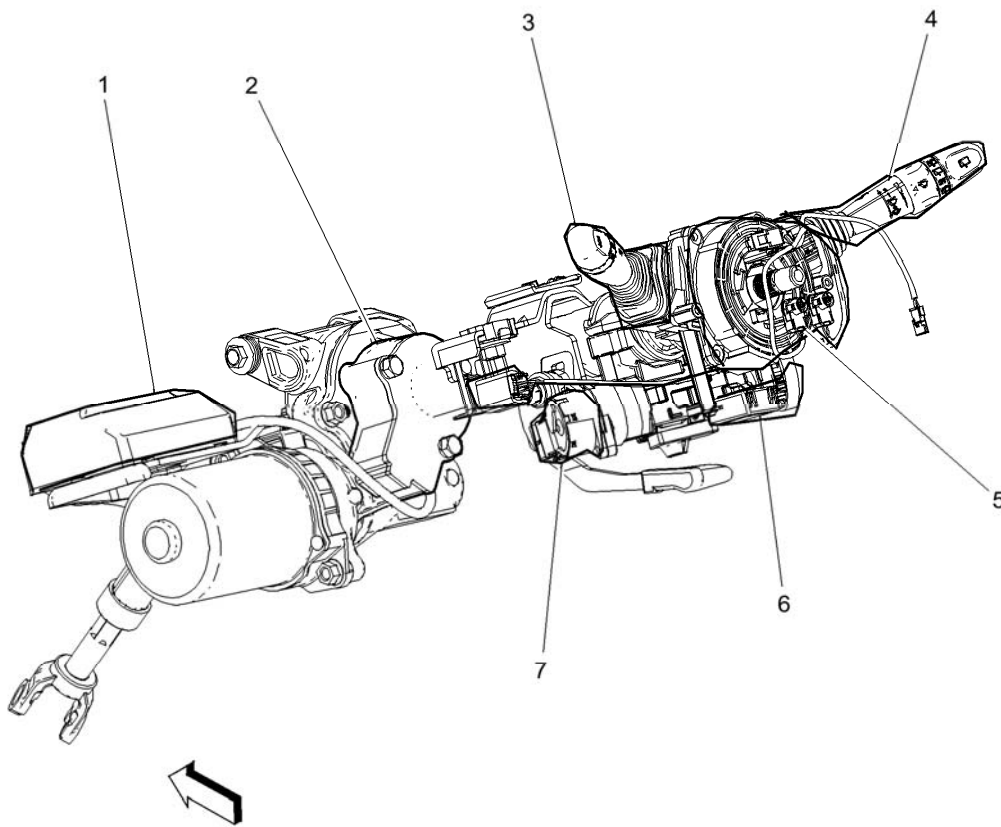


Fig. 3: Steering Column Components (Left Hand Drive)
 Courtesy of GENERAL MOTORS COMPANY

Items

- 1:** K43 Power Steering Control Module (NJ1) **K43 Power Steering Control Module X1 K43 Power Steering Control Module X2 K43 Power Steering Control Module X3 K43 Power Steering Control Module X4**
- 2:** B137 Power Steering Shaft Torque Sensor (NJ1)
- 3:** S78 Turn Signal/Multifunction Switch (#VALUE) **S78 Turn Signal Multifunction Switch**
- 4:** S82 Windshield Wiper/Washer Switch
- 5:** X85 Steering Wheel Air Bag Coil (AYF or AY0) **X85 Steering Wheel Air Bag Coil X1 X85 Steering Wheel Air Bag Coil X2**
- 6:** K89 Immobilizer Control Module **K89 Immobilizer Control Module**
- 7:** S39 Ignition Switch **S39 Ignition Switch**

STEERING COLUMN COMPONENTS (RIGHT HAND DRIVE)

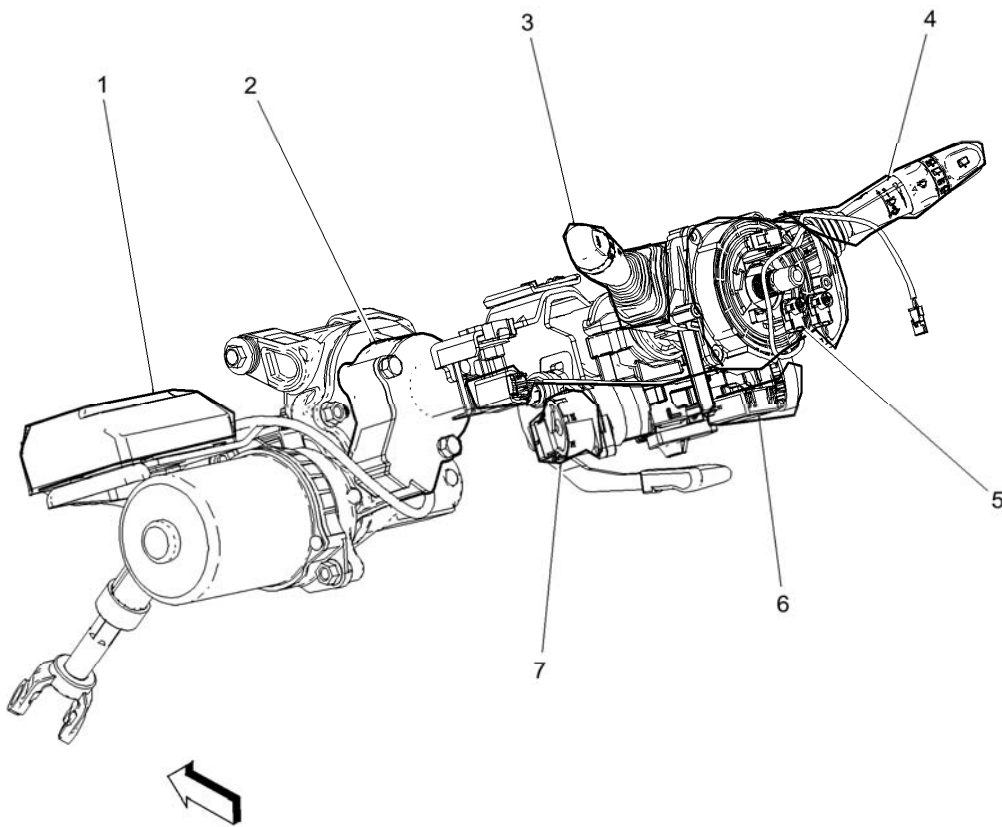


Fig. 4: Steering Column Components (Right Hand Drive)
Courtesy of GENERAL MOTORS COMPANY

STEERING WHEEL COMPONENTS

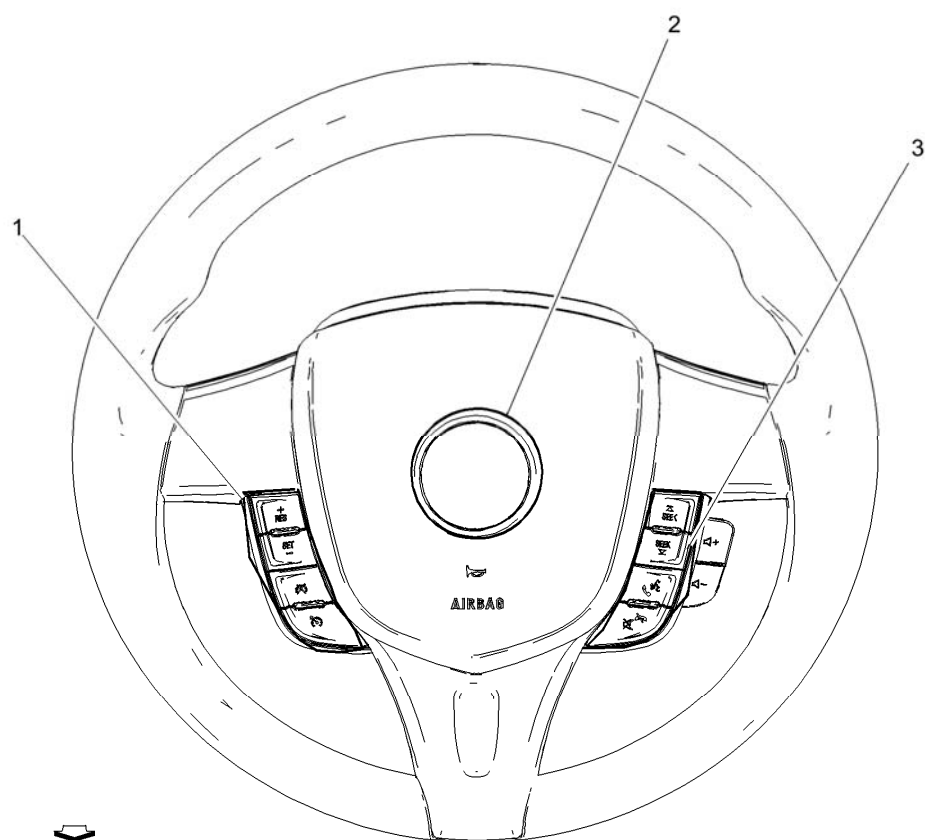


Fig. 5: Steering Wheel Components
Courtesy of GENERAL MOTORS COMPANY

Items

- 1: S70L Steering Wheel Controls Switch - Left (UK3) S70L Steering Wheel Controls Switch - Left (UK3)**
2: F107 Steering Wheel Air Bag F107 Steering Wheel Air Bag X1 F107 Steering Wheel Air Bag X2
3: S70R Steering Wheel Controls Switch - Right (UK3) S70R Steering Wheel Controls Switch - Right (UK3)

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Luggage Compartment/Rear of Vehicle Component Views - Spark

LUGGAGE COMPARTMENT/REAR OF VEHICLE COMPONENT VIEWS

LIFTGATE COMPONENTS (1/2)

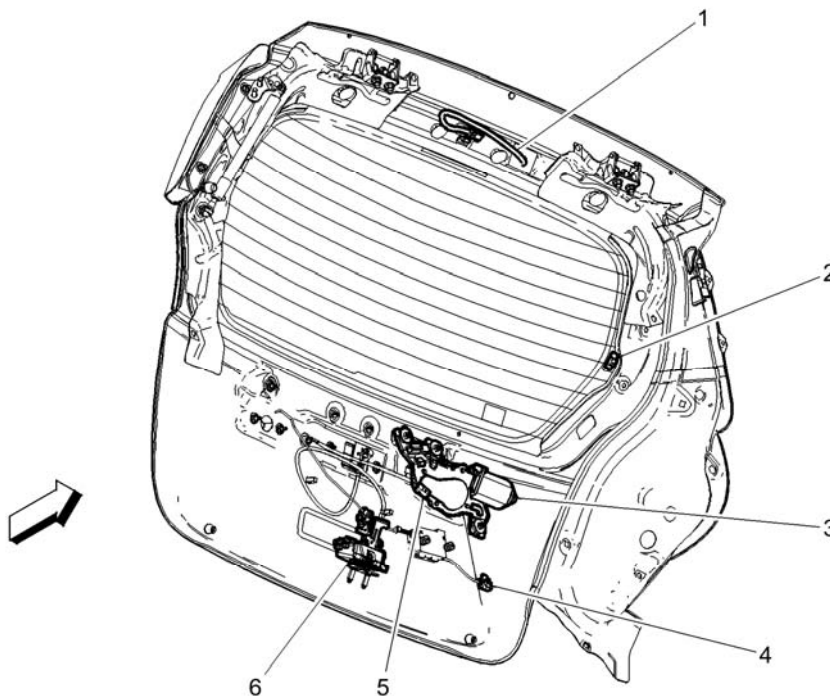


Fig. 1: Liftgate Components (1/2)

Courtesy of GENERAL MOTORS COMPANY

Items

- 1: E6 Center High Mounted Stop Lamp **E6 Center High Mounted Stop Lamp**
- 2: E18 Rear Defogger Grid (C50) **E18 Rear Defogger Grid X1** **E18 Rear Defogger Grid X2**
- 3: M45 Rear Wiper Motor **M45 Rear Wiper Motor**
- 4: B69 Liftgate Ajar Switch **B69 Liftgate Ajar Switch**
- 5: E7 License Plate Lamp **E7 License Plate Lamp**
- 6: M14B Door Lock Actuator - Liftgate (A91) **M14B Door Lock Actuator - Liftgate**

LIFTGATE COMPONENTS (2/2)

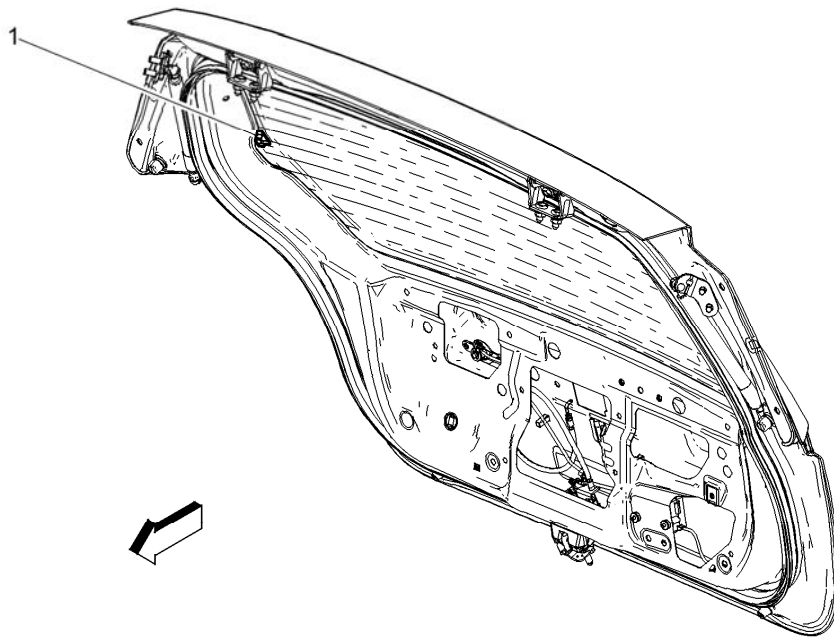


Fig. 2: Liftgate Components (2/2)

Courtesy of GENERAL MOTORS COMPANY

Items
1: E18 Rear Defogger Grid (C50) <u>E18 Rear Defogger Grid X1</u> <u>E18 Rear Defogger Grid X2</u>

REAR OF VEHICLE COMPONENTS

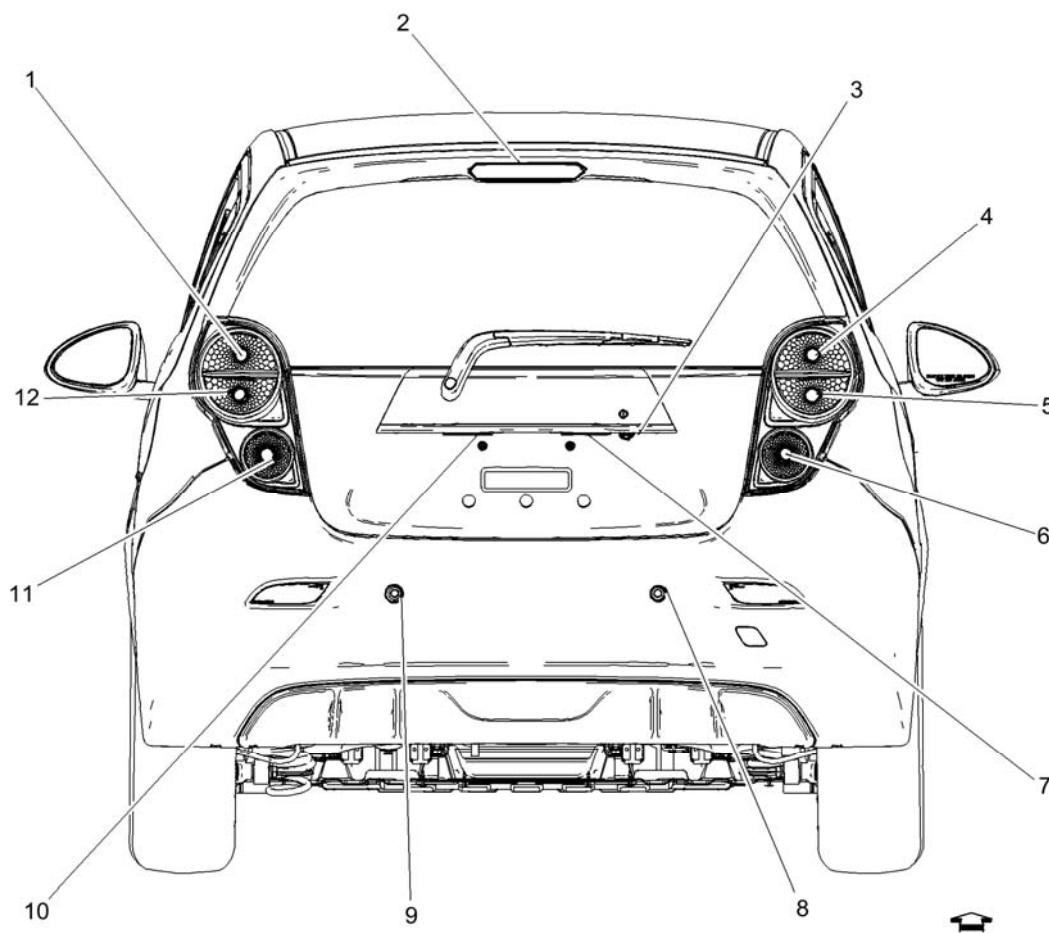


Fig. 3: Rear of Vehicle Components
 Courtesy of GENERAL MOTORS COMPANY

Items

- 1: E5AA Tail/Stop Lamp - Left
- 2: E6 Center High Mounted Stop Lamp **E6 Center High Mounted Stop Lamp**
- 3: B87 Rearview Camera (UVC)
- 4: E5AB Tail/Stop Lamp - Right
- 5: E5AB Tail/Stop Lamp - Right
- 6: E5B Backup Lamp - Right (without U05)
- 7: E7L License Plate Lamp - Left
- 8: B78H Rear Object Sensor - Right Outer ((UD7)) **B78H Rear Object Sensor - Right Outer (UD7)**
- 9: B78G Rear Object Sensor - Left Outer ((UD7)) **B78G Rear Object Sensor - Left Outer (UD7)**
- 10: E7L License Plate Lamp - Left
- 11: E5A Backup Lamp - Left
- 12: E5AA Tail/Stop Lamp - Left

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Master Electrical Component List - Spark

MASTER ELECTRICAL COMPONENT LIST

Master Electrical Component List

Code	Name	Option	Location	Locator View	Connect
A7	Fuel Pump and Level Sensor Assembly	-	Under the vehicle, in the top of the fuel tank	<u>Fuel Tank Components</u>	<u>A7 Fuel P Level Sen</u>
A9A	Outside Rearview Mirror - Driver	-	On the outside of the driver door, near the front of the door	• <u>Driver Door Components (Left Hand Drive)</u> • <u>Driver Door Components (Right Hand Drive)</u>	• <u>A9A Rea Driv</u> • <u>A9A Rea Driv Har</u>
A9B	Outside Rearview Mirror - Passenger	-	On the outside of the front passenger door, near the front of the door	• <u>Passenger Door Components (Left Hand Drive)</u> • <u>Passenger Door Components (Right Hand Drive)</u>	• <u>A9B Rea Pass Har</u> • <u>A9B Rea Pass Har</u>
A11	Radio	-	In the passenger compartment, in the center of the instrument panel	<u>Instrument Panel and Center Console Components</u>	• <u>A11</u> • <u>A11</u> • <u>A11</u> • <u>A11</u>
A23D	Door Latch Assembly - Driver	-	Inside the driver door, at rear below middle	• <u>Driver Door Components (Left Hand Drive)</u> • <u>Driver Door Components (Right Hand Drive)</u>	• <u>A23 Ass X1</u> • <u>A23 Ass X2</u>
			Inside the left		

A23LR	Door Latch Assembly - Left Rear	-	rear door, at rear below middle	<u>Left Rear Door Components</u>	<u>A23LR Door Latch Assembly</u>
A23P	Door Latch Assembly - Passenger	-	Inside the passenger door, at rear below middle	• <u>Passenger Door Components (Left Hand Drive)</u> • <u>Passenger Door Components (Right Hand Drive)</u>	<u>A23P Door Latch Assembly</u>
A23RR	Door Latch Assembly - Right Rear	-	Inside the right rear door, at rear below middle	<u>Right Rear Door Components</u>	<u>A23P Door Latch Assembly</u>
B1	A/C Refrigerant Pressure Sensor	C60	On the right side of the engine compartment, mounted on the A/C line, near the right headlamp	<u>Front of Engine Components</u>	<u>B1 A/C Refrigerant Pressure Sensor</u>
B5LF	Wheel Speed Sensor - Left Front	-	Near the left front wheel, to the rear of the knuckle	<u>Underbody - Wheel Components</u>	<u>A23RR Door Latch Assembly</u>
B5LR	Wheel Speed Sensor - Left Rear	-	Near the left rear wheel, inside the hub	<u>Underbody - Wheel Components</u>	<u>B5LR Wheel Speed Sensor - Left Rear</u>
B5RF	Wheel Speed Sensor - Right Front	-	Near the right front wheel, to the rear of the knuckle	<u>Underbody - Wheel Components</u>	<u>B5RF Wheel Speed Sensor - Right Front</u>
B5RR	Wheel Speed Sensor - Right Rear	-	Near the right rear wheel, inside the hub	<u>Underbody - Wheel Components</u>	<u>B5RR Wheel Speed Sensor - Right Rear</u>
B9	Ambient Air Temperature Sensor	-	On the front of the vehicle, to the right of the A/C condenser,	<u>Front of Vehicle</u>	<u>B9 Ambient Air Temperature Sensor</u>

			mounted in the grill		
B12A	Transmission Fluid Pressure Switch	MFM	In the engine compartment, part of the control solenoid valve assembly, mounted to the valve body inside the transmission	-	
B13	Transmission Fluid Temperature Sensor	MFM	In the engine compartment, part of the control solenoid valve assembly, mounted to the valve body inside the transmission	-	
B14A	Transmission Output Shaft Speed Sensor	MNG	On the transmission, near the wheel drive shafts	<u>Rear of Engine Components</u>	<u>B14A Tra Output Sl Sensor (M)</u>
B14A	Transmission Output Shaft Speed Sensor	M4M	On the transmission, near the wheel drive shafts	<u>Rear of Automatic Transmission Components (M4M)</u>	<u>B14A Tra Output Sl Sensor (M)</u>
B14B	Transmission Turbine Speed Sensor	M4M	On the transmission, near the wheel drive shafts	<u>Rear of Automatic Transmission Components (M4M)</u>	<u>B14B Tra Turbine S (M4M)</u>
B14C	Transmission Turbine Speed Sensor	MNG	On the transmission, attached to the transmission side cover	<u>Rear of Engine Components</u>	<u>B14C Tra Input Sha Sensor (M)</u>

B16	Backup Lamp Switch	MFN/MX2	On the transmission, above the side cover	<u>Manual Transmission Components (MFM/MX2)</u>	<u>B16 Backup Switch</u>
B18	Battery Current Sensor	-	In the engine compartment, left front, forward of battery, mounted to battery negative cable	<u>Left Side of Engine Compartment Components</u>	<u>B18 Battery Sensor</u>
B19C	Brake Booster Vacuum Switch	-	At the rear of the engine compartment, driver side, on the brake booster	-	<u>B19C Brake Vacuum Switch</u>
B20	Brake Fluid Level Switch	-	Left rear of engine compartment, on the brake fluid reservoir	<u>Left Side of Engine Compartment Components</u>	<u>B20 Brake Switch (R)</u>
B22	Brake Pedal Position Sensor	MFM	In the passenger compartment, under the driver side of the instrument panel, above the brake pedal	-	<u>B22 Brake Position Sensor</u>
B23E	Camshaft Position Sensor	-	Left side of the cylinder head, at the intake camshaft	<u>Rear of Engine Components</u>	<u>B23E Camshaft Sensor - Intake</u>
B23F	Camshaft Position Sensor Exhaust	-	In the engine compartment, on the left rear corner of the cylinder head	<u>Rear of Engine Components</u>	<u>B23F Camshaft Sensor - Exhaust</u>
			In the		

B24	Cellular Phone Microphone	UE1	passenger compartment, at the front of the headliner, next to the dome lamp	<u>Headliner Components (UE1)</u>	<u>B24 Cellular Phone Microphone</u>
B25B	Clutch Pedal Position Sensor	MFM	In the passenger compartment, under the driver side of the instrument panel, above the clutch pedal	-	<u>B25B Clutch Pedal Position Sensor</u>
B26	Crankshaft Position Sensor	(LFM/LL0+M4M)	In the engine compartment, front of the transmission	<u>Front of Engine Components</u>	<u>B26 Crankshaft Position Sensor (LFM/LL0+M4M)</u>
B26	Crankshaft Position Sensor	(LL0-M4M)	In the engine compartment, front of the transmission	<u>Front of Engine Components</u>	<u>B26 Crankshaft Position Sensor (LL0-M4M)</u>
B28D	Door Ajar Switch - Driver	-	In the driver door jamb, in the B-pillar, below the door latch striker	<u>Left and Front of the Passenger Compartment Components</u>	<u>B28D Door Ajar Switch - Driver</u>
B28LR	Door Ajar Switch - Left Rear	-	In the left rear door jamb, below the door latch striker	<u>Left and Front of the Passenger Compartment Components</u>	<u>B28LR Door Ajar Switch - Left Rear</u>
B28P	Door Ajar Switch - Passenger	-	In the front passenger door jamb, in the B-pillar, below the door latch striker	<u>Left and Rear of the Passenger Compartment Components</u>	<u>B28P Door Ajar Switch - Passenger</u>
B28RR	Door Ajar Switch - Right Rear	-	In the right rear door jamb, below the door latch striker	-	<u>B28RR Door Ajar Switch - Right Rear</u>

B34A	Engine Coolant Temperature Sensor 1	-	In the engine compartment, on the front of the cylinder head, near the thermostat	<u>Rear of Engine Components</u>	<u>B34A Engine Temperature</u>
B34B	Engine Coolant Temperature Sensor 2	EVP	In the engine compartment, in the right radiator tank	<u>Front of Engine Compartment Components</u>	<u>B34B Engine Temperature</u>
B37	Engine Oil Pressure Switch	-	At the rear of the engine, near the generator	<u>Front of Engine Components</u>	<u>B37 Engine Pressure</u>
B39	A/C Evaporator Temperature Sensor	C60	In the passenger compartment, behind the passenger side of the instrument panel	<u>HVAC Assembly Components</u>	<u>B39 A/C Temperature</u>
B46	Fuel Level Sensor	-	In the vehicle underbody, below rear seats, part of fuel pump and level sensor assembly, mounted to fuel tank	-	
B52A	Heated Oxygen Sensor 1	-	In the engine compartment, on the front of engine, in the exhaust manifold	<u>Front of Engine Components</u>	<u>B52A Heated Oxygen Sensor 1</u>
B52B	Heated Oxygen Sensor 2	-	In the engine compartment, below the catalytic converter, in the exhaust pipe	<u>Front of Engine Components</u>	<u>B52B Heated Oxygen Sensor 2</u>

B55	Hood Ajar Switch	UTJ(EF7/Z49)	In the engine compartment, to the left of the hood latch	-	<u>B55 Hood</u>
B59	Front Impact Sensor	EF7/Z49	In the engine compartment, near the hood latch	-	<u>B59 Front Sensor</u>
B59L	Front Impact Sensor - Left	EF7/Z49	In the engine compartment, front left of center, mounted to rear of radiator support, at top	-	<u>B59L Front Sensor</u>
B59R	Front Impact Sensor - Right	EF7/Z49	In the engine compartment, front right of center, mounted to rear of radiator support, at top	-	<u>B59R Front Sensor - Right</u>
B60	Passenger Presence Sensor	AL0	In the passenger compartment, right forward of center, in the passenger seat cushion, between seat cover and seat pad	<u>Right Front Seat Components</u>	
B61P	Seat Belt Tension Sensor - Passenger	AL0	In the passenger compartment, in the passenger seat belt buckle	<u>Right Front Seat Components</u>	
			In the driver	<u>Driver Door Components (Left Hand</u>	

B63LF	Side Impact Sensor - Left Front	AYF	door, near middle, mounted to door beam	<u>Drive)</u> • <u>Passenger Door Components (Right Hand Drive)</u>	<u>B63LF Si Sensor - I</u>
B63LR	Side Impact Sensor - Left Rear	AY0	In the passenger compartment, left rear, near outboard seat belt anchor bolt	-	<u>B63LR Si Sensor - I</u>
B63LR	Side Impact Sensor - Left Rear	AYF	In the passenger compartment, right rear, near outboard seat belt anchor bolt	-	<u>B63LR Si Sensor - I</u>
B63RF	Side Impact Sensor - Right Front	AYF	In the passenger door, near middle, mounted to door beam	• <u>Driver Door Components (Right Hand Drive)</u> • <u>Passenger Door Components (Left Hand Drive)</u>	<u>B63RF Si Sensor - F</u>
B63RR	Side Impact Sensor - Right Rear	AYF	In the passenger compartment, at the bottom front of the right B-pillar	-	<u>B63RR Si Sensor - F</u>
B68	Knock Sensor	-	On the rear side of the engine block, near the middle of the engine	<u>Rear of Engine Components</u>	<u>B68 Knoc</u>
B69	Liftgate Ajar Switch	-	In the cargo area, near the bottom center of the liftgate	<u>Liftgate Components (1/2)</u>	<u>B69 Liftg Switch</u>
	Manifold Absolute		In the engine compartment, on the left	<u>Rear of Engine</u>	<u>B74 Mani</u>

B74	Pressure Sensor	-	side of the intake manifold	<u>Components</u>	<u>Pressure</u>
B75B	Mass Air Flow/Intake Air Temperature Sensor	-	In the engine compartment, on the inlet air duct	<u>Rear of Automatic Transmission Components (M4M)</u>	<u>B75B Mass Air Flow/Intake Air Temperature Sensor</u>
B78G	Rear Object Sensor - Left Outer	(UD7)	At the rear of the vehicle, in the left center of the bumper fascia	<u>Rear of Vehicle Components</u>	<u>B78G Rear Object Sensor - Left Outer (UD7)</u>
B78H	Rear Object Sensor - Right Outer	(UD7)	At the rear of the vehicle, in the Right center of the bumper fascia	<u>Rear of Vehicle Components</u>	<u>B78H Rear Object Sensor - Right Outer (UD7)</u>
B80	Park Brake Switch	-	In the passenger compartment, near the center console	<u>Right Side of the Passenger Compartment Components</u>	<u>B80 Park Brake Switch</u>
B81	Park/Neutral Position Switch	MNG/M4M	On the transmission, attached to the top front of the transmission case	<u>Front of Engine Components</u> <u>Front of Automatic Transmission Components (M4M)</u>	<u>B81 Park/Neutral Position Switch</u> <u>B81 Park/Neutral Position Switch</u>
B87	Rearview Camera	UVC	At the rear of vehicle, mounted to liftgate above license plate, left of center	<u>Rear of Vehicle Components</u>	<u>B87 Rearview Camera (UVC)</u>
B88D	Seat Belt Switch - Driver	AJ3/AK5/AJ7/AYO/AYF	In the passenger compartment, in the driver seat belt buckle	<u>Right Front Seat Components</u>	<u>B88D Seat Belt Switch - Driver</u>
			In the passenger compartment,		

B88P	Seat Belt Switch - Passenger	TFC(EF7/Z49) A YF	in the passenger seat belt buckle	<u>Right Front Seat Components</u>	<u>B88P Sea Pa</u>
B107	Accelerator Pedal Position Sensor	-	In the passenger compartment, under the instrument panel near the accelerator pedal	-	<u>B107 Acc Position S</u>
B115	Vehicle Speed Sensor	M4M	On the transmission, attached to the top rear of the transmission case	<u>Rear of Automatic Transmission Components (M4M)</u>	<u>B115 Veh Sensor (M</u>
B115	Vehicle Speed Sensor	MFM/MX2	On the transmission, attached to the top rear of the transmission case	<u>Manual Transmission Components (MFM/MX2)</u>	<u>B115 Veh Sensor (M</u>
B119	Multi-axis Acceleration Sensor	FX3	In the passenger compartment, below the instrument panel near the center console	<u>Left and Front of the Passenger Compartment Components</u>	<u>B119 Mul Accelerat</u>
B137	Power Steering Shaft Torque Sensor	NJ1	In the passenger compartment, mounted to lower steering column	• <u>Steering Column Components (Left Hand Drive)</u> • <u>Steering Column Components (Right Hand Drive)</u>	
			Under the	<u>WHEELS/VEHICLE</u>	

B150	Fuel Tank Pressure Sensor	-	vehicle, on the fuel tank	<u>UNDERBODY COMPONENT VIEWS</u>	<u>B150 Fuel Pressure</u>
B153D	Seat Belt Buckle - Driver	-	In the passenger compartment, left forward of center, mounted to the inboard side of the driver seat	<u>Left Front Seat Components</u>	
B153P	Seat Belt Buckle - Passenger	-	In the passenger compartment, right forward of middle, mounted to the inboard side of the passenger seat	<u>Right Front Seat Components</u>	<u>B88P Seat Passenger</u>
C1	Battery	-	In the engine compartment, left side, near front, mounted to battery tray, below battery cover	-	
C3	Telematics Communication Interface Control Module Battery	UE1	In the passenger compartment, under the passengers seat	-	<u>C3 Telem Communi Interface Module B</u>
E6	Center High Mounted Stop Lamp	-	In the passenger compartment, at the top of the liftgate	<u>Liftgate Components (1/2)</u>	<u>E6 Center Mounted</u>
E13L	Headlamp - Left High Beam	-	Outside the front of the vehicle, the inner lamp of the left headlamp	<u>Front of Vehicle</u>	<u>E13L Hea</u>

			assembly		
E14R	Headlamp - Right Low Beam	-	At the front of vehicle, front right, within the headlamp assembly - right, bulb at center	<u>Front of Vehicle</u>	<u>E13R Headlamp - Right</u>
E4LF	Turn Signal Lamp - Left Front	-(CW1/EF7/Z49)	In the left front corner of the vehicle, in the left headlamp assembly	<u>Front of Vehicle</u>	<u>E4LF Turn Signal Lamp - Left Front</u>
E4N	Park/Turn Signal Lamp - Left	CW1	In the left front corner of the vehicle, in the left headlamp assembly	<u>Front of Vehicle</u>	<u>E4N Park/Turn Signal Lamp - Left</u>
E4P	Park/Turn Signal Lamp - Right	CW1	In the right front corner of the vehicle, in the right headlamp assembly	<u>Front of Vehicle</u>	<u>E4P Park/Turn Signal Lamp - Right</u>
E4RF	Turn Signal Lamp - Right Front	-(CW1/EF7/Z49)	In the right front corner of the vehicle, in the right headlamp assembly	<u>Front of Vehicle</u>	<u>E4RF Turn Signal Lamp - Right Front</u>
E4Y	Turn Signal Repeater Lamp - Left	T90	Near the left front corner of the vehicle, at the rear of the fender	-	<u>E4Y Turn Signal Repeater (T90)</u>
E4Z	Turn Signal Repeater Lamp - Right	T90	Near the right front corner of the vehicle, at	-	<u>E4Z Turn Signal Repeater</u>

			the rear of the fender		<u>(T90)</u>
E5A	Backup Lamp - Left	-	In the left rear corner of the vehicle, in the left rear lamp assembly	<u>Rear of Vehicle Components</u>	
E5AA	Tail/Stop Lamp - Left	-	In the left rear corner of the vehicle, in the left rear lamp assembly	<u>Rear of Vehicle Components</u>	
E5AB	Tail/Stop Lamp - Right	-	In the right rear corner of the vehicle, in the right rear lamp assembly	<u>Rear of Vehicle Components</u>	
E5AC	Tail/Turn Signal Lamp - Left	-	In the left rear corner of the vehicle, in the left rear lamp assembly	<u>Rear of Vehicle Components</u>	
E5AD	Tail/Turn Signal Lamp - Right	-	In the right rear corner of the vehicle, in the right rear lamp assembly	<u>Rear of Vehicle Components</u>	
E5B	Backup Lamp - Right	without U05	In the right rear corner of the vehicle, in the right rear lamp assembly	<u>Rear of Vehicle Components</u>	
E6	Center High Mounted Stop Lamp	-	In the passenger compartment, at the top of the liftgate	<u>Rear of Vehicle Components</u>	<u>E6 Center Mounted</u>
E7L	License Plate Lamp - Left	-	On the outside of the liftgate, near the outside	<u>Rear of Vehicle Components</u>	<u>E7 Licens</u>

			handle		
E7	License Plate Lamp	-	On the outside of the liftgate, near the outside handle	<u>Rear of Vehicle Components</u>	<u>E7 Licens</u>
E8S	Rear Compartment Courtesy Lamp	U25	In the rear compartment, on the left side	-	<u>E8S Rear Courtesy</u>
E13L	Headlamp - Left	-	On the outside of the vehicle, at the left front corner of the vehicle	<u>Front of Vehicle</u>	<u>E13L He</u>
E13LA	Headlamp Assembly - Left	-	On the outside of the vehicle, at the left front corner of the vehicle	<u>Front of Vehicle</u>	
E13R	Headlamp - Right	-	On the outside of the vehicle, at the right front corner of the vehicle	<u>Front of Vehicle</u>	<u>E13R Hea</u>
E13RA	Headlamp Assembly - Right	-	On the outside of the vehicle, at the right front corner of the vehicle	<u>Front of Vehicle</u>	
E14B	Seat Heating Element - Driver Cushion	C37 or C38	In the passenger compartment, inside the driver seat cushion	• <u>Left Front Seat Components</u> • <u>Right Front Seat Components</u>	<u>E14B Sea Element - Cushion</u>
E14D	Seat Heating Element - Passenger Cushion	C37 or C38	In the passenger compartment, inside the front passenger seat cushion	• <u>Left Front Seat Components</u> • <u>Right Front Seat Components</u>	<u>E14D Sea Element - Cushion</u>

E17D	Outside Rearview Mirror Glass - Driver	-	On outside of driver door, front middle, within outside rearview mirror - driver	• <u>Driver Door Components (Left Hand Drive)</u> • <u>Driver Door Components (Right Hand Drive)</u>	
E17P	Outside Rearview Mirror Glass - Passenger	-	On outside of passenger door, front middle, within outside rearview mirror - passenger	• <u>Passenger Door Components (Left Hand Drive)</u> • <u>Driver Door Components (Left Hand Drive)</u>	
E18	Rear Defogger Grid	C50	Inside the passenger compartment, attached to the rear window	<u>Liftgate Components (1/2)</u>	• <u>E18 Def</u> • <u>E18 Def</u>
E29LF	Fog Lamp - Left Front	-	On the vehicle exterior, at the left front corner of the vehicle	<u>Front of Vehicle</u>	• <u>E29 - Le</u> • <u>E29 LAI FR</u>
E29RF	Fog Lamp - Right Front	-	On the vehicle exterior, at the right front corner of the vehicle	<u>Front of Vehicle</u>	• <u>E29 - Ri (T3)</u>
E36AH	Dome Lamp	-	In the passenger compartment, at the front center of the headliner	• <u>Headliner Components (UE1)</u> • <u>Headliner Components (-UE1)</u>	<u>E36AH D</u>
E41	Engine Coolant Thermostat Heater	-	In the engine compartment, on the left side of the engine, on	<u>Rear of Engine Components</u>	<u>E41 Engi Thermost</u>

			the thermostat housing		
E42L	Tail Lamp Assembly - Left	-	At the rear of vehicle, rear left, mounted to body	-	
E42R	Tail Lamp Assembly - Right	-	At the rear of vehicle, rear right, mounted to body	-	
F101	Passenger Instrument Panel Air Bag	AYF	In the passenger compartment, in the passenger side of the instrument panel	<u>Instrument Panel and Center Console Components</u>	<u>F101 Passenger Instrument Bag</u>
F105L	Roof Rail Air Bag - Left	AYO/AYF	In the passenger compartment, on the left side of the roof	-	<u>F105L Roof Rail Air Bag - Left</u>
F105R	Roof Rail Air Bag - Right	AYO/AYF	In the passenger compartment, on the right side of the roof	<u>Right Side of the Passenger Compartment Components</u>	<u>F105R Roof Rail Air Bag - Right</u>
F106D	Seat Air Bag - Left Front	AJ7/AYO/AYF	In the passenger compartment, in the left front seat back	<u>Left Front Seat Components</u>	<u>F106D Seat Air Bag - Left Front</u>
F106LR	Side Air Bag - Left Rear	AJ7/AYO/AYF	In the passenger compartment, on the left side of the rear seat back	-	<u>F106LR Side Air Bag - Left Rear</u>
			In the passenger compartment,	<u>Right Front Seat</u>	<u>F106P Side Air Bag - Right Front</u>

F106P	Seat Air Bag - Right Front	AJ7/AYO/AYF	in the right front seat back	<u>Components</u>	<u>Passenger</u>
F106RR	Side Air Bag - Right Rear	AJ7/AYO/AYF	In the passenger compartment, on the right side of the rear seat back	-	<u>F106RR S</u> <u>Right Rea</u>
F107	Steering Wheel Air Bag	-	In the passenger compartment, in the steering wheel	<u>Instrument Panel</u> <u>and Center Console</u> <u>Components</u>	• <u>F10 Wh</u> • <u>F10 Wh</u>
F112D	Seat Belt Retractor Pretensioner - Driver	AWT	In the passenger compartment, at the bottom of the left B-pillar	• <u>Right Side of the Passenger Compartment Components</u>	<u>F112D Se</u> <u>Retractor Driver</u>
F112P	Seat Belt Retractor Pretensioner - Passenger	AID or AWS	In the passenger compartment, at the bottom of the right B-pillar	• <u>Right Side of the Passenger Compartment Components</u>	<u>F112P Se</u> <u>Retractor Passenger</u>
F113D	Seat Belt Anchor Pretensioner - Driver	AYF	In the passenger compartment, on the lower outside of the driver seat, mounted to the floor	-	<u>F113D Se</u> <u>Pretensio</u>
F113P	Seat Belt Anchor Pretensioner - Passenger	AYF	In the passenger compartment, on the lower outside of the passenger seat, mounted to the floor	-	<u>F113P Se</u> <u>Pretensio</u> <u>Passenger</u>
			In the passenger compartment,		

F114D	Knee Air Bag - Driver	AYF	at the bottom of the driver side of the instrument panel	<u>Instrument Panel and Center Console Components</u>	<u>F114D Kr Driver</u>
F114P	Knee Air Bag - Passenger	AYF	In the passenger compartment, at the bottom of the passenger side of the instrument panel	<u>Instrument Panel and Center Console Components</u>	<u>F114P Kr Passenger</u>
F122	A/C Compressor Temperature Switch	C60	In the engine compartment, mounted into the back of A/C compressor	-	
G1	A/C Compressor	C60	In the engine compartment, front lower right of engine, mounted to engine block	-	
G10	Cooling Fan Motor	-	In the engine compartment, attached to the radiator shroud	<u>Front of Engine Compartment Components</u>	<u>G10 Cooli</u>
G12	Fuel Pump	-	In the vehicle underbody, below rear seats, part of fuel pump and level sensor assembly, within the fuel tank	-	
G13	Generator	-	In the engine compartment, on the right rear side of the engine	<u>Rear of Engine Components</u>	<u>G13 Gene</u>

G19	Rear Window Washer Pump	CD6	In the engine compartment, in the left front corner near the washer fluid reservoir	<u>Right Side of Engine Compartment Components</u>	<u>G19 Rear Washer P</u>
G24	Windshield Washer Pump	-	In the engine compartment, in the left front corner, near the washer fluid reservoir	<u>Right Side of Engine Compartment Components</u>	<u>G24 Wind Washer P</u>
K9	Body Control Module	-	In the passenger compartment, instrument panel	-	• <u>K9</u> <u>Mod</u> • <u>K9</u> <u>Mod</u> • <u>K9</u> <u>Mod</u> • <u>K9</u> <u>Mod</u> • <u>K9</u> <u>Mod</u> • <u>K9</u> <u>Mod</u> • <u>K9</u> <u>Mod</u>
K17	Electronic Brake Control Module	JM4/FX3	In the engine compartment, behind the right headlamp	<u>Right Side of Engine Compartment Components</u>	<u>K17 Elect Control M</u>
K20	Engine Control Module	LFM/LL0+M4M	In the engine compartment, left front corner, near the battery	-	• <u>K20</u> <u>Con</u> <u>X1</u> <u>(LF</u> • <u>K20</u> <u>Con</u> <u>X2</u> <u>(LF</u> • <u>K20</u> <u>Con</u> <u>X3</u>

					<u>(LF</u>
K20	Engine Control Module	LL0-M4M	In the engine compartment, left front corner, near the battery	-	• <u>K20</u> <u>Con</u> <u>X1</u> • <u>K20</u> <u>Con</u> <u>X2</u>
K33	HVAC Control Module	-	In the passenger compartment, in the center of the instrument panel, behind the HVAC controls	<u>Instrument Panel and Center Console Components</u>	<u>K33 HVA</u> <u>Module</u>
K36	Inflatable Restraint Sensing and Diagnostic Module	-	In the passenger compartment, under the driver seat	<u>Left and Front of the Passenger Compartment Components</u>	• <u>K36</u> <u>Res</u> <u>and</u> <u>Mod</u> • <u>K36</u> <u>Res</u> <u>and</u> <u>Mod</u>
K41R	Rear Parking Assist Control Module	UD7	In left rear corner of body behind rear fascia	-	<u>K41R Rea</u> <u>Assist Co</u>
K43	Power Steering Control Module	NJ1	In the passenger compartment, behind the instrument panel	• <u>Steering Column Components (Left Hand Drive)</u> • <u>Steering Column Components (Right Hand Drive)</u>	• <u>K43</u> <u>Stee</u> <u>Mod</u> • <u>K43</u> <u>Stee</u> <u>Mod</u> • <u>K43</u> <u>Stee</u> <u>Mod</u> • <u>K43</u> <u>Stee</u> <u>Mod</u>
K71	Transmission Control	M4M	In the passenger compartment, behind the instrument	-	• <u>K71</u> <u>Con</u> <u>X1</u>

	Module		panel located on the left side of the brake pedal		• <u>K71 Con X2</u>
K71	Transmission Control Module	MFL/MNG	In the passenger compartment, behind the instrument panel located on the left side of the brake pedal	-	• <u>K71 Con X1</u> • <u>K71 Con X2</u>
K73	Telematics Communication Interface Control Module	UE1	In the passenger compartment, under the driver's seat	-	• <u>K73 Con Inte Mod</u> • <u>K73 Con Inte Mod</u>
K77	Remote Control Door Lock Receiver	UTJ/UJM	In the passenger compartment, behind the center of the instrument panel	<u>Left and Rear of the Passenger Compartment Components</u>	<u>K77 Remote Door Lock</u>
K85	Passenger Presence Module	AYF	Under passenger seat mounted to seat frame	-	<u>K85 Passenger Module (L</u>
K89	Immobilizer Control Module	-	In the passenger compartment, behind the instrument panel near the steering column	-	<u>K89 Immobilizer Control M</u>
M4	Air Temperature Door Actuator	-	In the passenger compartment, behind the center of the instrument	<u>HVAC Assembly Components</u>	<u>M4 Air In Actuator</u>

			panel		
M7	Transmission Shift Lock Control Solenoid Actuator		In the passenger compartment, center, in the center console, part of the transmission shift lever	-	
M8	Blower Motor	-	In the passenger compartment, behind the passenger side of the instrument panel	<u>HVAC Assembly Components</u>	<u>M8 Blower Motor</u>
M9	Brake Booster Pump Motor	-	At the rear of the engine compartment, driver side, below the master cylinder	<u>Left Side of Engine Compartment Components</u>	<u>M9 Brake Booster Pump Motor</u>
M14B	Door Lock Actuator - Liftgate	A91	In the passenger compartment, inside the liftgate	-	<u>M14B Door Lock Actuator</u>
M38	Power Steering Motor	NJ1	In passenger compartment mounted to steering column.	• <u>Steering Column Components (Left Hand Drive)</u> • <u>Steering Column Components (Right Hand Drive)</u>	
M45	Rear Wiper Motor	-	In the vehicle interior, inside the liftgate	-	<u>M45 Rear Wiper Motor</u>
			In the engine compartment,	<u>Rear of Engine</u>	

M64	Starter Motor	-	on the rear side of the engine	<u>Components</u>	<u>M64 Starter Motor</u>
M74D	Window Motor - Driver	A32 or AE3	In the passenger compartment, inside the driver door	• <u>Driver Door Components (Left Hand Drive)</u> • <u>Driver Door Components (Right Hand Drive)</u>	<u>M74D Window Motor - Driver</u>
M74LR	Window Motor - Left Rear	AE3	In the passenger compartment, inside the left rear door	-	<u>M74LR Window Motor - Left Rear</u>
M74P	Window Motor - Passenger	A32 or AE3	In the passenger compartment, inside the passenger door	• <u>Passenger Door Components (Left Hand Drive)</u> • <u>Passenger Door Components (Right Hand Drive)</u>	<u>M74P Window Motor - Passenger</u>
M74RR	Window Motor - Right Rear	AE3	In the passenger compartment, inside the right rear door	<u>Right Rear Door Components</u>	<u>M74RR Window Motor - Right Rear</u>
M75	Windshield Wiper Motor	-	In the cowl panel, at the base of the windshield	<u>Left Side of Engine Compartment Components</u>	<u>M75 Windshield Wiper Motor</u>
M77D	Outside Rearview Mirror Motor - Driver	-	On outside of driver door, front middle, within outside rearview mirror - driver, forward of mirror glass	-	
			On outside of passenger		

M77P	Outside Rearview Mirror Motor - Passenger	-	door, front middle, within outside rearview mirror - passenger, forward of mirror glass	-	
M93	Key Capture Solenoid Actuator	-	In the passenger compartment, on the steering column, near the ignition switch	-	<u>M93 Key Solenoid</u>
P2	Transmission Shift Lever Position Indicator	-	In the passenger compartment, center near front, at top of center console, mounted to shift lever bezel	-	
P12	Horn	-	In the engine compartment, near the left front corner of the vehicle	-	<u>P12 Horn</u>
P16	Instrument Cluster	-	In the passenger compartment, in the driver side of the instrument panel	<u>Instrument Panel and Center Console Components</u>	<u>P16 Instr</u>
P17	Info Display Module	-	In the passenger compartment, in the Center of the instrument panel, above radio	<u>Instrument Panel and Center Console Components</u>	<u>P17 Info I Module</u>

P19J	Speaker - Left Instrument Panel	UF7/UH7/UM7/UCH	In the passenger compartment, on the left side of the instrument panel	<u>Instrument Panel and Center Console Components</u>	<u>P19J Speaker Instrument Panel</u>
P19L	Speaker Left Rear Compartment	-	In the passenger compartment, in the left rear compartment trim panel, near the strut tower	-	<u>P19J Speaker Rear Compartment</u>
P19W	Speaker Right Instrument Panel	UF7/UH7/UM7/UCH	In the passenger compartment, on the right side of the instrument panel	-	<u>P19W Speaker Instrument Panel</u>
P19Y	Speaker Right Rear Compartment	-	In the passenger compartment, in the right rear compartment trim panel, near the strut tower	-	<u>P19Y Speaker Rear Compartment</u>
P28	Speaker - Parking Assist	UD7	In left rear corner of body behind rear fascia	-	<u>P28 Speaker Parking Assist (UI)</u>
Q2	A/C Compressor Clutch	C60	In the engine compartment, on the A/C compressor	<u>Front of Engine Components</u>	<u>Q2 A/C Compressor Clutch</u>
Q6E	Camshaft Position Actuator Solenoid Valve - Intake	-	In the engine compartment, on the upper, right front of the engine	<u>Front of Engine Components</u>	<u>Q6E Camshaft Actuator - Intake</u>
			In the engine compartment,		<u>Q6F Camshaft Actuator - Exhaust</u>

Q6F	Camshaft Position Actuator Solenoid Valve - Exhaust	-	on the upper, right rear of the engine	<u>Front of Engine Components</u>	<u>Actuator Intake</u>
Q5	Brake Pressure Modulator	-	At the rear of the engine compartment, driver side, mounted to the electronic brake control module	-	
Q8	Control Solenoid Valve Assembly	-	In the engine compartment, left middle, in automatic transmission, at front of case, behind front cover	-	
Q12	Evaporative Emission Purge Solenoid Valve	-	In the engine compartment, on the rear side of the engine	<u>Rear of Engine Components</u>	<u>Q12 Evap Emission Solenoid Valve</u>
Q13	Evaporative Emission Vent Solenoid Valve	-	Under the vehicle, on the top of the fuel tank	<u>Fuel Tank Components</u>	<u>Q13 Evap Emission Valve</u>
Q17A	Fuel Injector 1	-	In the engine compartment, on the front side of the engine	<u>Top of Engine Components</u>	<u>Q17A Fuel Injector</u>
Q17B	Fuel Injector 2	-	In the engine compartment, on the front side of the engine	<u>Top of Engine Components</u>	<u>Q17B Fuel Injector</u>
Q17C	Fuel Injector 3	-	In the engine compartment, on the front side of the engine	<u>Top of Engine Components</u>	<u>Q17C Fuel Injector</u>
Q17D	Fuel Injector 4	-	In the engine compartment, on the front side of the	<u>Top of Engine Components</u>	<u>Q17D Fuel Injector</u>

			engine		
Q27A	Pressure Control Solenoid Valve 1	MNG	In the engine compartment, part of the control solenoid valve assembly, mounted to the valve body inside the transmission	-	
Q27B	Pressure Control Solenoid Valve 2	MNG	In the engine compartment, part of the control solenoid valve assembly, mounted to the valve body inside the transmission	-	
Q27C	Pressure Control Solenoid Valve 3	MNG	In the engine compartment, part of the control solenoid valve assembly, mounted to the valve body inside the transmission	-	
Q32A	Shift Solenoid Valve 1	MNG	In the engine compartment, part of the control solenoid valve assembly, mounted to the valve body inside	-	

			the transmission		
Q38	Throttle Body	M4M	In the engine compartment, on the top of the engine	<u>Rear of Engine Components</u>	<u>Q38 Thro (M4M)</u>
Q38	Throttle Body	-M4M	In the engine compartment, on the top of the engine	<u>Rear of Engine Components</u>	<u>Q38 Thro M4M)</u>
Q39A	Torque Converter Clutch Pressure Control Solenoid Valve	MNG	In the engine compartment, part of the control solenoid valve assembly, mounted to the valve body inside the transmission	-	
R3	Blower Motor Resistor	C41/C60	-	<u>HVAC Assembly Components</u>	<u>R3 Blowe Resistor</u>
R10	Cooling Fan Resistor	-	In the engine compartment, near the left front corner	-	• <u>R10 Res</u> • <u>R10 Res</u>
S3	Transmission Shift Lever	MNG	In the passenger compartment, in the center console	<u>Instrument Panel and Center Console Components</u>	<u>S3 Transi Lever</u>
S13D	Door Lock Switch - Driver	AU3	In the passenger compartment, inside the driver door	• <u>Driver Door Components (Left Hand Drive)</u> • <u>Driver Door Components (Right Hand Drive)</u>	<u>S13D Doo - Driver (Drive witl</u>
S13P	Door Lock Switch - Driver	AU3	In the passenger compartment,	• <u>Passenger Door Components (Left Hand Drive)</u>	<u>S13P Doo - Passengi</u>

			inside the passenger door	• <u>Passenger Door Components (Right Hand Drive)</u>	<u>Drive with</u>
S26	Hazard Warning Switch	-	In the passenger compartment, in the center of the instrument panel	<u>Instrument Panel and Center Console Components</u>	<u>S26 Hazard Switch</u>
S32D	Seat Heating Switch - Driver	C37/C38	In the passenger compartment, at the front of the center console	<u>Instrument Panel and Center Console Components</u>	<u>S32D Seat Switch - I</u>
S32P	Seat Heating Switch - Passenger	C37/C38	In the passenger compartment, at the front of the center console	<u>Instrument Panel and Center Console Components</u>	<u>S32P Seat Switch - P</u>
S33	Horn Switch	-	In the passenger compartment, within the steering wheel, forward of the air bag.	-	<u>S33 Horn</u>
S36	Instrument Panel Dimmer Switch	WU5	In the passenger compartment, on the instrument panel left of steering wheel	<u>Instrument Panel and Center Console Components</u>	<u>S36 Instrument Dimmer Switch</u>
S39	Ignition Switch	-	In the passenger compartment, on the steering column	<u>Left and Rear of the Passenger Compartment Components</u>	<u>S39 Ignition Switch</u>
			In the		

S46B	Liftgate Unlatch Switch	-AU3	passenger compartment, on the instrument panel	<u>Instrument Panel and Center Console Components</u>	<u>S46B Lift Switch (V</u>
S51	Tellematics Button Assembly	MNG	In the passenger compartment, front center, within the overhead dome light, at front	<u>Headliner Components (UE1)</u>	
S52	Outside Rearview Mirror Switch	LHD + (DLW/D71/DLS)	In the passenger compartment, on the driver side of the instrument panel	<u>Instrument Panel and Center Console Components</u>	<u>S52 Outsi Mirror S</u>
S70L	Steering Wheel Controls Switch - Left	UK3	In the passenger compartment, left front, on steering wheel, left spoke facing driver	-	<u>S70L Stee Controls ! (UK3)</u>
S70R	Steering Wheel Controls Switch - Right	UK3	In the passenger compartment, left front, on steering wheel, right spoke facing driver	-	<u>S70R Stee Controls ! (UK3)</u>
S75	Traction Control Switch	FX3	In the passenger compartment, in the center of the instrument panel	<u>Instrument Panel and Center Console Components</u>	<u>S75 Tract Switch</u>
S78	Turn Signal/MultifunctionSwitch	-C80	In the passenger compartment, on the	<u>Instrument Panel and Center Console</u>	<u>S78 Turn Multifunc</u>

			steering column	<u>Components</u>	
S79D	Window Switch - Driver	A32 or AE3	In the passenger compartment, in the driver door	• <u>Driver Door Components (Left Hand Drive)</u> • <u>Driver Door Components (Right Hand Drive)</u>	• <u>S79 Swi (A3</u> • <u>S79 Swi (AE</u>
S79LR	Window Switch - Left Rear	AE3	In the passenger compartment, in the left rear door	• <u>Passenger Door Components (Left Hand Drive)</u> • <u>Passenger Door Components (Right Hand Drive)</u>	<u>S79LR W - Left Rea</u>
S79P	Window Switch - Passenger	A32 or AE3	In the passenger compartment, in the passenger door	• <u>Passenger Door Components (Left Hand Drive)</u> • <u>Passenger Door Components (Right Hand Drive)</u>	<u>S79P Win Passenger</u>
S79RR	Window Switch - Right Rear	AE3	In the passenger compartment, in the right rear door	<u>Right Rear Door Components</u>	<u>S79RR W - Right R</u>
S82	Windshield Wiper/Washer Switch	-	In the passenger compartment, left front, within the steering column, forward of the steering wheel, on right side	-	
			In the passenger compartment,		<u>S94 Blow</u>

S94	Blower Motor Switch	C41/C60	in the center of the instrument panel	-	<u>Switch</u>
T4D	Cellular Phone and Digital Radio Antenna	-	Outside the vehicle, at the center rear of the roof	-	
T4M	Radio Antenna	-	Outside the vehicle, at the center rear of the roof	-	
T8A	Ignition Coil 1	-	In the engine compartment, on the engine cylinder head	<u>Top of Engine Components</u>	<u>T8A Ignit</u>
T8B	Ignition Coil 2	-	In the engine compartment, on the engine cylinder head	<u>Top of Engine Components</u>	<u>T8B Ignit</u>
T8C	Ignition Coil 3	-	In the engine compartment, on the engine cylinder head	<u>Top of Engine Components</u>	<u>T8C Ignit</u>
T8D	Ignition Coil 4	-	In the engine compartment, on the engine cylinder head	<u>Top of Engine Components</u>	<u>T8D Ignit</u>
T12	Automatic Transmission Assembly	M4M/MFL/MNG	In the engine compartment, mounted to the left side of the engine	<u>Automatic Transmission Components (MFL/MNG)</u>	
X50A	Fuse Block - Underhood	-	In the engine compartment, in the left rear corner of the engine compartment	<u>Left Side of Engine Compartment Components</u>	<u>X50A Fus Underhoo</u>
X50B	Fuse Block - Underhood Auxiliary	-	In the engine compartment, on the left side of the engine	<u>Left Side of Engine Compartment Components</u>	<u>X50B Fus Underhoo Top View</u>

			compartment		
X50D	Fuse Block - Battery	-	In the engine compartment, left side, near front, mounted to top of battery, below battery cover	-	
X51A	Fuse Block - Instrument Panel	-	In the passenger compartment, on the driver side of the instrument panel	-	
X80G	Accessory Power Receptacle - Instrument Panel	-	In the passenger compartment, center front, behind compartment door, below HVAC controls	<u>Instrument Panel and Center Console Components</u>	<u>X80G Ac Receptacle</u>
X83	Auxiliary Audio Input	-	In the passenger compartment, center middle, Instrument panel under HVAC control head	<u>Instrument Panel and Center Console Components</u>	• <u>X83 Aud</u> • <u>X83 Aud</u>
X84	Data Link Connector	-	In the passenger compartment, on the driver side of the instrument panel	<u>Instrument Panel and Center Console Components</u>	<u>X84 Data Connector</u>
X85	Steering Wheel Air Bag Coil	AYF or AY0	In the passenger compartment, behind the steering	<u>Instrument Panel and Center Console</u>	• <u>X85 Wh Coil</u> • <u>X85</u>

			wheel, on the steering column	<u>Components</u>	<u>Wh</u> <u>Coil</u>
X90	Assembly Plant ABS Data Connector	FX3	In the engine compartment, behind the left headlamp assembly	<u>Left Side of Engine Compartment Components</u>	<u>X90 Asse</u> <u>ABS Data</u>
X111	Forward Lamp Harness to Engine Harness	-	-	<u>ENGINE HARNESS ROUTING - REAR (LFM/LLO WITH M4M)</u>	<u>X111 Fo</u> <u>Harne</u> <u>H</u>
X160	Fuel Injector Harness to Engine Harness	-	In the engine compartment, on the engine, above the fuel rail	• <u>Engine Harness Routing (LL0 with MNG)</u> • <u>Engine Harness Routing (LL0 with MX2)</u>	<u>X160 Eng</u> <u>Fuel Injec</u>
X170	Engine Harness to Fuel Injector Harness	-	In the engine compartment, on the engine, above the fuel rail	<u>Ignition Coil Harness Routing</u>	<u>X170 Eng</u> <u>Ignition C</u>
X201	Instrument Panel Harness to Body Harness	-	On the left side of the instrument panel	-	<u>X201 Inst</u> <u>Harness t</u> <u>Harness</u>
X205	Forward Lamp Harness to Instrument Panel Harness	-	In the engine compartment, left side	<u>Forward Lamp Harness Routing (3 of 3)</u>	<u>X205 For</u> <u>Harness t</u> <u>Panel Ha</u>
X210	Foward Lamp Harness to Body Harness	-	On the left side of the instrument panel	<u>Forward Lamp Harness Routing (3 of 3)</u>	<u>X210 For</u> <u>Harness t</u> <u>Harness</u>
X214	Engine Harness to Instrument Panel Harness	-	At the center of the instrument panel	<u>Forward Lamp Harness Routing (3 of 3)</u>	<u>X214 Eng</u> <u>Instru</u> <u>H</u>
X230	Engine Harness to Body Harness		In the passenger compartment, in the center of the	<u>X230 Engine Harness to Body Harness</u>	<u>X230 Eng</u> <u>Body Har</u>

			instrument panel		
X410	Left Tail Lamp Harness to Body Harness	-	Near the left tail lamp	-	<u>X410 Bod Left Rear Harness</u>
X420	Right Tail Lamp Harness to Body Harness	-	Near the right tail lamp	-	<u>X420 Bod Right Rear Harness</u>
X500	Instrument Panel Harness to Left Front Door Harness	-	At the left front door hinge	-	<u>X500 Bod Driver Door</u>
X600	Instrument Panel Harness to Right Front Door Harness	-	At the right front door hinge	-	<u>X600 Pass Right Front Door Harness to</u> <u>Right Front Door Harness</u>
X700	Body Harness to Left Rear Door Harness	-	Where the left rear door is hinged	<u>Left and Right Rear Door Harness Routing</u>	<u>X700 Left Rear Door Harness to</u> <u>Left Rear Door Harness</u>
X800	Body Harness to Right Rear Door Harness	-	Where the right rear door is hinged	<u>Left and Right Rear Door Harness Routing</u>	<u>X800 Right Rear Door Harness to</u> <u>Right Rear Door Harness</u>
X900	Body Harness to Liftgate Harness	-	At the left rear corner of the vehicle	<u>Liftgate Harness Routing</u>	<u>X900 Bod Liftgate F</u>
X902	Liftgate Harness to Liftgate Extension Harness	C49	Inside liftgate assembly	<u>Liftgate Harness Routing</u>	<u>X902 Liftgate to Liftgate Extension Harness</u>
G101	Forward Lamp Harness	-	Near the left headlamp assembly	<u>G101</u>	
G102	Engine Harness	-	On the rear of the engine, behind the alternator	<u>G102 and G106</u>	
G103	Engine Harness	-	In the Engine compartment on left frame rail top, behind battery	<u>G103</u>	
G104	Engine Harness	-	On the rear of the engine, near the starter	<u>G104 and G107</u>	
			Near the electronic		

G106	Forward Lamp Harness	-	brake control module	<u>G102 and G106</u>	
G107	Engine Harness	-	On the rear of the engine, near the water pump.	<u>G104 and G107</u>	
G200	Instrument Panel	LHD	Behind the instrument panel, on the right side	-	
G201	Instrument Panel	RHD	Behind the instrument panel, on the right side	-	
G202	Instrument Panel	-	Behind the instrument panel, on the left side	-	
G300	Body Harness	LHD	Near the front of the right front door, down low	-	
G301	Body Harness	RHD	Near the front of the left front door, down low	-	
G302	Instrument Panel	-	Below the center of the instrument panel	-	
G303	Air Bag Harness	-	In the center of the passenger compartment	-	
G400	Body Harness	-	At the right rear of the luggage compartment	-	
G401	Body Harness	-	At the left rear of the luggage compartment	-	
G900	Tailgate Harness	A91	In the center of the liftgate	-	

J100	Engine Harness	-	At the left front of the engine compartment, near the engine control module	-	
J101	Engine Harness	-	At the front of the engine, near the knock sensor	<u>Engine Harness Routing (LL0 with MNG)</u>	
J102	Ignition Coil Harness	LMU	On the left side of the engine, near the ignition coils	-	
J103	Engine Harness	LMU	At the rear of the engine, near G102	-	
J104	Engine Harness	LMU	At the rear of the engine, near G102	-	
J105	Ignition Coil Harness	LMU	On the left side of the engine, near the ignition coils	-	
J107	Ignition Coil Harness	LMU	Near X108	-	
J108	Ignition Coil Harness	LMU	Near X108	-	
J109	Engine Harness	LC5, LCP or LMT	On the left side of the engine, near the ignition coil module	<u>Forward Lamp Harness Routing (1 of 3)</u>	
J110	Engine Harness	LC5, LCP or LMT	At the left front of the engine compartment, near the engine control module	-	
J111	Engine Harness	LC5, LCP or LMT	At the front of the engine, near the	<u>Forward Lamp Harness Routing (2</u>	

			crankshaft position sensor	<u>of 3)</u>	
J113	Instrument Panel Harness	-	Under passenger side of instrument panel, near the fuse block - instrument panel	-	
J114	Engine Harness	MNG	At the front of the transmission, near the internal mode switch	-	
J115	Forward Lamp Harness	-	In the left front of the engine compartment, near the underhood fuse block	-	
J117	Engine Harness	-	At the left rear of the engine compartment, near X107	-	
J118	Ignition Coil Harness	LMU	Near X108	-	
J119	Ignition Coil Harness	LMU	Near X108	-	
J120	Engine Harness	LMU	At the front of the engine, near the crankshaft position sensor	-	
J121	Engine Harness	LCP	At the left rear of the engine compartment, near X107	<u>Forward Lamp Harness Routing (1 of 3)</u>	
J122	Engine Harness	-	At the front of the engine, near the	<u>Engine Harness Routing - Rear</u>	

			crankshaft position sensor	<u>(LFM/LLO with M4M)</u>	
J123	Engine Harness	-	In the left front of the engine compartment, near the underhood fuse block	<u>Engine Harness Routing - Rear (LFM/LLO with M4M)</u>	
J124	Engine Harness	-	In the left front of the engine compartment, near the underhood fuse block	<u>Engine Harness Routing - Rear (LFM/LLO with M4M)</u>	
J125	Engine Harness	-	In the left front of the engine compartment, near the underhood fuse block	<u>Forward Lamp Harness Routing (1 of 3)</u>	
J126	Engine Harness	-	In the left front of the engine compartment, near the underhood fuse block	<u>Engine Harness Routing - Rear (LFM/LLO with M4M)</u>	
J127	Engine Harness	-	In the left front of the engine compartment, near the underhood fuse block	<u>Engine Harness Routing - Rear (LFM/LLO with M4M)</u>	
J128	Engine Harness	-	In the left front of the engine compartment, near the underhood fuse block	<u>Engine Harness Routing - Rear (LFM/LLO with M4M)</u>	
			In the left front of the		

J129	Engine Harness	-	engine compartment, near the underhood fuse block	<u>Engine Harness Routing - Rear (LFM/LLO with M4M)</u>	
J130	Engine Harness	-	-	<u>Forward Lamp Harness Routing (2 of 3)</u>	
J131	Engine Harness	-	-	<u>Forward Lamp Harness Routing (2 of 3)</u>	
J132	Engine Harness	-	-	<u>Forward Lamp Harness Routing (3 of 3)</u>	
J133	Engine Harness	-	-	<u>Forward Lamp Harness Routing (3 of 3)</u>	
J139	Engine Harness	-	-	<u>Engine Harness Routing (LL0 with MNG)</u>	
J140	Engine Harness	-	-	<u>Engine Harness Routing (LL0 with MNG)</u>	
J150	Engine Harness	-	-	<u>Forward Lamp Harness Routing (1 of 3)</u>	
J151	Engine Harness	-	-	<u>Forward Lamp Harness Routing (1 of 3)</u>	
J152	Engine Harness	-	-	-	
J153	Engine Harness	-	-	<u>Forward Lamp Harness Routing (2 of 3)</u>	
J154	Engine Harness	-	-	<u>Forward Lamp Harness Routing (2 of 3)</u>	
J160	Engine Harness	-	-	<u>Engine Harness Routing (LL0 with MNG)</u>	
J170	Engine Harness	-	-	<u>Engine Harness Routing (LL0 with MNG)</u>	
J171	Engine Harness	-	-	-	
J172	Engine Harness	-	-	-	
J173	Engine Harness	-	-	-	

J174	Engine Harness	-	-	-	
J175	Engine Harness	-	-	-	
J201	Instrument Panel Harness	-	On the driver side of the instrument panel, near the ignition switch (LHD) or the right front speaker (RHD)	-	
J202	Instrument Panel Harness	LHD	On the driver side of the instrument panel, near the ignition switch	-	
J203	Instrument Panel Harness	BTV	On the driver side of the instrument panel, near the ignition switch	-	
J205	Instrument Panel Harness	-	On the driver side of the instrument panel, near the immobilizer control module	-	
J206	Instrument Panel Harness	-	In the instrument panel, near the headlamp leveling switch	-	
J207	Instrument Panel Harness	-	In the instrument panel, near G200 (LHD) or G201 (RHD)	-	
J208	Instrument Panel Harness	UV8	In the instrument panel, near	-	

			the earphone connector		
J209	Instrument Panel Harness	UV8	In the instrument panel, near the earphone connector	-	
J210	Instrument Panel Harness to Right Front Door Harness (30 cavities)	UV8	In the instrument panel, near the mobile telephone control module	-	
J211	Instrument Panel Harness to Left Front Door Harness (30 cavities)	UV8	In the instrument panel, near the mobile telephone control module	-	
J212	Instrument Panel Harness to Right Front Door Harness (30 cavities)	UV8	In the instrument panel, near the mobile telephone control module	-	
J213	Body Harness to Right Tail Lamp Harness (6 cavities)	UV8	In the instrument panel, near the cellular phone microphone	-	
J214	Instrument Panel Harness to Left Front Door Harness (30 cavities)	-	In the instrument panel, near the cellular phone microphone	-	
J219	Instrument Panel Harness	-	In the instrument panel, near the hazard lamps switch	-	
			In the instrument		

J220	Instrument Panel Harness	-	panel, near the turn signal/hazard flasher module	-	
J221	Instrument Panel Harness	-	In the instrument panel, near the accelerator pedal position sensor	-	
J222	Instrument Panel Harness	-	In the instrument panel, near the accelerator pedal position sensor	-	
J223	Instrument Panel Harness	-	In the instrument panel, near the accelerator pedal position sensor	-	
J224	Instrument Panel Harness	-	In the instrument panel, near the turn signal/hazard flasher module	-	
J225	Instrument Panel Harness	-	In the instrument panel, near the headlamp leveling switch	-	
J226	Instrument Panel Harness	-	In the instrument panel, near the data link connector	-	

J227	Instrument Panel Harness	-	In the instrument panel, near the left front door	-	
J228	Instrument Panel Harness	-	In the instrument panel, near the left front door	-	
J229	Instrument Panel Harness	-	In the instrument panel, near the turn signal/hazard flasher module	-	
J230	Instrument Panel Harness	-	In the instrument panel, near the headlamp leveling switch	-	
J231	Instrument Panel Harness	-	In the instrument panel, near the data link connector	-	
J232	Instrument Panel Harness	-	In the instrument panel, near the inflatable restraint sensing and diagnostic module X1 harness connector	-	
J233	Instrument Panel Harness	-	In the instrument panel, near the data link connector	-	
			In the instrument panel, near the inflatable		

J234	Instrument Panel Harness	-	restraint sensing and diagnostic module X1 harness connector	-	
J236	HVAC Harness	-	Near the mode door actuator	-	
J237	HVAC Harness	-	Near the recirculation actuator	-	
J238	HVAC Harness	-	Near the air temperature door actuator	-	
J239	Instrument Panel Harness	-	Near the sunload sensor	-	
J240	Instrument Panel Harness	NJ1	-	-	
J300	Instrument Panel Harness	-	In the center of the instrument panel, near G302	-	
J301	Harness	-	In the body harness, on the floor, between the driver seat and the driver door	-	
J302	Body Harness	-	In the body harness, on the floor, between the driver seat and the driver door	-	
J303	Body Harness	-	In the body harness, near the X201 connector	-	
J304	Body Harness	-	In the body harness, near the left side impact sensor	-	

J394	Body Harness	-	In body harness, on the floor, between the driver seat and the driver door	-	
J350	Body Harness	-	-	-	
J395	Body Harness	-	In body harness, on floor, Under driver seat	-	
J500	Left Front Door Harness	LHD	In the left front door, near the inline connector	-	
J600	Right Front Door Harness	RHD	In the right front door, near the inline connector	-	
J950	-	-	-	-	

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Passenger Compartment/Roof Component Views - Spark

PASSENGER COMPARTMENT/ROOF COMPONENT VIEWS

LEFT AND FRONT OF THE PASSENGER COMPARTMENT COMPONENTS

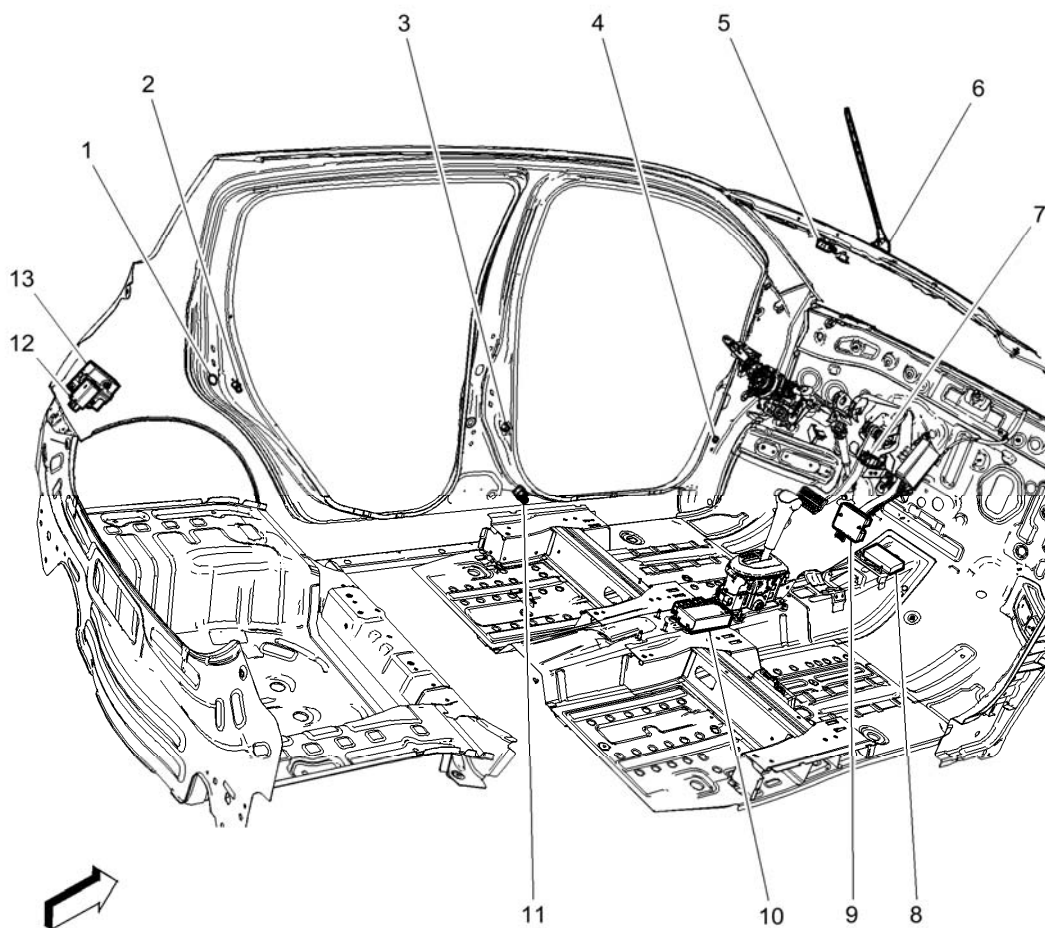


Fig. 1: Left and Front of Passenger Compartment Components
Courtesy of GENERAL MOTORS COMPANY

Items

- 1: G401
- 2: B28LR Door Ajar Switch - Left Rear **B28LR Door Ajar Switch - Left Rear**
- 3: B28D Door Ajar Switch - Driver **B28D Door Ajar Switch - Driver**
- 4: G201 (RHD)

- 5: B24 Cellular Phone Microphone (UE1) B24 Cellular Phone Microphone
- 6: T4M Radio Antenna
- 7: B22 Brake Pedal Position Sensor (MFM) B22 Brake Pedal Position Sensor
- 8: B119 Multi-axis Acceleration Sensor (FX3) B119 Multi-axis Acceleration Sensor
- 9: K71 Transmission Control Module K71 Transmission Control Module X1 (-M4M) K71 Transmission Control Module X1 (M4M) K71 Transmission Control Module X2 (-M4M) K71 Transmission Control Module X2 (M4M)
- 10: K36 Inflatable Restraint Sensing and Diagnostic Module K36 Inflatable Restraint Sensing and Diagnostic Module X1 K36 Inflatable Restraint Sensing and Diagnostic Module X2
- 11: B63L Side Impact Sensor - Left
- 12: P28 Speaker - Parking Assist (UD7)
- 13: K41R Rear Parking Assist Control Module (UD7) K41R Rear Parking Assist Control Module

LEFT AND REAR OF THE PASSENGER COMPARTMENT COMPONENTS

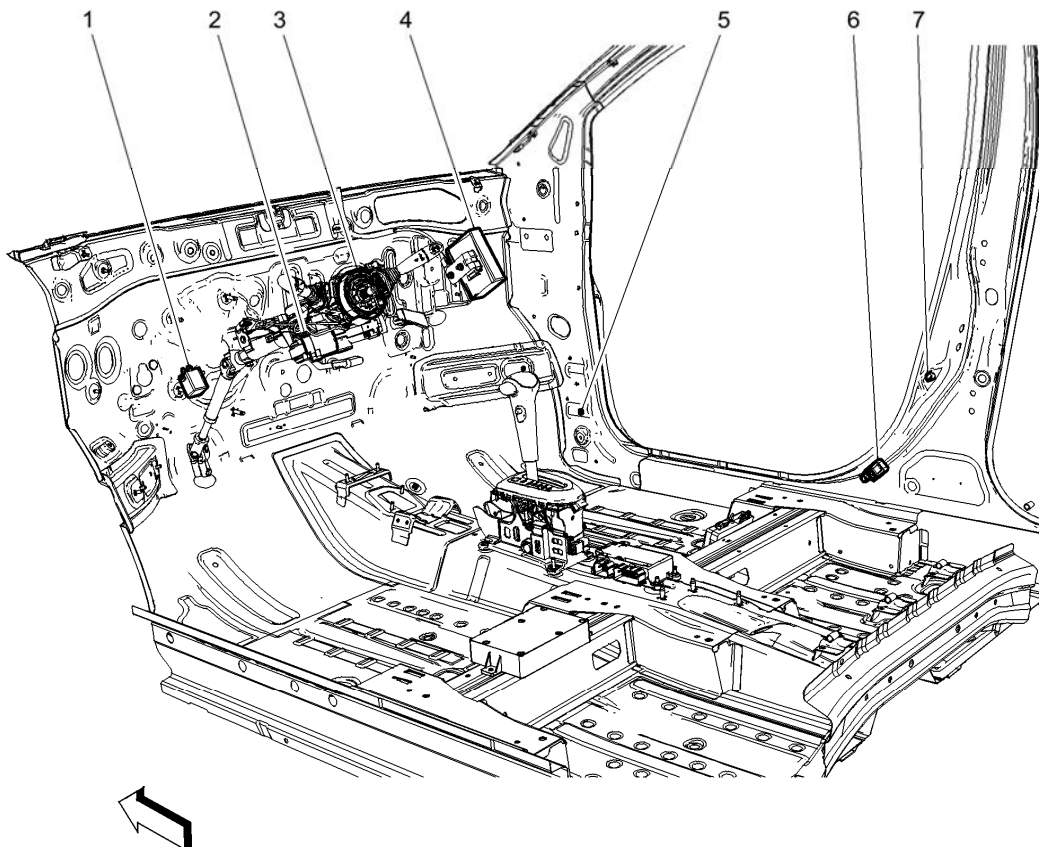


Fig. 2: Left and Rear of Passenger Compartment Components
 Courtesy of GENERAL MOTORS COMPANY

Items

- 2: S39 Ignition Switch **S39 Ignition Switch**
3: X85 Steering Wheel Air Bag Coil (AYF or AY0) **X85 Steering Wheel Air Bag Coil X1 X85 Steering Wheel Air Bag Coil X2**
4: K77 Remote Control Door Lock Receiver (UTJ/UJM) **K77 Remote Control Door Lock Receiver**
5: G302
6: B63R Side Impact Sensor - Right (AY0)
7: B28P Door Ajar Switch - Passenger **B28P Door Ajar Switch - Passenger**

RIGHT SIDE OF THE PASSENGER COMPARTMENT COMPONENTS

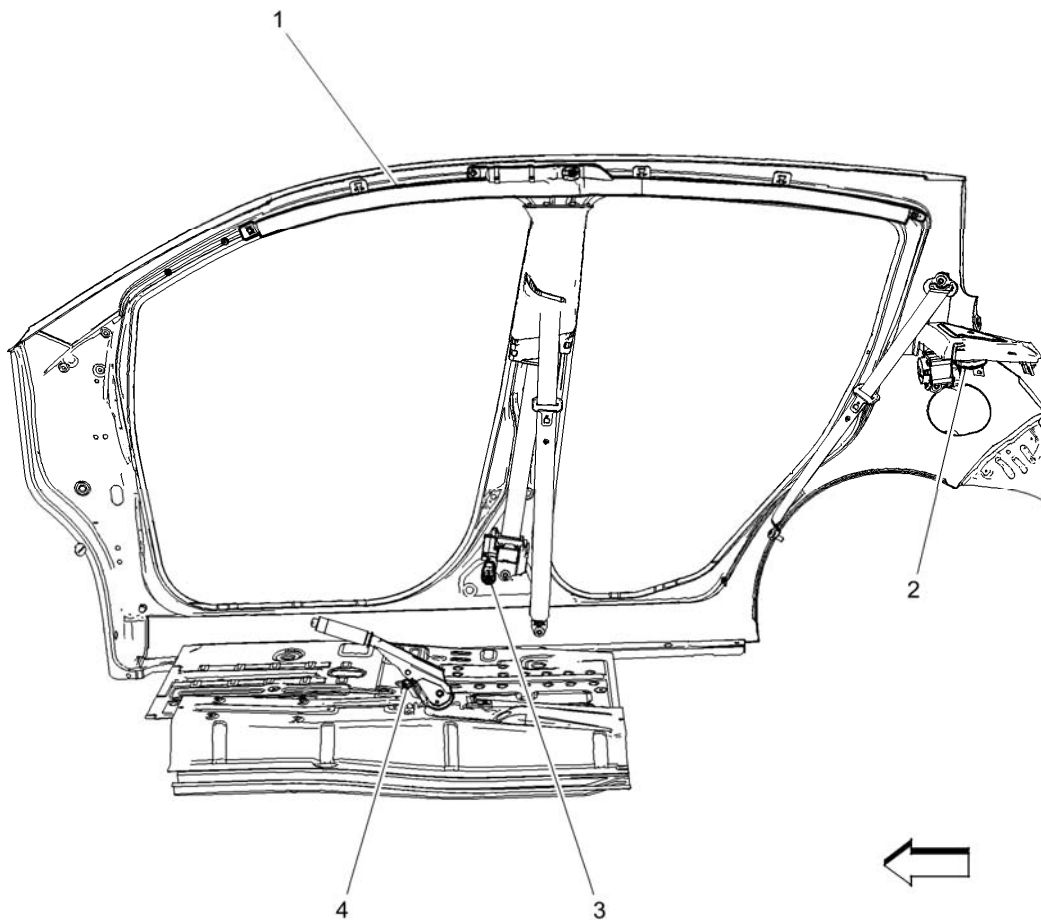


Fig. 3: Right Side of Passenger Compartment Components
Courtesy of GENERAL MOTORS COMPANY

Items

- 1: F105R Roof Rail Air Bag - Right (AYO/AYF) **F105R Roof Rail Air Bag - Right**
2: P19L Speaker - Left Rear Compartment **P19L Speaker - Left Rear Compartment**

3: F112P Seat Belt Retractor Pretensioner - Passenger (AID or AWS) F112P Seat Belt Retractor Pretensioner - Passenger

4: B80 Park Brake Switch B80 Park Brake Switch

HEADLINER COMPONENTS (UE1)

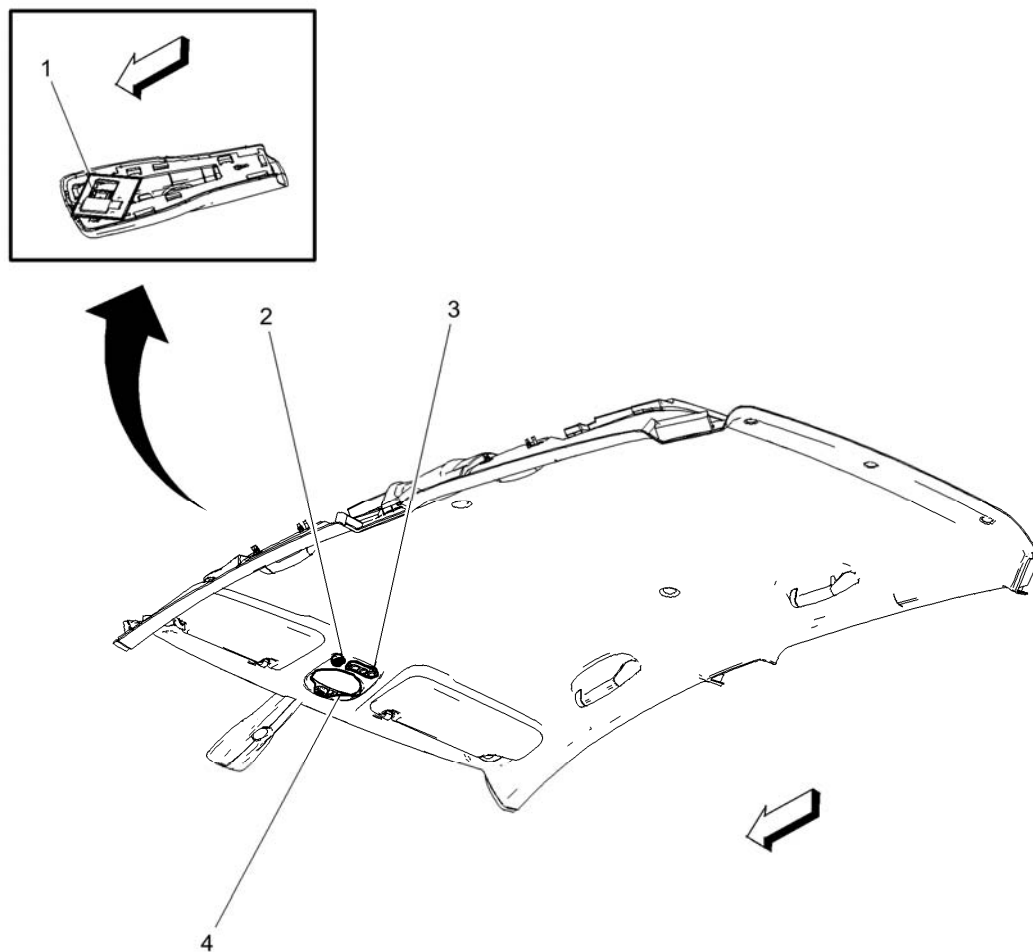


Fig. 4: Headliner Components (UE1)

Courtesy of GENERAL MOTORS COMPANY

Items

1: B160 Windshield Temperature and Inside Moisture Sensor

2: B24 Cellular Phone Microphone (UE1) B24 Cellular Phone Microphone

3: S51 Telematics Button Assembly (MNG)

4: E36AH Dome Lamp E36AH Dome Lamp

HEADLINER COMPONENTS (-UE1)

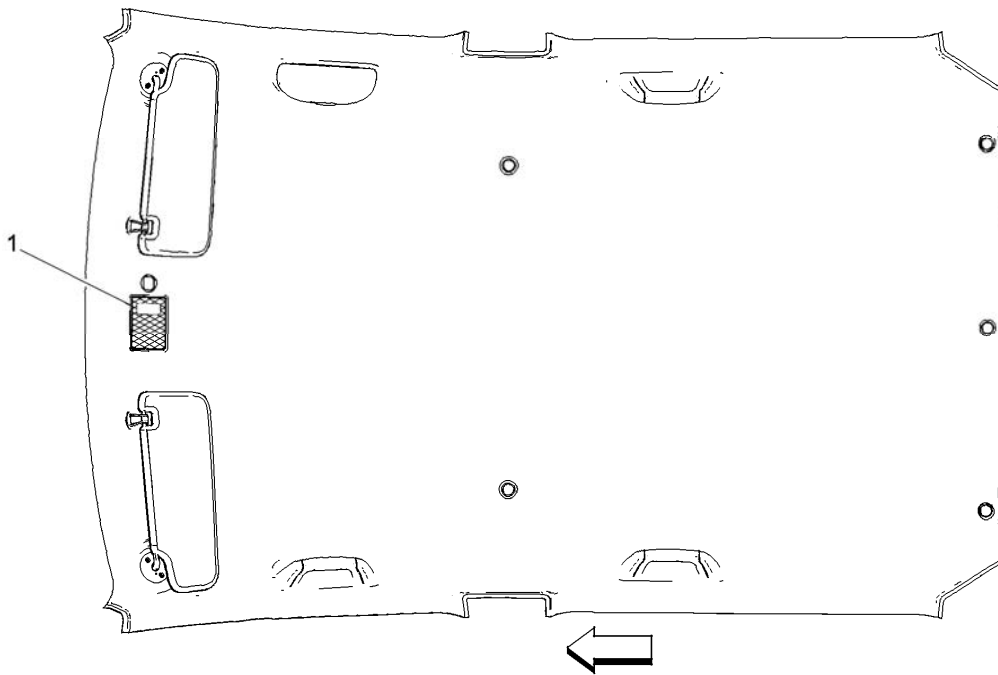


Fig. 5: Headliner Components (-UE1)
Courtesy of GENERAL MOTORS COMPANY

	Items
1: E36AH Dome Lamp	<u>E36AH Dome Lamp</u>

REAR SEAT COMPONENTS



Fig. 6: Rear Seat Components

Courtesy of GENERAL MOTORS COMPANY

Items

1: F106RR Seat Side Air Bag - Right Rear (AJ7/AYO/AYF) F106RR Seat Air Bag - Right Rear

2: F106LR Seat Side Air Bag - Left Rear (AJ7/AYO/AYF) F106LR Seat Air Bag - Left Rear

LEFT FRONT SEAT COMPONENTS

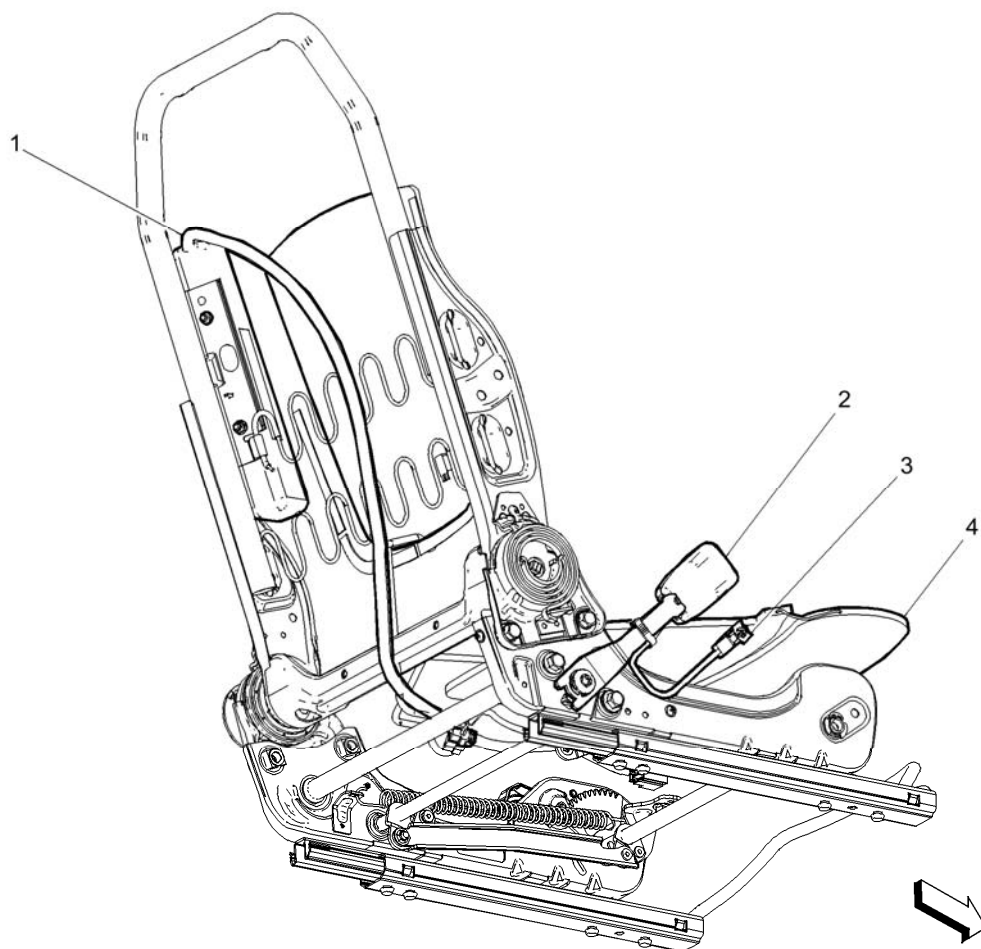


Fig. 7: Left Front Seat Components
Courtesy of GENERAL MOTORS COMPANY

Items

- 1: F106D Seat Side Air Bag - Driver (AJ7/AYO/AYF) F106D Seat Air Bag - Driver**
- 2: B153D Seat Belt Buckle - Driver**
- 3: B88D Seat Belt Switch - Driver (AJ3/AK5/AJ7/AYO/AYF) B88D Seat Belt Switch - Driver**
- 4: E14B Seat Heating Element - Driver Cushion (C37 or C38) E14B Seat Heating Element - Driver Cushion**

RIGHT FRONT SEAT COMPONENTS

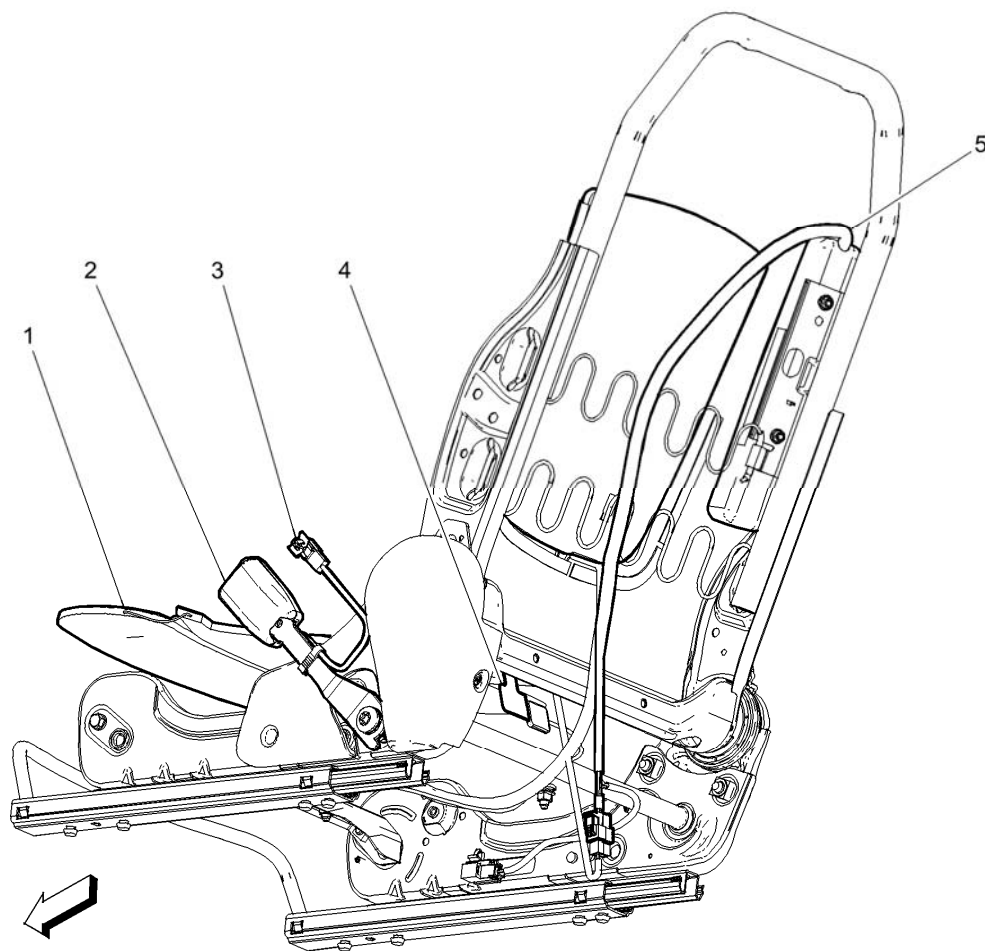


Fig. 8: Right Front Seat Components
 Courtesy of GENERAL MOTORS COMPANY

Items

- 1:** E14B Seat Heating Element - Driver Cushion (C37 or C38) **E14B Seat Heating Element - Driver Cushion**
- 2:** B153D Seat Belt Buckle - Driver
- 3:** B88D Seat Belt Switch - Driver (AJ3/AK5/AJ7/AYO/AYF) **B88D Seat Belt Switch - Driver**
- 4:** B60 Passenger Presence Sensor (AL0)
- 5:** F112P Seat Belt Retractor Pretensioner - Passenger (AID or AWS) **F112P Seat Belt Retractor Pretensioner - Passenger**

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Powertrain Component Views - Spark

POWERTRAIN COMPONENT VIEWS

FRONT OF ENGINE COMPONENTS

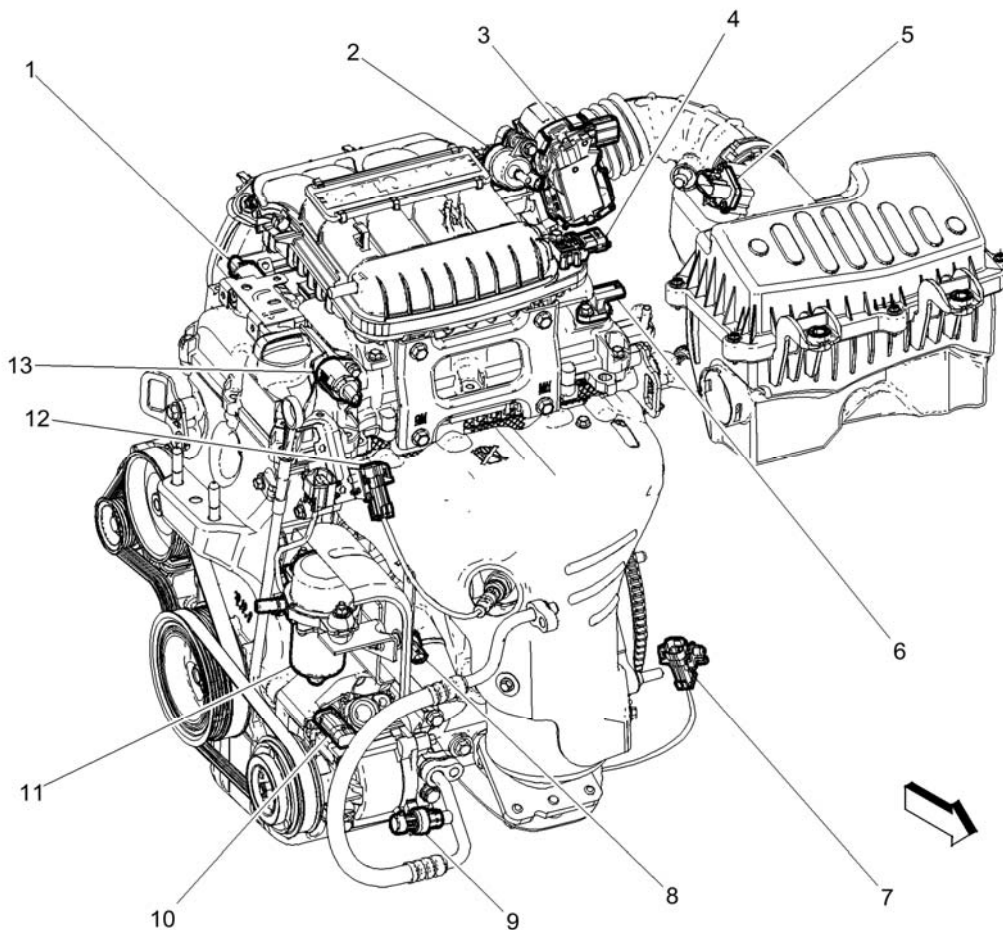


Fig. 1: Front of Engine Components

Courtesy of GENERAL MOTORS COMPANY

Items

- 1: Q6F Camshaft Position Actuator Solenoid Valve - Intake
- 2: Q12 Evaporative Emission Purge Solenoid Valve Q12 Evaporative Emission Purge Solenoid Valve
- 3: Q38 Throttle Body Q38 Throttle Body (-M4M) Q38 Throttle Body (M4M)
- 4: B74 Manifold Absolute Pressure Sensor B74 Manifold Absolute Pressure Sensor

- 5: B75B Mass Air Flow/Intake Air Temperature Sensor **B75B Mass Air Flow Intake Air Temperature Sensor**
- 6: B23E Camshaft Position Sensor - Exhaust **B23E Camshaft Position Sensor - Exhaust**
- 7: B52B Heated Oxygen Sensor 2 **B52B Heated Oxygen Sensor 2**
- 8: B37 Engine Oil Pressure Switch **B37 Engine Oil Pressure Switch**
- 9: B1 A/C Refrigerant Pressure Sensor (C60) **B1 A/C Refrigerant Pressure Sensor**
- 10: Q2 A/C Compressor Clutch (C60) **Q2 A/C Compressor Clutch**
- 11: M9 Brake Booster Pump Motor **M9 Brake Booster Pump Motor**
- 12: B52B Heated Oxygen Sensor 2 **B52B Heated Oxygen Sensor 2**
- 13: Q6E Camshaft Position Actuator Solenoid Valve - Exhaust **Q6E Camshaft Position Actuator Solenoid Valve - Exhaust**

REAR OF ENGINE COMPONENTS

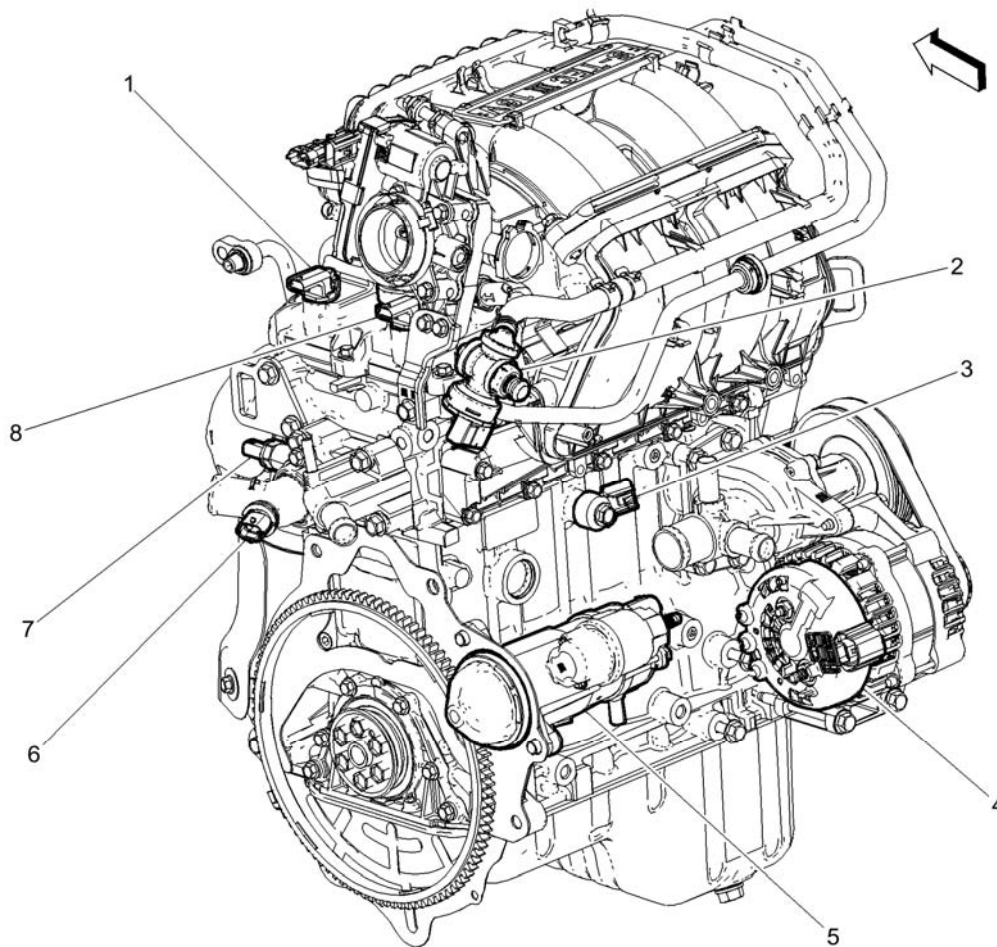


Fig. 2: Rear of Engine Components

Courtesy of GENERAL MOTORS COMPANY

Items

- 1: B23E Camshaft Position Sensor - Exhaust **B23E Camshaft Position Sensor - Exhaust**
2: B19C Brake Booster Vacuum Switch **B19C Brake Booster Vacuum Switch**
3: B68 Knock Sensor **B68 Knock Sensor**
4: G13 Generator **G13 Generator**
5: M64 Starter Motor **M64 Starter Motor**
6: E41 Engine Coolant Thermostat Heater **E41 Engine Coolant Thermostat Heater**
7: B34A Engine Coolant Temperature Sensor 1 **B34A Engine Coolant Temperature Sensor 1**
8: B23F Camshaft Position Sensor - Intake **B23F Camshaft Position Sensor - Intake**

TOP OF ENGINE COMPONENTS

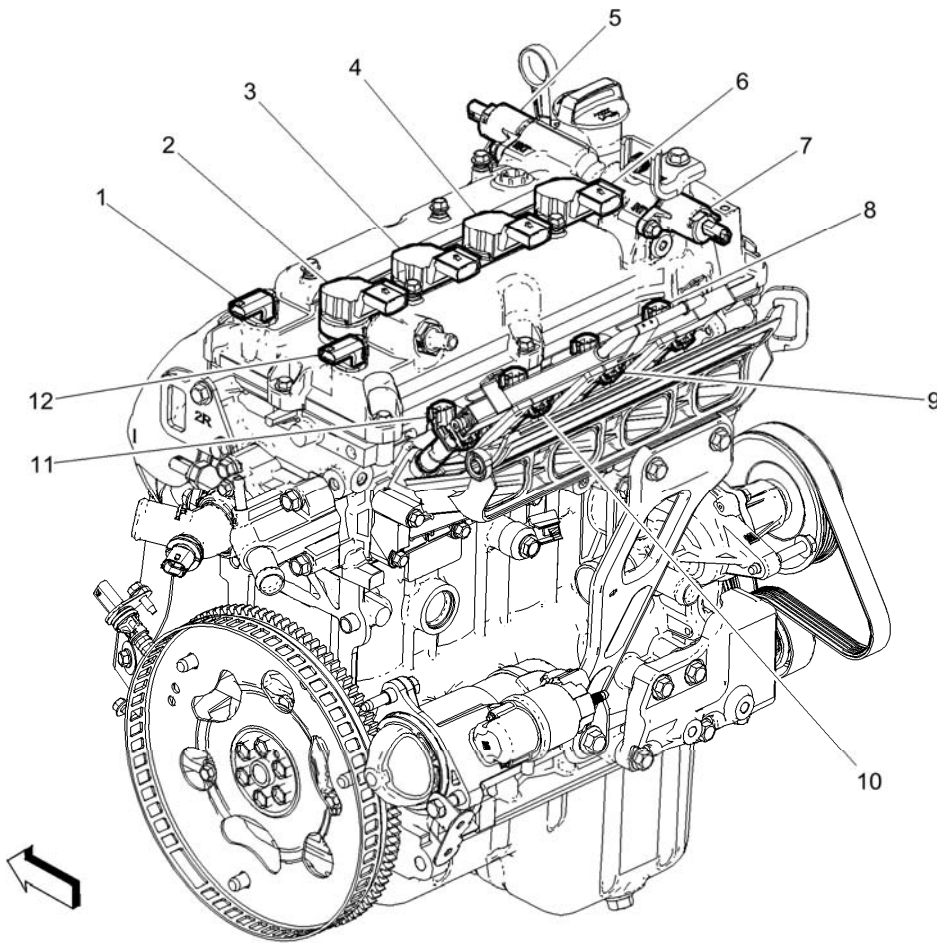


Fig. 3: Top of Engine Components

Courtesy of GENERAL MOTORS COMPANY

Items

- 1: B23E Camshaft Position Sensor - Exhaust **B23E Camshaft Position Sensor - Exhaust**

- 2: T8D Ignition Coil 4 **T8D Ignition Coil 4**
- 3: T8C Ignition Coil 3 **T8C Ignition Coil 3**
- 4: T8B Ignition Coil 2 **T8B Ignition Coil 2**
- 5: Q6E Camshaft Position Actuator Solenoid Valve - Exhaust **Q6E Camshaft Position Actuator Solenoid Valve - Exhaust**
- 6: T8A Ignition Coil 1 **T8A Ignition Coil 1**
- 7: Q6F Camshaft Position Actuator Solenoid Valve - Intake
- 8: Q17A Fuel Injector 1 **Q17A Fuel Injector 1**
- 9: Q17B Fuel Injector 2 **Q17B Fuel Injector 2**
- 10: Q17C Fuel Injector 3 **Q17C Fuel Injector 3**
- 11: Q17D Fuel Injector 4 **Q17D Fuel Injector 4**
- 12: B23F Camshaft Position Sensor - Intake **B23F Camshaft Position Sensor - Intake**

REAR OF AUTOMATIC TRANSMISSION COMPONENTS (M4M)

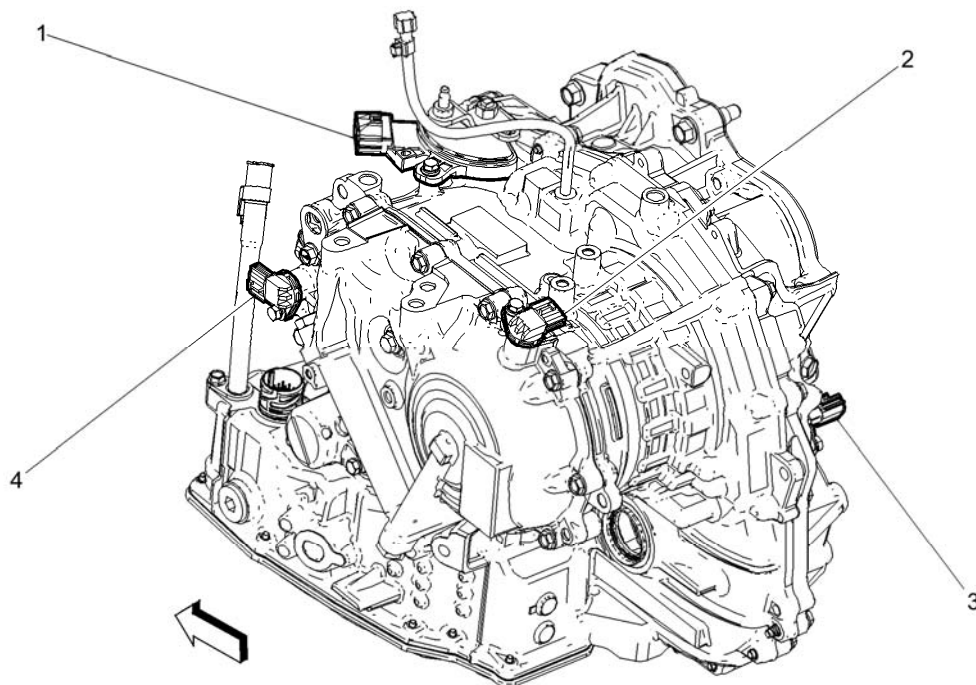


Fig. 4: Rear of Automatic Transmission Components (M4M)
Courtesy of GENERAL MOTORS COMPANY

Items

- 1: B81 Park/Neutral Position Switch (MNG/M4M) **B81 Park/Neutral Position Switch B81 Park/Neutral Position Switch (M4M)**
- 2: B14A Transmission Output Shaft Speed Sensor **B14A Transmission Output Shaft Speed Sensor (M4M) B14A Transmission Output Shaft Speed Sensor (MFL/MNG)**
- 3: B115 Vehicle Speed Sensor **B115 Vehicle Speed Sensor (M4M) B115 Vehicle Speed Sensor**

(MFM/MX2)

4: B14C Transmission Input Shaft Speed Sensor (MNG) B14C Transmission Input Shaft Speed Sensor (MFL/MNG)

FRONT OF AUTOMATIC TRANSMISSION COMPONENTS (M4M)

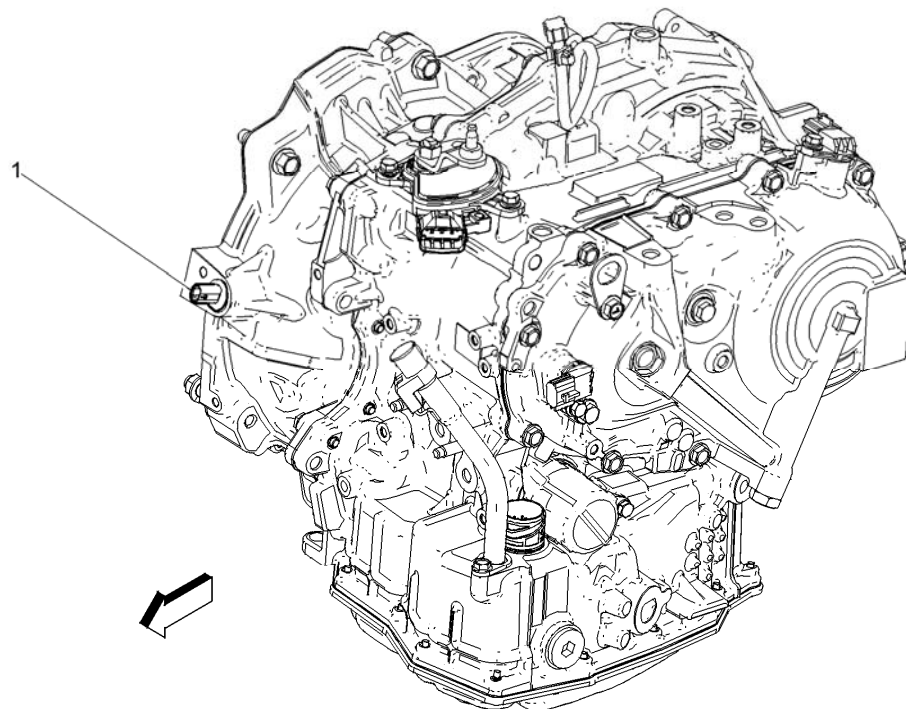


Fig. 5: Front of Automatic Transmission Components (M4M)

Courtesy of GENERAL MOTORS COMPANY

Items

1: B26 Crankshaft Position Sensor B26 Crankshaft Position Sensor (LFM/LL0+M4M) B26 Crankshaft Position Sensor (LLO-M4M)

AUTOMATIC TRANSMISSION COMPONENTS (MFL/MNG)

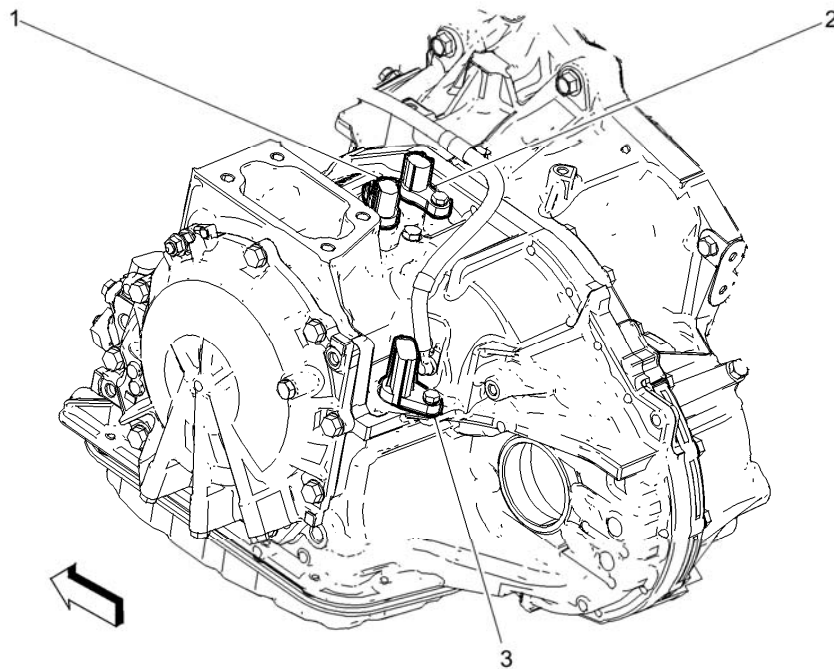


Fig. 6: Automatic Transmission Components (MFL/MNG)
Courtesy of GENERAL MOTORS COMPANY

Items
1: B14A Transmission Output Shaft Speed Sensor <u>B14A Transmission Output Shaft Speed Sensor (M4M)</u> <u>B14A Transmission Output Shaft Speed Sensor (MFL/MNG)</u>
2: B14C Transmission Input Shaft Speed Sensor (MNG) <u>B14C Transmission Input Shaft Speed Sensor (MFL/MNG)</u>
3: Q8 Control Solenoid Valve Assembly <u>Q8 Control Solenoid Valve Assembly</u>

MANUAL TRANSMISSION COMPONENTS (MFM/MX2)

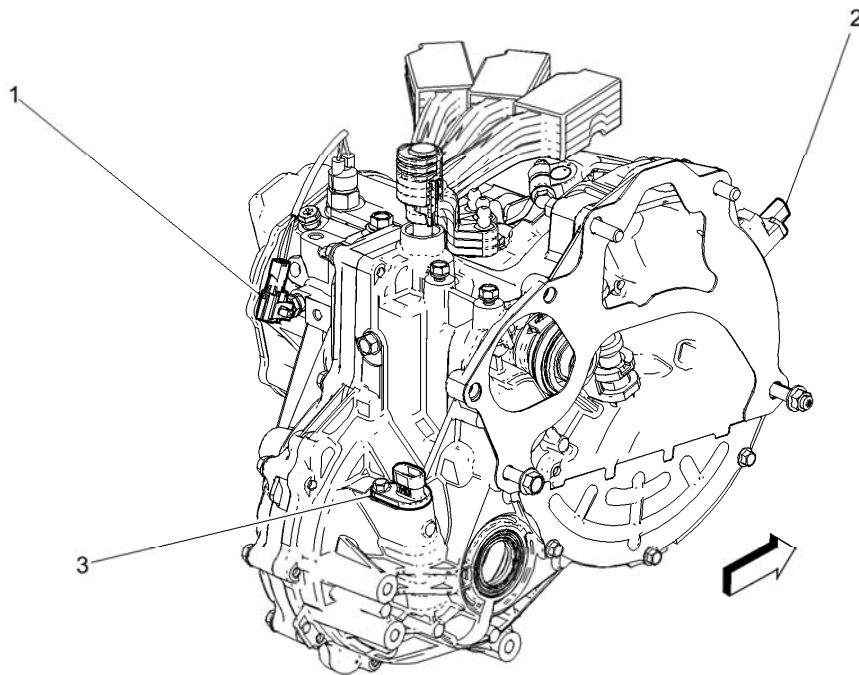


Fig. 7: Manual Transmission Components (MFM/MX2)
Courtesy of GENERAL MOTORS COMPANY

Items

- 1: B16 Backup Lamp Switch (MFN/MX2) B16 Backup Lamp Switch**
2: B26 Crankshaft Position Sensor B26 Crankshaft Position Sensor (LFM/LL0+M4M) B26 Crankshaft Position Sensor (LLO-M4M)
3: B115 Vehicle Speed Sensor B115 Vehicle Speed Sensor (M4M) B115 Vehicle Speed Sensor (MFM/MX2)

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Wheels/Vehicle Underbody
Component Views - Spark

WHEELS/VEHICLE UNDERBODY COMPONENT VIEWS

FUEL TANK COMPONENTS

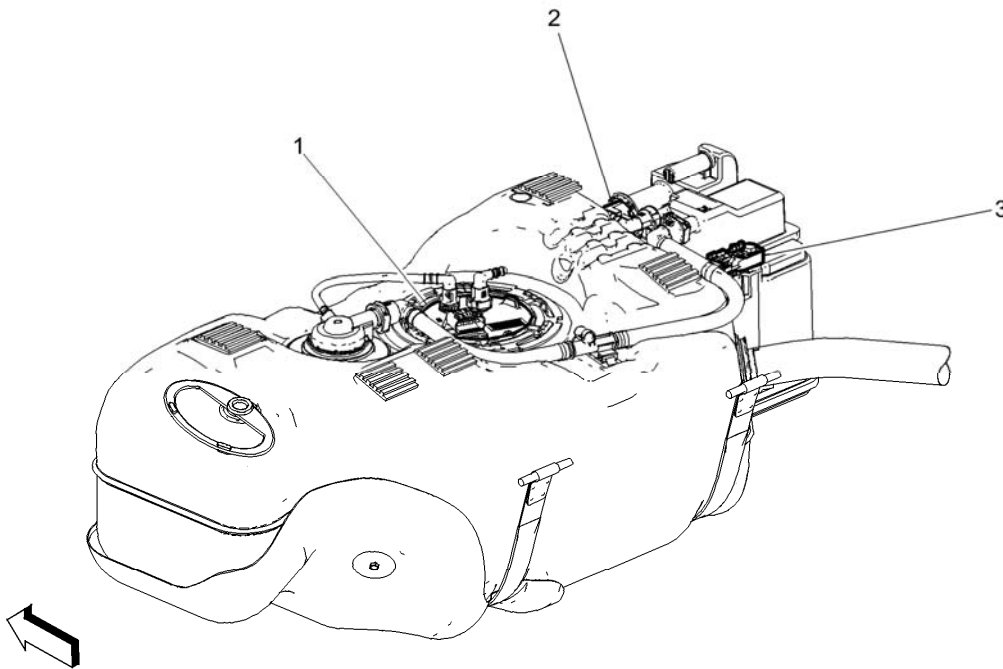


Fig. 1: Fuel Tank Components

Courtesy of GENERAL MOTORS COMPANY

Items

- | | |
|---|---|
| 1: A7 Fuel Pump and Level Sensor Assembly | <u>A7 Fuel Pump and Level Sensor Assembly</u> |
| 2: Q13 Evaporative Emission Vent Solenoid Valve | <u>Q13 Evaporative Emission Vent Solenoid Valve</u> |
| 3: B150 Fuel Tank Pressure Sensor | <u>B150 Fuel Tank Pressure Sensor</u> |

UNDERBODY - WHEEL COMPONENTS

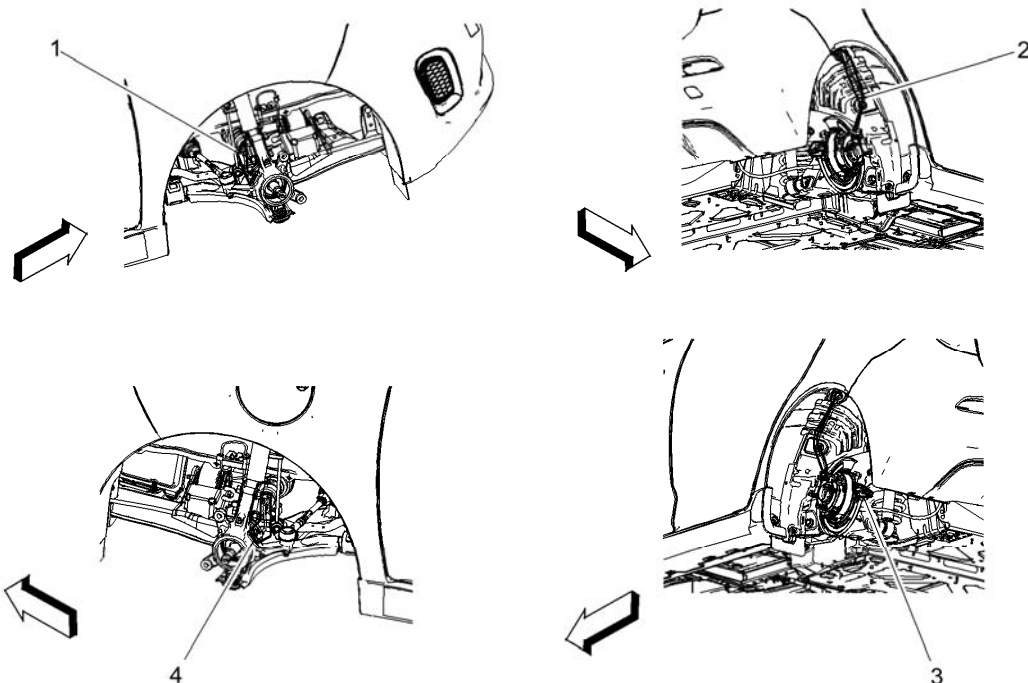


Fig. 2: Underbody - Wheel Components
Courtesy of GENERAL MOTORS COMPANY

Items

- 1: B5RF Wheel Speed Sensor - Right Front
- 2: B5RR Wheel Speed Sensor - Right Rear
- 3: B5LR Wheel Speed Sensor - Left Rear
- 4: B5LF Wheel Speed Sensor - Left Front

ACCESSORIES & EQUIPMENT

Cruise Control - Spark

SCHEMATIC WIRING DIAGRAMS

CRUISE CONTROL WIRING SCHEMATICS

Cruise Control (K34) Wiring Schematics

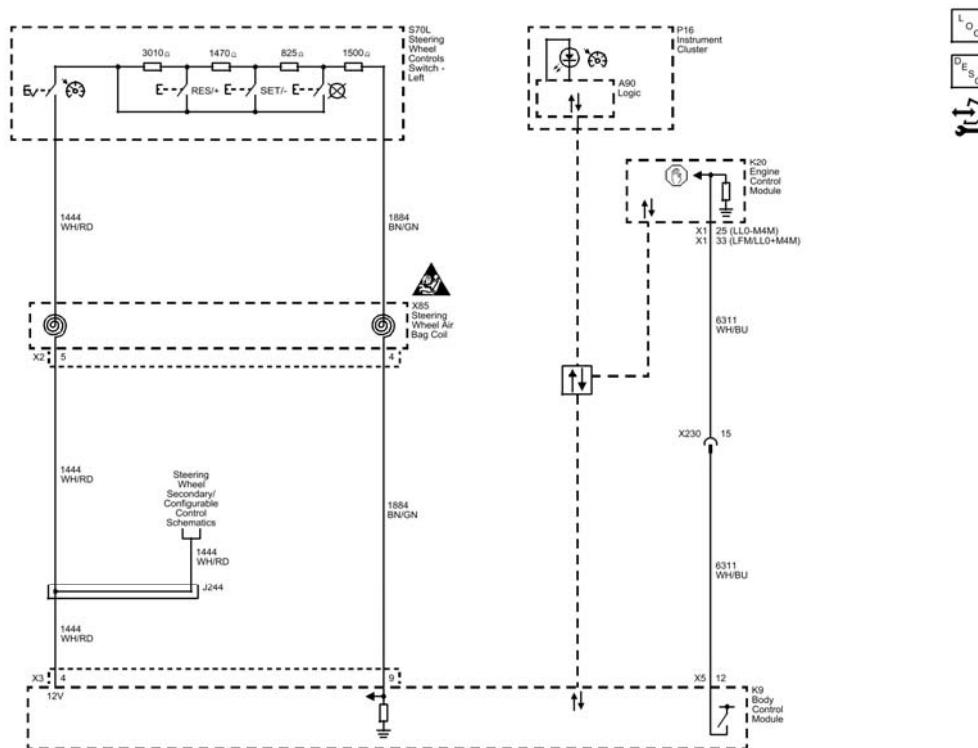


Fig. 1: Cruise Control (K34) Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C</u>	DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C: Cruise Control Malfunction

<u>DTC P0572 or P0573</u>	DTC P0572 Brake Switch Circuit 1 Low Voltage DTC P0573 Brake Switch Circuit 1 High Voltage
<u>DTC P0575</u>	DTC P0575 Cruise Control Switch Signal Message Counter Incorrect
<u>DTC P0703</u>	DTC P0703 Brake Switch Signal Message Counter Incorrect

DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, OR P162C: CRUISE CONTROL MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B3794 08

Cruise Control Function Request Circuit

DTC B3794 61

Cruise Control Function Request Circuit

DTC P0564

Cruise Control Multifunction Switch Circuit

DTC P0565

Cruise Control Switch Circuit

DTC P0567

Cruise Control Resume Switch Circuit

DTC P0568

Cruise Control Set Switch Circuit

DTC P056C

Cruise Control Cancel Switch Circuit

DTC P0580

Cruise Control Multifunction Switch Circuit Low Voltage

DTC P0581

Cruise Control Multifunction Switch Circuit High Voltage

DTC P155A

Cruise Control Switch State Undetermined

DTC P155B

Cruise Control Set/Coast Switch 2 Circuit

DTC P155C

Cruise Control Resume/Acceleration Switch 2 Circuit

DTC P162C

Vehicle Speed Limiting/Warning Switch Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	1	1	-	-
Signal	1	P0564	B3794 08, P0567, P0568	B3794 61, P0564
1. Cruise Control Malfunction				

Circuit/System Description

The cruise control switch is an input to the body control module (BCM). The BCM monitors the cruise control on/off, set/coast, resume/accelerate and cancel switches via the cruise control switch signal circuit in order to detect when the driver has requested to perform a cruise control function. The BCM detects a specific voltage signal on the cruise control switch signal circuit when a switch is applied. The engine control module (ECM) receives the requested cruise control switch function from the BCM via a serial data message.

Conditions for Running the DTC

- The cruise switch is ON.
- The ignition is ON.

Conditions for Setting the DTC

B3794 08

The BCM detects an invalid voltage signal on the cruise control switch signal circuit for 1 second.

B3794 61

Stuck switch for either Resume/Accel or Set/Coast button for 60 seconds.

P0564, P0565, P0567, P0568, P056C

- The BCM detects an invalid voltage signal on the cruise control switch signal circuit for greater than 2 seconds and sends a serial data message to the ECM. The ECM sets these DTCs when the message is received.
- The ECM runs this diagnostic continuously.

P0580, P0581

- The ECM detects an invalid voltage signal on the cruise control switch signal circuit.
- The above condition is present for greater than 2 seconds.
- The ECM runs this diagnostic continuously.

P155A

The ECM is unable to determine the state of the cruise control switch.

P162C

The ECM is unable to determine the state of the vehicle speed limiting switch.

Actions Taken When the DTC Sets

B3794

- The malfunction indicator lamp (MIL) will not illuminate.
- The cruise control system is disabled.

P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A, P162C

DTCs P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A and P162C are type C DTCs

Conditions for Clearing the DTC

B3794

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear after 40 malfunction-free ignition cycles have occurred.

P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A, P162C

DTCs P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A and P162C are type C DTCs.

Reference Information

Schematic Reference

Cruise Control Schematics

Connector End View Reference

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Description and Operation

Cruise Control Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool ECM Cruise Control Switch Status parameter changes between Off and On, Resume and Set when switching between each position on the cruise control switch.
 - **If the parameter does not change**

Refer to Circuit/System Testing.
 - **If the parameter changes**
3. All OK.

Circuit/System Testing

NOTE:

- **An open ignition circuit or fuse before the control module will cause communication DTCs or power mode mismatch DTCs to set against or in**

the control module. This failure mode will be diagnosed in the no communications diagnostic procedure or power mode mismatch.

- **This test assumes the ignition circuit has a driver that will open under a high current condition before the fuse opens.**
- **The driver can open under normal conditions such as battery run down protection or a retained accessory power mode.**

1. Ignition OFF, disconnect the harness connector at the S70L Steering Wheel Controls Switch-Left, ignition ON.
2. Verify a test lamp illuminates between the ignition circuit terminal 1 and ground.
 - **If the test lamp does not illuminate**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for greater than 100 ohms between the ignition circuit and ground.
 - If 100 ohms or less, repair the short to ground on the circuit.
 - If greater than 100 ohms
 3. Test for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the K9 Body Control Module.
 - **If the test lamp illuminates**
3. Verify the scan tool ECM Cruise Control Switch Status parameter is Off.
 - **If not Off**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit terminal 3 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If Off**
4. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the ignition circuit terminal 1.
5. Verify the scan tool ECM Cruise Control parameter is Disabled.
 - **If not Error**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal 9 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If Error**
6. Test or replace the S70L Steering Wheel Controls Switch-Left.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for BCM replacement, programming and setup.

DTC P0572 OR P0573: BRAKE SWITCH

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0572

Brake Switch Circuit 1 Low Voltage

DTC P0573

Brake Switch Circuit 1 High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Stop Lamp Switch Signal	P0572	P0572	P0573	P0572, P0573

Circuit/System Description

The stop lamp switch signal circuit is a B+ input from the body control module (BCM) to the engine control module (ECM). The ECM monitors the stop lamp switch circuit to detect when the brake pedal has been applied. The BCM monitors the brake pedal position sensor to determine when the brake pedal is applied. When the brake pedal is applied, the BCM supplies B+ on the stop lamp switch signal circuit and also sends a serial data message to the ECM indicating that the brake pedal has been applied.

Conditions for Running the DTC

- The engine is running.
- Battery voltage is greater than 11.5 V.
- Brakes applied.

Conditions for Setting the DTC

P0572

This DTC will set when the ECM detects a short to ground or an open on the discrete brake signal circuit when the serial data message from the BCM indicates the brakes are applied. This diagnostic will run when the serial data message and the voltage signal on the brake switch signal circuit do not match for 8 out of 10 times, and the condition is present for greater than 2 seconds.

P0573

This DTC will set when the ECM detects a short to voltage on the discrete brake signal circuit when the serial data message from the BCM indicates the brakes are NOT applied. This diagnostic will run when the serial data message and the voltage signal on the brake switch signal circuit do not match for 8 out of 10 times, and the condition is present for greater than 2 seconds.

Actions Taken When the DTC Sets

- The malfunction indicator lamp (MIL) will not illuminate.
- The cruise control system is disabled.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear after 40 malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Cruise Control Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Cruise Control Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module, ignition ON.
2. Connect a test lamp between the signal circuit terminal 25 and ground.
3. Verify the test lamp turns ON and OFF when pressing and releasing the brake pedal.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If not infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
4. Replace the K20 Engine Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for BCM or ECM replacement, programming and setup

DTC P0575: CRUISE CONTROL SWITCH

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0575

Cruise Control Switch Signal Message Counter Incorrect

Circuit/System Description

When a cruise control function switch is activated, the body control module (BCM) detects a predetermined voltage. The BCM sends a serial data message to the engine control module (ECM) indicating the function that has been requested.

Conditions for Running the DTC

- The ignition is ON.
- The vehicle speed is greater than 40 km/h (25 MPH) and the cruise control is engaged.

Conditions for Setting the DTC

- The ECM receives an invalid cruise control switch status serial data message from the BCM.
- This diagnostic runs continuously.

Actions Taken When the DTC Sets

DTC P0575 is a type C DTC.

Conditions for Clearing the DTC

DTC P0575 is a type C DTC.

Reference Information

Schematic Reference

Cruise Control Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Cruise Control Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that no DTCs are set, except DTC P0575.
 - **If any other DTC is set, except DTC P0575**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If only DTC P0575 is set**
3. Replace the K9 Body Control Module.
 4. Verify DTC P0575 does not set when operating the vehicle within the Conditions for Running the DTC.
 - **If the DTC sets**

Replace the K20 Engine Control Module.

- **If the DTC does not set**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for BCM or ECM replacement, programming, and setup.

DTC P0703: BRAKE SWITCH SIGNAL MESSAGE COUNTER

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0703

Brake Switch Signal Message Counter Incorrect

Circuit/System Description

The body control module (BCM) monitors the brake pedal position sensor. When the brake pedal is applied, the BCM detects a predetermined voltage signal. The BCM sends a serial data message to the engine control

module (ECM) indicating the status of the stop lamps.

Conditions for Running the DTC

The engine is ON.

Conditions for Setting the DTC

- The ECM receives an invalid brake pedal status serial data message from the BCM.
- This diagnostic runs continuously.

Actions Taken When the DTC Sets

- The malfunction indicator lamp (MIL) will not illuminate.
- The cruise control system is disabled.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear after 40 malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Cruise Control Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Cruise Control Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that no DTCs are set, except DTC P0703.
 - **If any other DTC is set, except DTC P0703**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If only DTC P0703 is set**
3. Replace the K9 Body Control Module.
 4. Verify DTC P0703 does not set when operating the vehicle within the conditions for running the DTC.
 - **If the DTC sets**

Replace the K20 Engine Control Module.

- **If the DTC does not set**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for BCM or ECM replacement, programming, and setup.

SYMPTOMS - CRUISE CONTROL

NOTE: **The following steps must be completed before using the symptom tables.**

1. Before using the symptom diagnostic table, perform the **Diagnostic System Check - Vehicle** in order to verify the following conditions:
 - There are no DTCs set.
 - The module can communicate via the serial data.
2. Review the system operation in order to understand the system functions. Refer to **Cruise Control Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which can affect the operation of the Cruise Control System. Refer to **Checking Aftermarket Accessories** .
- Inspect the accessible system components or the visible system components for obvious damage or for obvious conditions which can cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for**

Intermittent Conditions and Poor Connections .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C**
- **Cruise Control Indicator Malfunction**

CRUISE CONTROL INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The instrument cluster illuminates the cruise control engaged indicator based on serial data messages received from the engine control module (ECM). The indicator is commanded ON when the cruise control system is controlling vehicle speed, and turned OFF with the system disengaged.

Reference Information

Schematic Reference

Cruise Control Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Cruise Control Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the cruise control indicator turns ON and OFF when commanding the All Indicators ON and OFF with a scan tool.
 - **If the indicator does not turn ON and OFF**

Replace the P16 Instrument Cluster.
 - **If the indicator turns ON and OFF**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for instrument cluster replacement, programming and setup.

DESCRIPTION AND OPERATION

CRUISE CONTROL DESCRIPTION AND OPERATION

Cruise Control System Block Diagram

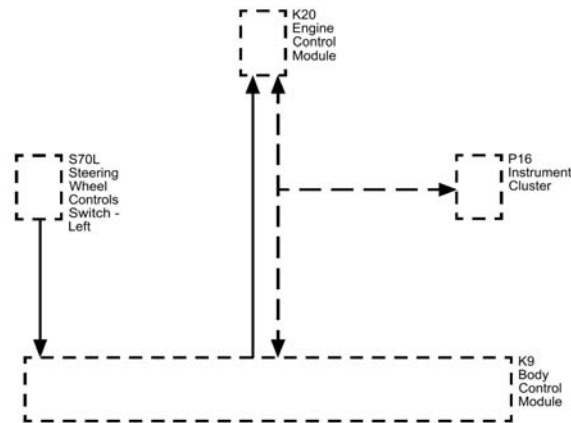


Fig. 2: Identifying Cruise Control System Block Diagram
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
HW	Hard-Wired
HW	Hard-Wired
DD	Serial Data - GMLAN High Speed
K20	K20 Engine Control Module
S70L	S70L Steering Wheel Controls Switch - Left
P16	P16 Instrument Cluster
K9	K9 Body Control Module

Cruise control is a speed control system that maintains a desired vehicle speed under normal driving conditions at speeds above 40 km/h (25 mph). Steep grades may cause variations in the selected vehicle speeds.

The following are the main components of the Cruise Control System:

- The accelerator pedal
- The brake pedal position (BPP) sensor
- The body control module (BCM)
- The cruise on/off switch
- The cruise control cancel switch
- The + RES switch (equivalent to resume/accel switch)

- The - SET switch (equivalent to set/coast switch)
- The engine control module (ECM)
- The throttle actuator control (TAC) motor (gasoline engines only)
- The vehicle speed sensor

The body control module (BCM) monitors the signal circuit of the cruise control switches, which are located on the steering wheel. The BCM relays the cruise control switch status to the engine control module (ECM) via the serial data circuit. The ECM uses the status of the cruise control switch to determine when to capture and maintain the vehicle speed. The ECM monitors the vehicle speed signal circuit in order to determine the desired vehicle speed.

Voltage is supplied to the cruise control switch via the steering wheel control switch reference voltage circuit supplied by the BCM. The cruise control function switches are arranged in a resistive ladder design, with each cruise control function switch having a different resistance value. The BCM detects a specific voltage value that is associated with the cruise control function switch being activated. The BCM sends a serial data message to the ECM indicating that the on/off switch is active. Similarly, when the normally open + RES switch or the normally open - SET switch are pressed, the switch closes and the BCM detects the predetermined voltage signal on the cruise control resume/accel and set/coast switch signal circuit. The BCM sends a serial data message to the ECM indicating that the + RES switch or the - SET switch is active.

Cruise Control Engaged

The Cruise Control System will engage and adjust vehicle speeds, based on the activation of the following cruise control switches, which are located on the steering wheel:

- On/Off
- + RES
- - SET

To engage the Cruise Control System, ensure that the vehicle speed is above 40.2 km/h (25 mph), turn the cruise On/Off switch ON and momentarily press the - SET switch. The ECM will engage the Cruise Control System and record the vehicle speed. The ECM sends a serial data message to the instrument panel cluster (IPC) in order to illuminate the Cruise Engaged indicator in the IPC. Refer to the vehicle owner's manual for the location and operation of the cruise control On/Off indicators and driver information center (DIC) messages.

Pressing the accelerator pedal while the Cruise Control System is engaged, allows the driver to override the Cruise Control System in order to accelerate the vehicle beyond the current set vehicle speed. When the accelerator pedal is released, the vehicle will decelerate and resume the current set vehicle speed.

The driver can also override the current set vehicle speed via the - SET switch and the + RES switch. When the Cruise Control System is engaged, pressing and holding the - SET switch will allow the vehicle to decelerate from the current set vehicle speed without deactivating the Cruise Control System. When the - SET switch is released, the ECM will record the vehicle speed and maintain the vehicle speed as the new set vehicle speed. When the Cruise Control System is engaged, momentarily pressing the - SET switch will allow the vehicle to decelerate at a vehicle specific calibratable increment, commonly 1.6 km/h (1 mph), each time that the - SET is momentarily pressed, with a minimum vehicle speed of 38 km/h (24 mph). Refer to the vehicle Owner's Manual

for more information.

Pressing and holding the + RES switch, when the Cruise Control System is engaged, will allow the vehicle to accelerate to a greater vehicle speed than the current set vehicle speed. When the + RES switch is released, the ECM will record the vehicle speed and maintain the vehicle speed as the new set vehicle speed. When the Cruise Control System is engaged, momentarily pressing the + RES switch will allow the vehicle to accelerate at a vehicle specific calibratable increment, commonly 1.6 km/h (1 mph), each time that the + RES switch is momentarily pressed. Momentarily activating the + RES switch will recall the previous vehicle speed, after the cruise control system has been disengaged by pressing the brake pedal, or CANCEL switch. Refer to the vehicle Owner's Manual for more information.

Cruise Control Disengaged

The engine control module (ECM) disengages the cruise control operation based on the signals from the following switches:

- The brake pedal position (BPP) sensor
- The On/Off switch
- The cruise control cancel switch

The Cruise Control System will disengage when the brake pedal is applied. The body control module (BCM) monitors the BPP sensor via the BPP sensor signal circuit as the voltage signal increases while the pedal is further applied. The ECM monitors the BPP signal through a discrete input and a serial data message signal from the BCM indicating the brake status. When either signal indicates the brake pedal is applied, the ECM will disengage the cruise control system.

The Cruise Control System will also disengage when the cruise control on/off switch is switched OFF, or the cruise control cancel switch is activated. The body control module (BCM) determines when the cruise control cancel switch is activated. When the normally open cancel switch is closed, the BCM detects the predetermined voltage signal on the cruise control function switch circuit. The vehicle speed stored in the memory of the engine control module will be erased when the cruise control On/Off switch is turned OFF, or the ignition switch is turned OFF. The BCM sends a serial data message to the ECM in order to disengage the cruise control system. When the Cruise Control System has been disengaged, the ECM sends a serial message to the instrument panel cluster (IPC) in order to turn OFF the Cruise Engaged indicator.

Every time the Cruise Control System is disengaged, the ECM will keep track of the reason for system disengagement. The last 8 disengagement reasons will be recorded within the ECM memory. The scan tool will display the last 8 Cruise Disengage History parameters, in which one out of approximately 50 possible reasons will be displayed in each of these 8 parameters. For the disengagement reason to be displayed within the scan tool parameter the Cruise Control System is active and disengagement is requested.

When engagement of the system is requested but an engagement inhibit is present, the most recent inhibit reason is recorded in the ECM history. The scan tool will display the most recent inhibit reason, in which one out of approximately 50 possible reasons will be displayed.

Cruise Control Inhibited

The engine control module (ECM) inhibits the cruise control operation when any of the following conditions exist:

- The ECM has not detected a brake pedal activation from the body control module (BCM) this ignition cycle.
- A Cruise Control System DTC has been set.
- The vehicle speed is less than 38.6 km/h (24 mph).
- The vehicle speed is too high.
- The vehicle is in PARK, REVERSE, NEUTRAL, or 1st gear.
- The engine RPM is low.
- The engine RPM is high.
- The system voltage is not between 9 volts and 16 volts.
- The Antilock Brake System (ABS)/Traction Control System (TCS) is active for more than a calibratable time (typically 0.3 to 0.7 seconds).

Cruise Control Inhibit Reasons

This is a general list of inhibit reasons. Not every inhibit reason is applicable to all vehicles. Refer to the scan tool inhibit reason list for the last 8 reasons that have been recorded during the current ignition cycle.

Scan Tool Name	Description	Long Description
ACC BRAKE INOP	Adaptive Cruise Control Automatic Braking Failed	Adaptive Cruise Control Automatic Braking Inoperative
ACC DATA	Serial data fault for Adaptive Cruise Control Throttle Control and Brake Control signals sent by Adaptive Cruise Control module	Adaptive Cruise Control Module serial data fault is active or communication has been lost between ACC module and ECM.
ACC INHIBIT	Adaptive Cruise Control Inhibited	Adaptive Cruise Control Inhibited
ACC OPTION	Adaptive Cruise Control option mismatch	Cruise control type (adaptive cruise or conventional cruise) mismatched between ECM and BCM.
ACCEL RATE	High acceleration	Vehicle acceleration rate is too high.
Accel Time	Rate Limiting Fault	Cruise torque request rate limiting active too long
APP OVERRIDE	Pedal greater than cruise (override)	Driver has overridden cruise control set speed with accelerator pedal for greater than an allowable time.
Auto Brk Data	Automatic Braking Engine Torque Request Signal Communication Malfunction	ECM to EBCM serial data fault is active or communication has been lost between ECM and EBCM.
AXLE RANGE	Rear Axle Low	Rear axle in low range
BPP DATA	DTC P0703 active or maximum time elapsed without receiving valid Brake Pedal Position signal.	Serial data fault is active or communication has been lost with module sending brake pedal apply state

BPP DTC	Brake Pedal Position signal invalid	Brake Pedal Apply Circuit fault has been detected.
BPP Not Learned	Brake Apply Sensor Home Position Not Learned	Brake Pedal Position Sensor Released Position Not Learned.
BRAKE	Brake pedal apply	Brake Pedal was applied.
Brk Ped Press	Brake Pedal Driver Applied Pressure Detected	A Brake Pedal Apply has been detected based on brake pedal pressure as measured by the EBCM.
Calc Eng Torque	Calculated Torque	Engine torque calculation is incorrect.
CANCEL	Cancel switch active	Cancel Switch was depressed.
CLUTCH	Clutch switch active	Clutch Pedal was applied.
COAST DISENGAGE	Coast disengage	Cruise control is in coast mode with the Set/Coast switch depressed and is requesting no throttle
COAST SPEED LOW	Coast below low speed inhibit	Set / Coast switch was depressed. Vehicle slowed below minimum cruise operating speed.
Cruise Brk Inop	Brake System Malfunction	EBCM has detected a failure that does not allow automatic braking to be performed.
CRUISE S/W	Sequence of completion checks	Cruise control software execution error has occurred.
CRUISE SW DATA	Serial data fault (Cruise switch serial communication fault)	Cruise switch serial data fault is active or communication has been lost with module sending cruise switch states
CRUISE SW. OFF	On/Off switch in Off state	Cruise On/Off switch turned Off
DECEL RATE	High deceleration	Vehicle deceleration rate is too high.
DLC OVERRIDE	ALDL	Scan Tool plugged into ALDL connector
DTC SET	Malfunction in PCM/ECM (DTC active)	DTC is active or in history that inhibits cruise control operation.
D WHL SPD HI	Driven Whl Spd Greater (wheel slip detection)	Driven wheel speed greater than Non Driven wheel speed (slip detection)
D WHL SPD LOW	Un-driven Whl speed Greater	Non Driven wheel speed greater than driven wheel speed
ECM INHIBIT	PCM/ECM inhibit (RAM corruption)	ECM internal communication error
ECM RESET	ECM Running Reset	ECM Running Reset occurred
ECT OVERTEMP	Engine metal overtemp active	Engine over temperature. Overheated.
ENG RUN TIME	Engine run time not elapsed	Engine has not been running long enough, typically five seconds.
ENGINE SPEED	Engine speed too low or too high	Engine RPM too low (near stall) or too high (near engine RPM fuel shutoff).
FIRST GEAR	1st Gear	Transmission is engaged in 1st gear

HIGH SPEED	Vehicle speed exceeds high speed threshold	Vehicle speed has exceeded maximum cruise operating speed
HIGH VOLTAGE	Voltage above high voltage threshold	Ignition Voltage High at ECM (typically 18 volts)
ILLEGAL MODE	Illegal cruise mode	Cruise control mode is incorrect based on switch states.
LOST FWD GEAR	Transmission in neutral. Reverse or park	Gear selector not in forward gear
LOW SPEED	Vehicle speed drops below low speed threshold	Vehicle speed dropped below the cruise control minimum operating speed. May be due to hilly terrain and low vehicle speed. Manual transmission gear selection and engine torque may contribute to this disengagement reason.
LOW VOLTAGE	Voltage below low voltage threshold	Ignition Voltage Low at ECM (typically 9 volts)
MEMORY DTC	Memory Failure	Control module memory failure detected.
MPH LIMIT	MPH Limited Fuel (Vehicle overspeed fuel cut-off active)	Vehicle overspeed protection active with fuel cut off active
M/T Gear Changed	Manual transmission out of gear with no clutch pedal apply	Manual transmission shifted to Neutral without clutch pedal being applied.
NONE	None	This disengagement reason may be displayed after a dead battery repair or module replacement.
OVER SET SPEED	Over schedule	Vehicle speed has exceeded driver selected set speed by more than an allowable amount. This may occur while driving down a significant grade or driver overriding cruise while performing a passing maneuver.
PARK BRAKE	Park Brake Switch signal Active	Parking Brake Applied
PEDAL INITIALIZE	Brake before cruise	The brake pedal has not been seen as applied prior to driver request to engage cruise with set switch. A brake pedal apply must be seen before allowing cruise engagement during each key cycle. On a vehicle equipped with a manual transmission, a clutch pedal apply may satisfy the brake pedal apply criteria.
PTO ACTIVE	Power Take Off Active	Power Take Off is active.
Ram DTC	Processor Integrity Fault (Ram corruption)	ECM software error has occurred

RPM LIMIT	Injectors Disabled (Engine overspeed fuel cut-off active)	Engine RPM limiter active with fuel cut off active.
S/C ON SPEED HI	Over schedule tap-down	Set/Coast switch selected, vehicle speed is above set speed and does not decrease. May be due to traveling down hill
SIMUL S/C-R/A	SET and RESUME switches simultaneously active	Set/Coast and Resume Accelerate switches pressed simultaneously
SL/W Sys On	Speed Limiter / Warning On/Off switch turned on	Driver has turned on the Speed Limiter/Warning on/off switch. Cruise is disabled / inhibited and cruise on/off switch will be set to OFF.
SW. INVALID	Analog cruise switch input out of range	Cruise switch voltage signal in invalid range
TAC INHIBIT	ETC prevents cruise operation	Electronic Throttle Control has detected a failure in the throttle control hardware
TCS	Traction control active	Traction Control was Active
TRANS DTC	Trans Gear Fault	Transmission DTC is active or in history that inhibits cruise control operation
UNDER SET SPEED	Under schedule	Vehicle speed is below cruise control set speed by more than an allowable amount
VSES	Vehicle stability active	Vehicle Stability Control was active
4WD Low	4WD Low	Transfer case in low range

ACCESSORIES & EQUIPMENT

Data Communications - Spark

SCHEMATIC WIRING DIAGRAMS

DATA COMMUNICATION WIRING SCHEMATICS

Power, Ground, and Low Speed GMLAN Wiring Schematics

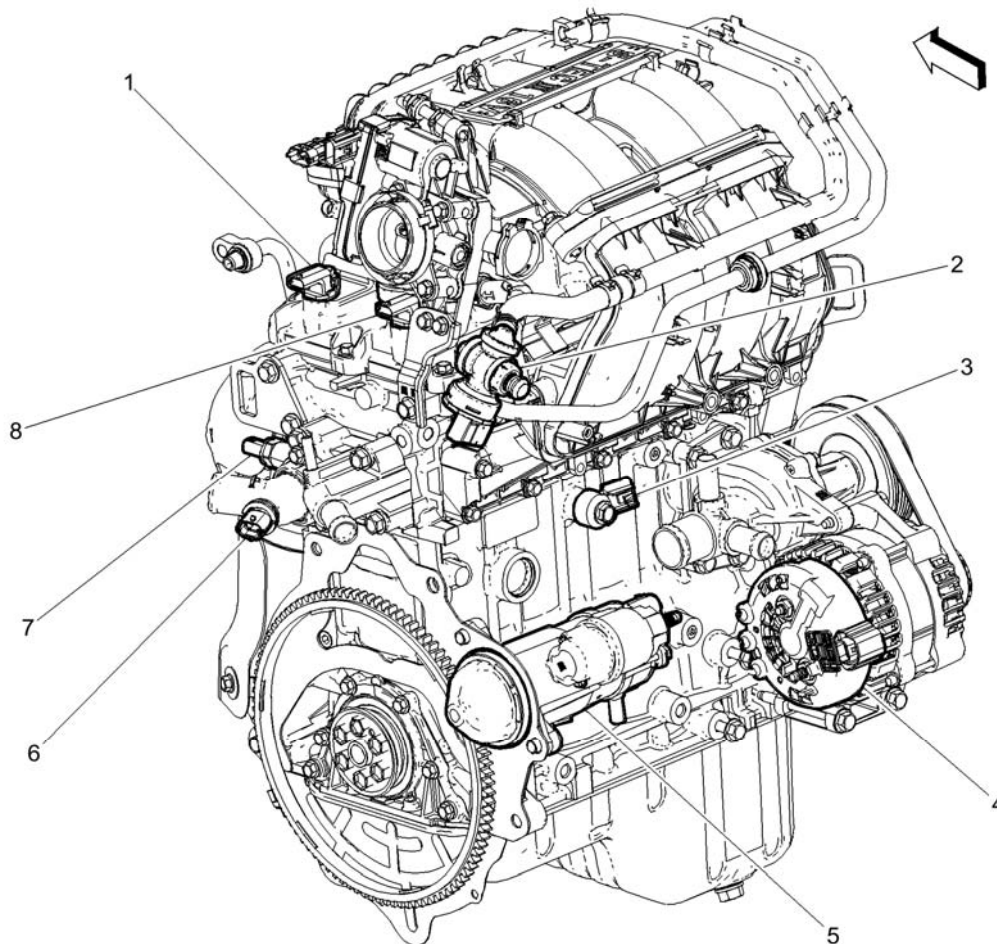


Fig. 1: Power, Ground, and Low Speed GMLAN Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

High Speed GMLAN Bus 1 (1 of 2) Wiring Schematics

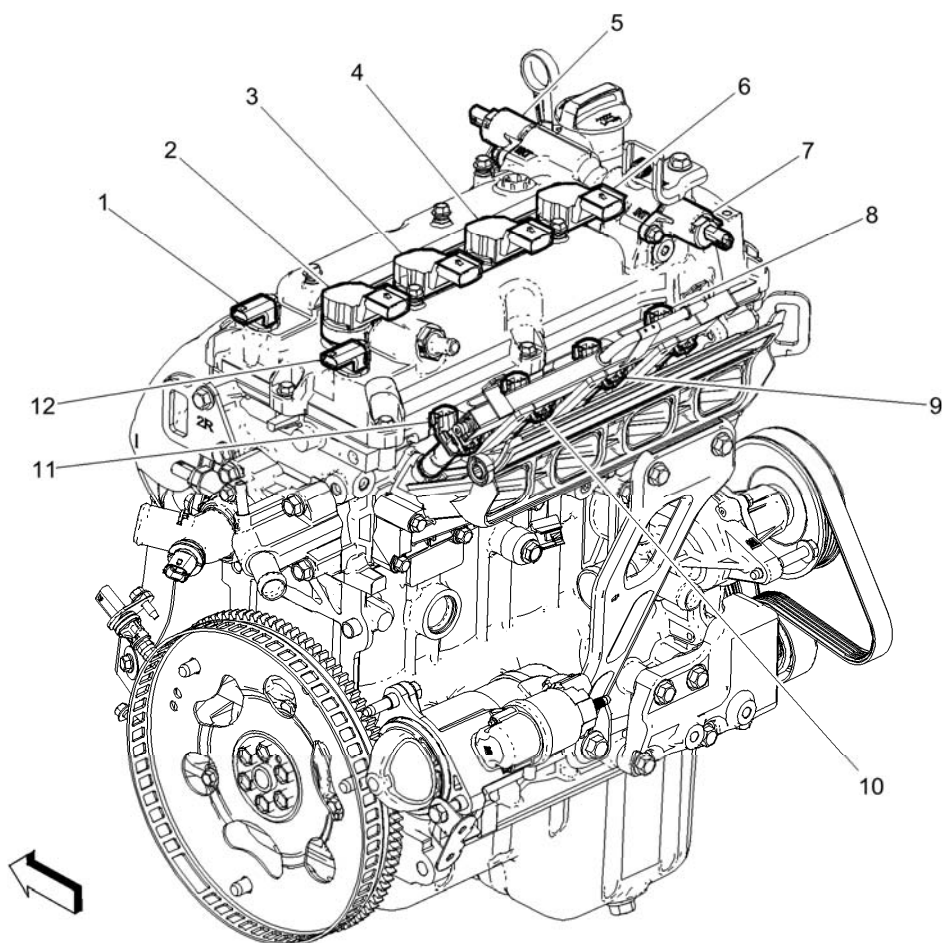


Fig. 2: High Speed GMLAN Bus 1 (1 of 2) Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

High Speed GMLAN Bus 1 (2 of 2) Wiring Schematics

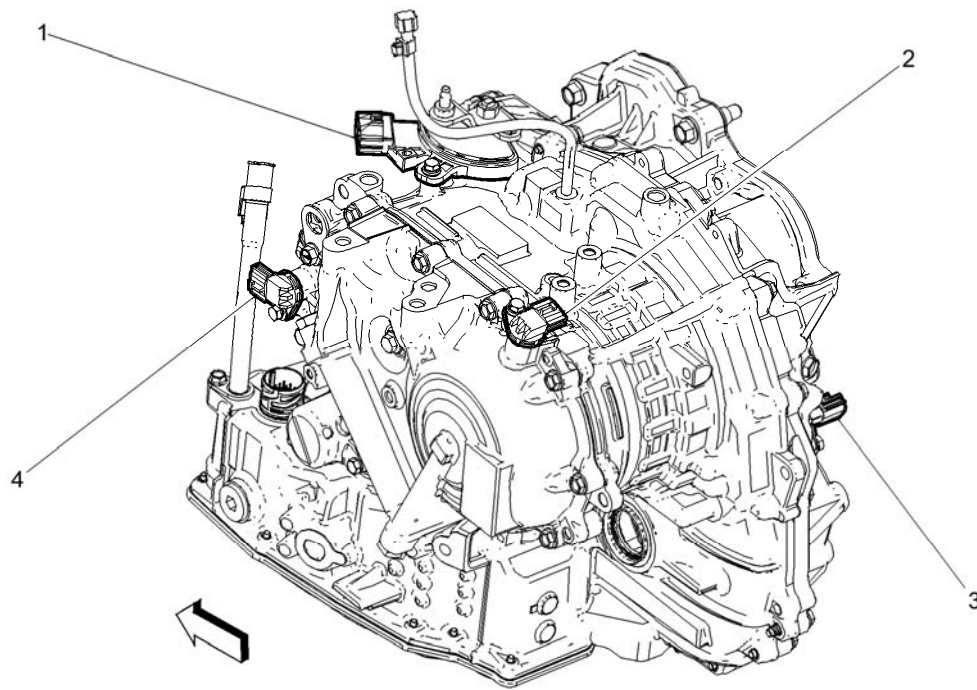


Fig. 3: High Speed GMLAN Bus 1 (2 of 2) Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

High Speed GMLAN Bus 2 Wiring Schematics

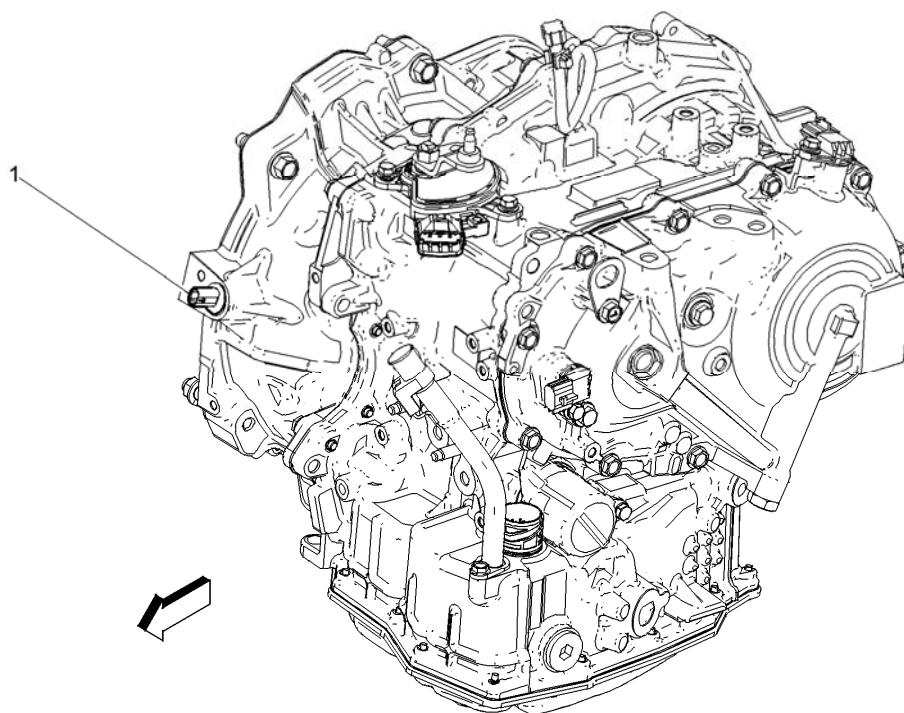


Fig. 4: High Speed GMLAN Bus 2 Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Communication Enable Wiring Schematics

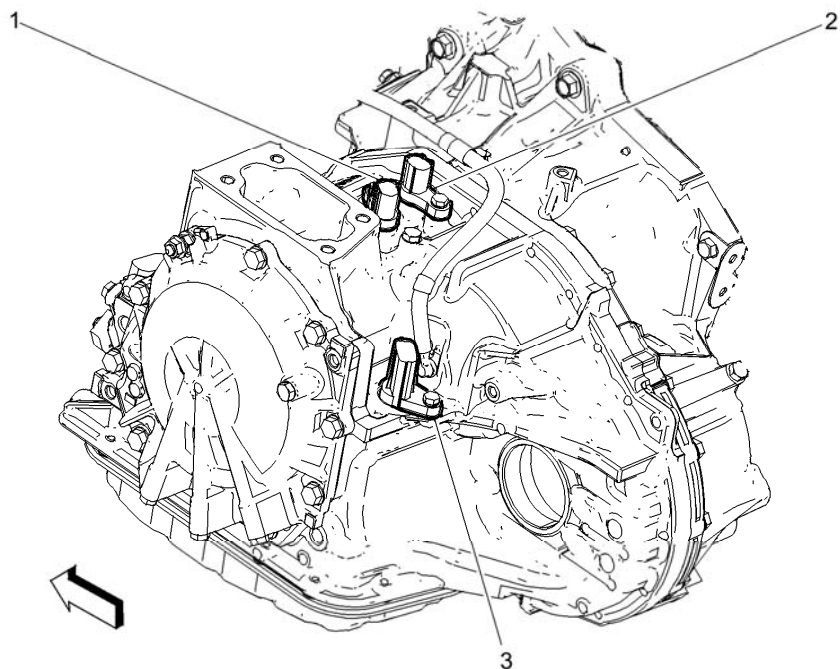


Fig. 5: Communication Enable Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

BODY CONTROL SYSTEM WIRING SCHEMATICS

Power, Ground, Data Communications, and Subsystem References (1 of 5) Wiring Schematics

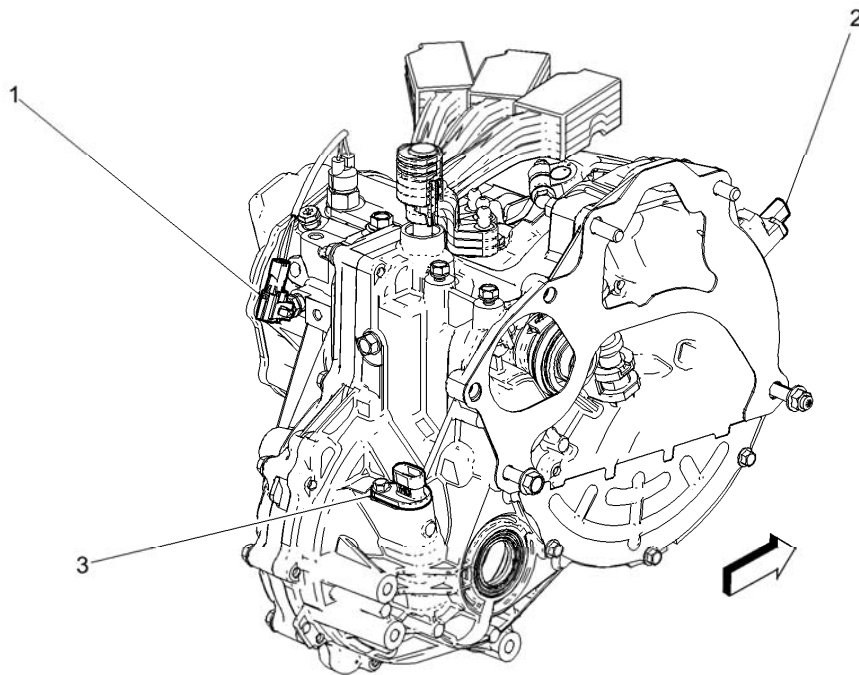


Fig. 6: Power, Ground, Data Communications, and Subsystem References (1 of 5) Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Subsystem References (2 of 5) Wiring Schematics

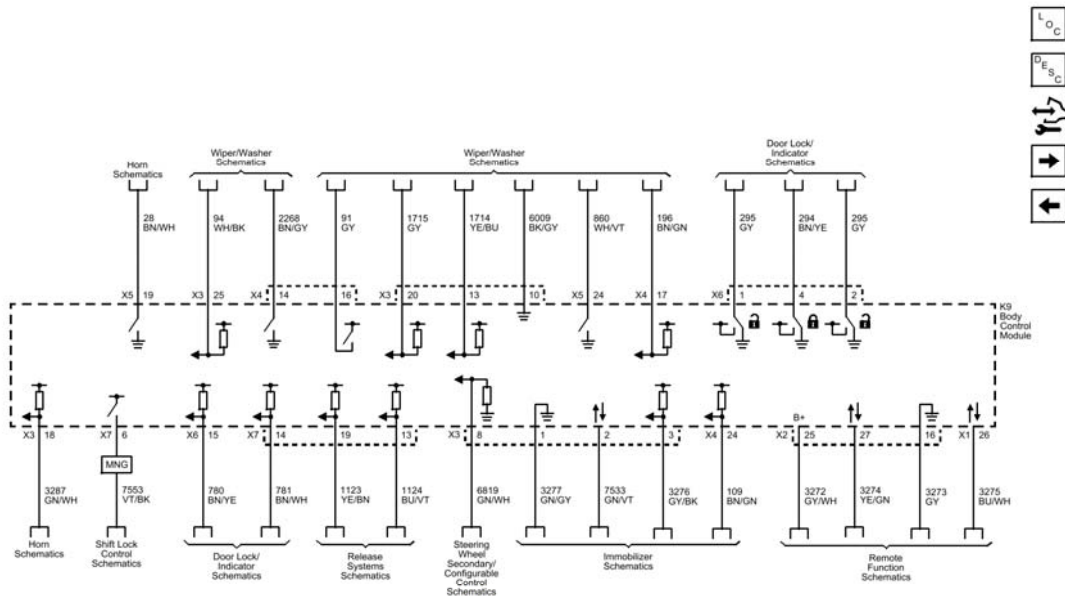


Fig. 7: Subsystem References (2 of 5) Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Subsystem References (3 of 5) Wiring Schematics

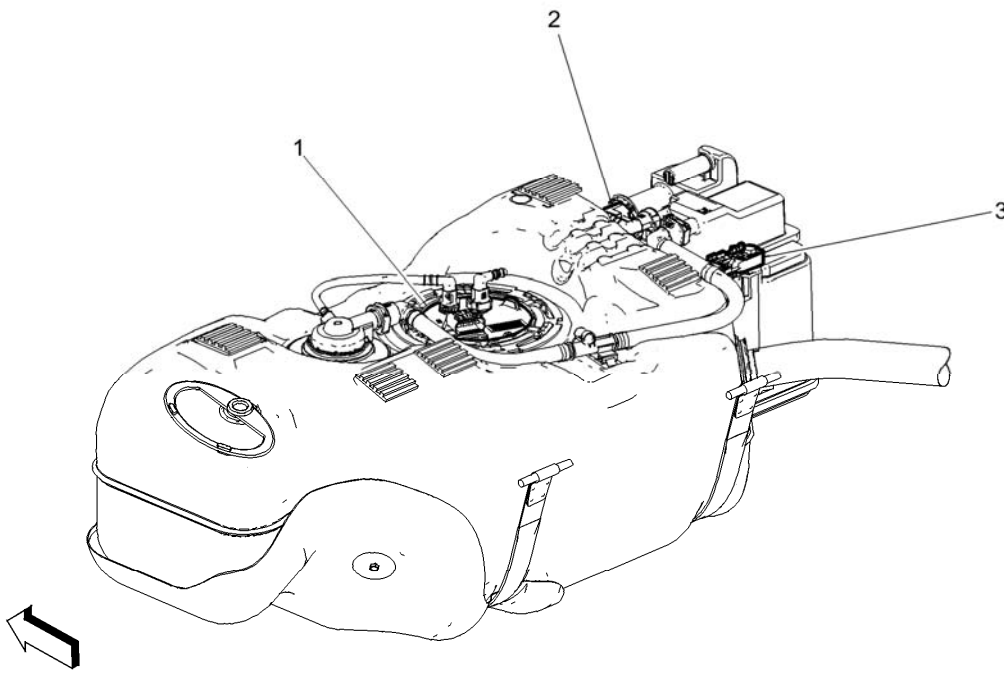


Fig. 8: Subsystem References (3 of 5) Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Subsystem References (4 of 5) Wiring Schematics

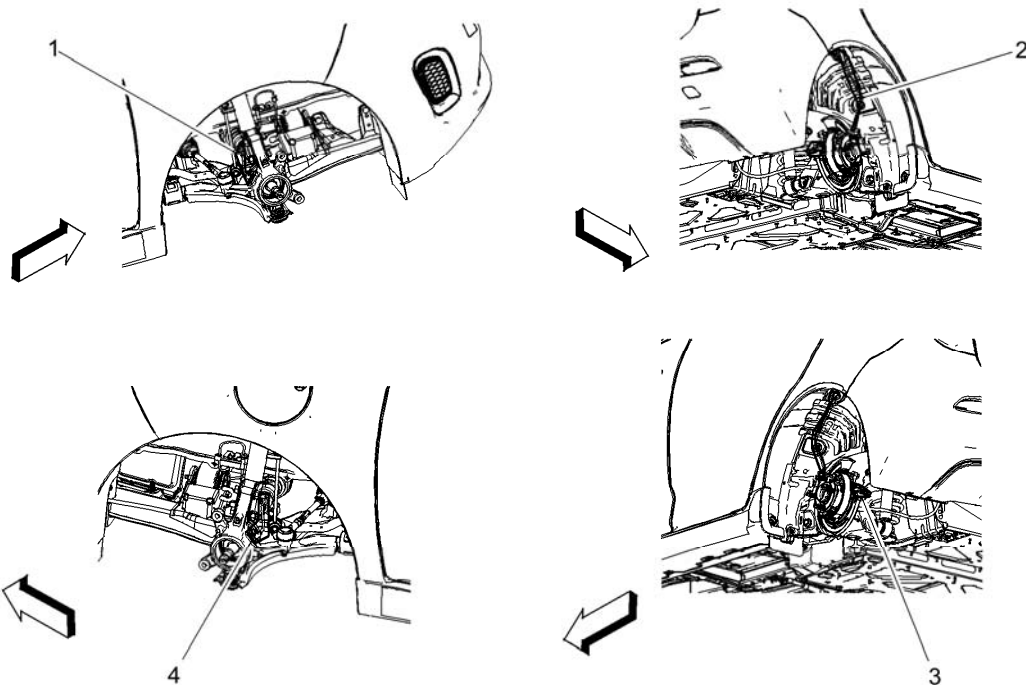


Fig. 9: Subsystem References (4 of 5) Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Subsystem References (5 of 5) Wiring Schematics

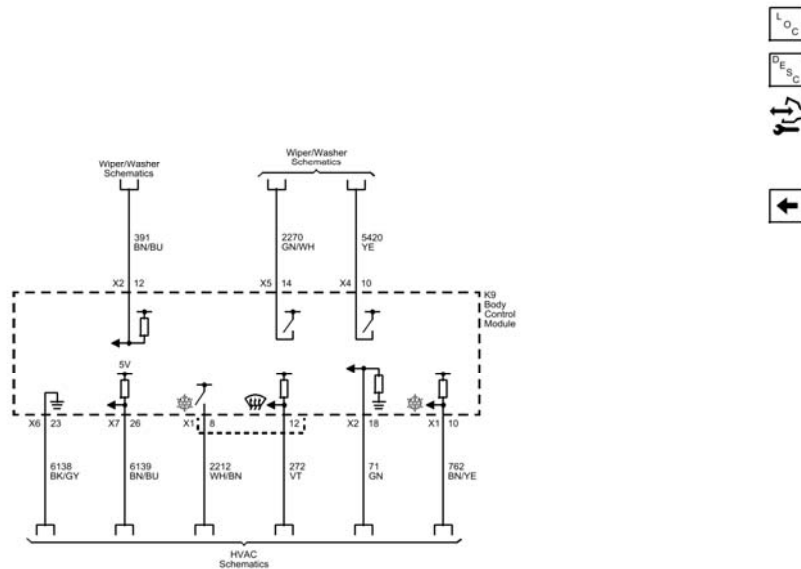


Fig. 10: Subsystem References (5 of 5) Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC B1000</u>	DTC B1000 Electronic Control Unit
<u>DTC B1001</u>	DTC B1001 Option Configuration
<u>DTC B101D</u>	DTC B101D Electronic Control Unit Hardware
<u>DTC B101E</u>	DTC B101E Electronic Control Unit Software
<u>DTC C056D</u>	DTC C056D Electronic Control Unit Hardware
<u>DTC C056E</u>	DTC C056E Electronic Control Unit Software
<u>DTC P0601-P0606, P060A, P062F, or P262B</u>	DTC P0601 Control Module Read Only Memory Performance DTC P0602 Control Module Not Programmed DTC P0603 Control Module Long Term Memory Reset DTC P0604 Control Module Random Access Memory Performance

	DTC P0605 Control Module Programming Read Only Memory Performance DTC P0606 Control Module Processor Performance DTC P060A Control Module Monitoring Processor Performance DTC P062F Control Module Long Term Memory Performance DTC P262B Control Module Power Off Timer Performance
<u>DTC U0001</u>	DTC U0001 00 High Speed CAN Communication Bus Malfunction
<u>DTC U0020</u>	DTC U0020 Low Speed CAN Bus
<u>DTC U0073 or U2100</u>	DTC U0073 Control Module Communication Bus A Off DTC U2100 CAN Bus Communication
<u>DTC U0074</u>	DTC U0074 Control Module Communication Bus B Off
<u>DTC U0078</u>	DTC U0078 Control Module Communication Low Speed CAN Bus Off
<u>DTC U0100-U02FF</u>	See <u>Control Module U Code List</u>
<u>DTC U0300-U0336</u>	See <u>Control Module U Code List</u>
<u>DTC U0400-U05FF</u>	See <u>Control Module U Code List</u>
<u>DTC U1500-U15FF</u>	See <u>Control Module U Code List</u>
<u>DTC U1814</u>	DTC U1814 Powertrain Wake-Up Communication Circuit
<u>DTC U18B9-U18BF</u>	DTC U18B9 Primary High Speed CAN Bus Subnet Configuration List DTC U18BF Secondary High Speed CAN Bus Subnet Configuration List
<u>DTC U2099</u>	DTC U2099 High Speed Communication Enable Circuit
<u>DTC U2101</u>	DTC U2101 CAN Bus Maximum List of Control Modules

CONTROL MODULE U CODE LIST

This list includes all Data Communications related U-code DTCs in alphanumeric order with descriptors for all devices. Not all DTCs listed will be applicable to all vehicles.

For symptom byte information, refer to **Symptom Byte List** .

Control Module U Code List

DTC	DTC Descriptor
U0001	High Speed CAN Bus Malfunction
U0002	High Speed CAN Bus

U0009	High Speed CAN Bus [-] Shorted to Bus [+]
U0020	Low Speed CAN Bus
U0028	MOST Bus
U0029	MOST Bus Performance
U0073	Control Module Communication Bus A Off
U0074	Control Module Communication Bus B Off
U0075	Control Module Communication Object Detection CAN Bus Off
U0077	Control Module Communication Chassis Expansion CAN Bus Off
U0078	Control Module Communication Low Speed CAN Bus Off
U007A	Control Module Communication High Voltage Energy Management CAN Bus Off
U0100	Lost Communication With Engine Control Module
U0101	Lost Communication With Transmission Control Module
U0102	Lost Communication with Transfer Case Control Module
U0103	Lost Communication with Shift Lever Module
U0104	Lost Communication With Cruise Control Module
U0105	Lost Communication with Fuel Injector Control Module
U0106	Lost Communication with Glow Plug Control Module
U0109	Lost Communication with Fuel Pump Control Module (2013 and prior)
	Lost Communication with Chassis Control Module (2014 and beyond)
U010E	Lost Communication with Reductant Sensor Module
U010F	Lost Communication with Air Conditioning Control Module
U0111	Lost Communication with Battery Energy Control Module
U0112	Lost Communication with Battery Energy Control Module
U0115	Lost Communication with Engine Control Module B
U0117	Lost Communication With Power Take-Off Control Module
U0121	Lost Communication With Electronic Brake Control Module
U0122	Lost Communication With Vehicle Stability Control Module
U0123	Lost Communication with Yaw Rate Sensor Module
U0125	Lost Communication With Multi-axis Acceleration Sensor Module
U0126	Lost Communication With Steering Wheel Angle Sensor Module
U0128	Lost Communication With Park Brake Control Module
U0129	Lost Communication with Brake System Control Module
U012A	Lost Communication With Chassis Control Module
U0130	Lost Communication With Electric Power Steering Control Module
U0131	Lost Communication With Power Steering Control Module
U0132	Lost Communication With Suspension Control Module
U0133	Lost Communication With Air Suspension Control Module
U0136	Lost Communication With Differential Control Module - Rear
U0137	Lost Communication with Trailer Brake Control Module
U0139	Lost Communication With Suspension Control Module
U0140	Lost Communication With Body Control Module

U0146	Lost Communication with Infotainment Gateway Module
U0151	Lost Communication With Inflatable Restraint Sensing and Diagnostic Module
U0155	Lost Communication With Instrument Cluster
U0158	Lost Communication With Head-Up Display
U0159	Lost Communication With Parking Assist Control Module
U0160	Lost Communication With Chime Alarm Control Module
U0164	Lost Communication with HVAC Control Module
U0166	Lost Communication with Auxiliary Heater Control Module
U0167	Lost Communication with Immobilizer Control Module
U0168	Lost Communication With Keyless Entry Control Module
U016B	Lost Communication with Electric A/C Compressor Control Module
U0170	Lost Communication with Passenger Presence Detection Sensor Module
U0181	Lost Communication With Headlamp Leveling Control Module
U0182	Lost Communication With Lighting Control Module - Front
U0184	Lost Communication With Radio
U0186	Lost Communication With Speaker Amplifier Module
U0196	Lost Communication With Rear Audio Control Module
U0191	Lost Communication With Television
U0193	Lost Communication With Digital Radio Receiver Control Module
U0197	Lost Communication With Telephone Control Module
U0198	Lost Communication With Telematic Control Module
U0201	Lost Communication With Transfer Case Control Module
U0203	Lost Communication With Left Rear Door Switch Panel Control Module
U0204	Lost Communication With Right Rear Door Switch Panel Control Module
U0207	Lost Communication With Moveable Roof Control Module
U0208	Lost Communication with Seat Memory Control Module
U0209	Lost Communication With Front Seat Heating Control Module
U0210	Lost Communication With Rear Seat Heating Control Module
U0230	Lost Communication With Liftgate Control Module
U0232	Lost Communication with Side Object Detection Control Module - Left
U0233	Lost Communication with Side Object Detection Control Module - Right
U0236	Lost Communication With Steering Column Lock Module
U0237	Lost Communication With Multimedia Player Interface Module
U023A	Lost Communication With Vehicle Direction Camera Control Module (<i>without UGN</i>)
	Lost Communication With Active Safety Control Module (<i>with UGN</i>)
U0248	Lost Communication with Remote Accessory Module
U0249	Lost Communication with Entertainment Control Module - Rear
U0250	Lost Communication with Impact Classification System Module
U0252	Lost Communication With Trailer Interface Control Module
U0254	Lost Communication With Remote Start Module

U0255	Lost Communication With Info Display Module
U0256	Lost Communication With Infotainment Faceplate Control Module
U0257	Lost Communication With Info Display Module/Infotainment Faceplate Control Module
U025B	Lost Communication with Special Purpose Vehicle Control Module "C"
U0264	Lost Communication With Camera Module - Rear
U0265	Lost Communication with Left Front Short Range Radar Sensor Module
U0268	Lost Communication with Right Front Short Range Radar Sensor Module
U0269	Lost Communication with Front Long Range Object Sensor
U026A	Lost Communication with Frontview Camera Module
U026B	Lost Communication with Rear Short Range Object Sensor
U0293	Lost Communication with Hybrid/EV Powertrain Control Module
U029D	Lost Communication with NOx Sensor 1 Module
U029E	Lost Communication with NOx Sensor 2 Module
U02A3	Lost Communication With Particulate Matter Sensor Module
U0301	Software Incompatibility with Engine Control Module
U0302	Software Incompatibility with Transmission Control Module
U0305	Software Incompatibility With Cruise Control Module
U0315	Software Incompatibility with Electronic Brake Control Module
U0401	Invalid Data Received From Engine Control Module
U0402	Invalid Data Received From Transmission Control Module
U0403	Invalid Data Received From Transfer Case Control Module
U0405	Invalid Data Received From Cruise Control Module
U0415	Invalid Data Received From Electronic Brake Control Module
U0416	Invalid Data Received From Vehicle Dynamics Control Module
U0417	Invalid Data Received From Park Brake Control Module
U0418	Invalid Data Received From Brake System Control Module
U0420	Invalid Data Received From Power Steering Control Module
U0421	Invalid Data Received From Suspension Control Module
U0422	Invalid Data Received From Body Control Module
U0423	Invalid Data Received From Instrument Cluster
U0424	Invalid Data Received From HVAC Control Module
U0428	Invalid Data Received From Steering Wheel Angle Sensor Module
U042B	Invalid Data Received From Chassis Control Module
U0431	Invalid Data Received From Body Control Module "A"
U0432	Invalid Data Received From Multi-axis Acceleration Sensor Module
U0437	Invalid Data Received From Differential Control Module - Rear
U0438	Invalid Data Received From Trailer Brake Control Module
U0452	Invalid Data Received From Inflatable Restraint Sensing and Diagnostic Module
U045A	Invalid Data Received From Parking Assist Control Module "A"
U0465	Invalid Data Received From Power Take-Off Control Module

U0499	Invalid Data Received From Telematic Control Module
U0513	Invalid Data Received From Yaw Rate Sensor Module
U053B	Invalid Data Received From Active Safety Control Module
U056B	Invalid Data Received From Camera Module - Front
U0594	Invalid Data Received From Hybrid/EV Powertrain Control Module
U1501	LIN Bus
U1502	LIN Bus
U1505	LIN Bus
U1509	LIN Bus
	A26 HVAC Controls / P17 Info Display Module Lost Communication with K33 HVAC Control Module on LIN Bus
U150E	LIN Bus
	A22 Radio Controls / P17 Info Display Module Lost Communication with A11 Radio on LIN Bus
U150F	LIN Bus
	A22 Radio Controls / P17 Info Display Module Lost Communication with K74 Human Machine Interface Control Module on LIN Bus
U1510	K9 Body Control Module Lost Communication with B67 Ultrasonic Intrusion Sensor / B165 Content Theft Deterrent Sensor Module on LIN Bus
	K33 HVAC Control Module Lost Communication with A26 HVAC Controls / A20 Radio/HVAC Controls / P17 Info Display Module on LIN Bus
	A11 Radio Lost Communication with A20 Radio/HVAC Control / P17 Info Display Module on LIN Bus
	K39 Liftgate Control Module Lost Communication with K171 Hands-Free Liftgate Sensor Control Module on LIN Bus
	P16 Instrument Cluster Lost Communication with S70R Steering Wheel Controls Switch - Right on LIN Bus
U1511	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13L Headlamp - Left on LIN Bus
	K40 Seat Memory Control Module Lost Communication with K99 Steering Column Position Control Module on LIN Bus
U1512	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13R Headlamp - Right on LIN Bus
U1513	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13L Headlamp - Left on LIN Bus
U1514	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13R Headlamp - Right on LIN Bus
U1515	K9 Body Control Module Lost Communication with M75 Windshield Wiper Motor on LIN Bus
U1516	K9 Body Control Module Lost Communication with B110 Battery Sensor Module on LIN Bus
U1517	K9 Body Control Module Lost Communication with K62 Sunroof Sunshade Motor Module on LIN Bus

U1518	P16 Instrument Cluster Lost Communication with P29 Head-Up Display on LIN Bus
U1519	K40 Seat Memory Control Module Lost Communication with S52 Outside Rearview Mirror Switch on LIN Bus
	K40 Seat Memory Control Module Lost Communication with K96 Mirror Control Module / K96L Mirror Control Module - Left on LIN Bus
U151A	K9 Body Control Module Lost Communication with B117 Rain Sensor / B177 Rain/Ambient Light Sensor Module on LIN Bus
U151B	K9 Body Control Module Lost Communication with K61 Sunroof Control Module on LIN Bus
	K40 Seat Memory Control Module Lost Communication with S79P Window Switch - Passenger on LIN Bus
U151C	K33 HVAC Control Module Lost Communication with K33A HVAC Control Module - Auxiliary on LIN Bus
U1520	K9 Body Control Module Lost Communication with P25 Power Sounder Content Theft Deterrent Alarm Module on LIN Bus
U1521	K9 Body Control Module Lost Communication with S48E Multifunction Switch - Center Console on LIN Bus
	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13L Headlamp - Left on LIN Bus
U1522	K9 Body Control Module Lost Communication with K65 Tire Pressure Indicator Module / B178 Tire Pressure Sensor Locator Module on LIN Bus
	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13R Headlamp - Right on LIN Bus
U1523	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13L Headlamp - Left on LIN Bus
U1524	K9 Body Control Module Lost Communication with K29 Seat Heating Control Module / K29F Seat Heating Control Module - Front on LIN Bus
	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13R Headlamp - Right on LIN Bus
U1526	K9 Body Control Module Lost Communication with K29R Seat Heating Control Module - Rear on LIN Bus
U1528	K40D Seat Memory Control Module - Driver Lost Communication with S64D Seat Adjuster Switch - Driver on LIN Bus
	K40P Seat Memory Control Module - Passenger Lost Communication with S64P Seat Adjuster Switch - Passenger on LIN Bus
U152C	K9 Body Control Module Lost Communication with K18 Compass Module on LIN Bus
U152D	K9 Body Control Module Lost Communication with P2 Transmission Shift Lever Position Indicator on LIN Bus
U1530	K9 Body Control Module Lost Communication with M74P Window Motor - Passenger on LIN Bus
U1531	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13LA Headlamp Assembly - Left on LIN Bus

U1532	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13RA Headlamp Assembly - Right on LIN Bus
U1534	K9 Body Control Module Lost Communication with M74D Window Motor - Driver on LIN Bus
U1538	K9 Body Control Module Lost Communication with S79D Window Switch - Driver on LIN Bus
U153A	K9 Body Control Module Lost Communication with S79P Window Switch - Passenger on LIN Bus
U1540	K9 Body Control Module Lost Communication with M74RR Window Motor - Right Rear on LIN Bus
U1544	K9 Body Control Module Lost Communication with M74LR Window Motor - Left Rear on LIN Bus
U1548	K9 Body Control Module Lost Communication with S79LR Window Switch - Left Rear on LIN Bus
U154A	K9 Body Control Module Lost Communication with S79RR Window Switch - Right Rear on LIN Bus
U154B	K9 Body Control Module Lost Communication with K49 Rear Seat Control Module on LIN Bus
U1550	K9 Body Control Module Lost Communication with S31D Seat Heating and Cooling Switch - Driver on LIN Bus
U1556	K38 Chassis Control Module Lost Communication with K133 Trailer Brake Power Control Module on LIN Bus
U1558	K9 Body Control Module Lost Communication with S31P Seat Heating and Cooling Switch - Passenger on LIN Bus
U15E1	A11 Radio Lost Communication with A26 HVAC Controls / P17 Info Display Module on LIN Bus
U15F0	K74 Human Interface Control Module Lost Communication with P17 Info Display Module on LIN Bus
U1793	14V Power Module Lost Communication with Hybrid/EV Powertrain Control Module on Powertrain Expansion Communication Bus
U1795	14V Power Module Powertrain Expansion Communication Bus Off
U179A	Lost Communication with Hybrid/EV Powertrain Control Module 2
U1803	Lost Communication with Hybrid/EV Powertrain Control Module 2
U1804	Lost Communication with Inside Rearview Mirror Control Module
U1806	Battery Energy Control Module High Voltage Energy Management CAN Bus Off
U1807	Battery Charger Control Module High Voltage Energy Management CAN Bus Off
U180A	Electric A/C Compressor Control Module High Speed CAN Bus Off
U180B	Battery Energy Control Module High Speed CAN Bus Off
U180C	Battery Charger Control Module High Speed CAN Bus Off
U180D	Electronic Brake Control Module Chassis Expansion CAN Bus Off
U1811	Battery Energy Control Module Powertrain Expansion CAN Bus Off
U1814	Powertrain Wake-Up Communication Circuit
U1815	Lost Communication with Drive Motor Control Module 1 on Bus B

U1816	Lost Communication with Drive Motor Control Module B on Bus B
U1817	Lost Communication with Hybrid/EV Powertrain Control Module on Powertrain Expansion CAN Bus
U1818	Lost Communication with Engine Control Module on Powertrain Expansion Communication Bus
U1821	Lost Communication with 14V Power Module on Powertrain Expansion Communication Bus
U1826	Lost Communication with Multi-Axis Acceleration Sensor Module on Powertrain Expansion CAN Bus
U1827	Lost Communication with Steering Angle Sensor Module on Powertrain Expansion CAN Bus
U182A	Hybrid/EV Powertrain Control Module Lost Communication with Battery Energy Control Module on Powertrain Expansion CAN Bus
U182D	Lost Communication with Hybrid/EV Powertrain Control Module 2 on Powertrain Expansion Communication Bus
U182E	Drive Motor Control Module 1 Lost Communication with Hybrid/EV Powertrain Control Module 2 on Powertrain Expansion Communication Bus
U182F	Drive Motor Control Module 2 Lost Communication with Hybrid/EV Powertrain Control Module 2 on Powertrain Expansion Communication Bus
U1831	Drive Motor Control Module 1 Lost Communication with Hybrid/EV Powertrain Control Module on Powertrain Expansion CAN Bus
U1833	Lost Communication with Electronic Brake Control Module on Chassis Expansion CAN Bus
U1838	Lost Communication with Battery Charger Control Module on High Voltage Energy Management CAN Bus
U1839	Auxiliary Transmission Fluid Pump Control Module Lost Communication with Engine Control Module
U183A	Lost Communication with Telematics Communication Interface Control Module on High Speed CAN Bus
U183B	Auxiliary Transmission Fluid Pump Control Module Lost Communication with Transmission Control Module
U183C	Auxiliary Transmission Fluid Pump Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2 on Powertrain Expansion Communication Bus
U183E	Lost Communication with Telematics Communication Interface Control Module on Low Speed CAN Bus
U1844	Battery Energy Control Module Lost Communication with Hybrid/EV Powertrain Control Module on Bus B
U1845	Drive Motor Control Module 1 Lost Communication with Hybrid/EV Powertrain Control Module
U1846	Drive Motor Control Module 2 Lost Communication with Hybrid/EV Powertrain Control Module
U1847	Drive Motor Control Module 1 Lost Communication with Battery Energy Control Module on Powertrain Expansion CAN Bus

U1849	Drive Motor Control Module 1 Lost Communication with Transmission Control Module
U184A	Lost Communication with Body Control Module on Low Speed CAN Bus
U184B	Lost Communication with Remote Heater and Air Conditioning Control Module on Low Speed CAN Bus
U184C	Lost Communication with Instrument Cluster on Low Speed CAN Bus
U184D	Lost Communication with Radio on Low Speed CAN Bus
U184E	Lost Communication with Inflatable Restraint Sensing and Diagnostic Module on Low Speed CAN Bus
U184F	Electric A/C Compressor Control Module Lost Communication with Engine Control Module
U1850	Drive Motor Control Module 2 Lost Communication with Transmission Control Module
U1858	Electronic Brake Control Module Lost Communication with Hybrid/EV Powertrain Control Module on Chassis Expansion CAN Bus
U185A	Lost Communication with Battery Energy Control Module on High Voltage Energy Management CAN Bus
U185B	Battery Energy Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2 on High Voltage Energy Management CAN Bus
U185C	Battery Charger Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2 on High Voltage Energy Management CAN Bus
U185D	Fuel Injector Control Module Lost Communication with Engine Control Module
U185E	Fuel Injector Control Module Lost Communication with Body Control Module
U1860	Electric A/C Compressor Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2
U1861	Battery Charger Control Module Lost Communication with Engine Control Module
U186A	Electronic Brake Control Module Lost Communication with Engine Control Module
U186B	Electronic Brake Control Module Lost Communication with Transmission Control Module
U1875	Drive Motor Control Module 1 Lost Communication with Battery Energy Control Module
U1876	Drive Motor Control Module 1 Lost Communication with Engine Control Module
U1879	Drive Motor Control Module 2 Lost Communication with Engine Control Module
U1885	Battery Energy Control Module Lost Communication with Hybrid/EV Powertrain Control Module
U1886	Battery Energy Control Module Lost Communication with Engine Control Module
U1888	Hybrid/EV Powertrain Control Module Lost Communication with Battery Energy Control Module
U18A1	Lost Communication with Coolant Temperature Control Module on High Voltage Energy Management CAN Bus
U18A2	Lost Communication with Fuel Pump Driver Control Module
U18A3	Lost Communication with Human Machine Interface Control Module

U18A4	Lost Communication with Hybrid/EV Battery DC Charging Communications Gateway Module on High Voltage Energy Management CAN Bus
U18A5	Lost Communication with Fuel Injector Control Module on Powertrain Expansion CAN Bus
U18A6	Lost Communication with Right Object Detection Control Module on Dedicated Bus 1
U18B9	Primary High Speed CAN Bus Subnet Configuration List
U18BF	Secondary High Speed CAN Bus Subnet Configuration List
U1900	Lost Communication With Speech to Text Interface Module
U1901	Lost Communication with Infotainment Multifunction Switch Module
U2098	MOST Communication Enable Circuit
U2099	High Speed Communication Enable Circuit
U209E	Object Detection Control Module High Speed Communication Enable Circuit 1
U209F	Object Detection Control Module High Speed Communication Enable Circuit 2
U2100	CAN Bus Communication
U2101	CAN Bus Maximum List of Control Modules
U2103	Fewer Controllers On Bus Than Programmed
U2105	Lost Communication with Engine Control Module
U2106	Lost Communication with Transmission Control Module
U2107	Lost Communication with Body Control Module
U2108	Lost Communication with Electronic Brake Control Module
U2125	Lost Communication with Telematic Unit
U2127	Lost Communication with Front HVAC Control Module
U2139	Lost Communication with Column Integration Module
U2144	Lost Communication with Distance Sensing Cruise Control Module
U216A	Lost Communication with Front Object Detection Control Module
U216B	Lost Communication with Rear Object Detection Control Module
U2176	Lost Communication with Power Take-Off Control Module
U2178	Lost Communication With Trailer Interface Control Module
U2400	Fuel Injector Control Module High Speed CAN Bus Off
U2401	Battery Energy Control Module Dedicated Bus 1 Off
U2501	Invalid Data Received From Hybrid/EV Powertrain Control Module 2
U2502	Invalid Data Received From Electronic Brake Control Module on Chassis Expansion CAN Bus
U2503	Invalid Data Received From Object Detection Control Module
U2504	Invalid Data Received From Trailer Brake Driver Control Module
U2505	Invalid Data Received from Human Machine Interface Control Module on MOST Bus
U2506	Invalid Data Received From Dual Battery Control Module
U2507	Invalid Data Received from Instrument Cluster on MOST Bus
U2508	Invalid Data Received from Audio Amplifier on MOST Bus
	Battery Energy Control Module Lost Communication with Hybrid/EV Powertrain

U2602	Control Module 2
U2603	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 1
U2604	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 2
U2605	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 3
U2606	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 4
U2608	Electric A/C Compressor Control Module Lost Communication with Hybrid/EV Powertrain Control Module
U2609	Battery Charger Control Module Lost Communication with Hybrid/EV Powertrain Control Module
U2611	Auxiliary Transmission Fluid Pump Control Module Lost Communication with Hybrid/EV Powertrain Control Module
U2612	Battery Charger Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2
U2613	Drive Motor 1 Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2
U2614	Drive Motor 2 Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2
U2615	Auxiliary Transmission Fluid Pump Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2
U2616	Fuel Pump Driver Control Module Lost Communication with ECM
U2617	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 5
U2618	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 6
U2619	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 7
U2620	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 8
U2621	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 9
U2622	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 10

DTC B1000: ELECTRONIC CONTROL UNIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B1000

Electronic Control Unit

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

The internal fault detection is handled inside the device. The symptom byte information is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

The device runs the program to detect an internal fault when power up is commanded. The only requirements are voltage and ground. This program runs even if the voltage is out of the valid operating range.

Conditions for Setting the DTC

The device has detected an internal malfunction.

Action Taken When the DTC Sets

The device refuses all additional inputs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- This DTC may be stored as a history DTC without affecting the operation of the device.
- If stored only as a history DTC and not retrieved as a current DTC, do not replace the device.
- If this DTC is retrieved as both a current and history DTC, replace the device that set the DTC.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC B1000 is not set.
 - **If DTC B1000 is set**

Replace the device that set the DTC.

- **If DTC B1000 is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

DTC B1001: OPTION CONFIGURATION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B1001

Option Configuration

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

Some devices must be configured with serial numbers, vehicle options, or other information. If a device was not properly configured after installation that device may set DTC B1001. The symptom byte information is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

Battery voltage is between 9-16 V and data link communications operate normally.

Conditions for Setting the DTC

The device is not configured properly.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC B1001 is not set.
 - **If DTC B1001 is set**
 1. Program the device that set the DTC.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the device that set the DTC.
 - If the DTC does not set
 - **If DTC B1001 is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

DTC B101D: ELECTRONIC CONTROL UNIT HARDWARE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B101D

Electronic Control Unit Hardware

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

The internal fault detection is handled inside the device. The symptom byte information is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

- The device runs the program to detect an internal fault when power up is commanded. The only requirements are voltage and ground. This program runs even if the voltage is out of the valid operating range.
- The keyless entry control module will set this DTC with symptom byte 39 when the keyless entry control module antenna is activated.

Conditions for Setting the DTC

The device has detected an internal malfunction.

Action Taken When the DTC Sets

The device refuses all additional inputs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- This DTC may be stored as a history DTC without affecting the operation of the device.
- Do not replace a device based only on DTC B101D being set in history with the exception of the following devices:
 - K36 Inflatable Restraint Sensing and Diagnostic Module (SDM)
 - K85 Passenger Presence Detection Module
- If DTC B101D is set as current, replace the appropriate device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC B101D is not set.
 - **If DTC B101D is set with symptom byte 43**
 1. Program the device that set the DTC.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the device that set the DTC.
 - If the DTC does not set
 - 3. All OK.
 - **If DTC B101D is set with any symptom byte, except symptom byte 43**

Replace the device that set the DTC.
 - **If DTC B101D is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

DTC B101E: ELECTRONIC CONTROL UNIT SOFTWARE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B101E

Electronic Control Unit Software

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

Some devices must be configured with specific software, serial numbers, vehicle options, or other information. If a device was not properly configured after installation that module may set DTC B101E. The symptom byte information is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

Battery voltage is between 9-16 V and data link communications operate normally.

Conditions for Setting the DTC

The device is not configured properly.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC U0028 or U0029 is not set.
 - **If any of the DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If none of the DTCs are set**
3. Verify DTC B101E is not set.
 - **If DTC B101E is set**
 1. Program the device that set the DTC.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the device that set the DTC.
 - If the DTC does not set
 3. All OK.
 - **If DTC B101E is not set**
 4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

DTC C056D: ELECTRONIC CONTROL UNIT HARDWARE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC C056D

Electronic Control Unit Hardware

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

The internal fault detection is handled inside the device. The symptom byte information is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

The device runs the program to detect an internal fault when power up is commanded. The only requirements are voltage and ground. This program runs even if the voltage is out of the valid operating range.

Conditions for Setting the DTC

The device has detected an internal malfunction.

Action Taken When the DTC Sets

The device refuses all additional inputs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- This DTC may be stored as a history DTC without affecting the operation of the device.
- If stored only as a history DTC and not retrieved as a current DTC, do not replace the device.
- If this DTC is retrieved as both a current and history DTC, replace the device that set the DTC.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC C056D is not set.
 - **If DTC C056D is set in a device that can be programmed**
 1. Program the device that set the DTC.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the device that set the DTC.
 - If the DTC does not set
 - 3. All OK.
 - **If DTC C056D is set in a device that cannot be programmed**

Replace the device that set the DTC.
 - **If DTC C056D is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

DTC C056E: ELECTRONIC CONTROL UNIT SOFTWARE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC C056E

Electronic Control Unit Software

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

Some devices must be configured with specific software, serial numbers, vehicle options, or other information. If a device was not properly configured after installation that module may set DTC C056E. The symptom byte information is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

Battery voltage is between 9-16 V and data link communications operate normally.

Conditions for Setting the DTC

The device is not configured properly.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

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- **Wiring Repairs**

Scan Tool References

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC C056E is not set.
 - **If DTC C056E is set**
 1. Program the device that set the DTC.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the device that set the DTC.
 - If the DTC does not set
 - **If DTC C056E is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

DTC P0601-P0606, P060A, P062F, OR P262B: CONTROL MODULE MEMORY

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0601

Control Module Read Only Memory Performance

DTC P0602

Control Module Not Programmed

DTC P0603

Control Module Long Term Memory Reset

DTC P0604

Control Module Random Access Memory Performance

DTC P0605

Control Module Programming Read Only Memory Performance

DTC P0606

Control Module Processor Performance

DTC P060A

Control Module Monitoring Processor Performance

DTC P062F

Control Module Long Term Memory Performance

DTC P262B

Control Module Power Off Timer Performance

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

This diagnostic applies to internal microprocessor integrity conditions within the device. This diagnostic also addresses if the device is not programmed. The device monitors its ability to read and write to the memory. It also monitors a timing function. No external circuits are involved.

Conditions for Running the DTC

- The ignition is ON.
- The system voltage is greater than 9.5 V.

Conditions for Setting the DTC

The device detects an internal malfunction or incomplete programming.

Action Taken When the DTC Sets

DTCs P0601-P0606, P060A, P062F, and P262B are Type A DTCs.

Conditions for Clearing the DTC

DTCs P0601-P0606, P060A, P062F, and P262B are Type A DTCs.

Diagnostic Aids

If stored only as a history DTC and not retrieved as a current DTC, do not replace the device.

Reference Information

Schematic Reference

Data Communication Schematics

Connector End View Reference

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DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool References

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC P0602 is not set.
 - **If DTC P0602 is set**
 1. Program the device that set the DTC.
 2. Verify that the DTC does not set.
 - If the DTC sets, replace the device that set the DTC.
 - If the DTC does not set
 - 3. All OK.
 - **If DTC P0602 is not set**
3. Verify that DTC P0601, P0603, P0604, P0605, P0606, P060A, P062F, or P262B is not set.
 - **If any of the DTCs are set**

Replace the device that set the DTC.

- **If none of the DTCs are set**

4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

DTC U0001: HIGH SPEED CAN COMMUNICATION BUS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U0001 00

High Speed CAN Communication Bus Malfunction

Circuit Description

Devices connected to the GMLAN serial data circuits monitor for serial data communications on the GMLAN network during normal vehicle operation. Operating information and commands are exchanged among the devices. Each device on GMLAN network maintains a transmit error counter and a receive error counter. The counter values increase with detected errors and will decrease with error-free messages. If the transmit error counter value exceeds 255 the device removes itself from the network and a DTC U0001 will be set.

Conditions for Running the DTC

- System voltage is in the normal operating voltage range.
- The vehicle power mode requires serial data communication to occur.

Conditions for Setting the DTC

A certain number of no valid transmitted messages on the GMLAN serial data circuits are detected by the device.

Action Taken When the DTC Sets

- The device suspends all message transmission.
- The device uses default values for all parameters received on the GMLAN serial data circuits.

- The device inhibits the setting of all other GMLAN communication DTCs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Circuit/System Verification

This DTC may not be retrieved with a current status. Diagnosis is accomplished via the symptom, Scan Tool Does Not Communicate with High Speed GMLAN Device. Refer to **Scan Tool Does Not Communicate with High Speed GMLAN Device** in order to isolate an intermittent condition caused by a short on the GMLAN serial data circuits.

DTC U0020: LOW SPEED CAN BUS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC U0020

Low Speed CAN Bus

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

Devices connected to the GMLAN serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have programmed information about what messages are needed to be exchanged on the serial data circuits. The messages are also supervised and some periodic messages are used by the receiver device as an availability indication of the transmitter device.

Conditions for Running the DTCs

- Supply voltage to the devices is in the normal operating range.
- The vehicle power mode requires serial data communication to occur.
- The DTC U2100 does not have a current status.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTCs Sets

The device uses a default value for the missing parameter.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Circuit/System Verification

Diagnosis of this DTC is accomplished via the symptom or an additional DTC. Refer to **Scan Tool Does Not Communicate with Low Speed GMLAN Device**, or **Diagnostic Trouble Code (DTC) List - Vehicle** .

DTC U0073 OR U2100: CONTROL MODULE COMMUNICATION BUS A/CAN BUS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC U0073

Control Module Communication Bus A Off

DTC U2100

CAN Bus Communication

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

The serial data circuits are used to communicate information between the devices. The serial data circuits also connect directly to the data link connector (DLC).

Conditions for Running the DTCs

- Supply voltage to the devices is in the normal operating range.
- The vehicle power mode requires serial data communications.

Conditions for Setting the DTC

The device setting the DTC has attempted to establish communications on the serial data circuits more than 3 times in 5 s.

Action Taken When the DTCs Sets

- The device suspends all message transmission.
- The device uses default values for all parameters received on the serial data circuits.
- In the transmission control module, DTC U0073 will cause the transmission to go into default gears.
- In the engine control module and transmission control module, DTC U0073 will cause the malfunction indicator lamp (MIL) to illuminate.
- If equipped with eAssist, DTC U0073 in the hybrid powertrain control module is a type B DTC and will cause the malfunction indicator lamp to illuminate and result in the engine operating in conventional engine mode and will maintain 14 V module operation.
- The device inhibits the setting of all other communication DTCs.

Conditions for Clearing the DTC

- The engine control module or transmission control module turns OFF the MIL after 4 consecutive ignition cycles that the diagnostic runs and does not fail.
- If equipped with eAssist, the hybrid powertrain control module turns off the MIL after the diagnostic runs and does not fail during subsequent ignition cycles. Normal operation will resume 5 s after subsequent ignition cycle.
- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Circuit/System Verification

1. Refer to **Data Link References** to determine which serial data communication system is used for a specific device.
2. This DTC may not be retrieved with a current status. Diagnosis is accomplished using the symptom. Refer to **Symptoms - Data Communications**.

DTC U0074: CONTROL MODULE COMMUNICATION BUS B

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U0074

Control Module Communication Bus B Off

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Chassis High Speed GMLAN Serial Data (+)	U0074	U0074, U0100-U02FF*	U0074	-
Chassis High Speed GMLAN Serial Data (-)	U0074	U0074, U0100-U02FF*	U0074	-
Ground (DLC, terminal 5)	-	1	-	-
* An open between the data link connector (DLC) and the first splice/device will only affect the communication with the scan tool. The devices will still communicate. An open in only one chassis high speed GMLAN serial data circuit may allow degraded communication between the devices. 1. No communication with any chassis high speed GMLAN device.				

Circuit/System Description

The devices connected to the chassis high speed GMLAN serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices when the ignition switch is in any position other than OFF. The chassis high speed GMLAN serial data bus uses terminating resistors that are in parallel with the chassis high speed GMLAN (+) and (-) circuits.

Conditions for Running the DTC

The system voltage is between 9-16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

Specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Use the **Data Link References** to identify the chassis high speed GMLAN devices.
- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of-communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss-of-communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between some devices and the scan tool with the chassis high speed GMLAN serial data system inoperative. This condition is due to those devices using multiple serial data communication systems.
- An open in the DLC ground circuit terminal 5 will allow the scan tool to operate but not communicate with the vehicle.
- Technicians may find various Local Area Network (LAN) communication Diagnostic Trouble Codes (DTC).
- Some devices may not have internal protection for specific voltage outputs and may open a battery positive voltage or ignition voltage source fuse. If a voltage input fuse is open and no short is found in that circuit, ensure that no device output voltage circuit is shorted to ground before replacing the device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify two or more devices are not communicating on the chassis high speed GMLAN serial data circuit. Refer to **Data Link References** to determine how many devices should be communicating on the bus.
 - **If only one device is not communicating**

Refer to Circuit/System Testing - Testing the Device Circuits.

- **If two or more devices are not communicating**
3. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the scan tool from the X84 Data Link Connector. The following tests will be done at the X84 Data Link Connector. It may take up to 2 minutes for all vehicle systems to power down.
 4. Test for less than 10 ohms between the ground circuit terminal 5 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
 5. Ignition ON.
 6. Test for less than 4.5 V between the serial data circuits listed below and ground:
 - Chassis high speed GMLAN serial data terminal 12
 - Chassis high speed GMLAN serial data terminal 13
 - **If 4.5 V or greater**

Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short to Voltage.

- **If less than 4.5 V**
7. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.

8. Test for greater than 100 ohms between the serial data circuits listed below and ground:

- Chassis high speed GMLAN serial data terminal 12
- Chassis high speed GMLAN serial data terminal 13
- **If 100 ohms or less**

Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short to Ground.

- **If greater than 100 ohms**

9. Test for 50-70 ohms between the serial data circuit terminals 12 and 13:

- **If less than 35 ohms**

Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short between the Circuits.

- **If between 35-50 ohms**

There may be a third terminating resistor between the serial data circuits. This can happen if the incorrect device is installed. Some devices are available with and without the terminating resistors installed to reduce the need of terminating resistors in the wiring harness. Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short between the Circuits.

- **If greater than 70 ohms but less than infinite**

Refer to Circuit/System Testing - Testing the Serial Data Circuits for an Open/High Resistance.

- **If infinite resistance**

Repair the open/high resistance in the circuit between the X84 Data Link Connector and the first splice/device in the serial data circuit.

- **If between 50-70 ohms**

10. Refer to Circuit/System Testing - Testing the Device Circuits.

Circuit/System Testing

NOTE: Each device may need to be disconnected to isolate a circuit fault.

Use the schematic to identify the following:

- Chassis high speed GMLAN devices the vehicle is equipped with
- Chassis high speed GMLAN serial data circuit terminating resistors
- Device locations on the chassis high speed GMLAN serial data circuits
- Each device's ground, B+, ignition, and chassis high speed GMLAN serial data circuit terminals

Some devices with an internal terminating resistor have a loop in the harness that connects the internal terminating resistor to the serial data circuit. When wired this way, test these loop circuits for the appropriate failure mode short to voltage, short to ground, or open/high resistance prior to replacing the device for each of the following tests.

Testing the Serial Data Circuits for a Short to Voltage

1. Ignition OFF, disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at an easily accessible device, ignition ON.
2. Test for greater than 4.5 V between each serial data circuit at the device connector that was just disconnected and ground.
 - **If each serial data circuit is 4.5 V or less**
 1. Ignition OFF.
 2. Test for less than 10 ohms between each of the device's ground circuit terminals and ground.
 - If 10 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 10 ohms, replace the device that was disconnected.
 - **If any serial data circuit is greater than 4.5 V**
3. Ignition OFF, disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to voltage, ignition ON.
4. Test for greater than 4.5 V between each serial data circuit at the device connector that was just disconnected and ground.
 - **If each serial data circuit is 4.5 V or less**
 1. Ignition OFF.
 2. Test for less than 10 ohms between each of the device's ground circuit terminals and ground.
 - If 10 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 10 ohms, replace the device that was disconnected.
 - **If any serial data circuit is greater than 4.5 V**
5. Repeat step 3 until one of the following conditions are isolated:
 - A short to voltage on the serial data circuit between two devices or splice packs, if equipped.
 - A short to voltage on the serial data circuit between a device and a terminating resistor.

Testing the Serial Data Circuits for a Short to Ground

1. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at an easily accessible device.
3. Test for greater than 100 ohms between each serial data circuit at the device connector that was just disconnected and ground.
 - **If each serial data circuit is 100 ohms or greater**

Replace the device that was disconnected.

- **If any serial data circuit is less than 100 ohms**

4. Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to ground.
5. Test for greater than 100 ohms between each serial data circuit at the device connector that was just disconnected and ground.

- **If both serial data circuits are 100 ohms or greater**

Replace the device that was disconnected.

- **If any serial data circuit is less than 100 ohms**

6. Repeat step 4 until one of the following conditions are isolated:
 - A short to ground on the serial data circuit between two devices or splice packs, if equipped.
 - A short to ground on the serial data circuit between a device and a terminating resistor.
 - A short to ground on the serial data circuit between the X84 Data Link Connector and the first device or splice pack.

Testing the Serial Data Circuits for a Short between the Circuits

1. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at an easily accessible device that is not communicating.
3. Test for greater than 110 ohms between each pair of serial data circuits at the device connector that was just disconnected.

- **If each pair of serial data circuits is 110 ohms or greater**

Replace the device that was disconnected.

- **If any pair of serial data circuits is less than 110 ohms**

4. Connect the harness connectors at the device that was disconnected.
5. Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted together.
6. Test for greater than 110 ohms between each pair of serial data circuits at the device connector that was just disconnected.

- **If each pair of serial data circuits is 110 ohms or greater**

Replace the device that was disconnected.

- **If any pair of serial data circuits is less than 110 ohms**

7. Repeat step 4 until one of the following conditions are isolated:
 - Serial data circuits shorted together between two devices or splice packs, if equipped.

- Serial data circuits shorted together between a device and a terminating resistor.
- Serial data circuits shorted together between the X84 Data Link Connector and the first device or splice pack.
- A shorted terminating resistor.

Testing the Serial Data Circuits for an Open/High Resistance

1. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at an easily accessible device that is not communicating.
3. Test for less than 130 ohms between each pair of serial data circuits at the device connector that was just disconnected.

- **If each pair of serial data circuits is 130 ohms or less**

Replace the device that was disconnected.

- **If any pair of serial data circuits is greater than 130 ohms**

4. Connect the harness connectors at the device that was disconnected.
5. Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at another device, in the direction of the circuit with the open/high resistance.
6. Test for less than 130 ohms between each pair of serial data circuits at the device connector that was just disconnected.

- **If each pair of serial data circuits is 130 ohms or less**

Replace the device that was disconnected.

- **If any pair of serial data circuits is greater than 130 ohms**

7. Repeat step 4 until one of the following conditions are isolated:
 - An open/high resistance on the serial data circuit between two devices or splice packs, if equipped.
 - An open/high resistance on the serial data circuit between a device and a terminating resistor.
 - An open/high resistance terminating resistor.

Testing the Device Circuits

1. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the harness connectors at an easily accessible device that is not communicating.
3. Test for less than 10 ohms between each ground circuit terminal and ground.

- **If 10 ohms or greater**

1. Ignition OFF.
2. Test for less than 2 ohms in the ground circuit end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.
- If less than 2 ohms, repair the open/high resistance in the ground connection.
- **If less than 10 ohms**
- 4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the disconnected device.
 - **If the test lamp illuminates**
- 5. Ignition ON.
- 6. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which has a fuse in the circuit, and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the disconnected device.
 - **If the test lamp illuminates**
- 7. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground.
 - **If the test lamp does not illuminate**
 1. Ignition OFF, disconnect the harness connectors at the control module that controls the ignition circuit.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the ignition circuit end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.
- If less than 2 ohms, replace the control module that controls the ignition circuit.

- **If the test lamp illuminates**

8. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
9. Test for less than 130 ohms between each pair of chassis high speed GMLAN serial data circuits at the device connector that was just disconnected.
 - **If any pair of serial data circuits is greater than 130 ohms**

Repair the open/high resistance in the serial data circuits between the disconnected device and the circuit splice in the serial data circuits.

- **If each pair of serial data circuits is 130 ohms or less**

10. Replace the device that was disconnected.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **GMLAN and Media Oriented Systems Transport (MOST) Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U0078: CONTROL MODULE COMMUNICATION LOW SPEED CAN BUS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U0078

Control Module Communication Low Speed CAN Bus Off

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

The low speed GMLAN serial data bus is used to communicate information between the devices. The serial data is transmitted over a single wire to the appropriate devices. The low speed GMLAN serial data circuits also connect directly to the data link connector (DLC).

Conditions for Running the DTC

- Supply voltage to the devices are in the normal operating range.
- The vehicle power mode requires serial data communications.

Conditions for Setting the DTC

The device setting the DTC has attempted to establish communications on the serial data circuits more than 3 times in 5 s.

Action Taken When the DTC Sets

- The device suspends all message transmission.
- The device uses default values for all parameters received on the serial data circuits.
- The device inhibits the setting of all other communication DTCs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Circuit/System Verification

1. Ignition ON.
2. Verify DTC U0078 is not set.
 - If DTC U0078 is set

Refer to Scan Tool Does Not Communicate with Low Speed GMLAN Device.

- If DTC U0078 is not set
3. All OK

DTC U0100-U02FF: MODULE ERROR

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

For device DTC descriptors, refer to Control Module U Code List.

Diagnostic Fault Information

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Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U0100-U02FF	U0100-U02FF	-	-
Ignition	U0100-U02FF, U1814, U2099	U0100-U02FF	-	-
Object High Speed GMLAN Serial Data (+)	U0075	U0100-U02FF	U0075	-
Object High Speed GMLAN Serial Data (-)	U0075	U0100-U02FF	U0075	-
Chassis High Speed GMLAN Serial Data (+)	U0074, U0077	U0100-U02FF	U0074, U0077	-
Chassis High Speed GMLAN Serial Data (-)	U0074, U0077	U0100-U02FF	U0074, U0077	-
Mid Speed GMLAN Serial Data (+)	U0074	U0100-U02FF	U0074	-
Mid Speed GMLAN Serial Data (-)	U0074	U0100-U02FF	U0074	-
High Speed GMLAN Serial Data (+)	U0073, 2	U0100-U02FF	U0073, 2	-
High Speed GMLAN Serial Data (-)	U0073, 2	U0100-U02FF	U0073, 2	-
Low Speed GMLAN Serial Data	U0078, 1	U0100-U02FF	U0078, 1	-
Ground	-	U0100-U02FF	-	-
1. Scan tool does not communicate with most low speed GMLAN device 2. Scan tool does not communicate with most high speed GMLAN device				

Circuit/System Description

The serial data circuit is the means by which the devices in the vehicle communicate with each other. Once the scan tool is connected to the serial data circuit through the Data Link Connector (DLC), the scan tool can be used to monitor each device for diagnostic purposes and to check for Diagnostic Trouble Codes (DTC). When the ignition switch is in RUN, each device communicating on the serial data circuit sends a state of health message to ensure that the device is operating properly. When a device stops communicating on the serial data circuit, for example if the device loses power or ground, the state of health message it normally sends on the serial data circuit disappears. Other devices on the serial data circuit, which expect to receive that state of health message, detect its absence; those devices in turn set a DTC associated with the loss of state of health of the non-communicating device. The DTC is unique to the device which is not communicating and one or more devices may set the same exact code. A loss of serial data communications DTC does not represent a failure of the devices that contain the stored code.

Conditions for Running the DTC

The system voltage is between 9-16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

- Specific subsystems will not function.
- DTC U0100 in the Transmission Control Module will cause the transmission to go into default gears.
- Both DTC U0100 in the Transmission Control Module and DTC U0101 in the Engine Control Module will cause the malfunction indicator lamp (MIL) to illuminate.

Conditions for Clearing the DTC

- The Engine Control Module or Transmission Control Module turns OFF the MIL after 4 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between some devices and the scan tool with either the low or high speed GMLAN serial data system inoperative. This condition is due to those devices using multiple serial data communication systems.
- Use **Data Link References** to determine what serial data communications the device uses.

- Some devices may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the device.
- Some intermittent communication concerns may be caused by fretting corrosion on the serial data circuit terminals. Inspect all connectors at the device that set the communication DTC, the device that the communication DTC was set against, and any inline harness connectors between the two devices. Do not replace a device based only on fretting corrosion. Refer to bulletin 09-06-03-004 for assistance with the diagnosis and repair of this condition, if applicable.
- This diagnostic can be used for any device that is not communicating, regardless of the type of serial data circuit it is connected to, providing the vehicle is equipped with the device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Determine the device that is not communicating. Refer to **Control Module U Code List**.
2. Verify that DTC U0073, U2100, U0074, U0078, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
 - **If any of the DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If none of the DTCs are set**
- 3. Verify that DTC U0125 and DTC U0126 are not set together.
- **If both of the DTCs are set together**

Refer to **Scan Tool Does Not Communicate with Chassis High Speed GMLAN Device.**

- **If both of the DTCs are not set together**
- 4. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wakeup serial data, serial data communication enable, and serial data circuit terminals.

1. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect all the harness connectors at the device that is not communicating.
2. Test for less than 10 ohms between each ground circuit terminal and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Ignition ON.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the disconnected device.
 - **If the test lamp illuminates**
5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**

1. Ignition OFF.
 2. Test for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the disconnected device.
 - **If the test lamp illuminates**
 6. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground.
 - **If the test lamp does not illuminate**
 1. Ignition OFF, disconnect the harness connectors at the control module that controls the ignition circuit.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the control module that controls the ignition circuit.
 - **If the test lamp illuminates**
 7. Test for less than 4.5 V between each GMLAN serial data circuit terminal and ground.
 - **If 4.5 V or greater between a low speed GMLAN serial data circuit and ground**
- Refer to **Scan Tool Does Not Communicate with Low Speed GMLAN Device** to test for a short to voltage.
- **If 4.5 V or greater between a high speed GMLAN serial data circuit and ground**
- Refer to **Scan Tool Does Not Communicate with High Speed GMLAN Device** to test for a short to voltage.
- **If less than 4.5 V**
8. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
 9. Test for greater than 100 ohms between each GMLAN serial data circuit terminal and ground.
 - **If 100 ohms or less between a low speed GMLAN serial data circuit and ground**

Refer to **Scan Tool Does Not Communicate with Low Speed GMLAN Device** to test for a short to ground.

- **If 100 ohms or less between a high speed GMLAN serial data circuit and ground**

Refer to **Scan Tool Does Not Communicate with High Speed GMLAN Device** to test for a short to ground.

- **If greater than 100 ohms**

10. Test for less than 2 ohms in each of the GMLAN serial data circuits end to end between the device harness connector and the X84 Data Link Connector terminals listed below.

- Low speed GMLAN serial data circuit terminal 1
- High speed GMLAN serial data circuit terminal 6 or 14
- Mid speed GMLAN serial data circuit terminal 3 or 11
- Chassis high speed GMLAN serial data circuit terminal 12 or 13
- Object high speed GMLAN serial data circuit terminal 3 or 11

- **If 2 ohms or greater**

Repair the open/high resistance in the serial data circuit between the non communicating device and the device setting the DTC or a serial data splice pack.

- **If less than 2 ohms**

NOTE: **The following test step is only applicable to a high speed GMLAN device with 2 pairs of serial data circuits or a high speed GMLAN device with an internal terminating resistor.**

11. Test for 110-130 ohms between each pair of high speed GMLAN serial data circuits.

- **If less than 110 ohms**

Refer to **Scan Tool Does Not Communicate with High Speed GMLAN Device** to test for a short to ground or a short between the serial data circuits.

- **If greater than 130 ohms**

Refer to **Scan Tool Does Not Communicate with High Speed GMLAN Device** to test for an open/high resistance in the serial data circuit.

- **If between 110-130 ohms**

12. Replace the device that is not communicating.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **GMLAN and Media Oriented Systems Transport (MOST) Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U0300-U0336: MODULE ERROR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

Refer to **Control Module U Code List**.

Circuit/System Description

Some devices must be configured with specific software, serial numbers, vehicle options, or other information. If a device was not properly configured after installation that device may set the appropriate communication DTCs. No external circuit diagnosis is involved.

Conditions for Running the DTC

Battery voltage is between 9-16 V and data link communications operate normally.

Conditions for Setting the DTC

The device is not configured properly.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC U0300-U0336 is not set.
 - **If DTC U0300-U0336 is set**
 1. Program the device specified by the DTC descriptor.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the device specified by the DTC descriptor.
 - If the DTC does not set
 - 3. All OK.
 - **If DTC U0300-U0336 is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

DTC U0400-U05FF: MODULE ERROR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

Refer to **Control Module U Code List**.

Circuit/System Description

Some devices are constantly receiving information from other devices through serial data communication network. The invalid data code will be set when a receiving device detects a discrepancy in information it receives from another device causing its integrity to be questioned. The symptom byte listed in the DTC Descriptor is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

Battery voltage is between 9-16 V and data link communications operate normally.

Conditions for Setting the DTC

The device is not configured properly.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Engine running for 10 s.
2. Ignition ON, engine OFF, verify DTC U0400-U05FF is not set.
 - **If DTC U0400-U05FF is set along with other DTCs set**

Diagnose all other DTCs first. Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If DTC U0400-U05FF is set without other DTCs set**
 1. Program the device specified by the DTC descriptor.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the appropriate device.
 - If the DTC does not set
 3. All OK.
 - **If DTC U0400-U05FF is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

DTC U1500-U15FF: MODULE ERROR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

For device DTC descriptors, refer to **Control Module U Code List**.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U1500-U15BF	U1500-U15BF	-	-
Ignition	U1500-U15BF	U1500-U15BF	-	-
LIN Serial Data	U1500-U15BF	U1500-U15BF	U1500-U15BF	-
Ground	-	U1500-U15BF	-	-

Circuit/System Description

The serial data is transmitted over a Local Interconnect Network (LIN) single wire network circuit bus between a master control module and other LIN devices within a particular subsystem. If serial data communication is lost between any of the LIN devices on the LIN bus network, a no communication code against the non-communicating LIN device will be set. A master control module is the one that reports the non communication code.

Conditions for Running the DTC

The system voltage is between 9-16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

Specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for

a communication issue.

- Communication will be available between the master control module and the scan tool if there is a loss of communications with any of the other LIN devices on the LIN bus network.
- Some devices may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the device.
- Some intermittent communication concerns may be caused by fretting corrosion on the serial data circuit terminals. Inspect all connectors at the device that set the communication DTC, the device that the communication DTC was set against, and any inline harness connectors between the two devices. Do not replace a device based only on fretting corrosion. Refer to bulletin 09-06-03-004 for assistance with the diagnosis and repair of this condition, if applicable.
- An open in the LIN bus serial data circuit between the splice pack and a LIN device will only affect that specific LIN device. This type of failure will set a loss of communication DTC for each LIN device affected and the other LIN devices will still communicate.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Determine the LIN device that is not communicating. Refer to **Control Module U Code List**.
2. Verify that DTC B1325, B1330, B1370, B1380, B1424, B1440, B1441, B1517, C0800, C0899, C12E1,

P0560, or P0562 is not set.

- **If any of the DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If none of the DTCs are set**

3. Verify that DTC U0100-U02FF is not set.

- **If any of the DTCs are set**

Refer to **DTC U0100-U02FF**.

- **If none of the DTCs are set**

4. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE:

- **For some vehicles, both headlamps may be connected to the same LIN circuit through a splice. Or both LIN circuits to the headlamps may be internally connected at the connector of the K26 Headlamp Control Module or K28 Headlamp Leveling Control Module. A short in one headlamp or its LIN circuit may cause no communication to both headlamps. Ensure to diagnose both LIN circuits and headlamps prior to replacing a headlamp.**
- **Use the schematic to identify the following:**
 - **The master control module and the LIN devices on the same LIN serial data circuit**
 - **The master control module's LIN serial data circuit terminal and the LIN device's B+, ignition, ground, and LIN serial data circuit terminals**

1. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connector at a LIN device that is not communicating. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 ohms between each ground circuit terminal and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Ignition ON.
4. Verify a test lamp illuminates between each B+ circuit terminal and ground, if equipped.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.

2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
1. Ignition OFF.
2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the disconnected LIN device.
 - **If the test lamp illuminates**
5. Ignition ON.
6. Verify a test lamp illuminates between each ignition circuit terminal and ground, if equipped.
 - **If the test lamp does not illuminate and the circuit fuse is good**
1. Ignition OFF.
2. Test for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
1. Ignition OFF.
2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the disconnected LIN device.
 - **If the test lamp illuminates**
7. Ignition ON.
8. Verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground, if equipped.
 - **If the test lamp does not illuminate**
1. Ignition OFF, disconnect the harness connectors at the control module that controls the ignition circuit.
2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the control module that controls the ignition circuit.
 - **If the test lamp illuminates**
9. Ignition ON.

NOTE: For accurate voltage reading, disconnect the battery charger prior to

performing the following test step.

10. Test for 2-13 V between the LIN serial data circuit terminal and ground.
 - **If less than 2 V**
 1. Ignition OFF, disconnect the harness connector at the control module setting the DTC and all LIN devices that share the same LIN serial data circuit.
 2. Test for infinite resistance between the serial data circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the serial data circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms
 4. Reconnect the control module that set the DTC, ignition ON.
 5. Test for 2-13 V between the LIN serial data circuit terminal and ground.
 - If less than 2 V, replace the control module setting the DTC.
 - If greater than 2 V, replace the LIN device that causes a current DTC to set when connected.
 - **If greater than 13 V**
 1. Ignition OFF, disconnect the harness connector at the control module setting the DTC and all LIN devices that share the same LIN serial data circuit.
 2. Ignition ON.
 3. Test for less than 1 V between the serial data circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 4. Ignition OFF, reconnect the control module that set the DTC, ignition ON.
 5. Test for 2-13 V between the LIN serial data circuit terminal and ground.
 - If greater than 13 V, replace the control module setting the DTC.
 - If less than 13 V, replace the LIN device that causes a current DTC to set when connected.
 - **If between 2-13 V**
11. Replace the disconnected LIN device.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **GMLAN and Media Oriented Systems Transport (MOST) Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U1814: POWERTRAIN WAKE-UP COMMUNICATION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U1814

Powertrain Wake-Up Communication Circuit

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	U1814 02*	U0100-U02FF	-	-
* Vehicle may not start.				

Circuit/System Description

The body control module (BCM) activates the ignition circuit, when the ignition key is in ACC, ON or START. The ignition circuit wakes up the devices for serial data bus communication.

Conditions for Running the DTC

- The system voltage is between 9-16 V.
- The vehicle power mode master requires serial data communication to occur.

Conditions for Setting the DTC

The BCM senses a short to ground on the ignition circuit.

Action Taken When the DTC Sets

- The output command is turned off while the malfunction is present.
- The devices use a default value for the missing parameters until the next ignition cycle.
- The device(s) is never signaled. Therefore, the specific subsystem(s) will not function.
- The vehicle will not start while the circuit is shorted to ground.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

NOTE: Use the schematic to determine which devices are on the K9 Body Control Module's ignition circuit terminal 22 X4. Use the connector end view to identify the ignition circuit terminal for each of those devices.

1. Ignition OFF, disconnect the harness connectors at an easily accessible device that shares the K9 Body Control Module's ignition circuit terminal 22 X4. Ignition ON.
2. Verify that the DTC U1814 remains current.

- **If the DTC becomes history**

Replace the device that was just disconnected.

- **If the DTC remains current**

3. With the prior devices disconnected, repeat steps 1 and 2 for each device on the ignition circuit except the K9 Body Control Module.
4. Ignition OFF, disconnect the X4 harness connector at the K9 Body Control Module.
5. Test for infinite resistance between the ignition circuit terminal 22 X4 at the K9 Body Control Module and ground.

- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

6. Replace the K9 Body Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **GMLAN and Media Oriented Systems Transport (MOST) Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U18B9-U18BF: HIGH SPEED CAN BUS SUBNET CONFIGURATION LIST

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U18B9

Primary High Speed CAN Bus Subnet Configuration List

DTC U18BF

Secondary High Speed CAN Bus Subnet Configuration List

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

Devices on the high speed GMLAN serial data bus and the chassis high speed GMLAN serial data bus must be programmed with software that specifically identifies the correct type and quantity of devices on the bus based on RPO configuration. If a device was not properly configured after installation, the appropriate U Code may be set for that device. No external circuit diagnosis is involved.

Conditions for Running the DTC

- Voltage supplied to the device is in the normal operating voltage range.
- The vehicle power mode requires serial data communication to occur.

Conditions for Setting the DTC

- The device is not configured properly.
- Control unit recognises a programming error.
- CAN-Bus configuration is invalid

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC U18B9-U18BF is not set.
 - **If DTC U18B9-U18BF is set along with other DTCs set**

Diagnose all other DTCs first. Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If DTC U18B9-U18BF is set without other DTCs set**

1. Program the device that set the DTC.
2. Ignition OFF, remove the scan tool, open and close the driver door. Wait 60 s.
3. Verify the DTC does not set.
 - If the DTC sets, replace the appropriate device.
 - If the DTC does not set

4. All OK.

- **If DTC U18B9-U18BF is not set**

3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

DTC U2099: HIGH SPEED COMMUNICATION ENABLE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U2099

High Speed Communication Enable Circuit

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	U2099*	U0100-U02FF	U0100-U02FF	-
* Vehicle may not start.				

Circuit/System Description

The body control module (BCM) activates the ignition circuit, when the ignition key is in ACC, ON or START. The ignition circuit wakes up the devices for serial data bus communication.

Conditions for Running the DTC

- The system voltage is between 9-16 V.
- The vehicle power mode master requires serial data communication to occur.

Conditions for Setting the DTC

The BCM senses a short to ground on the ignition circuit.

Action Taken When the DTC Sets

- The output command is turned off while the malfunction is present.
- The devices use a default value for the missing parameters until the next ignition cycle.
- The device(s) is never signaled. Therefore, the specific subsystem(s) will not function.
- The vehicle will not start while the circuit is shorted to ground.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

NOTE: Use the schematic to determine which devices are on the K9 Body Control Module's ignition circuit terminal 23 X4. Use the connector end view to identify the ignition circuit terminal for each of those devices.

1. Ignition OFF, disconnect the harness connectors at an easily accessible device that shares the K9 Body Control Module's ignition circuit terminal 23 X4. Ignition ON.
2. Verify that the DTC U2099 remains current.

- **If the DTC becomes history**

Replace the device that was just disconnected.

- **If the DTC remains current**

3. With the prior devices disconnected, repeat steps 1 and 2 for each device on the ignition circuit except the K9 Body Control Module.
4. Ignition OFF, disconnect the X4 harness connector at the K9 Body Control Module.
5. Test for infinite resistance between the ignition circuit terminal 23 X4 at the K9 Body Control Module and ground.

- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

6. Replace the K9 Body Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **GMLAN and Media Oriented Systems Transport (MOST) Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U2101: CAN BUS MAXIMUM LIST OF CONTROL MODULES

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U2101

CAN Bus Maximum List of Control Modules

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

Some devices must be programmed with software that specifically identifies the correct type and quantity of devices on the serial data bus based on RPO configuration. If a device was not properly configured after installation, the appropriate U Code may be set for that device. No external circuit diagnosis is involved.

Conditions for Running the DTC

- The system voltage is in the normal operating voltage range.
- The vehicle power mode requires serial data communication to occur.

Conditions for Setting the DTC

- The device is not configured properly.
- Control unit recognizes a programming error.
- CAN Bus configuration is invalid.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition ON.
2. Verify DTC U2101 is not set.
 - **If DTC U2101 is set along with other DTCs set**

Diagnose all other DTCs first. Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If DTC U2101 is set without other DTCs set**
 1. Program the device that set the DTC.
 2. Clear the DTC.
 3. Ignition OFF, remove the scan tool, open and close the driver door. Wait 60 s.
 4. Verify the DTC does not set.
 - If the DTC sets, replace the appropriate device.
 - If the DTC does not set
 5. All OK.
 - **If DTC U2101 is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

SYMPTOMS - DATA COMMUNICATIONS

NOTE: **The following steps must be completed before using the symptom tables.**

1. Perform the **Diagnostic System Check - Vehicle** before using the symptom tables in order to verify that all of the following are true:
 - There are no Diagnostic Trouble Codes (DTC) set.
 - The devices can communicate via the serial data links.

2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Data Link Communications Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the systems. Refer to **Checking Aftermarket Accessories**.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections**.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Scan Tool Does Not Power Up**
- **Scan Tool Does Not Communicate with High Speed GMLAN Device**
- **Scan Tool Does Not Communicate with Low Speed GMLAN Device**

SCAN TOOL DOES NOT POWER UP

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Data Link Connector B+	1	1	-	-
Data Link Connector Ground	-	1	-	-
1. Scan Tool Does Not Power Up				

Circuit/System Description

The data link connector (DLC) is a standardized 16 cavity connector. Connector design and location is dictated by an industry wide standard, and is required to provide the following:

- Scan tool B+ voltage at terminal 16

- Scan tool ground at terminal 4
- Common ground at terminal 5

Diagnostic Aids

- The scan tool will power up with the ignition OFF. Some devices however, will not communicate unless the ignition is ON and the power mode master device sends the appropriate power mode message.
- If the B+ circuit, ground circuits, and connections of the data link connector are functioning properly, the malfunction must be due to the scan tool.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 2 ohms between each of the X84 Data Link Connector ground circuit terminals listed below and ground.
 - Ground circuit terminal 4
 - Ground circuit terminal 5
 - **If 2 ohms or greater**

1. Ignition OFF.
2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 2 ohms**
3. Ignition ON.
4. Verify a test lamp illuminates between the B+ circuit terminal 16 at the X84 Data Link Connector and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - **If the test lamp illuminates**
5. Refer to the scan tool user guide.

SCAN TOOL DOES NOT COMMUNICATE WITH CHASSIS HIGH SPEED GMLAN DEVICE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Chassis High Speed GMLAN Serial Data (+)	1	U0100-U02FF*	1	-
Chassis High Speed GMLAN Serial Data (-)	1	U0100-U02FF*	1	-
Ground (DLC, terminal 5)	-	1	-	-
* No communications with one or more chassis high speed GMLAN devices. An open in only one chassis high speed GMLAN serial data circuit may allow degraded communication between the devices. An open between the data link connector (DLC) and the first splice/device will only affect the communication with the scan tool. The devices will still communicate. 1. No communication with any chassis high speed GMLAN device.				

Circuit/System Description

The chassis high speed GMLAN bus functions the same as the primary high speed GMLAN bus, and the two buses operate in parallel. The chassis high speed GMLAN bus is added to reduce message congestion on the primary high speed bus. Since the chassis high speed GMLAN bus and primary high speed GMLAN bus operate in the same manner, the diagnostics for each are the same.

The serial data is transmitted on two twisted wires that allow speeds up to 500 kbit/s. The twisted pair is terminated with two 120 ohms resistors, one is internal to the electronic brake control module and the other can be a separate resistor in a connector assembly or in another device. The resistors are used as the load for the chassis high speed GMLAN bus during normal vehicle operation. The chassis high speed GMLAN is a differential bus. The chassis high speed GMLAN serial data bus (+) and chassis high speed GMLAN serial data (-) are driven to opposite extremes from a rest or idle level of approximately 2.5 V. Driving the lines to their extremes, adds 1 V to the chassis high speed GMLAN serial data bus (+) circuit and subtracts 1 V from the chassis high speed GMLAN serial data bus (-) circuit. If serial data is lost, devices will set a no communication code against the non-communicating device. Note that a loss of serial data DTC does not represent a failure of the device that set it.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of-communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss-of-communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between some devices and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to those devices using multiple serial data communication systems.
- An open in the DLC ground circuit terminal 5 will allow the scan tool to operate but not communicate with the vehicle.
- Technicians may find various Local Area Network (LAN) communication Diagnostic Trouble Codes (DTC).

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify two or more devices are not communicating on the chassis high speed GMLAN serial data circuit. Refer to **Data Link References** to determine how many devices should be communicating on the bus.
 - **If only one device is not communicating**

Refer to Circuit/System Testing - Testing the Device Circuits.
 - **If two or more devices are not communicating**
3. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the scan tool from the X84 Data Link Connector. The following tests will be done at the X84 Data Link Connector. It may take up to 2 minutes for all vehicle systems to power down.
4. Test for less than 10 ohms between the ground circuit terminal 5 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, repair the open/high resistance in the ground connection.

- **If less than 10 ohms**

5. Ignition ON.

6. Test for less than 4.5 V between the serial data circuits listed below and ground.

- Terminal 12

- Terminal 13

- **If 4.5 V or greater**

Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short to Voltage.

- **If less than 4.5 V**

7. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.

8. Test for greater than 100 ohms between the serial data circuits listed below and ground.

- Terminal 12

- Terminal 13

- **If 100 ohms or less**

Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short to Ground.

- **If greater than 100 ohms**

9. Test for 50-70 ohms between the serial data circuit terminals 12 and 13.

- **If less than 35 ohms**

Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short between the Circuits.

- **If between 35-50 ohms**

There may be a third terminating resistor between the serial data circuits. This can happen if the incorrect device is installed. Some devices are available with and without the terminating resistors installed to reduce the need of terminating resistors in the wiring harness. Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short between the Circuits.

- **If greater than 70 ohms but less than infinite**

Refer to Circuit/System Testing - Testing the Serial Data Circuits for an Open/High Resistance.

- **If infinite resistance**

Repair the open/high resistance in the circuit between the X84 Data Link Connector and the first splice/device in the serial data circuit.

- **If between 50-70 ohms**

10. Refer to Circuit/System Testing - Testing the Device Circuits.

Circuit/System Testing

NOTE: Each device may need to be disconnected to isolate a circuit fault.

Use the schematic to identify the following:

- Chassis high speed GMLAN devices the vehicle is equipped with
- Chassis high speed GMLAN serial data circuit terminating resistors
- Device locations on the chassis high speed GMLAN serial data circuits
- Each device's ground, B+, ignition, and chassis high speed GMLAN serial data circuit terminals

Some devices with an internal terminating resistor have a loop in the harness that connects the internal terminating resistor to the serial data circuit. When wired this way, test these loop circuits for the appropriate failure mode short to voltage, short to ground, or open/high resistance prior to replacing the device for each of the following tests.

Testing the Serial Data Circuits for a Short to Voltage

1. Ignition OFF, disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at an easily accessible device, ignition ON.
2. Test for greater than 4.5 V between each serial data circuit at the device connector that was just disconnected and ground.
 - **If each serial data circuit is 4.5 V or less**
 1. Ignition OFF.
 2. Test for less than 10 ohms between each of the device's ground circuit terminals and ground.
 - If 10 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 10 ohms, replace the device that was disconnected.
 - **If any serial data circuit is greater than 4.5 V**
3. Ignition OFF, disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to voltage, ignition ON.
4. Test for greater than 4.5 V between each serial data circuit at the device connector that was just disconnected and ground.
 - **If each serial data circuit is 4.5 V or less**
 1. Ignition OFF.
 2. Test for less than 10 ohms between each of the device's ground circuit terminals and ground.
 - If 10 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 10 ohms, replace the device that was disconnected.
 - **If any serial data circuit is greater than 4.5 V**

5. Repeat step 3 until one of the following conditions are isolated:
 - A short to voltage on the serial data circuit between two devices or splice packs, if equipped.
 - A short to voltage on the serial data circuit between a device and a terminating resistor.

Testing the Serial Data Circuits for a Short to Ground

1. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at an easily accessible device.
3. Test for greater than 100 ohms between each serial data circuit at the device connector that was just disconnected and ground.
 - **If each serial data circuit is 100 ohms or greater**

Replace the device that was disconnected.

- **If any serial data circuit is less than 100 ohms**
4. Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to ground.
 5. Test for greater than 100 ohms between each serial data circuit at the device connector that was just disconnected and ground.
 - **If both serial data circuits are 100 ohms or greater**

Replace the device that was disconnected.

- **If any serial data circuit is less than 100 ohms**
6. Repeat step 4 until one of the following conditions are isolated:
 - A short to ground on the serial data circuit between two devices or splice packs, if equipped.
 - A short to ground on the serial data circuit between a device and a terminating resistor.
 - A short to ground on the serial data circuit between the X84 Data Link Connector and the first device or splice pack.

Testing the Serial Data Circuits for a Short between the Circuits

1. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at an easily accessible device that is not communicating.
3. Test for greater than 110 ohms between each pair of serial data circuits at the device connector that was just disconnected.
 - **If each pair of serial data circuits is 110 ohms or greater**

Replace the device that was disconnected.

- **If any pair of serial data circuits is less than 110 ohms**

4. Connect the harness connectors at the device that was disconnected.
5. Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted together.
6. Test for greater than 110 ohms between each pair of serial data circuits at the device connector that was just disconnected.

- **If each pair of serial data circuits is 110 ohms or greater**

Replace the device that was disconnected.

- **If any pair of serial data circuits is less than 110 ohms**

7. Repeat step 4 until one of the following conditions are isolated:
 - Serial data circuits shorted together between two devices or splice packs, if equipped.
 - Serial data circuits shorted together between a device and a terminating resistor.
 - Serial data circuits shorted together between the X84 Data Link Connector and the first device or splice pack.
 - A shorted terminating resistor.

Testing the Serial Data Circuits for an Open/High Resistance

1. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at an easily accessible device that is not communicating.
3. Test for less than 130 ohms between each pair of serial data circuits at the device connector that was just disconnected.

- **If each pair of serial data circuit is 130 ohms or less**

Replace the device that was disconnected.

- **If any pair of serial data circuits is greater than 130 ohms**

4. Connect the harness connectors at the device that was disconnected.
5. Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at another device, in the direction of the circuit with the open/high resistance.
6. Test for less than 130 ohms between each pair of serial data circuits at the device connector that was just disconnected.

- **If each pair of serial data circuits is 130 ohms or less**

Replace the device that was disconnected.

- **If any pair of serial data circuits is greater than 130 ohms**

7. Repeat step 4 until one of the following conditions are isolated:

- An open/high resistance on the serial data circuit between two devices or splice packs, if equipped.
- An open/high resistance on the serial data circuit between a device and a terminating resistor.
- An open/high resistance terminating resistor.

Testing the Device Circuits

1. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the harness connectors at an easily accessible device that is not communicating.
3. Test for less than 10 ohms between each ground circuit terminal and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the disconnected device.
 - **If the test lamp illuminates**
5. Ignition ON.
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which has a fuse in the circuit, and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the disconnected device.
 - **If the test lamp illuminates**
7. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground.
- **If the test lamp does not illuminate**
 1. Ignition OFF, disconnect the harness connectors at the control module that controls the ignition circuit.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the control module that controls the ignition circuit.
 - **If the test lamp illuminates**
8. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
9. Test for less than 130 ohms between each pair of chassis high speed GMLAN serial data circuits at the device connector that was just disconnected.
- **If any pair of serial data circuits is greater than 130 ohms**
- Repair the open/high resistance in the serial data circuits between the disconnected device and the circuit splice in the serial data circuits.
- **If each pair of serial data circuits is 130 ohms or less**
10. Replace the device that was disconnected.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **GMLAN and Media Oriented Systems Transport (MOST) Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

SCAN TOOL DOES NOT COMMUNICATE WITH HIGH SPEED GMLAN DEVICE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
High Speed GMLAN Serial Data (+)	1	U0100-U02FF*	1	-
High Speed GMLAN Serial Data (-)	1	U0100-U02FF*	1	-
Ground (DLC, terminal 5)	-	1	-	-
* No communications with one or more high speed GMLAN devices. An open in only one high speed GMLAN serial data circuit may allow degraded communication between the devices. An open between the data link connector (DLC) and the first splice/device will only affect the communication with the scan tool. The devices will still communicate. 1. No communication with any high speed GMLAN device				

Circuit/System Description

The serial data is transmitted on two twisted wires that allow speeds up to 500 Kb/s. The twisted pair is terminated with two 120 ohms resistors, one is internal to the engine control module (ECM) and the other can be a separate resistor in a connector assembly or in another device. The resistors are used as the load for the High Speed GMLAN bus during normal vehicle operation. The high speed GMLAN is a differential bus. The high speed GMLAN serial data bus (+) and high speed GMLAN serial data bus (-) are driven to opposite extremes from a rest or idle level of approximately 2.5 V. Driving the lines to their extremes, adds 1 V to the high speed GMLAN serial data bus (+) circuit and subtracts 1 V from the high speed GMLAN serial data bus (-) circuit. If serial data is lost, devices will set a no communication code against the non-communicating device. Note that a loss of serial data DTC does not represent a failure of the device that set it.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of-communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.

- Communication may be available between some devices and the scan tool with the high speed GMLAN serial data system inoperative. This condition is due to those devices using multiple serial data communication systems.
- An open in the DLC ground circuit terminal 5 will allow the scan tool to operate but not communicate with the vehicle.
- The engine will not start when there is a total malfunction of the high speed GMLAN serial data bus.
- Technicians may find various Local Area Network (LAN) communication Diagnostic Trouble Codes (DTC) and no low speed GMLAN communications with the scan tool.
- These conditions may be caused by the installation of an aftermarket navigation radio module (see bulletins). Some customers may comment of one or more of the following concerns:
 - Vehicle will not crank
 - Vehicle cranks but will not start
 - Vehicle stability enhancement system warning lights and messages
 - PRNDL gear indicator position errors

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.

2. Verify two or more devices are not communicating on the high speed GMLAN serial data circuit. Refer to **Data Link References** to determine how many devices should be communicating on the bus.

- **If only one device is not communicating**

Refer to Circuit/System Testing - Testing the Device Circuits.

- **If two or more devices are not communicating**

3. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the scan tool from the X84 data link connector. The following tests will be done at the X84 data link connector. It may take up to 2 minutes for all vehicle systems to power down.

4. Test for less than 10 ohms between the ground circuit terminal 5 and ground.

- **If 10 ohms or greater**

1. Ignition OFF.
2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.

- **If less than 10 ohms**

5. Ignition ON.

6. Test for less than 4.5 V between the serial data circuits listed below and ground.

- Terminal 6
- Terminal 14
- **If 4.5 V or greater**

Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short to Voltage.

- **If less than 4.5 V**

7. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.

8. Test for greater than 100 ohms between the serial data circuits listed below and ground.

- Terminal 6
- Terminal 14
- **If 100 ohms or less**

Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short to Ground.

- **If greater than 100 ohms**

9. Test for 50-70 ohms between the serial data circuit terminals 6 and 14.

- **If less than 35 ohms**

Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short between the Circuits.

- **If between 35-50 ohms**

There may be a third terminating resistor between the serial data circuits. This can happen if the incorrect device is installed. Some devices are available with and without the terminating resistors installed to reduce the need of terminating resistors in the wiring harness. Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short between the Circuits.

- **If greater than 70 ohms but less than infinite**

Refer to Circuit/System Testing - Testing the Serial Data Circuits for an Open/High Resistance.

- **If infinite resistance**

Repair the open/high resistance in the circuit between the X84 data link connector and the first splice/device in the serial data circuit.

- **If between 50-70 ohms**

10. Refer to Circuit/System Testing - Testing the Device Circuits.

Circuit/System Testing

NOTE: Each device may need to be disconnected to isolate a circuit fault.

Use the schematic to identify the following:

- High speed GMLAN devices the vehicle is equipped with
- High speed GMLAN serial data circuit terminating resistors
- Device locations on the high speed GMLAN serial data circuits
- Each device's ground, B+, ignition, and high speed GMLAN serial data circuit terminals

Some devices with an internal terminating resistor have a loop in the harness that connects the internal terminating resistor to the serial data circuit. When wired this way, test these loop circuits for the appropriate failure mode short to voltage, short to ground, or open/high resistance prior to replacing the device for each of the following tests.

Testing the Serial Data Circuits for a Short to Voltage

1. Ignition OFF, disconnect the harness connectors with the high speed GMLAN serial data circuits at an easily accessible device, ignition ON.
 2. Test for greater than 4.5 V between each serial data circuit at the device connector that was just disconnected and ground.
 - **If each serial data circuit is 4.5 V or less**
1. Ignition OFF.

2. Test for less than 10 ohms between each of the device's ground circuit terminals and ground.
 - If 10 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 10 ohms, replace the device that was disconnected.
 - **If any serial data circuit is greater than 4.5 V**
3. Ignition OFF, disconnect the harness connectors with the high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to voltage, ignition ON.
4. Test for greater than 4.5 V between each serial data circuit at the device connector that was just disconnected and ground.
 - **If each serial data circuit is 4.5 V or less**
 1. Ignition OFF.
 2. Test for less than 10 ohms between each of the device's ground circuit terminals and ground.
 - If 10 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 10 ohms, replace the device that was disconnected.
 - **If any serial data circuit is greater than 4.5 V**
5. Repeat step 3 until one of the following conditions are isolated:
 - A short to voltage on the serial data circuit between two devices or splice packs, if equipped.
 - A short to voltage on the serial data circuit between a device and a terminating resistor.

Testing the Serial Data Circuits for a Short to Ground

1. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the harness connectors with the high speed GMLAN serial data circuits at an easily accessible device.
3. Test for greater than 100 ohms between each serial data circuit at the device connector that was just disconnected and ground.
 - **If each serial data circuit is 100 ohms or greater**

Replace the device that was disconnected.

 - **If any serial data circuit is less than 100 ohms**
4. Disconnect the harness connectors with the high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to ground.
5. Test for greater than 100 ohms between each serial data circuit at the device connector that was just disconnected and ground.
 - **If both serial data circuits are 100 ohms or greater**

Replace the device that was disconnected.

 - **If any serial data circuit is less than 100 ohms**
6. Repeat step 4 until one of the following conditions are isolated:

- A short to ground on the serial data circuit between two devices or splice packs, if equipped.
- A short to ground on the serial data circuit between a device and a terminating resistor.
- A short to ground on the serial data circuit between the X84 data link connector and the first device or splice pack.

Testing the Serial Data Circuits for a Short between the Circuits

1. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the harness connectors with the high speed GMLAN serial data circuits at an easily accessible device that is not communicating.
3. Test for greater than 110 ohms between each pair of serial data circuits at the device connector that was just disconnected.

- **If each pair of serial data circuits is 110 ohms or greater**

Replace the device that was disconnected.

- **If any pair of serial data circuits is less than 110 ohms**

4. Connect the harness connectors at the device that was disconnected.
5. Disconnect the harness connectors with the high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted together.
6. Test for greater than 110 ohms between each pair of serial data circuits at the device connector that was just disconnected.

- **If each pair of serial data circuits is 110 ohms or greater**

Replace the device that was disconnected.

- **If any pair of serial data circuits is less than 110 ohms**

7. Repeat step 4 until one of the following conditions are isolated:
 - Serial data circuits shorted together between two devices or splice packs, if equipped.
 - Serial data circuits shorted together between a device and a terminating resistor.
 - Serial data circuits shorted together between the X84 data link connector and the first device or splice pack.
 - A shorted terminating resistor.

Testing the Serial Data Circuits for an Open/High Resistance

1. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the harness connectors with the high speed GMLAN serial data circuits at an easily accessible device that is not communicating.
3. Test for less than 130 ohms between each pair of serial data circuits at the device connector that was just disconnected.

- **If each pair of serial data circuits is 130 ohms or less**

Replace the device that was disconnected.

- **If any pair of serial data circuits is greater than 130 ohms**

4. Connect the harness connectors at the device that was disconnected.
5. Disconnect the harness connectors with the high speed GMLAN serial data circuits at another device, in the direction of the circuit with the open/high resistance.
6. Test for less than 130 ohms between each pair of serial data circuits at the device connector that was just disconnected.

- **If each pair of serial data circuits is 130 ohms or less**

Replace the device that was disconnected.

- **If any pair of serial data circuits is greater than 130 ohms**

7. Repeat step 4 until one of the following conditions are isolated:
 - An open/high resistance on the serial data circuit between two devices or splice packs, if equipped.
 - An open/high resistance on the serial data circuit between a device and a terminating resistor.
 - An open/high resistance terminating resistor.

Testing the Device Circuits

1. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the harness connectors at an easily accessible device that is not communicating.
3. Test for less than 10 ohms between each ground circuit terminal and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the disconnected device.
 - **If the test lamp illuminates**
- 5. Ignition ON.
- 6. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which has a fuse in the circuit, and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the disconnected device.
 - **If the test lamp illuminates**
- 7. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground.
 - **If the test lamp does not illuminate**
 1. Ignition OFF, disconnect the harness connectors at the control module that controls the ignition circuit.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the control module that controls the ignition circuit.
 - **If the test lamp illuminates**
- 8. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
- 9. Test for less than 130 ohms between each pair of high speed GMLAN serial data circuits at the device connector that was just disconnected.
 - **If any pair of serial data circuits is greater than 130 ohms**

Repair the open/high resistance in the serial data circuits between the disconnected device and the circuit splice in the serial data circuits.
 - **If each pair of serial data circuits is 130 ohms or less**
- 10. Replace the device that was disconnected.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **GMLAN and Media Oriented Systems Transport (MOST) Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

SCAN TOOL DOES NOT COMMUNICATE WITH LOW SPEED GMLAN DEVICE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Low Speed GMLAN Serial Data	1	U0100-U02FF*	1	-
Ground (DLC, terminal 5)	-	1*	-	-
* An open between the X84 Data Link Connector (DLC) and the first splice pack/device will only affect the communication with the scan tool. 1. No communication with any low speed GMLAN device				

Circuit/System Description

The serial data is transmitted over a single wire to the appropriate devices. The transmission speed for GMLAN low speed is up to 83.33 kbit/s. Under normal vehicle operating conditions, the speed of the bus is 33.33 kbit/s. The devices toggle the serial data circuit between 0-5 V during normal communications. To wake the devices connected to the low speed GMLAN serial data circuit, a voltage wake up pulse of 10 V is sent out. If serial data is lost, devices will set a no communication code against the non-communicating device. A loss of serial data communications DTC does not represent a failure of the device that set it.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis
 - A low battery condition was present, so some devices stop communicating when battery voltage

drops below a certain threshold.

- Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
- If a loss of communication U- code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with the low speed GMLAN serial data system inoperative. This condition is due to the device using both the high and low speed GMLAN systems.
- An open in the low speed GMLAN serial data circuit between the splice pack and a device will only affect that specific device. This type of failure will set a loss of communication DTC for each device affected, and the other devices will still communicate.
- An open in the X84 Data Link Connector (DLC) ground circuit terminal 5 will allow the scan tool to operate but not communicate with the vehicle.
- The engine may not start when there is a total malfunction of the low speed GMLAN serial data circuit.
- Technicians may find various Local Area Network (LAN) communication Diagnostic Trouble Codes (DTC) and no low speed LAN communications with the scan tool.
- These conditions may be caused by the installation of an aftermarket navigation radio device (see bulletins). Some customers may comment of one or more of the following concerns:
 - Vehicle will not crank
 - Vehicle cranks but will not start
 - Vehicle stability enhancement system warning lights and messages
 - PRNDL gear indicator position errors

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: Use the schematic to identify the following:

- **Devices the vehicle is equipped with**
- **Device and splice pack locations on the low speed GMLAN serial data circuit**
- **The low speed GMLAN serial data circuit terminals for each device or splice pack**

1. Attempt to communicate with all devices on the low speed GMLAN serial data circuit. Refer to **Data Link References**.

2. Verify which devices are communicating on the low speed GMLAN serial data circuit.

- **If only one device is not communicating**

Diagnose that device only. Refer to **DTC U0100-U02FF**.

- **If one or more devices are communicating but not all**

Refer to Circuit/System Testing - Testing the Serial Data Circuit for an Open/High Resistance.

- **If none of the devices are communicating**

3. Ignition OFF, all access doors closed, all vehicle systems OFF, all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the scan tool from the X84 Data Link Connector. The following tests will be done at the X84 Data Link Connector. It may take up to 2 minutes for all vehicle systems to power down.

4. Test for less than 10 ohms between the ground circuit terminal 5 and ground.

- **If 10 ohms or greater**

1. Ignition OFF.

2. Test for less than 2 ohms in the ground circuit end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, repair the open/high resistance in the ground connection.

- **If less than 10 ohms**

5. Ignition ON.

6. Test for less than 4.5 V between the serial data circuit terminal 1 and ground.

- **If 4.5 V or greater**

Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short to Voltage.

- **If less than 4.5 V**

7. Ignition OFF, all access doors closed, all vehicle systems OFF, all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
8. Test for greater than 100 ohms between the serial data circuit terminal 1 and ground.

- **If 100 ohms or less**

Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short to Ground.

- **If greater than 100 ohms**

9. Disconnect the appropriate harness connector at the first splice pack closest in the circuit to the X84 Data Link Connector.
10. Test for less than 2 ohms between the X84 Data Link Connector's serial data circuit terminal 1 and the splice pack harness connector's serial data input terminal.

- **If 2 ohms or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 ohms**

11. Replace the splice pack.

Circuit/System Testing

Testing the Serial Data Circuits for a Short to Voltage

1. Ignition OFF, disconnect the appropriate harness connectors at all low speed GMLAN serial data splice packs, ignition ON.
2. Test for less than 4.5 V between the serial data circuit terminal 1 at the X84 Data Link Connector and ground.

- **If 4.5 V or greater**

Repair the short to voltage on the serial data circuit.

- **If less than 4.5 V**

3. Test for less than 4.5 V between each low speed GMLAN serial data circuit at a splice pack and ground.

- **If any serial data circuit is greater than 4.5 V**

1. Ignition OFF, disconnect all devices on the failed serial data circuit, ignition ON.
2. Test for less than 1 V between each section of the failed serial data circuit and ground.
 - If 1 V or greater, repair the short to voltage in the circuit.
 - If less than 1 V

3. Connect the splice pack and connect the first device on the failed serial data circuit, ignition ON.
4. Verify the scan tool communicates or not with the low speed GMLAN serial data circuit.
 - If the scan tool does not communicate, replace the device that was just connected.
 - If the scan tool communicates and there are more devices to connect, connect the next device and repeat step 3.4.
 - If the scan tool communicates and there are no more devices to connect
5. All OK.
 - **If all serial data circuits are less than 4.5 V**
4. All OK.

Testing the Serial Data Circuits for a Short to Ground

1. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the appropriate harness connectors at all low speed GMLAN serial data splice packs.
2. Test for infinite resistance between the serial data circuit terminal 1 at the X84 Data Link Connector and ground.
 - **If less than infinite resistance**

Repair the short to ground on the serial data circuit.

- **If infinite resistance**
3. Test for greater than 100 ohms between each low speed GMLAN serial data circuit at a splice pack and ground.
 - **If any serial data circuit is 100 ohms or less**
 1. Disconnect all devices on the failed serial data circuit.
 2. Test for infinite resistance between each section of the failed serial data circuit and ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance
 3. Connect the splice pack and connect the first device on the failed serial data circuit, ignition ON.
 4. Verify the scan tool communicates or not with the low speed GMLAN serial data circuit.
 - If the scan tool does not communicate, replace the device that was just connected.
 - If the scan tool communicates and there are more devices to connect, connect the next device and repeat step 3.4.
 - If the scan tool communicates and there are no more devices to connect
 5. All OK.
 - **If all serial data circuits are greater than 100 ohms**
 4. All OK.

Testing the Serial Data Circuit for an Open/High Resistance

1. Ignition OFF and all vehicle systems OFF, disconnect the splice pack containing the devices that are not communicating on the low speed GMLAN serial data circuit.
2. Test for less than 2 ohms between the X84 Data Link Connector terminal 1 and the disconnected splice pack.

- **If 2 ohms or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 ohms**

3. Disconnect all devices on the failed serial data circuit.
4. Test for less than 2 ohms between each section of the failed serial data circuit end to end.

- **If 2 ohms or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 ohms**

5. Connect the splice pack and connect the first device on the failed serial data circuit.
6. Verify if the device communicates or not with the scan tool.

- **If the device does not communicates**

Replace the device.

- **If the device communicates and there are more devices to connect**

Connect the next device on the failed serial data circuit and repeat step 6.

- **If all devices are connected and communicating**

7. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **GMLAN and Media Oriented Systems Transport (MOST) Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DATA LINK REFERENCES

This table identifies which serial data link that a particular device uses for in-vehicle data transmission. Some devices may use more than one data link to communicate. Some devices may have multiple communication circuits passing through them without actively communicating on that data link. This table is used to assist in correcting a communication malfunction. Not all devices listed will be applicable to all vehicles. Refer to the schematics to determine which devices apply. For the description and operation of these serial data communication circuits, refer to **Data Link Communications Description and Operation**.

Data Link References

Code	Device	Data Link Type	Diagnostic Procedure
Schematic Reference: <u>Data Communication Schematics</u>			
A11	Radio	Low Speed GMLAN	<u>Scan Tool Does Not Communicate with Low Speed GMLAN Device</u>
B119	Multi-axis Acceleration Sensor	Chassis High Speed GMLAN	<u>Scan Tool Does Not Communicate with Chassis High Speed GMLAN Device</u>
K9	Body Control Module	• High Speed GMLAN • Low Speed GMLAN	• <u>Scan Tool Does Not Communicate with High Speed GMLAN Device</u> • <u>Scan Tool Does Not Communicate with Low Speed GMLAN Device</u>
K17	Electronic Brake Control Module	• High Speed GMLAN • Chassis High Speed GMLAN	• <u>Scan Tool Does Not Communicate with High Speed GMLAN Device</u> • <u>Scan Tool Does Not Communicate with Chassis High Speed GMLAN Device</u>
K20	Engine Control Module	High Speed GMLAN	<u>Scan Tool Does Not Communicate with High Speed GMLAN Device</u>
K36	Inflatable Restraint Sensing and Diagnostic Module	Low Speed GMLAN	<u>Scan Tool Does Not Communicate with Low Speed GMLAN Device</u>
K43	Power Steering Control Module	High Speed GMLAN	<u>Scan Tool Does Not Communicate with High Speed GMLAN Device</u>
K71	Transmission Control Module	High Speed GMLAN	<u>Scan Tool Does Not Communicate with High Speed GMLAN Device</u>
K73	Telematics Communication Interface Control Module	• High Speed GMLAN • Low Speed GMLAN	• <u>Scan Tool Does Not Communicate with High Speed GMLAN Device</u> • <u>Scan Tool Does Not Communicate with Low Speed GMLAN Device</u>
K85	Passenger Presence Detection Module	Low Speed GMLAN	<u>Scan Tool Does Not Communicate with Low Speed GMLAN Device</u>
			<u>Scan Tool Does Not</u>

P16	Instrument Cluster	Low Speed GMLAN	<u>Communicate with Low Speed GMLAN Device</u>
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REPAIR INSTRUCTIONS

BODY CONTROL MODULE REPLACEMENT

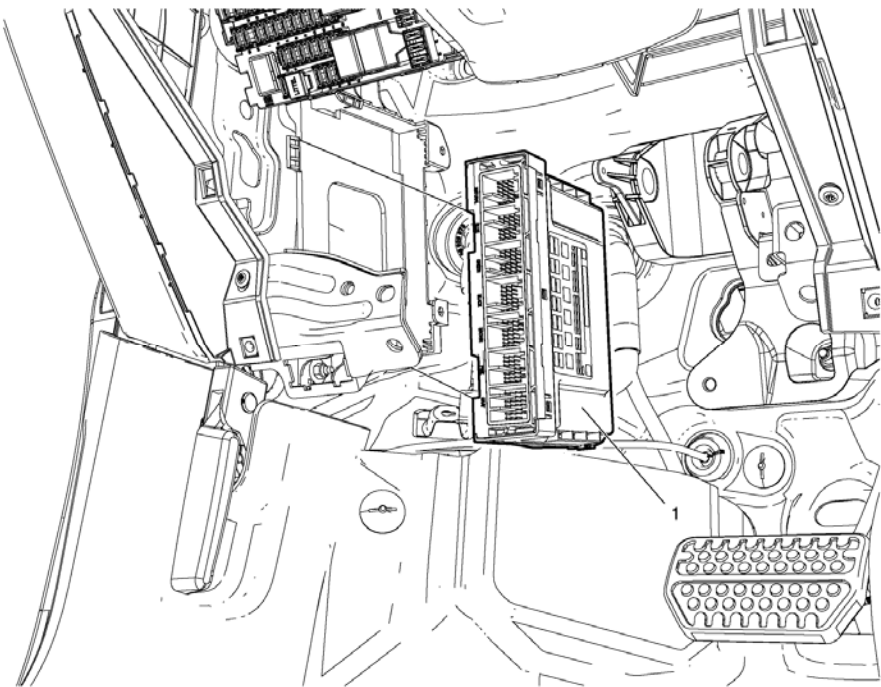


Fig. 11: Body Control Module
Courtesy of GENERAL MOTORS COMPANY

Body Control Module Replacement

Callout	Component Name
Preliminary Procedures 1. Prepare body control module for replacement. Refer to <u>Control Module References</u> . 2. Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 3. Remove instrument panel lower reinforcement bracket. Refer to <u>Instrument Panel Lower Reinforcement Bracket Replacement</u> .	
1	Body Control Module Procedure 1. Disconnect electrical connector. 2. Unclip body control module from body control module bracket.

3. After replacement, refer to **Control Module References** for programming and set up procedures.

BODY CONTROL MODULE BRACKET REPLACEMENT

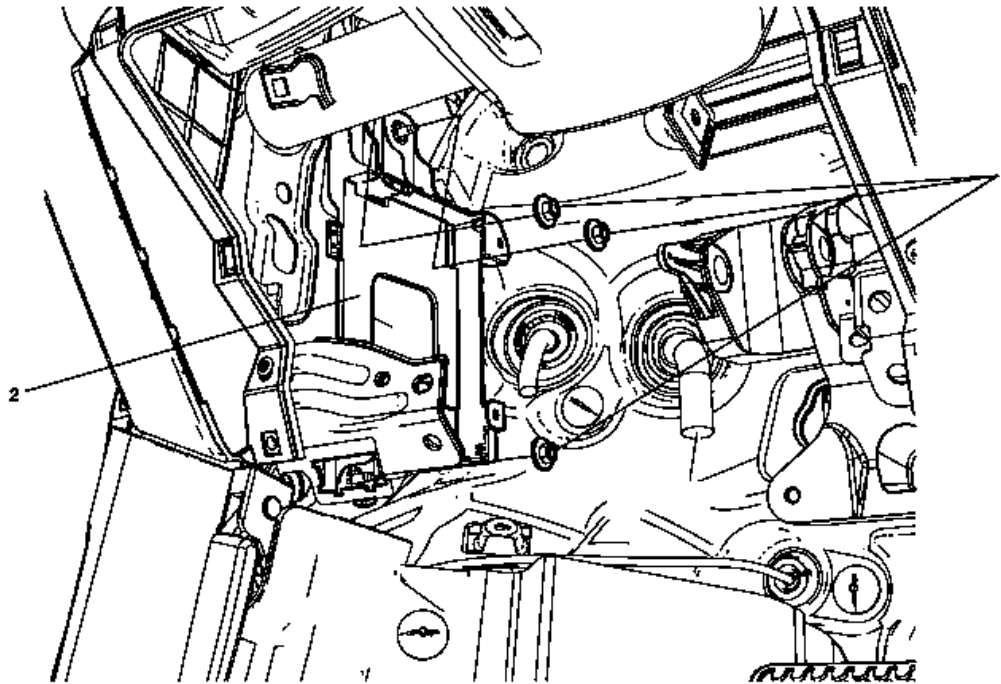


Fig. 12: Body Control Module Bracket
Courtesy of GENERAL MOTORS COMPANY

Body Control Module Bracket Replacement

Callout	Component Name
Preliminary Procedures	
1. Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> .	
2. Remove the body control module. Refer to <u>Body Control Module Replacement</u> .	
1	Body Control Module Bracket Nut (Qty: 3) CAUTION: Refer to <u>Fastener Caution</u> .
2	Body Control Module Bracket

DESCRIPTION AND OPERATION

BODY CONTROL SYSTEM DESCRIPTION AND OPERATION

The body control system consists of the body control module (BCM), communications, and various input and outputs. Some inputs, outputs and messages require other modules to interact with the BCM. The BCM also has discrete input and output terminals to control the vehicle's body functions. The BCM is wired to the high speed GMLAN serial data bus, low speed GMLAN serial data bus and Multiple LIN buses and acts as a gateway between them.

Power Mode Master

This vehicle body control module (BCM) functions as the power mode master (PMM). The ignition switch is a low current switch with multiple discrete ignition switch signals to the PMM for determining the power mode that will be sent over the serial data circuits to the other modules that need this information; the PMM will activate relays and other direct outputs of the PMM as needed. Refer to **Power Mode Description and Operation** for a complete description of power mode functions.

Gateway

The body control module (BCM) in this vehicle functions as a gateway or translator. The purpose of the gateway is to translate serial data messages between the GMLAN high speed bus and the GMLAN low speed bus for communication between the various modules. The gateway will interact with each network according to that network's transmission protocol.

All communication between the BCM and a scan tool is on the high speed GMLAN serial data circuits. A lost communication DTC typically is set in modules other than the module with a communication failure.

Body Control

The various body control module (BCM) input and output circuits are illustrated in the corresponding functional areas on the BCM electrical schematics. Refer to the **Body Control System Schematics** for more detailed information.

DATA LINK COMMUNICATIONS DESCRIPTION AND OPERATION

NOTE: This is an overview of different serial data buses used by GM devices to communicate with each others. Use **Data Communication Schematics** to find out which serial data buses are configured for a specific vehicle.

Circuit Description

There are many components in a vehicle that rely on information from other sources, transmit information to other sources, or both. Serial data communication networks provide a reliable, cost effective, way for various components of the vehicle to "talk" to one another and share information.

GM uses a number of different communication buses to insure the timely and efficient exchange of information between devices. When compared to each other, some of these buses are different in nature as far as speed, signal characteristics, and behavior. An example of this is the High Speed GMLAN and Low Speed GMLAN buses.

On the other hand, when other buses are compared to each other they have similar characteristics and simply

operate in parallel. In this case they are used to group together components which have high interaction. Examples are the High Speed GMLAN, Powertrain Expansion, and Chassis Expansion buses. This allows them to communicate with each other on a bus with reduced message congestion insuring faster and the more timely exchange of information than if all vehicle devices were on a single bus.

The majority of information that exists within a given network generally stays local; however some information will have to be shared on other networks. Control modules designated as Gateway's perform the function of transferring information between the various buses. A Gateway module is connected to at least 2 buses and will interact with each network according to its message strategy and transmission models.

GMLAN provides the capability for a receiving device to monitor message transmissions from other devices in order to determine if messages of interest are not being received. The primary purpose is to allow reasonable default values to be substituted for the information no longer being received. Additionally, a device may set a Diagnostic Trouble Code to indicate that the device it is expecting information from is no longer communicating.

High Speed GMLAN Circuit Description

A High Speed GMLAN Bus is used where data needs to be exchanged at a high enough rate to minimize the delay between the occurrence of a change in sensor value and the reception of this information by a control device using the information to adjust vehicle system performance.

The High Speed GMLAN serial data network consists of two twisted wires. One signal circuit is identified as GMLAN-High and the other signal circuit is identified as GMLAN-Low. At each end of the data bus there is a 120 ohms termination resistor between the GMLAN-High and GMLAN-Low circuits.

Data symbols (1's and 0's) are transmitted sequentially at a rate of 500 Kbit/s. The data to be transmitted over the bus is represented by the voltage difference between the GMLAN-High signal voltage and the GMLAN-Low signal voltage.

When the two wire bus is at rest the GMLAN-High and GMLAN-Low signal circuits are not being driven and this represents a logic "1". In this state both signal circuits are at the same voltage of 2.5 V. The differential voltage is approximately 0 V.

When a logic "0" is to be transmitted, the GMLAN-High signal circuit is driven higher to about 3.5 V and the GMLAN-Low circuit is driven lower to about 1.5 V. The differential voltage becomes approximately 2.0 (+/- 0.5) V.

Chassis High Speed GMLAN Circuit Description

The GMLAN Chassis Expansion Bus is basically a copy of the High Speed GMLAN Bus except that its use is reserved for chassis components. This implementation splits message congestion between two parallel buses helping to insure timely message transmission and reception. Sometimes communication is required between the Chassis Expansion Bus and the primary High Speed GMLAN Bus. This is accomplished by using the K17 Electronic Brake Control Module (EBCM) as the Gateway module. Since the High Speed GMLAN Chassis Expansion Bus and primary High Speed GMLAN Bus operate in the same manner, the diagnostics for each are similar.

Object High Speed GMLAN Circuit Description

The GMLAN Object Bus is basically a copy of the High Speed GMLAN Bus except that its use is reserved for the enhanced safety system. This implementation is used to isolate the heavy communication among the enhanced safety system devices from the other vehicle buses, reducing congestion. The K124 Active Safety Control Module is connected to the Object Bus as well as the Primary High Speed GMLAN Bus, the Chassis Expansion Bus, and the Low Speed GMLAN Bus. The K124 Active Safety Control Module acts as a Gateway module for all required communication between the Object Bus devices and devices on these other vehicle buses. The GMLAN Object Bus operates in the same manner as the Chassis Expansion and Primary High Speed buses and so the diagnostics are similar. The Object Bus is physically partitioned into a Front Object Bus and a Rear Object Bus with each partition having its own communication enable circuit to activate the partition, but functional operation of both is identical. The Front Object Bus standard devices are the K124 Active Safety Control Module, the K109 Frontview Camera Module, and the B233B Radar Sensor Module - Long Range. The Front Object Bus optional devices are the B233LF Radar Sensor Module - Short Range Left Front and the B233RF Radar Sensor Module - Short Range Right Front. The Rear Object Bus is optional and when present will have the K124 Active Safety Control Module and B233R Radar Sensor Module - Short Range Rear on the bus, and optionally the Radar Sensor Module - Short Range Right Rear. All Object Bus components are powered by the K124 Active Safety Control Module via the communication enable circuits, except the K109 Frontview Camera Module which is powered directly by battery.

Media Oriented Systems Transport (MOST) Circuit Description

The MOST Infotainment network is a dedicated high speed multimedia streaming data bus independent from GMLAN. The MOST bus will be configured in a physical hardwired loop with each device within the bus sends and receives data on an assigned MOST addresses in a set order. Each device on the MOST bus will be required to have twisted pair copper wires (2 transmit TX, 2 receive RX, and 1 electronic control line which is a 12 V wakeup signal line). The A11 Radio is the MOST Master and will monitor the bus for vehicle configuration, Infotainment data messages and errors on the bus. The MOST initialization consists of a short 100 ms low voltage pulse on the electronic control line (or MOST control line) connected to all devices contained on the MOST ring. This wakeup message once received by each device, will first respond with a generic device response. Once these initial responses on the MOST bus are reported successfully without error to the A11 Radio, the second data request will record the MOST device addresses, their functionality requirements and capabilities within. The A11 Radio will learn this information and also record the address node sequence on the MOST bus at this point. This node address list will now be stored within the A11 Radio as the MOST bus configuration (called "Last Working MOST ID of Node 1 - 9" on scan tool data display).

When MOST receive, transmit, or control line faults are detected, transmit/receive messages will not received as expected from the wakeup request. The A11 Radio and the K74 Human Machine Interface Control Module will then perform diagnostics to isolate these MOST faults. If the MOST control line is shorted low to 0 V for excess amount of time, the A11 Radio will set a U2098 DTC and K74 Human Machine Interface Control Module will set a U0029 02 DTC. At this point the MOST bus will be unable to communicate until the shorted MOST control line is repaired.

Once the shorted MOST control line diagnostics pass, the A11 Radio will attempt to resend the initial short pulse attempts up to 3 times on the MOST control line. If the expected responses are not received, the A11 Radio continues into a failure mode setting a U0028 DTC and will continue on to send one 300 ms long pulse, which will enable the furthest upstream transmitting device to become the surrogate MOST Master in this MOST fault/diagnostic mode. When the A11 Radio receives this new MOST Master identity, the surrogate

MOST master device can be identified based on scan tool data parameter "Surrogate MOST Master Node Upstream Position". The scan tool should be used to determine the MOST bus configuration and direction by utilizing the "Last Working MOST ID of Node 1 - 9" parameters from the A11 Radio data display. When a fault is present, it will indicate the newly enabled "Surrogate MOST Master Node Upstream Position" from the A11 Radio. This will assist in determining where the MOST bus/control is at fault. The MOST device upstream from the surrogate MOST master device, transmit, receive, or control lines will be the suspect areas for diagnostics at this point. These faults can be associated with any of the MOST transmit, receive, or control line twisted copper wires or possibly an internal device fault.

The K74 Human Machine Interface Control Module will set a U0029 00 DTC when it diagnoses a MOST bus not communicating properly after one attempt. When the DTC U0029 00 is set by the K74 Human Machine Interface Control Module without the corresponding DTC U0028 from the A11 Radio, it will be an indication of an intermittent wiring/device condition.

CAN Graphical Interface (CGI) Circuit Description

This bus is used by the Entertainment sub-system to transfer high-rate display graphics between the A11 Radio and the P17 Info Display Module and/or Radio/HVAC Control. The electrical characteristics of the CAN Graphical Interface (CGI) Bus are very similar to the High Speed GMLAN Bus. The message strategy and construction of messages are different however. Sometimes communication is required between the CAN Graphical Interface Bus and the Low Speed GMLAN Bus. This is accomplished by using the A11 Radio as the Gateway module. Since the CAN Graphical Interface Bus and primary High Speed GMLAN Bus have similar electrical characteristics, the diagnostics for each are similar.

In the case where the P17 Info Display Module and Radio/HVAC Control are separate devices the P17 Info Display Module is responsible for passing information between the A11 Radio and the Radio/HVAC Control. The A11 Radio interfaces only with the P17 Info Display Module and the P17 Info Display Module then communicates with the Radio/HVAC Control through a Local Interconnect Network (LIN) interface.

A bus wake up signal will be generated by the A11 Radio or by the P17 Info Display Module when the system functionality is required. The communication function of the CAN Graphical Interface shall be enabled or disabled based on the voltage level of the Center Stack Wake. The network will stay awake as long as the circuit voltage is driven low, to less than 1.5 V. Communications are disabled with a high circuit voltage around 5.0 V.

The A11 Radio can execute a warm reset of the P17 Info Display Module if the P17 Info Display Module fails to respond to the A11 Radio's request. The Center Stack Reset is a low-asserted pull down output (less than 1.5 V) from the A11 Radio to the P17 Info Display Module and has the same electrical characteristics as those for the Center Stack Wake signal defined above.

Mid Speed GMLAN Circuit Description

The Mid Speed GMLAN Bus is very similar to the High Speed GMLAN Bus except that it uses a slower transmission rate of 125 Kbit/s. This bus is intended for use where the system response time demands that a large amount of data be transmitted in a relatively short amount of time, such as updating a graphics display. As such it has usually been used for infotainment applications. Sometimes communication is required between the Low Speed GMLAN Bus and the Mid Speed GMLAN Bus. This is accomplished by using the A11 Radio as the Gateway module. Since the Mid Speed GMLAN Bus and primary High Speed GMLAN Bus operate in a

similar manner, the diagnostics for each are similar.

Low Speed GMLAN Circuit Description

Low Speed GMLAN Bus is used in applications where a high data rate is not required which allows for the use of less complex components. It is typically used for operator controlled functions where the response time requirements are slower than those required for dynamic vehicle control.

The Low Speed GMLAN Serial Data Network consists of a single wire, ground referenced bus with high side voltage drive. During on road vehicle operation data symbols (1's and 0's) are transmitted sequentially at the normal rate of 33.3 Kbit/s. For component programming only, a special high speed data mode of 83.3 Kbit/s may be used.

Unlike the high speed dual wire networks, the single wire low speed network does not use terminating resistors at either end of the network.

The data symbols to be transmitted over the bus are represented by different voltage signals on the bus. When the Low Speed GMLAN Bus is at rest and is not being driven, there is a low signal voltage of approximately 0.2 V. This represents a logic "1". When a logic "0" is to be transmitted, the signal voltage is driven higher to around 4.0 V or higher.

Local Interconnect Network (LIN) Circuit Description

The Local Interconnect Network (LIN) Bus consists of a single wire with a transmission rate of 10.417 Kbit/s. This bus is used to exchange information between a master control module and other smart devices which provide supporting functionality. This type of configuration does not require the capacity or speed of either a High Speed GMLAN Bus or Low Speed GMLAN Bus and is thus relatively simpler.

The data symbols (1's and 0's) to be transmitted are represented by different voltage levels on the communication bus. When the LIN Bus is at rest and is not being driven, the signal is in a high voltage state of approximately V_{batt} . This represents a logic "1". When a logic "0" is to be transmitted, the signal voltage is driven low to about ground (0.0 V).

Communication Enable Circuit Description

Devices on High Speed GMLAN Bus enable or disable communication based on the voltage level of the communication enable circuit. When the circuit voltage is high (around 12 V), communications are enabled. When the circuit is low, communications are disabled.

Data Link Connector (DLC)

The X84 Data Link Connector (DLC) is a standardized 16-cavity connector. Connector design and location is dictated by an industry wide standard, and is required to provide the following:

- Terminal 1 Low speed GMLAN communications terminal
- Terminal 2 Class 2 communications terminal
- Terminal 3 Mid speed GMLAN serial bus (+) terminal or Object high speed GMLAN serial bus (+) terminal

- Terminal 4 Scan tool power ground terminal
- Terminal 5 Common signal ground terminal
- Terminal 6 High speed GMLAN serial data bus (+) terminal
- Terminal 7 Keyword communications terminal
- Terminal 11 Mid speed GMLAN serial bus (-) terminal or Object high speed GMLAN serial bus (-) terminal
- Terminal 12 Chassis high speed GMLAN serial bus (+) terminal
- Terminal 13 Chassis high speed GMLAN serial bus (-) terminal
- Terminal 14 High speed GMLAN serial data bus (-) terminal
- Terminal 16 Scan tool power, battery positive voltage terminal

Serial Data Reference

The scan tool communicates over the various buses on the vehicle. When a scan tool is installed on a vehicle, the scan tool will try to communicate with every device that could be optioned into the vehicle. If an option is not installed on the vehicle, the scan tool will display No Comm (or Not Connected) for that optional device. In order to avert misdiagnoses of No Communication with a specific device, refer to **Data Link References** for a list of devices, the buses they communicate with, and the RPO codes for a specific device.

BRAKES

Disc Brakes - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Brake Caliper Bleeder Valve	8.5 N.m	75 lb in
Brake Caliper Guide Pin Bolts	28 N.m	21 lb ft
Brake Caliper Mounting Bracket Bolts	95 N.m	70 lb ft
Brake Hose to Brake Caliper Banjo Bolt	40 N.m	30 lb ft
Brake Rotor Screw	4 N.m	35 lb in
Disc Brake Splash Shield Bolts	4 N.m	35 lb in

DISC BRAKE COMPONENT SPECIFICATIONS

Disc Brake Component Specifications

Application	Specification	
	Metric	English
Front Brakes		
Brake Pad Discard Thickness	2.00 mm	0.079 in
Brake Pad Lining Minimum Thickness	2.00 mm	0.079 in
Brake Pad Lining Thickness- New	11.00 mm	0.433 in
Brake Pad Thickness- New	11.00 mm	0.433 in
Brake Rotor Diameter	236.00 mm	9.291 in
Brake Rotor Discard Thickness*	18.00 mm	0.709 in
Brake Rotor Maximum Allowable Assembled Lateral Runout	0.06 mm	0.002 in
Brake Rotor Maximum Allowable Scoring	1.50 mm	0.059 In
Brake Rotor Maximum Allowable Thickness Variation	0.01 mm	0.0004 in
Brake Rotor Minimum Thickness after Refinishing	22 mm	0.866 In
Brake Rotor Thickness- New	24 mm	0.945 in

DIAGNOSTIC INFORMATION AND PROCEDURES

BRAKE ROTOR THICKNESS MEASUREMENT

WARNING: Refer to Brake Dust Warning .

1. If the inboard friction surface of the brake rotor is not accessible, reposition and support the caliper with the brake pads. Refer to **Front Disc Brake Pads Replacement**.

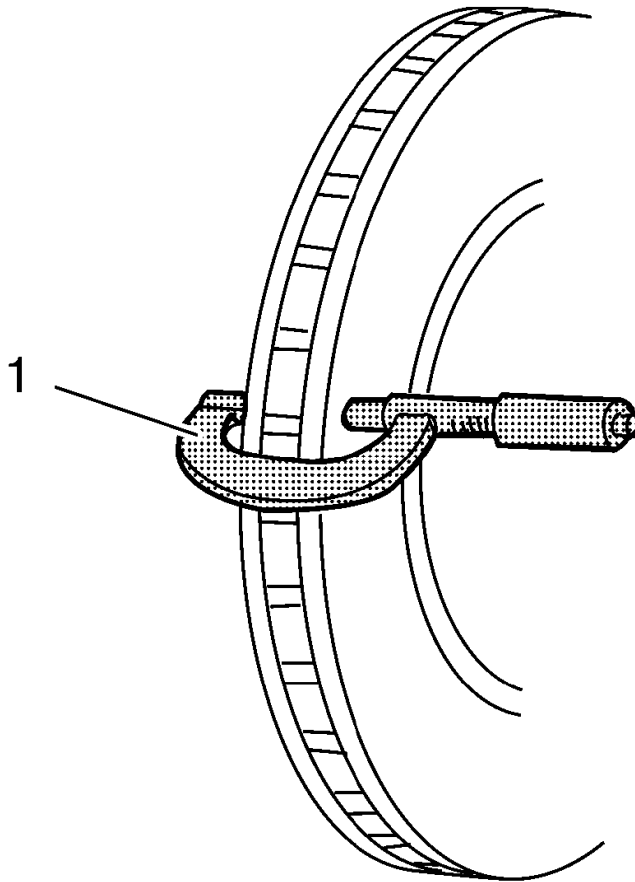


Fig. 1: Micrometer On Brake Rotor
Courtesy of GENERAL MOTORS COMPANY

2. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.
3. Using a micrometer (1) calibrated in thousandths-of-a-millimeter, or ten-thousandths-of-an-inch, measure and record the thickness of the brake rotor at four or more points, evenly spaced around the brake rotor.

Make sure that the measurements are only taken within the friction surfaces and that the micrometer is positioned the same distance from the outer edge of the brake rotor, about 13 mm (1/2 in), for each measurement.

4. Compare the lowest thickness measurement recorded to the following specifications:

Specification - Front

- Brake rotor minimum allowable thickness after refinishing: 18.20 mm (0.717 in)
 - Brake rotor discard thickness: 18.00 mm (0.709 in)
5. If the lowest thickness measurement of the brake rotor is above the minimum allowable thickness after refinishing specification, the brake rotor may be able to be refinished, depending upon surface and wear conditions which may be present.
 6. If the lowest thickness measurement of the brake rotor is at or below the minimum allowable thickness after refinishing specification, the brake rotor may not be refinished.
 7. If the lowest thickness measurement of the brake rotor is at or below the discard thickness specification, the brake rotor requires replacement.

BRAKE ROTOR THICKNESS VARIATION MEASUREMENT

WARNING: Refer to Brake Dust Warning .

NOTE: Any disc brake rotor that exhibits thickness variation exceeding the maximum acceptable level must be refinished or replaced. Thickness variation exceeding the maximum acceptable level can cause brake pulsation.

1. If the inboard friction surface of the brake rotor is not accessible, reposition and support the caliper with the brake pads. Refer to Front Disc Brake Pads Replacement.
2. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.

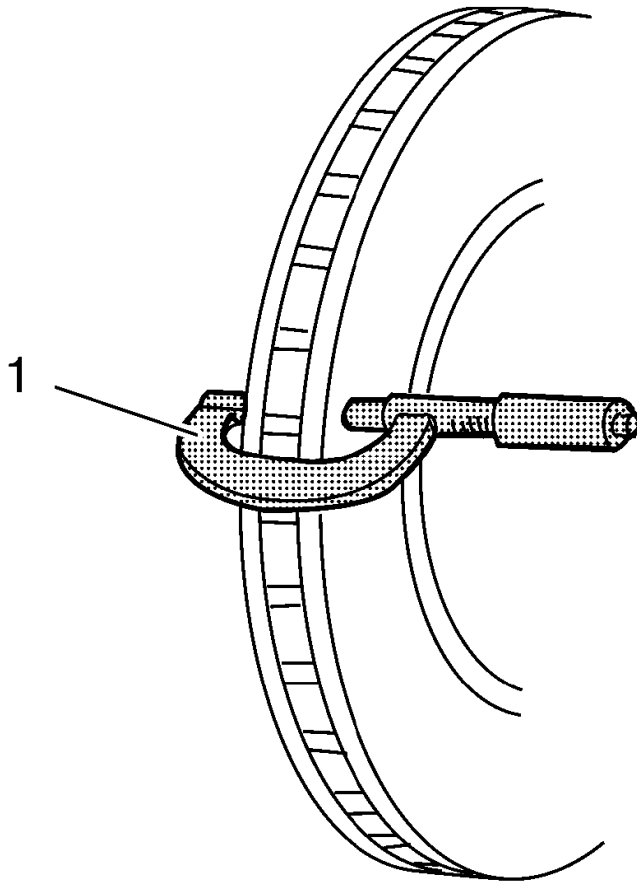


Fig. 2: Micrometer On Brake Rotor
Courtesy of GENERAL MOTORS COMPANY

3. Using a micrometer (1) calibrated in thousandths-of-a-millimeter, or ten-thousandths-of-an-inch, measure and record the thickness of the brake rotor at 4 or more points, evenly spaced around the brake rotor.

Make sure that the measurements are only taken within the friction surfaces and that the micrometer is positioned the same distance from the outer edge of the brake rotor, about 13 mm (1/2 in), for each measurement.

4. Calculate the difference between the highest and lowest thickness measurements recorded to obtain the amount of thickness variation.

NOTE: Whenever a brake rotor is refinished or replaced, the assembled lateral runout (LRO) of the brake rotor must be measured to make sure optimum performance of the disc brakes.

5. Compare the thickness variation measurement to the following specification:

Specification

Brake rotor maximum allowable thickness variation: 0.001 mm (0.0004 in).

6. If the brake rotor thickness variation measurement exceeds the specification, the brake rotor requires refinishing or replacement.

BRAKE ROTOR SURFACE AND WEAR INSPECTION

WARNING: Refer to **Brake Dust Warning** .

1. If the inboard friction surface of the brake rotor is not accessible, reposition and support the caliper with the brake pads. Refer to **Front Disc Brake Pads Replacement**.
2. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.
3. Inspect the friction surfaces of the brake rotor for the following braking surface conditions:
 - Heavy rust and/or pitting

Light surface rust can be removed with an abrasive disc. Heavy surface rust and/or pitting must be removed by refinishing the brake rotor.

- Cracks and/or heat spots
 - Too much blueing discoloration
4. If the friction surfaces of the brake rotor exhibit one or more of the braking surface conditions, the brake rotor requires refinishing or replacement.

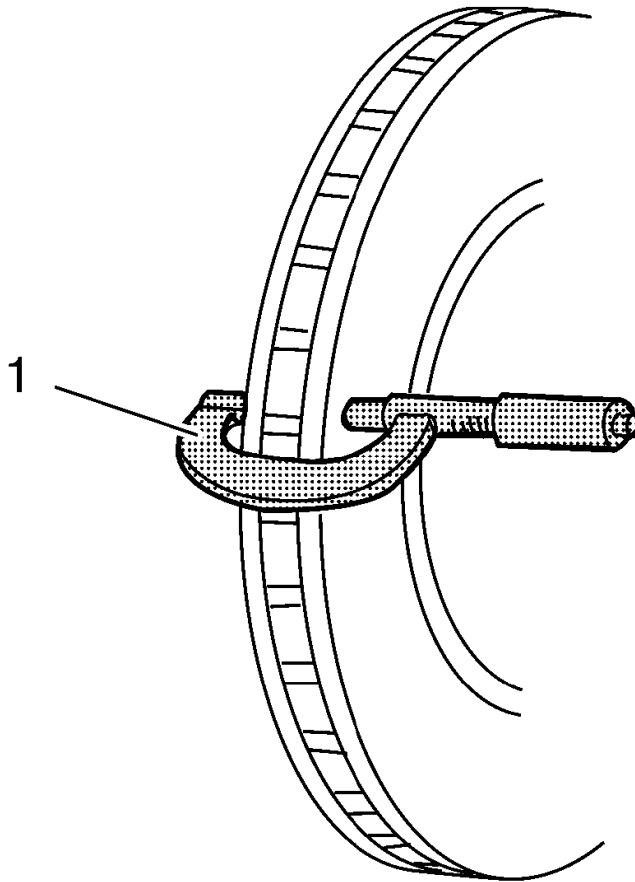


Fig. 3: Micrometer On Brake Rotor
Courtesy of GENERAL MOTORS COMPANY

5. Using a micrometer (1) calibrated in thousandths-of-a-millimeter, or ten-thousandths-of-an-inch, measure and record the scoring depth of any grooves present on the brake rotor friction surfaces.
6. Compare the groove scoring depth recorded to the following specification:

Specification

Brake rotor maximum allowable scoring: 1.50 mm (0.059 in).

7. If the brake disc rotor scoring depth exceeds the specification, or if an excessive amount of scoring is present, the brake rotor requires refinishing or replacement.

BRAKE ROTOR ASSEMBLED LATERAL RUNOUT MEASUREMENT

Special Tools

- **CH-41013** Rotor Surfacing Kit
- **CH-42450-A** Wheel Hub Resurfacing Kit
- **CH-45101** Hub and Wheel Runout Gauge
- **CH-45101-100** Conical Brake Rotor Washers

For equivalent regional tools, refer to **Special Tools**.

WARNING: Refer to Brake Dust Warning .

NOTE:

- **Brake rotor assembled lateral runout (LRO) exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4, 800-11, 300 km (3, 000-7, 000 mi).**
- **Brake rotor thickness variation MUST be inspected BEFORE inspecting for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to Brake Rotor Thickness Variation Measurement.**

1. Matchmark the position of the brake rotor to the wheel studs if this has not been done already.

NOTE:

Whenever the brake rotor has been separated from the hub/axle flange, any rust or contaminants should be cleaned from the hub/axle flange and the brake rotor mating surfaces. Failure to do this may result in excessive assembled lateral runout (LRO) of the brake rotor, which could lead to brake pulsation.

2. Inspect the mating surface of the hub/axle flange and the brake rotor to make sure that there are no foreign particles, corrosion, rust, or debris remaining. If the wheel hub/axle flange and/or brake rotor mating surfaces exhibit these conditions, perform the following steps:
 1. Remove the brake rotor from the vehicle. Refer to **Front Brake Rotor Replacement**.
 2. Using the **CH-42450-A** wheel hub resurfacing kit, thoroughly clean any rust or corrosion from the mating surface of the hub/axle flange.
 3. Using the **CH-41013** rotor resurfacing kit, thoroughly clean any rust or corrosion from the mating surface of the brake rotor.
 4. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.
3. Install the rotor to the hub/axle flange using the matchmark made prior to removal.

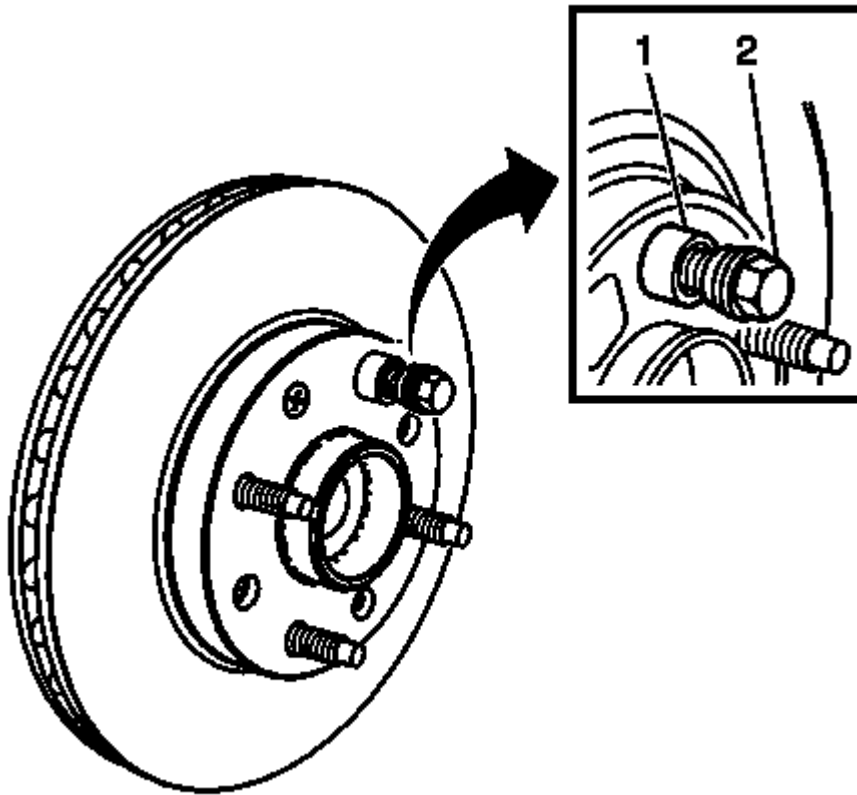


Fig. 4: One Lug Nut & Conical Brake Rotor Washers
Courtesy of GENERAL MOTORS COMPANY

4. Hold the brake rotor firmly in place against the hub/axle flange and install one of the **CH-45101-100** conical brake rotor washers (1), and one lug nut (2) onto the upper-most wheel stud.
5. Continue to hold the brake rotor secure and tighten the lug nut firmly by hand.

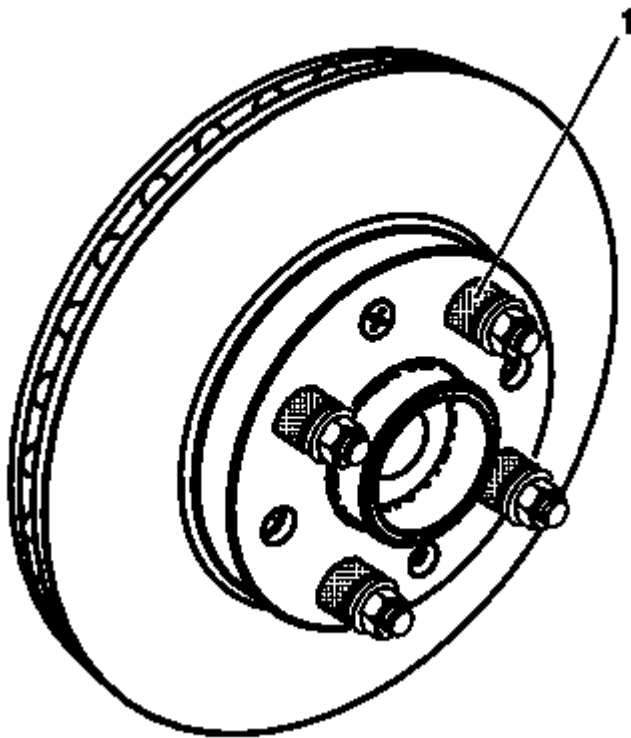


Fig. 5: Wheel Studs

Courtesy of GENERAL MOTORS COMPANY

6. Install the remaining **CH-45101-100** conical brake rotor washers (1) and lug nuts onto the wheel studs and tighten the nuts firmly by hand in the tightening sequence.
7. Tighten the lug nuts in sequence, in order to properly secure the rotor. Refer to **Tire and Wheel Removal and Installation** .
8. If the brake rotor has been REFINISHED or REPLACED with a new rotor, proceed to step 14.
9. If the brake rotor meets the following criteria, proceed to step 10.
 - The rotor is within specifications and is being REUSED.
 - The rotor has NOT been refinished.
 - The rotor does not exhibit thickness variation exceeding the maximum allowable level.

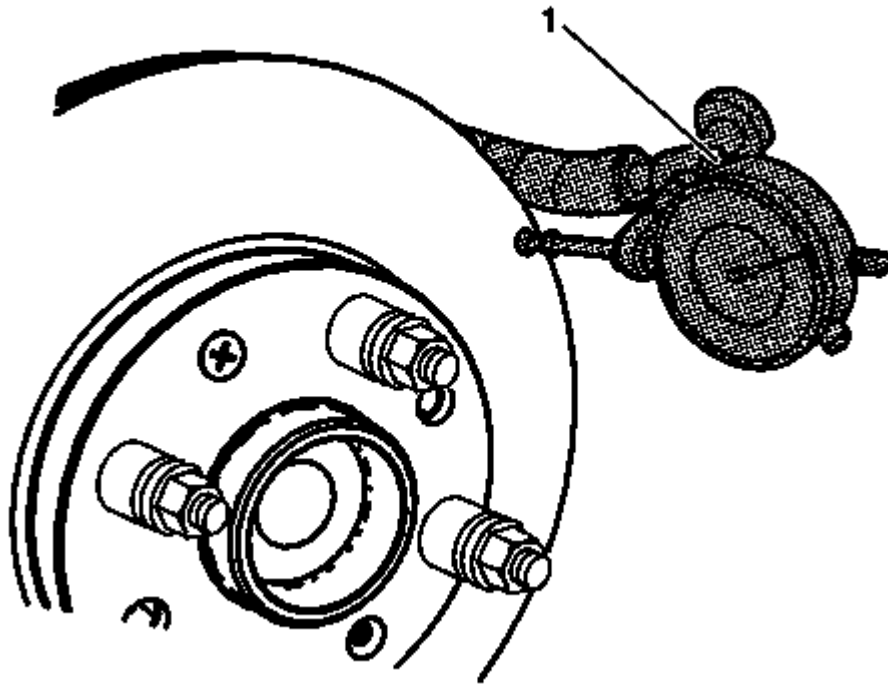


Fig. 6: Hub And Wheel Runout Gauge
Courtesy of GENERAL MOTORS COMPANY

10. Mount a dial indicator, **CH-45101** hub and wheel runout gauge (1), or equivalent, to the steering knuckle and position the indicator button so it contacts the brake rotor friction surface at a 90 degree angle, approximately 13 mm (0.5 in) from the outer edge of the rotor.
11. Measure and record the assembled LRO of the brake rotor:
 1. Rotate the rotor until the lowest reading is displayed on the indicator dial, then set the dial to zero.
 2. Rotate the rotor until the highest reading is displayed on the dial.
 3. Mark the location of the high spot relative to the nearest wheel stud, or studs.
 4. Measure and record the amount of assembled LRO.
12. Compare the brake rotor assembled LRO to the following specification:

Specification

Front brake rotor maximum allowable assembled lateral runout: 0.06 mm (0.002 in)

13. If the brake rotor assembled LRO is within specifications, proceed to step 18.

If the brake rotor assembled LRO exceeds the specification, refinish the rotor to ensure true parallelism. Refer to **Brake Rotor Refinishing**. After refinishing the rotor, proceed to step 14.

14. Mount a dial indicator, **CH-45101** hub and wheel runout gauge, or equivalent, to the steering knuckle and position the indicator button so it contacts the brake rotor friction surface at a 90 degree angle, approximately 13 mm (0.5 in) from the outer edge of the rotor.
15. Measure and record the assembled LRO of the brake rotor.
 1. Rotate the rotor until the lowest reading is displayed on the indicator dial, then set the dial to zero.
 2. Rotate the rotor until the highest reading is displayed on the dial.
 3. Mark the location of the high spot relative to the nearest wheel stud, or studs.
 4. Measure and record the amount of assembled LRO.
16. Compare the brake rotor assembled LRO to the following specification:

Specification

Front brake rotor maximum allowable assembled lateral runout: 0.06 mm (0.002 in).

17. If the brake rotor assembled LRO measurement exceeds the specification, bring the LRO to within specifications. Refer to **Brake Rotor Assembled Lateral Runout Correction**.
18. If the brake rotor assembled LRO measurement is within specification, install the brake caliper and depress the brake pedal several times to secure the brake rotor in place before removing the **CH-45101-100** conical brake rotor washers and the lug nuts.

BRAKE PAD INSPECTION

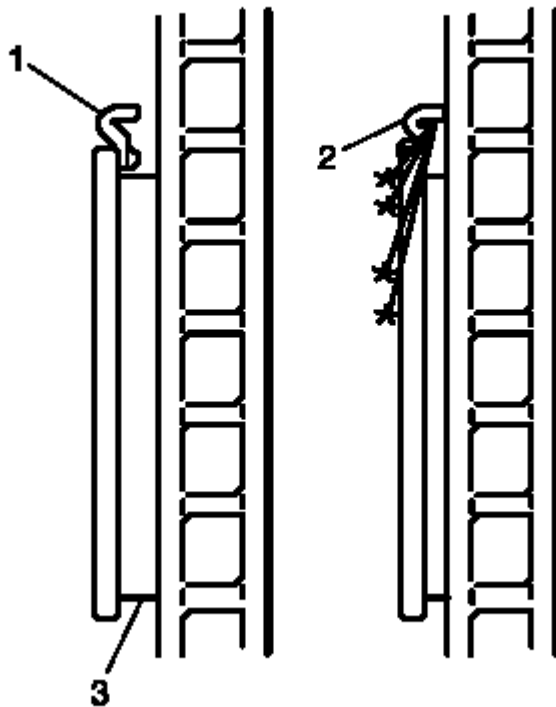


Fig. 7: Disc Brake Pads And Audible Wear Sensors
Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to Brake Dust Warning .

1. Inspect the disc brake pads at regular intervals, or whenever the tire and wheel assemblies are removed from the vehicle.
2. If replacement is necessary, always replace disc brake pads in axle sets.
3. Inspect both edges of the disc brake pad friction surfaces (3). The highest rate of wear normally occurs at the trailing edge of the disc brake pads.
4. Inspect the thickness of the disc brake pads (3) in order to ensure that they have not worn prematurely. The disc brake pad wear should be approximately even per axle set.
5. Front brake pads have integral, audible wear sensors (1). When the disc brake pad wear reaches the minimum allowable thickness, the wear sensor contacts the disc brake rotor (2). The wear indicator will then produce an audible, high-pitched warning noise during wheel rotation.
6. Replace the disc brake pads when the friction surface (3) is worn to within 2.00 mm (0.079 in) of the mounting plates.
7. Verify that any disc brake pad shims that may be required are in place and not damaged or excessively corroded. Replace any missing or damaged shims in order to preserve proper disc brake performance.
8. Replace the disc brake pads if any have separated from the mounting plates.

9. Inspect the disc brake pads friction surfaces for cracks, fractures, or damage which may cause noise or otherwise impair disc brake performance.

BRAKE CALIPER INSPECTION

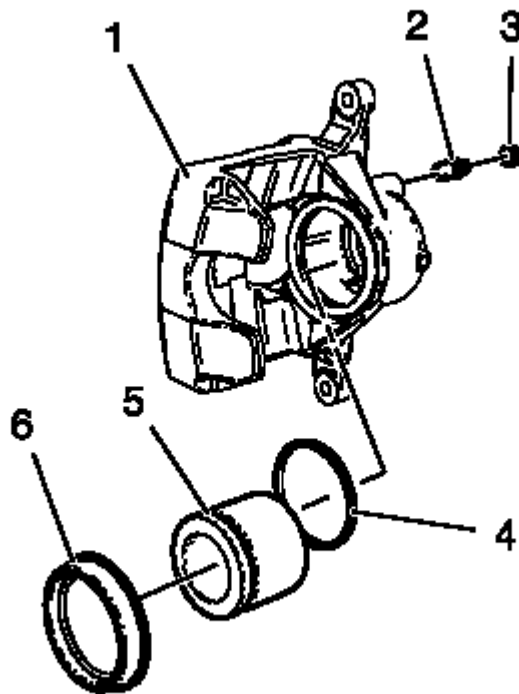


Fig. 8: Brake Caliper Components
Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to Brake Dust Warning .

1. Inspect the brake caliper housing (1) for cracks, excess wear, and/or damage. If any of these conditions are present, the brake caliper requires replacement.
2. Inspect the caliper piston dust boot seal (2) for cracks, tears, cuts, deterioration and/or improper seating in the caliper body. If any of these conditions are present, the brake caliper requires overhaul or replacement.
3. Inspect for brake fluid leakage around the caliper piston boot seal (6) and on the disc brake pads. If there is any evidence of brake fluid leakage, the brake caliper requires overhaul or replacement.

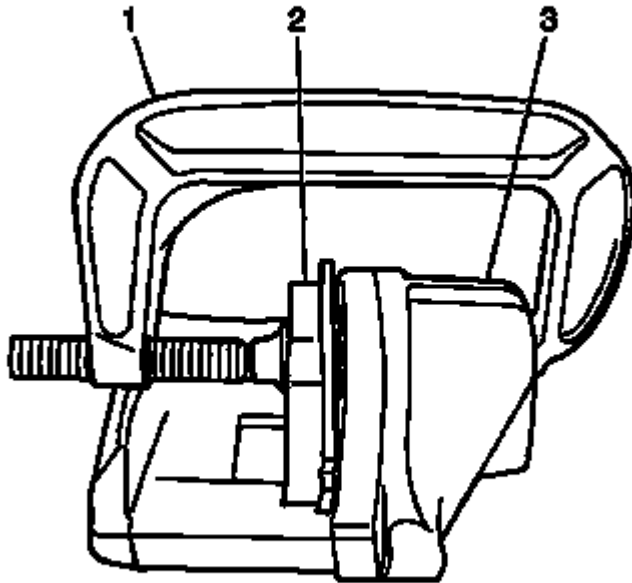


Fig. 9: Brake Caliper, Inner Brake Pad And C-Clamp
Courtesy of GENERAL MOTORS COMPANY

4. Inspect for smooth and complete travel of the caliper pistons into the caliper bores:
 - The movement of the caliper pistons into the caliper bores should be smooth and even. If the caliper piston is frozen or difficult to bottom, the caliper requires overhaul or replacement.
 - Insert a discarded inner brake pad (2) or block of wood in front of the piston. Using a large C-clamp (1) installed over the body of the caliper (3) and against the brake pad or block of wood, slowly bottom the piston in the bore.

FRONT DISC BRAKE MOUNTING AND HARDWARE INSPECTION

WARNING: Refer to **Brake Dust Warning** .

1. Inspect the fluid level in the brake master cylinder reservoir.
2. If the brake fluid level is midway between the maximum-full point and the minimum allowable level then no brake fluid needs to be removed from the reservoir before proceeding.
3. If the brake fluid level is higher than midway between the maximum-full point and the minimum allowable level then remove brake fluid to the midway point before proceeding.

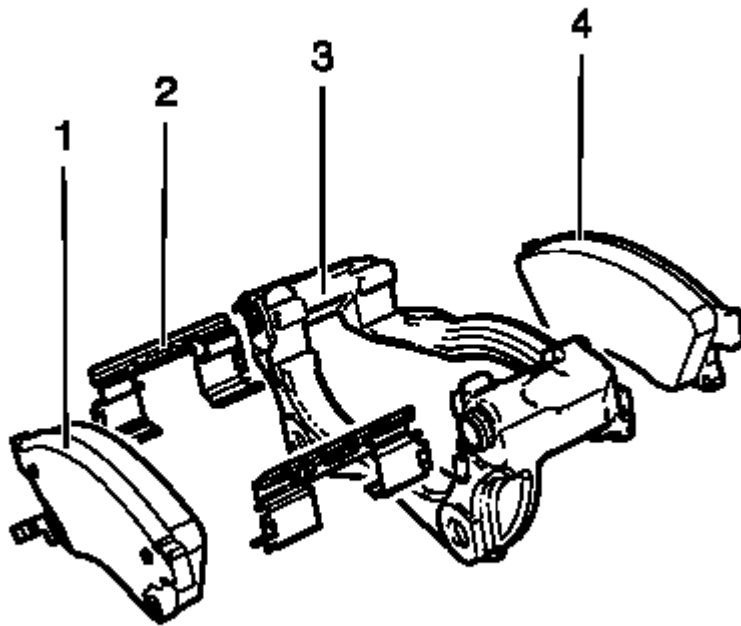


Fig. 10: Brake Caliper Mounting Bracket
Courtesy of GENERAL MOTORS COMPANY

4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**
5. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
6. Grasp the brake caliper housing and try to move the brake caliper housing up/down and forward/reverse in relation to the brake caliper mounting bracket (3). If excessive looseness is observed the brake caliper bracket bushings and/or the brake caliper mounting bolts may need to be replaced.
7. Compress the front caliper pistons.
 - Install a large C-clamp over the top of the caliper housing and against the back of the outboard pad (1).
 - Slowly tighten the C-clamp until the pistons are pushed completely into the caliper bores.
 - Remove the C-clamp from the caliper.
8. With the pistons compressed into the caliper bores, grasp the brake caliper housing and slide it back and forth on the brake caliper mounting bolts. Check for smooth operation. If the brake caliper housing slide force is high or the brake caliper housing does not slide smoothly, inspect the brake caliper mounting bolts and/or the brake caliper mounting bracket bushings for wear or damage. If wear or damage conditions are found, replacement of the brake caliper mounting bolts and/or the brake caliper mounting bracket bushings is necessary.
9. Remove the brake caliper mounting bolts from the brake caliper mounting bracket and support the brake caliper using heavy mechanics wire. Do not remove the hydraulic brake hose from the caliper. Refer to

Front Brake Caliper Replacement.

10. Remove the disc brake pads (1, 4) from the brake caliper mounting bracket (3).
11. Inspect the disc brake pad mounting hardware for the following:
 - Missing mounting hardware
 - Excessive corrosion
 - Bent mounting tabs (2)
 - Looseness at the brake caliper mounting bracket (3)
 - Looseness at the disc brake pads (1, 4)
 - Excessive contaminants in the brake caliper mounting bracket surface and threads
12. If any of the conditions listed are found, the disc brake pad mounting hardware requires replacement.
13. Ensure the disc brake pads are held firmly in place on the brake caliper mounting bracket, yet slide easily on the mounting hardware without binding.

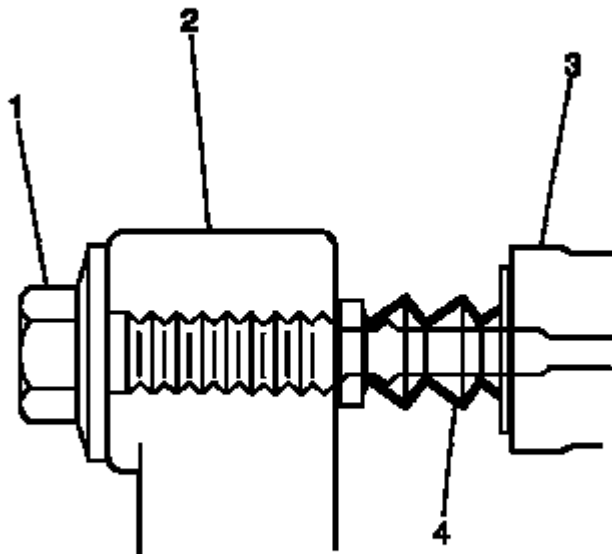


Fig. 11: Caliper Bolts

Courtesy of GENERAL MOTORS COMPANY

14. Inspect the caliper bolts (1) for the following:
 - Binding
 - Seizing
 - Looseness in the brake caliper mounting bracket (3)

- Bent or damaged brake caliper mounting bolts
 - Cracked or torn boots (4)
 - Missing boots
 - Bent or damaged brake caliper mounting bracket (3)
15. If any of the conditions listed are found then the brake caliper mounting hardware requires replacement.
 16. Install the disc brake pads to the brake caliper mounting bracket.
 17. Install the disc brake caliper to the brake caliper mounting bracket. Refer to **Front Brake Caliper Replacement**.

REPAIR INSTRUCTIONS

FRONT DISC BRAKE PADS REPLACEMENT

Removal Procedure

WARNING: Refer to **Brake Dust Warning** .

NOTE: **Always replace disc brake pads in axle sets.**

1. Inspect the fluid level in the master cylinder reservoir.
2. If the brake fluid level is midway between the maximum-full point and the minimum allowable level, no brake fluids needs to be removed from the reservoir before proceeding.
3. If the brake fluid level is higher than midway between the maximum-full point and the minimum allowable level, remove brake fluid to the midway point before proceeding.
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**
5. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .

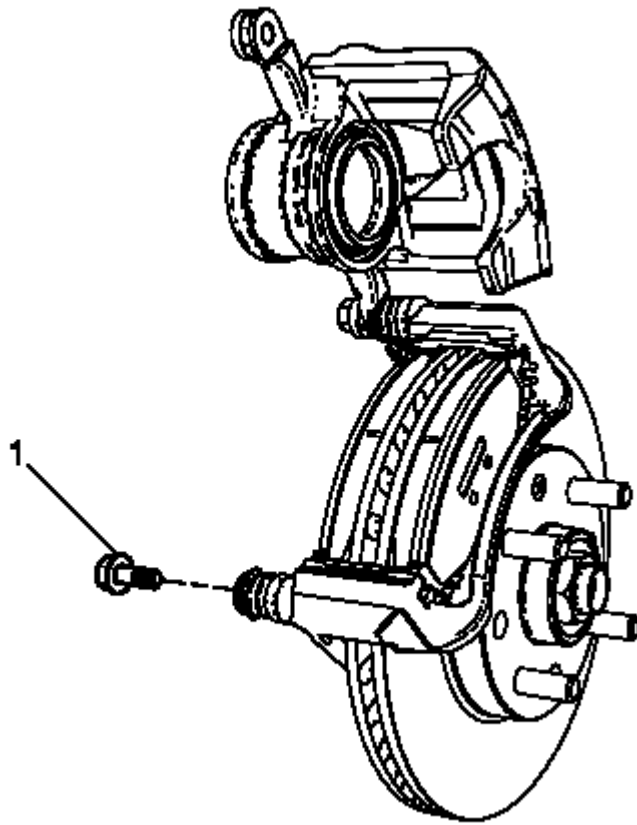


Fig. 12: Brake Caliper Lower Guide Pin Bolt
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

6. Remove the brake caliper lower guide pin bolt (1).

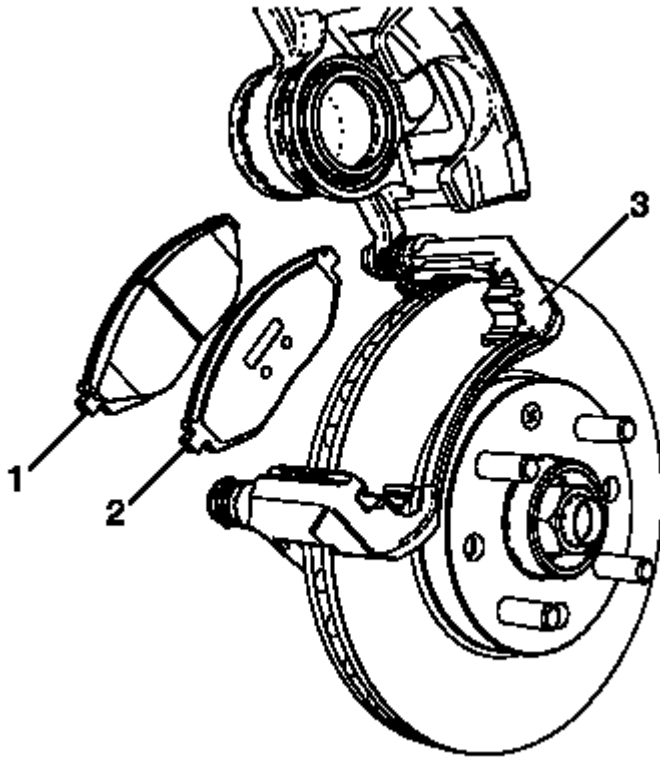


Fig. 13: Caliper Mounting Bracket
Courtesy of GENERAL MOTORS COMPANY

7. Without disconnecting the hydraulic brake flexible hose, pivot the caliper upward and secure the caliper with heavy mechanics wire, or equivalent.
8. Remove the inboard brake pad (1) from the caliper mounting bracket (3).

Note the location of the brake pad audible wear sensor.

9. Remove the outboard brake pad (2) from the caliper mounting bracket (3).

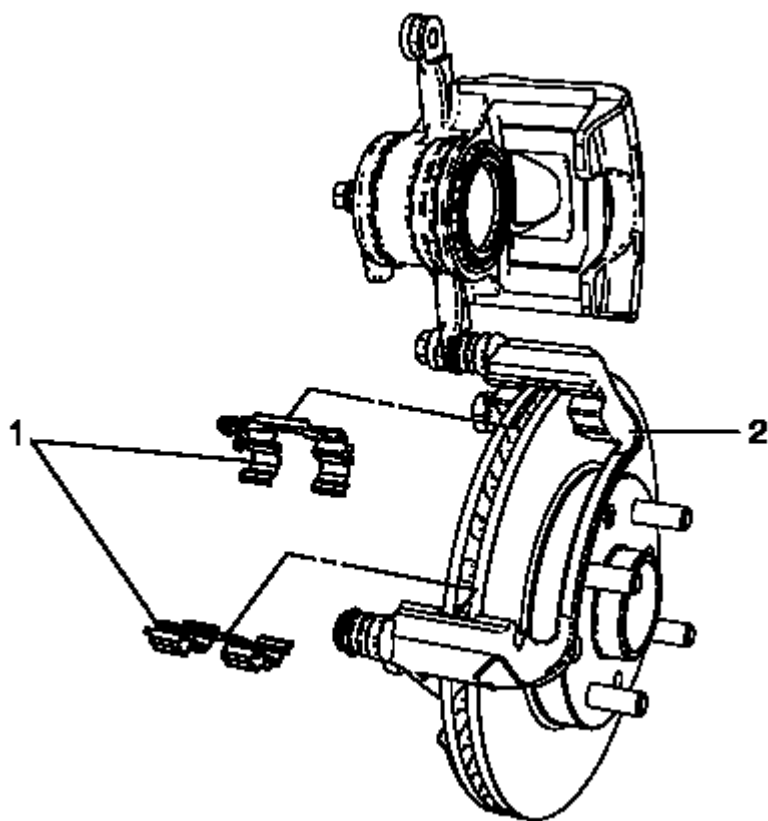


Fig. 14: Brake Pad Retainers

Courtesy of GENERAL MOTORS COMPANY

10. Remove the brake pad retainers (1) from the caliper bracket (2).
11. Inspect the disc brake mounting and hardware. Refer to **Front Disc Brake Mounting and Hardware Inspection**.

Installation Procedure

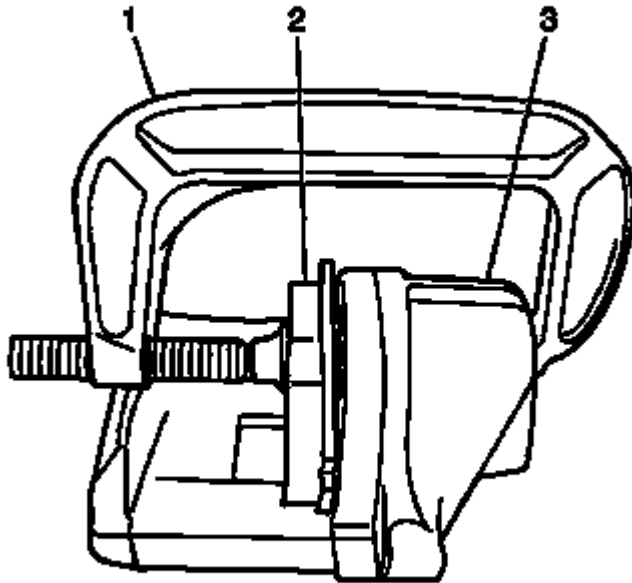


Fig. 15: Brake Caliper, Inner Brake Pad And C-Clamp
Courtesy of GENERAL MOTORS COMPANY

1. Install a large C-clamp (1) over the body of the brake caliper (3), with the C-clamp ends against the rear of the caliper body and against an old inboard brake pad (2) or a wood block installed against the caliper pistons.
2. Tighten the C-clamp evenly until the caliper piston is compressed completely into the caliper bore.
3. Remove the C-clamp and the old brake pad or wood block from the caliper.

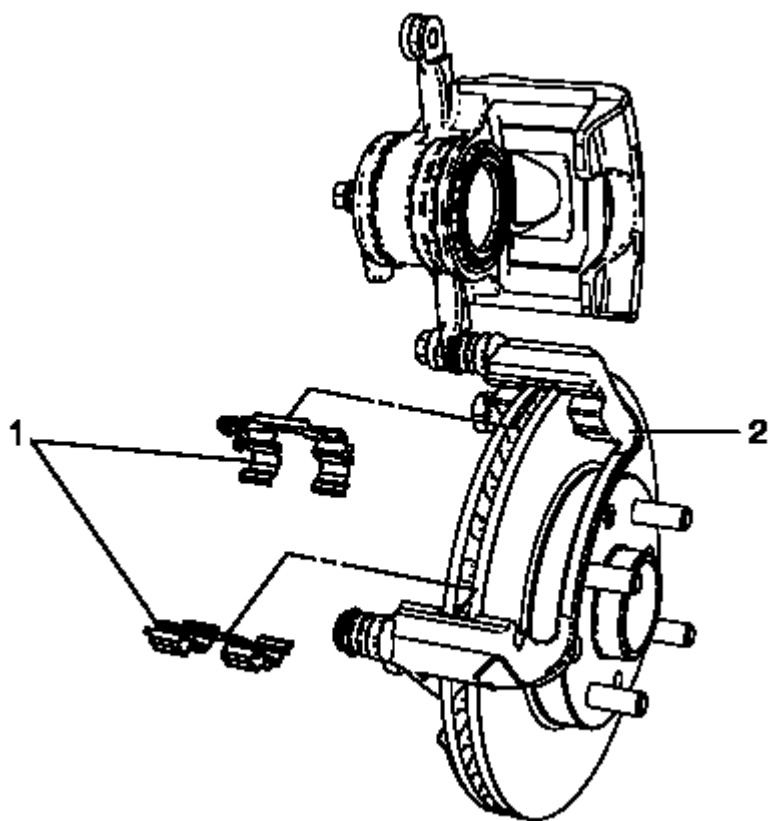


Fig. 16: Brake Pad Retainers

Courtesy of GENERAL MOTORS COMPANY

4. Install the brake pad retainers (1) to the caliper bracket (2).

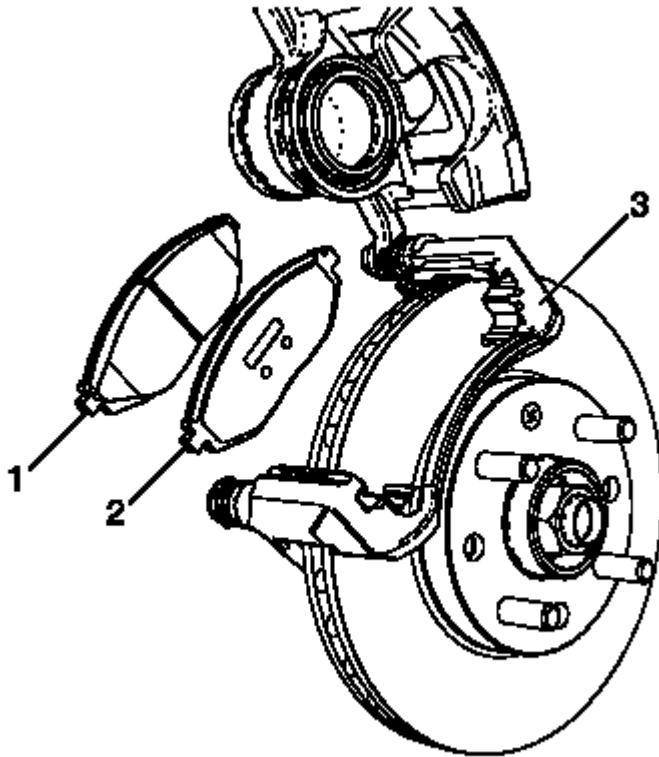


Fig. 17: Caliper Mounting Bracket
Courtesy of GENERAL MOTORS COMPANY

NOTE: The wear sensor equipped disc brake pad must be mounted inboard of the rotor with the leading edge of the sensor facing the brake rotor during forward wheel rotation, or at the top of the pad when installed in vehicle position.

5. Install the brake pads (1, 2) to the caliper bracket (3).
6. Remove the support, and rotate the brake caliper into position over the disc brake pads and to the caliper mounting bracket.

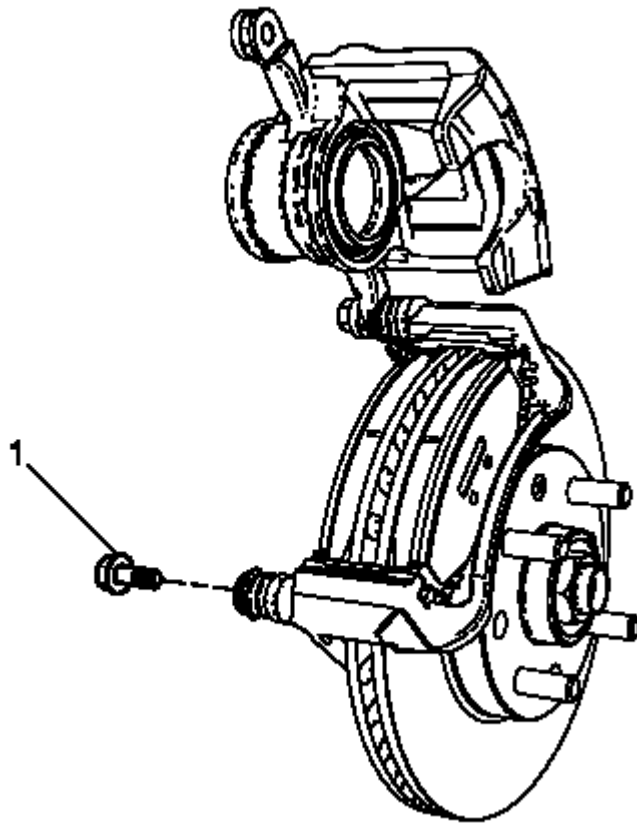


Fig. 18: Brake Caliper Lower Guide Pin Bolt
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

7. Install the lower brake caliper guide pin bolt (1) and tighten to 28 (21 lb ft).
8. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
9. Lower the vehicle.
10. With the engine OFF, gradually apply the brake pedal approximately 2/3 of its travel distance.
11. Slowly release the brake pedal.
12. Wait 15 seconds, then gradually apply the brake pedal approximately 2/3 of its travel distance again until a firm brake pedal apply is obtained. This will properly seat the brake caliper pistons and brake pads.
13. Fill the master cylinder reservoir to the proper level. Refer to **Master Cylinder Reservoir Filling** .
14. Burnish the pads and rotors. Refer to **Brake Pad and Rotor Burnishing**.

BRAKE PAD AND ROTOR BURNISHING

WARNING: Road test a vehicle under safe conditions and while obeying all traffic laws. Do not attempt any maneuvers that could jeopardize vehicle control.

Failure to adhere to these precautions could lead to serious personal injury and vehicle damage.

Burnishing the brake pads and brake rotors is necessary in order to ensure that the braking surface are properly prepared after service has been performed on the disc brake system.

This procedure should be performed whenever the disc brake rotors have been refinished or replaced, and/or whenever the brake pads have been replaced.

1. Select a smooth road with little or no traffic.
2. Accelerate the vehicle to 48 km/h (30 mph).

NOTE: Use care to avoid overheating the brakes while performing this step as it may adversely affect the heating characteristics of the NEW brake pad material.

3. Using moderate pressure, apply the brakes to bring the vehicle to a stop. Do not allow the brakes to lock.
4. Repeat steps 2 and 3 until approximately 20 stops have been completed. Allow sufficient cooling periods between stops in order to properly burnish the brake pads and rotors.

FRONT BRAKE CALIPER REPLACEMENT

WARNING: Refer to Brake Dust Warning .

WARNING: Refer to Brake Fluid Irritant Warning .

Removal Procedure

1. Inspect the fluid level in the master cylinder reservoir.
2. If the brake fluid level is midway between the maximum-full point and the minimum allowable level, no brake fluid needs to be removed from the reservoir before proceeding.
3. If the brake fluid level is higher than midway between the maximum-full point and the minimum allowable level, remove the brake fluid to the midway point before proceeding.
4. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
5. Remove the tire and wheel assembly. Refer to Tire and Wheel Removal and Installation .

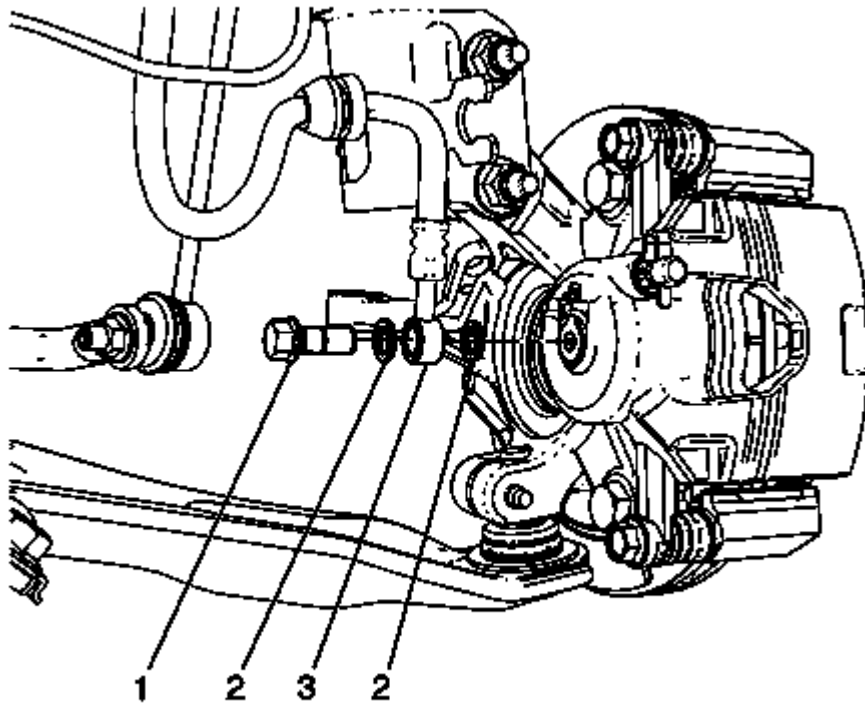


Fig. 19: Brake Caliper And Caliper Bolt
Courtesy of GENERAL MOTORS COMPANY

6. Remove the brake hose-to-caliper bolt (1) from the brake caliper.
7. Remove the brake hose (3) from the brake caliper.
8. Remove and discard the 2 copper brake hose washers (2). These washers may be stuck to the brake caliper and/or the brake hose end (3).
9. Cap or plug the opening in the brake caliper and the brake hose to prevent fluid loss and contamination.

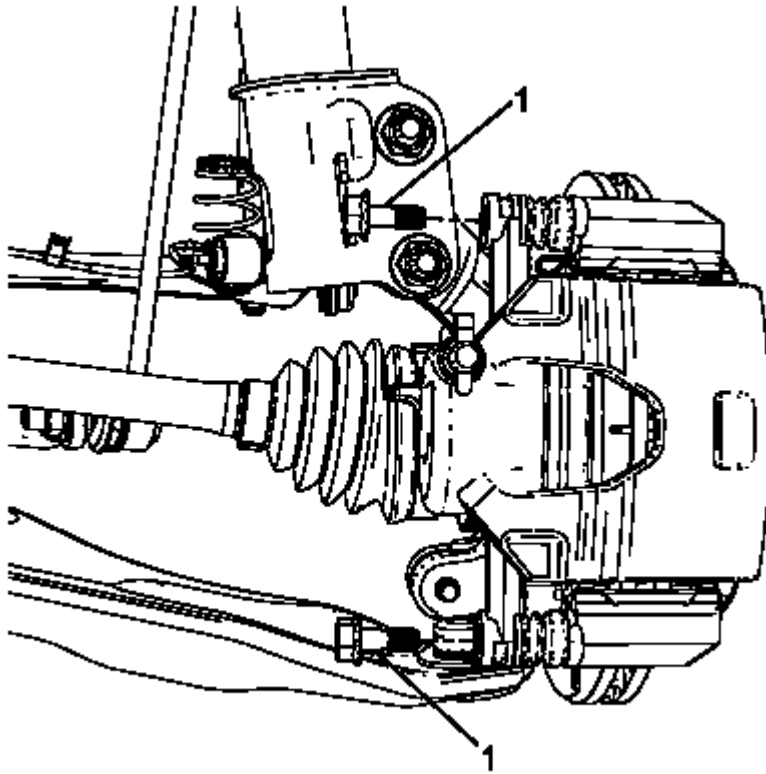


Fig. 20: Brake Caliper Guide Pin Bolts
Courtesy of GENERAL MOTORS COMPANY

10. Remove the brake caliper guide pin bolts (1).
11. Remove the brake caliper from the caliper brackets.
12. Inspect the brake caliper guide pins for freedom of movement, and inspect the condition of the guide pin boots. Move the guide pins inboard and outboard within the bracket bores, without disengaging the slides from the boots, and observe for the following:
 - Restricted caliper guide pin movement
 - Looseness in the brake caliper mounting bracket
 - Seized and binding caliper guide pins
 - Split or torn boots
13. If any of the conditions listed are found, the brake caliper guide pins and/or boots require replacement.

Installation Procedure

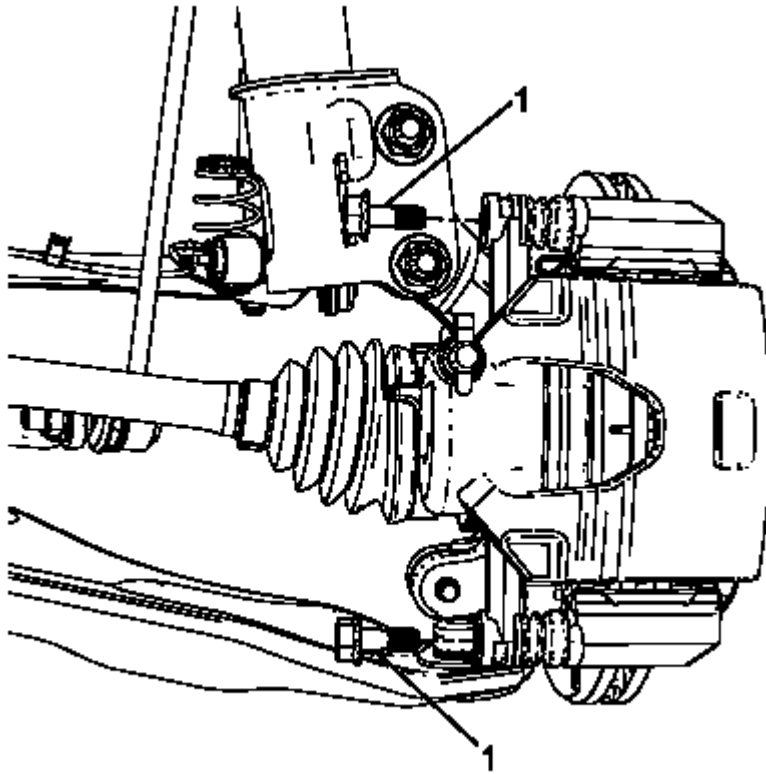


Fig. 21: Brake Caliper Guide Pin Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the brake caliper to the brake caliper bracket.

CAUTION: Refer to Fastener Caution .

2. Install the brake caliper guide pin bolts (1) and tighten to 28 N.m (21 lb ft).

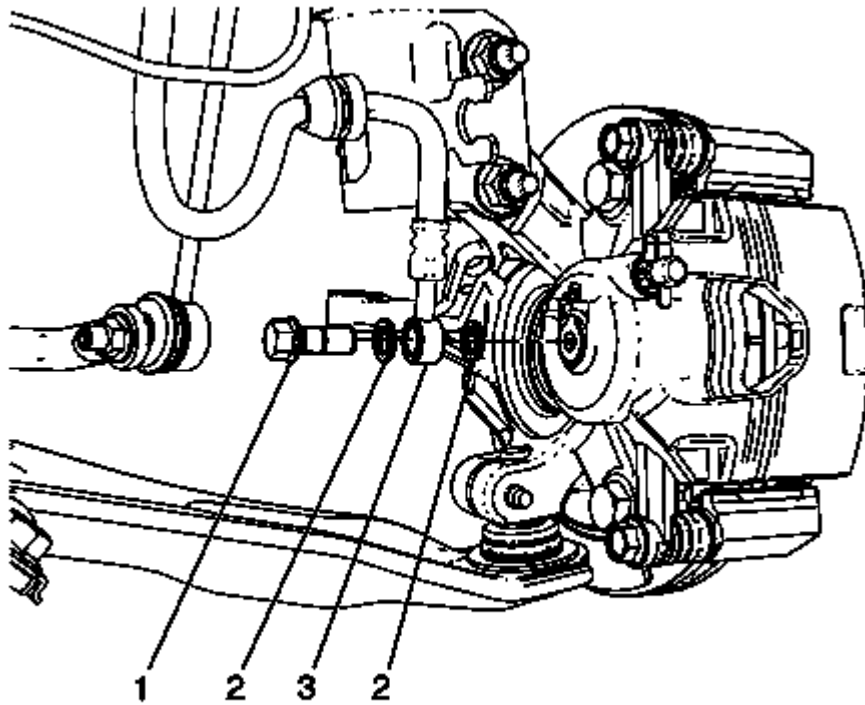


Fig. 22: Brake Caliper And Caliper Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Remove the caps or plugs from the brake caliper opening and the brake hose (3).

NOTE: Do not reuse the copper brake hose washers.

4. Install NEW copper brake hose washers (2) to the brake hose-to-caliper bolt (1) and to the brake hose (3).
5. Install the brake hose (3) and the brake hose-to-caliper bolt (1) to the brake caliper and tighten to 40 N.m (30 lb ft).
6. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** , **Hydraulic Brake System Bleeding (Pressure)** .
7. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
8. Lower the vehicle.
9. With the engine OFF, gradually apply the brake pedal to approximately 2/3 of its travel distance.
10. Slowly release the brake pedal.
11. Wait 15 seconds, then gradually apply the brake pedal approximately 2/3 of its travel distance again until a firm brake pedal apply is obtained. This will properly seat the brake caliper pistons and brake pads.

FRONT BRAKE CALIPER OVERHAUL

WARNING: Refer to Brake Dust Warning .

WARNING: Refer to Brake Fluid Irritant Warning .

Removal Procedure

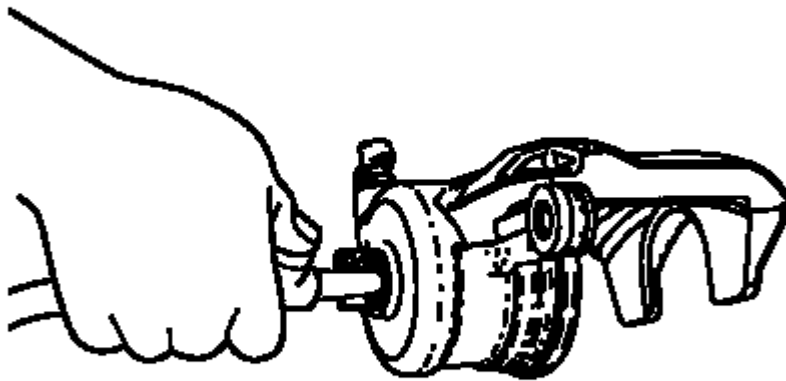


Fig. 23: Brake Caliper With Heavy Mechanic's Wire
Courtesy of GENERAL MOTORS COMPANY

WARNING: Do not place fingers in front of the caliper piston(s) in an attempt to catch or protect it when applying compressed air. The piston(s) can fly out with force and could result in serious bodily injury.

CAUTION: Use clean cloths to pad interior of caliper housing during piston removal. Use just enough air to ease the pistons out of the bores. If the pistons are blown out, even with the padding provided, it may be damaged.

1. Remove the brake caliper from the vehicle. Refer to Front Brake Caliper Replacement.

2. Remove the brake caliper piston from the caliper bore by directing low pressure compressed air into the caliper bore through the fluid inlet hole.

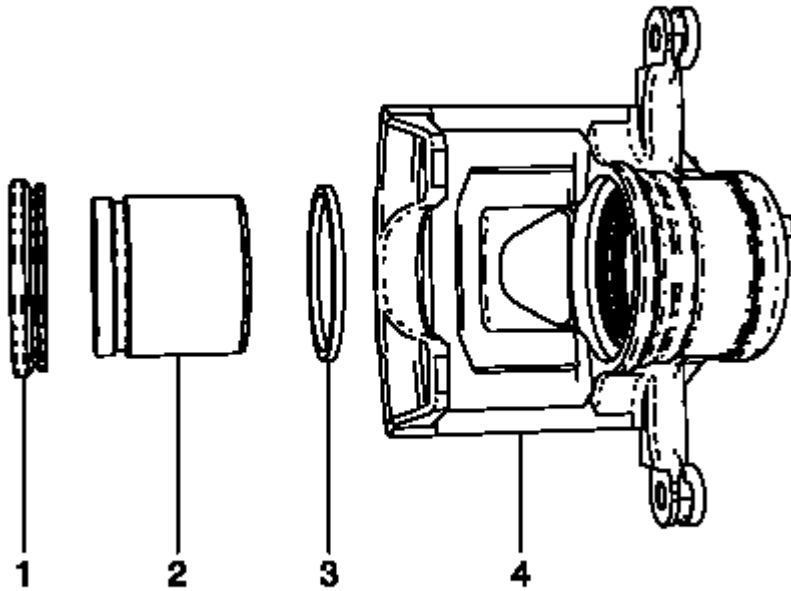


Fig. 24: New Piston Seal
Courtesy of GENERAL MOTORS COMPANY

3. Remove the piston dust boot seal (1) from the seal counter-bore in the caliper (4). Discard the boot seal.
4. Using a small wooden or plastic tool, remove the piston seal (4) from the caliper bore. Discard the piston seal.

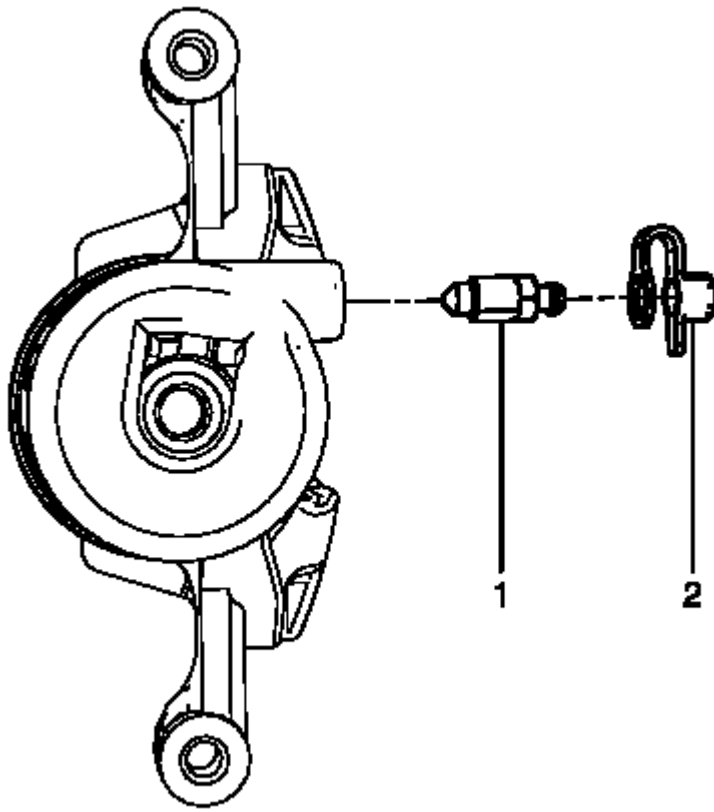


Fig. 25: Brake Bleeder Valve

Courtesy of GENERAL MOTORS COMPANY

5. Remove the brake bleeder valve cap (2).
6. Remove the brake bleeder valve (1).

NOTE: Do not use abrasives to clean the brake caliper piston.

7. Inspect the caliper bore for cracks, scoring, pitting, excessive rust, and/or excessive corrosion.
8. Clean the brake caliper piston bore and seal counterbore, and the caliper piston with denatured alcohol, or equivalent.
9. Dry the caliper piston bore and counterbore, and the piston with non-lubricated, filtered, compressed air.
10. If light rust or light corrosion are present in the caliper bore, attempt to remove the imperfection with a fine emery paper. If the imperfection cannot be removed, replace the caliper assembly.
11. If cracks, scoring, pitting, excessive rust, and/or excessive corrosion are present in the caliper bore, replace the caliper assembly.
12. Inspect the caliper piston for cracks, scoring, and/or damage to the plating. Replace the caliper piston if any of these conditions exist.

Installation Procedure

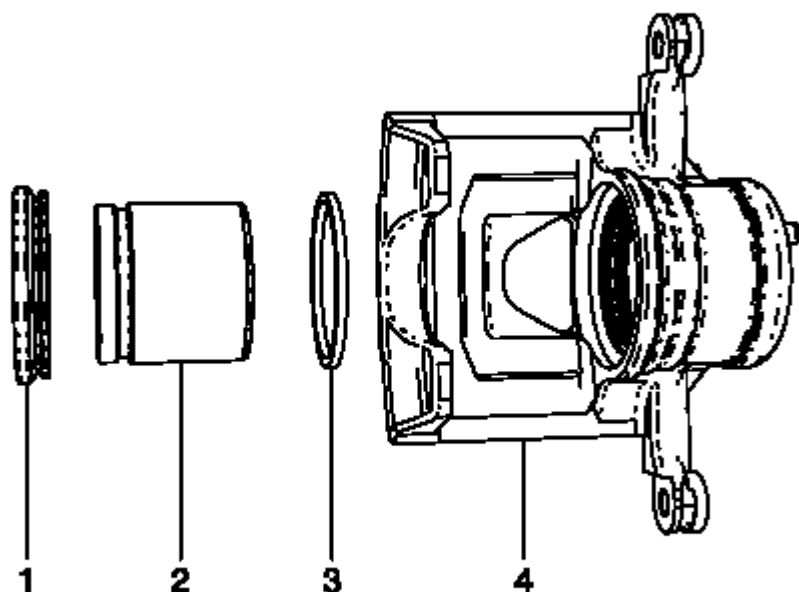


Fig. 26: New Piston Seal

Courtesy of GENERAL MOTORS COMPANY

1. Lubricate the new piston seal (3) with the brake fluid from a clean, sealed brake fluid container. Refer to **Brake System Specifications** for the recommended brake fluid.
2. Install the lubricated, new piston seal (3) into the caliper bore.
3. Apply a thin coat of brake fluid from a clean, sealed brake fluid container onto the outer surface area of the caliper piston (2). Refer to **Brake System Specifications** for the recommended brake fluid
4. Install the bottom half of the caliper piston (2) into the caliper bore.

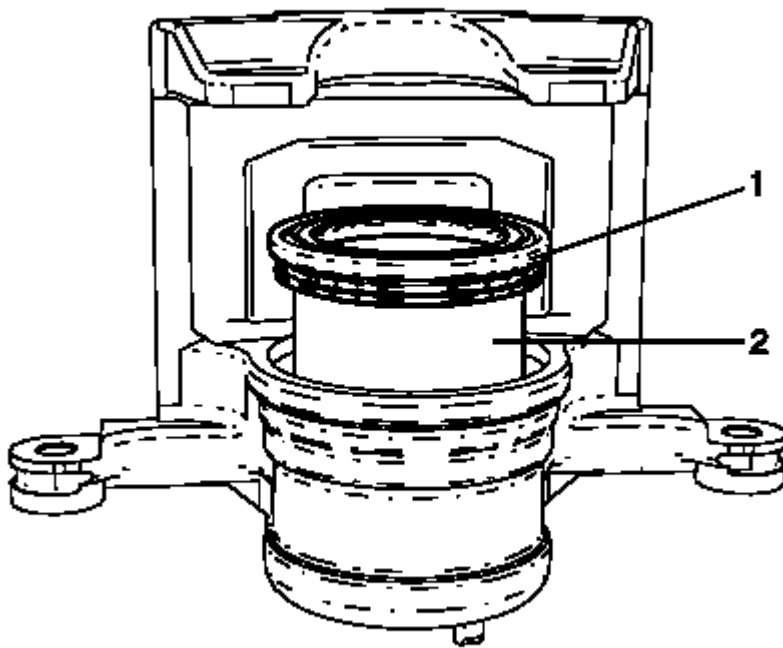


Fig. 27: Piston Dust Boot Seal And Over Caliper Piston
Courtesy of GENERAL MOTORS COMPANY

5. Install the new piston dust boot seal (1) over the caliper piston (2).
6. Compress the caliper piston (2) to the bottom of the caliper bore.
7. Fully seat the piston dust boot seal (1) into caliper counter-bore.

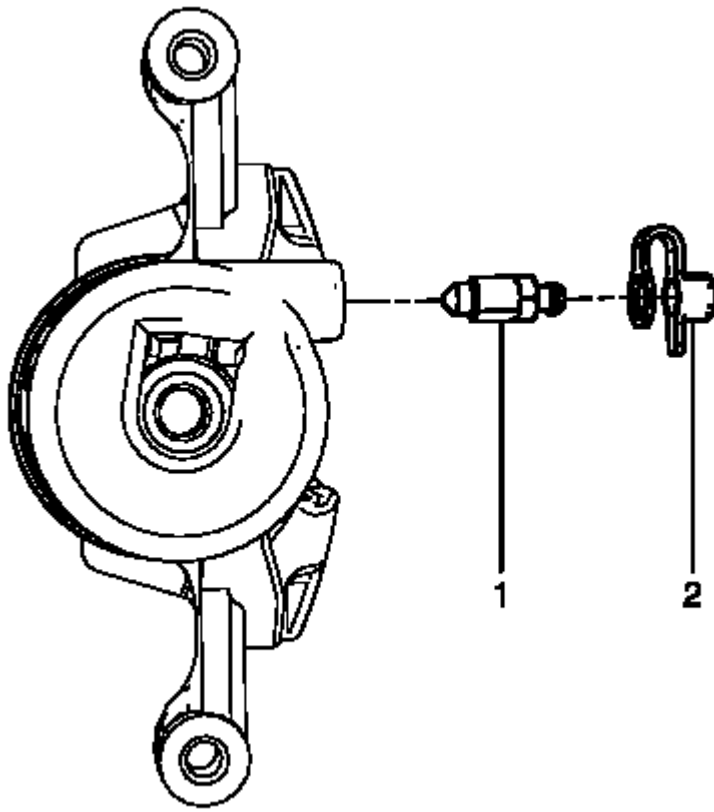


Fig. 28: Brake Bleeder Valve

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

8. Install the brake bleeder valve (1) to the caliper and tighten to 8.5 N.m (75 lb in).
9. Install the brake bleeder valve cap (1).
10. Install the brake caliper to the vehicle. Refer to Front Brake Caliper Replacement.

FRONT BRAKE CALIPER BRACKET REPLACEMENT

Removal Procedure

WARNING: Refer to Brake Dust Warning .

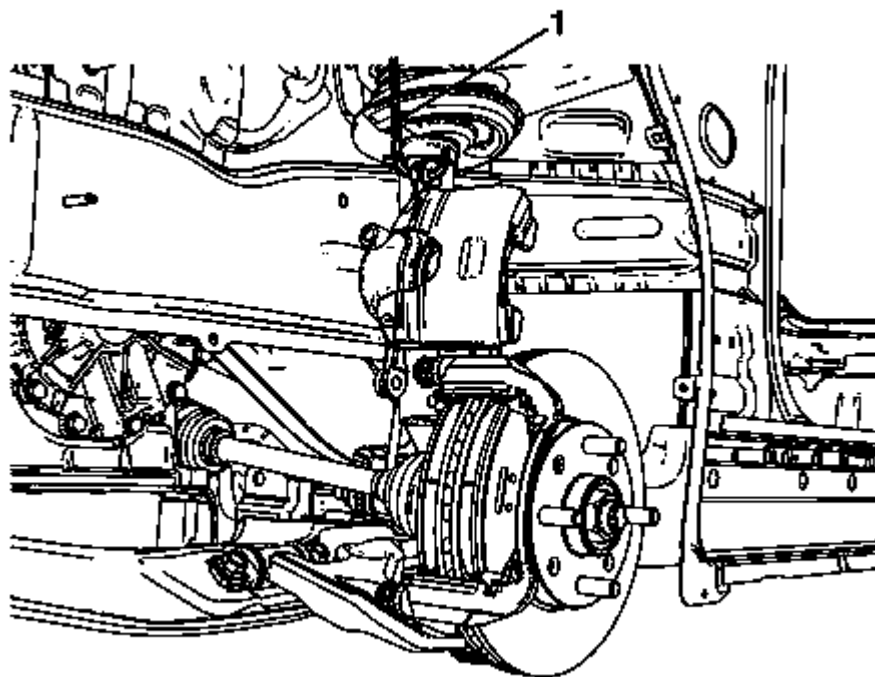


Fig. 29: Brake Caliper With Heavy Mechanic's Wire
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

1. Remove the brake caliper from the brake caliper mounting bracket and support the brake caliper with heavy mechanic's wire (1), or equivalent. Do NOT disconnect the hydraulic brake flexible hose from the caliper. Refer to **Front Brake Caliper Replacement**.

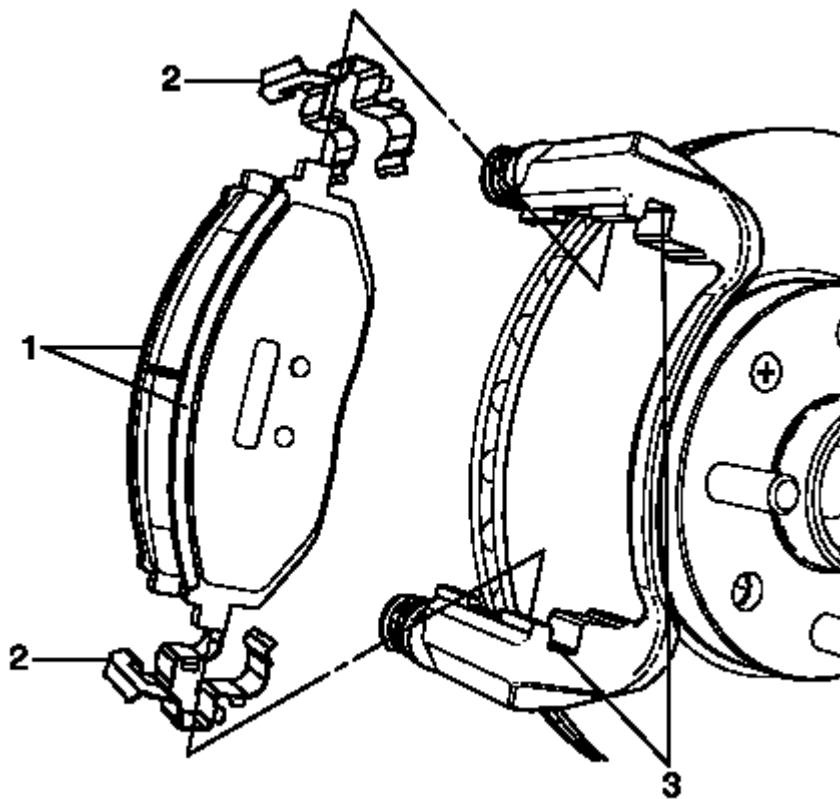


Fig. 30: Brake Pads

Courtesy of GENERAL MOTORS COMPANY

2. Remove the brake pads (1) from the brake caliper bracket.
3. Remove the brake pad retainers (2) from the brake caliper bracket.
4. If reusing the bracket, thoroughly clean the pad hardware mating surfaces of the caliper bracket (3), of any debris and corrosion.
5. Inspect the disc brake pad retainers (2) for the following:
 - Bent mounting tabs
 - Excessive corrosion
 - Looseness at the brake caliper mounting bracket
 - Looseness at the disc brake pads
6. If any of the conditions listed are found, the disc brake pad retainers require replacement.

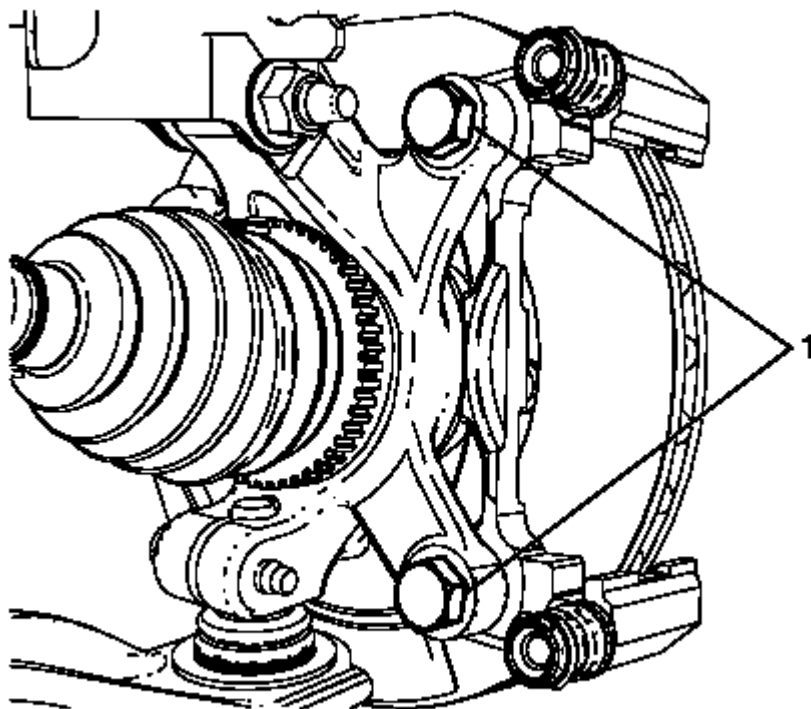


Fig. 31: Brake Caliper Mounting Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: The brake caliper mounting bracket bolts must not be used. Replace the bolts with new bolts whenever the bolts are removed or become loose.

7. Remove the brake caliper mounting bracket bolts (1).
8. Remove the brake caliper bracket from the steering knuckle.

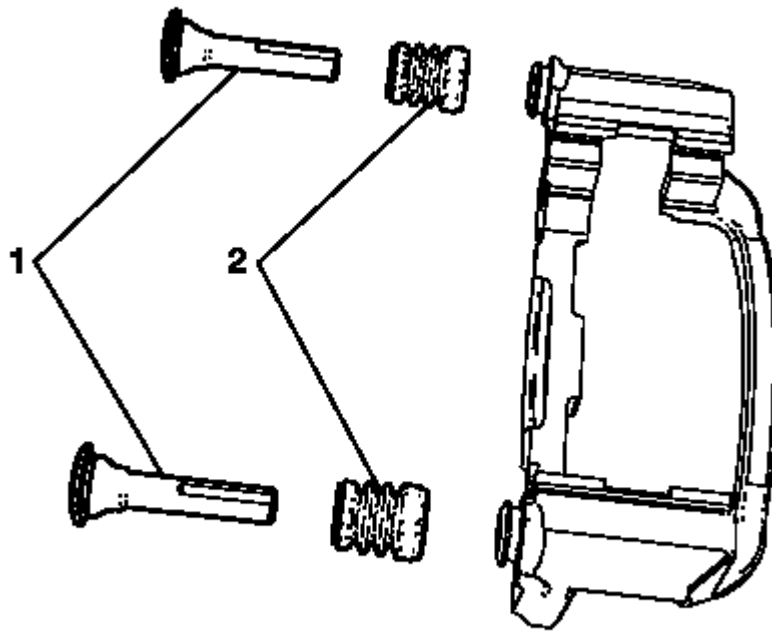


Fig. 32: Brake Caliper Guide Pins

Courtesy of GENERAL MOTORS COMPANY

9. Inspect the caliper bracket. If the brake caliper bracket is bent, cracked, or damaged, it requires replacement.
10. Inspect the brake caliper guide pins (1) for freedom of movement, and inspect the condition of the guide pin boots (2). Move the guide pins inboard and outboard within the bracket bores, without disengaging the slides from the boots, and observe for the following:
 - Restricted caliper guide pin movement
 - Looseness in the brake caliper mounting bracket
 - Seized or binding caliper guide pins
 - Split or torn boots
11. If any of the conditions listed are found, the brake caliper guide pins and/or boots require replacement.

Installation Procedure

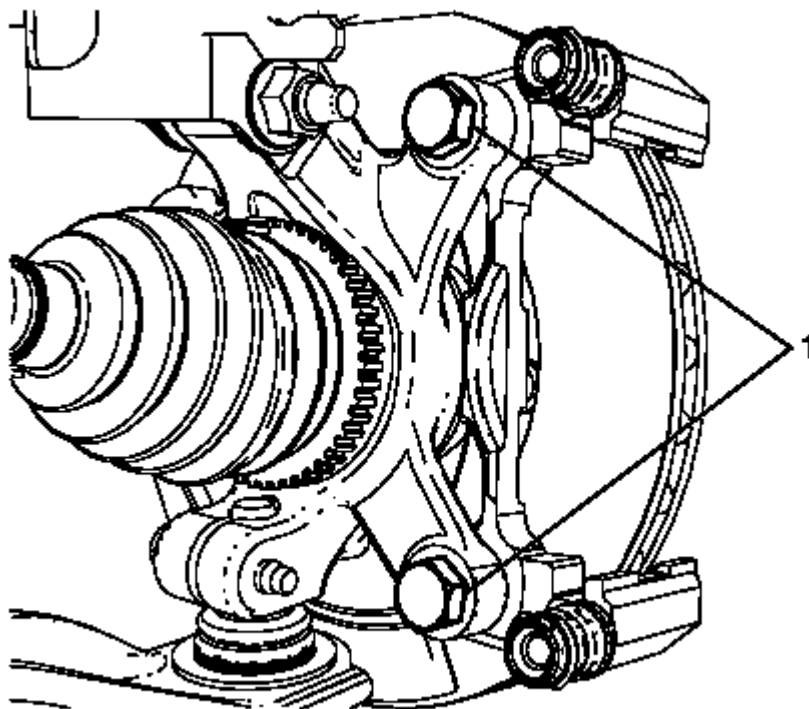


Fig. 33: Brake Caliper Mounting Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the brake caliper mounting bracket to the steering knuckle.

CAUTION: Refer to Fastener Caution .

2. Install the 2 NEW brake caliper mounting bracket bolts (1) and tighten to 95 N.m (70 lb ft).

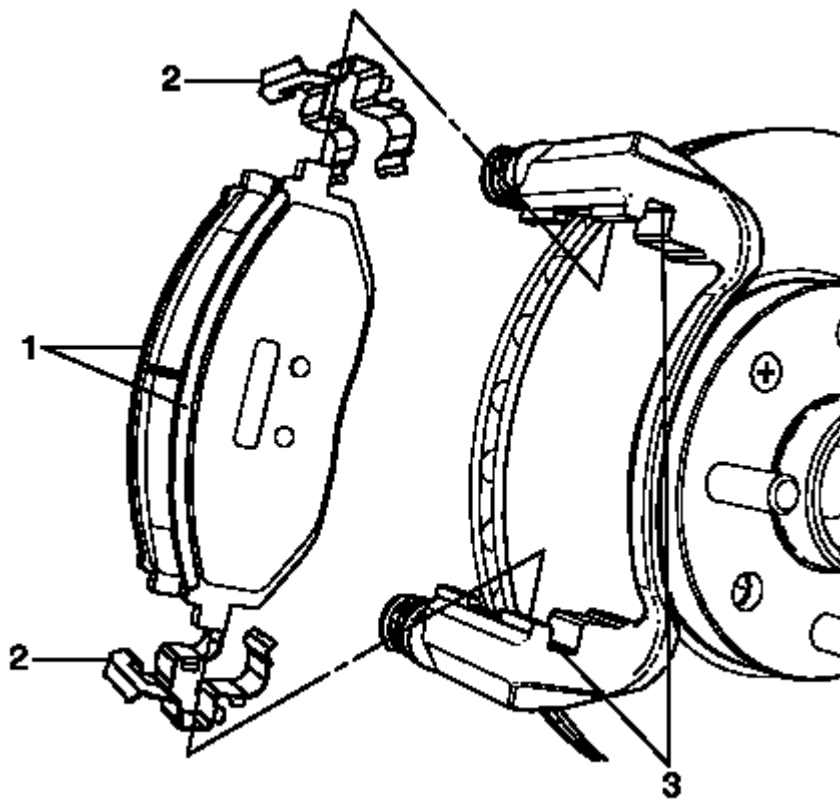


Fig. 34: Brake Pads

Courtesy of GENERAL MOTORS COMPANY

3. Apply a very thin coating of high temperature silicone brake lubricant to the pad hardware mating surfaces of the caliper bracket (3) only.
4. Clean the brake pad mating surfaces of the brake pad retainers (2).
5. Install the brake pad retainers (2) to the brake caliper bracket.

NOTE: The wear sensor equipped disc brake pad must be mounted inboard of the rotor with the leading edge of the sensor facing the brake rotor during forward wheel rotation, or at the top of the pad when installed in vehicle position.

6. Install the brake pads (1) to the brake caliper bracket.
7. Remove the support and reposition the brake caliper over the brake pads and to the mounting bracket. Refer to **Front Brake Caliper Replacement**.

FRONT BRAKE ROTOR REPLACEMENT

Special Tools

- CH-41013 Rotor Surfacing Kit

- **CH-42450-A** Wheel Hub Resurfacing Kit

For equivalent regional tools, refer to **Special Tools**.

WARNING: Refer to **Brake Dust Warning** .

Removal Procedure

CAUTION: Refer to **Vehicle Lifting and Jacking Caution** .

1. Raise and support the vehicle.
2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .

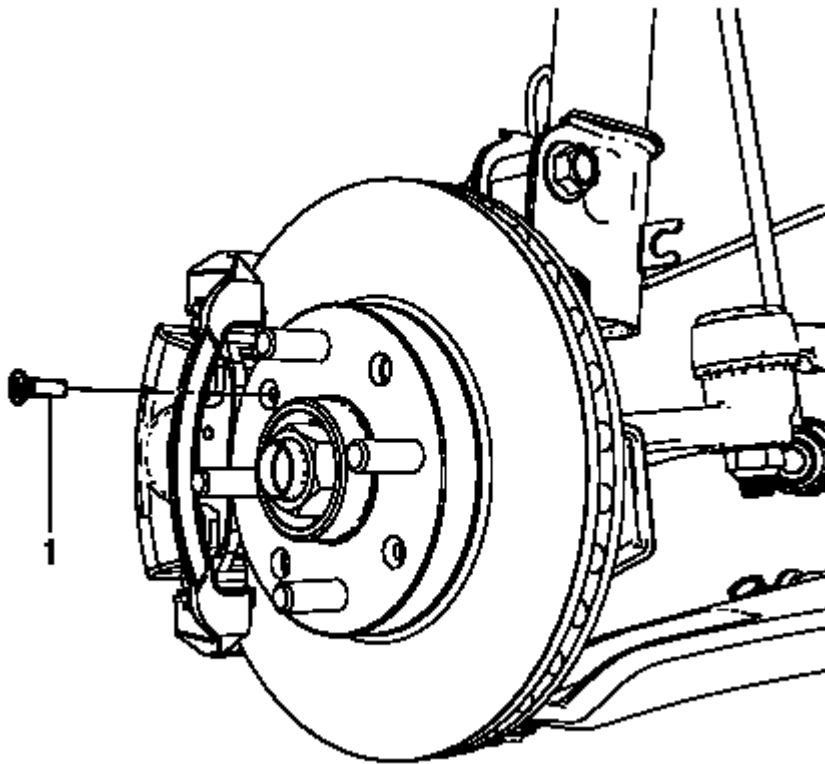


Fig. 35: Brake Rotor Screw

Courtesy of GENERAL MOTORS COMPANY

3. Remove the brake rotor screw (1).

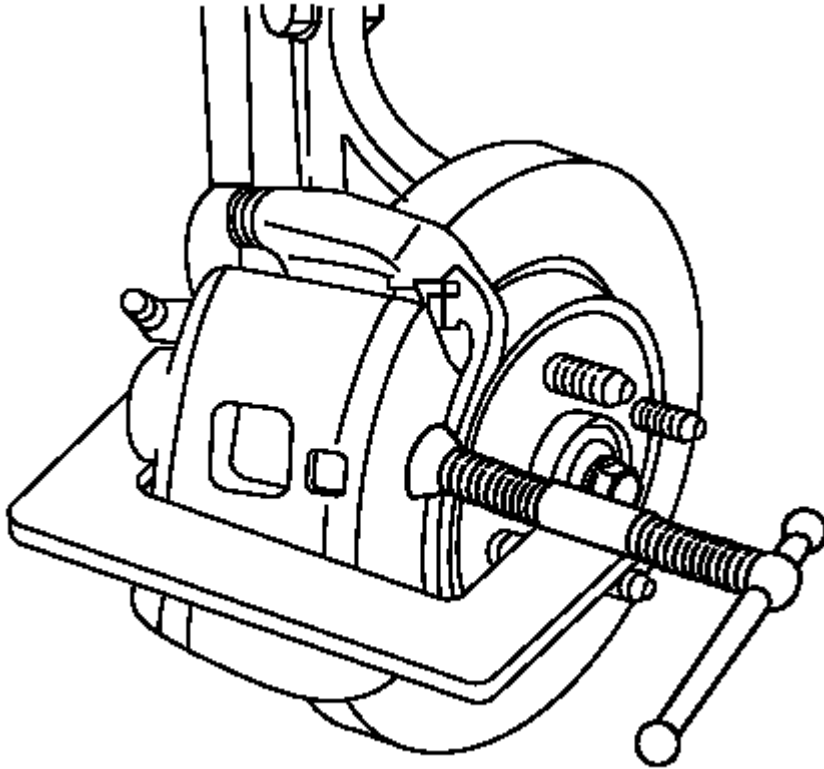


Fig. 36: C-clamp And Caliper Piston

Courtesy of GENERAL MOTORS COMPANY

4. Install a C-clamp over the body of the brake caliper, with the C-clamp ends against the rear of the caliper body and the outboard disc brake pad.
5. Tighten the C-clamp until the caliper piston is compressed into the caliper bore enough to allow the caliper to slide past the brake rotor.
6. Remove the C-clamp.

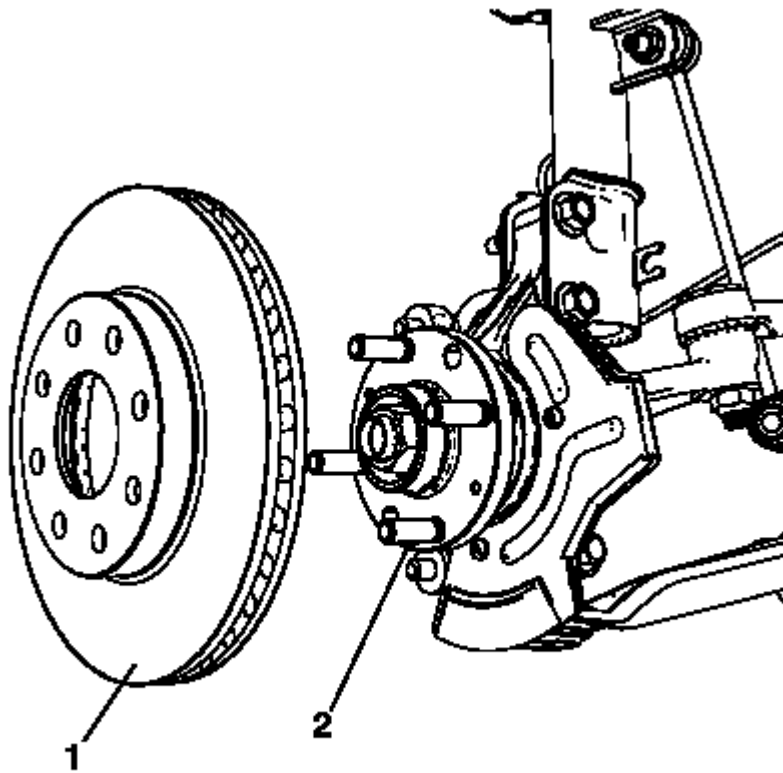


Fig. 37: Brake Rotor

Courtesy of GENERAL MOTORS COMPANY

7. Remove the brake caliper and the caliper mounting bracket as an assembly from the steering knuckle and support the assembly with heavy mechanics wire or equivalent. Ensure that there is no tension on the hydraulic brake flexible hose. Refer to **Front Brake Caliper Bracket Replacement**.
8. Remove the brake rotor (1) from the hub flange (2).

Installation Procedure

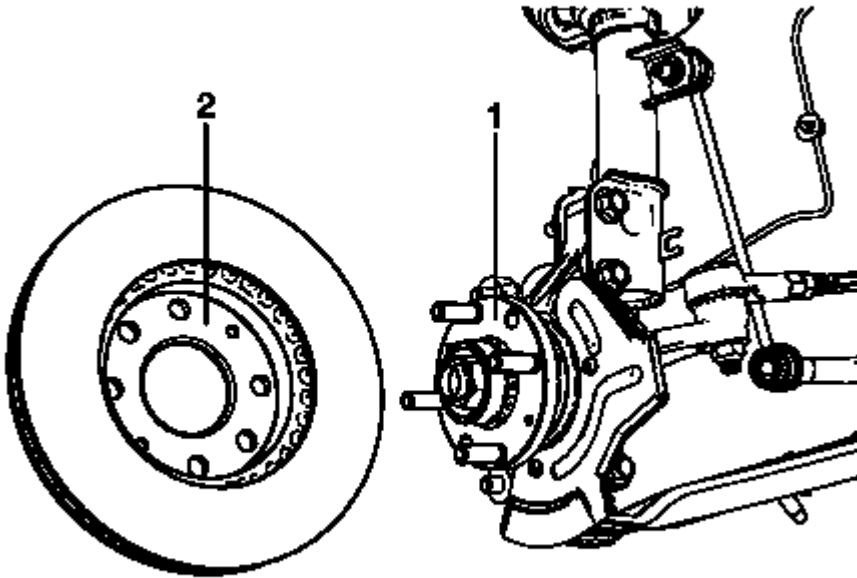


Fig. 38: Hub Flange

Courtesy of GENERAL MOTORS COMPANY

NOTE: Whenever the brake rotor has been separated from the hub/axle flange, any rust or contaminants should be cleaned from the hub/axle flange and the brake rotor mating surfaces. Failure to do this may result in excessive assembled lateral runout (LRO) of the brake rotor, which could lead to brake pulsation.

1. Using the **CH-42450-A** wheel hub resurfacing kit, thoroughly clean any rust or corrosion from the mating surface of the hub flange (1).
2. Using the **CH-41013** rotor resurfacing kit, thoroughly clean any rust or corrosion from the mating surface and mounting surface of the brake rotor (2).
3. Inspect the mating surfaces of the hub/axle flange and the rotor to ensure that there are no foreign particles or debris remaining.

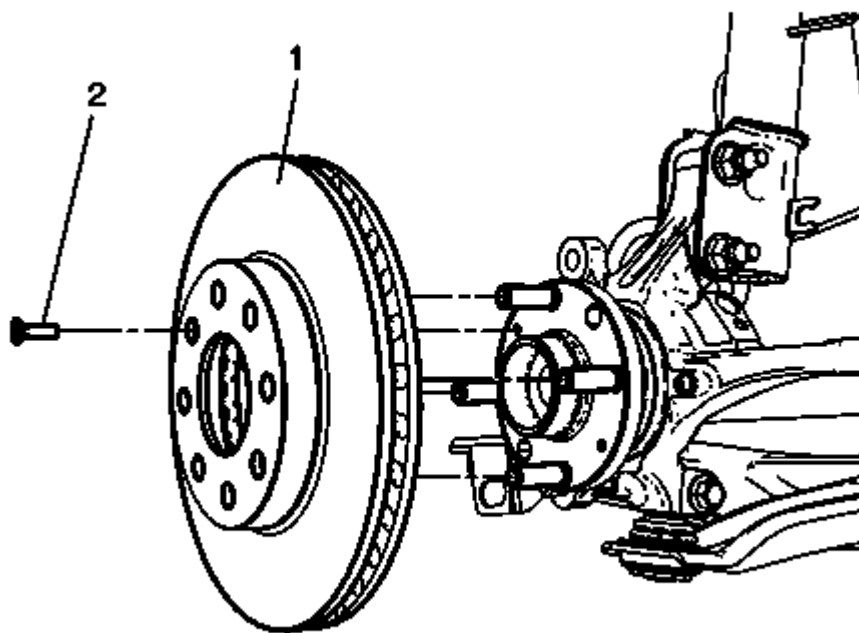


Fig. 39: Brake Rotor And Hub/Axle Flange
Courtesy of GENERAL MOTORS COMPANY

4. Install the brake rotor (1) to the hub/axle flange.

CAUTION: Refer to Fastener Caution .

5. Install the brake rotor screw (2) and tighten to 4 N.m (35 lb in).

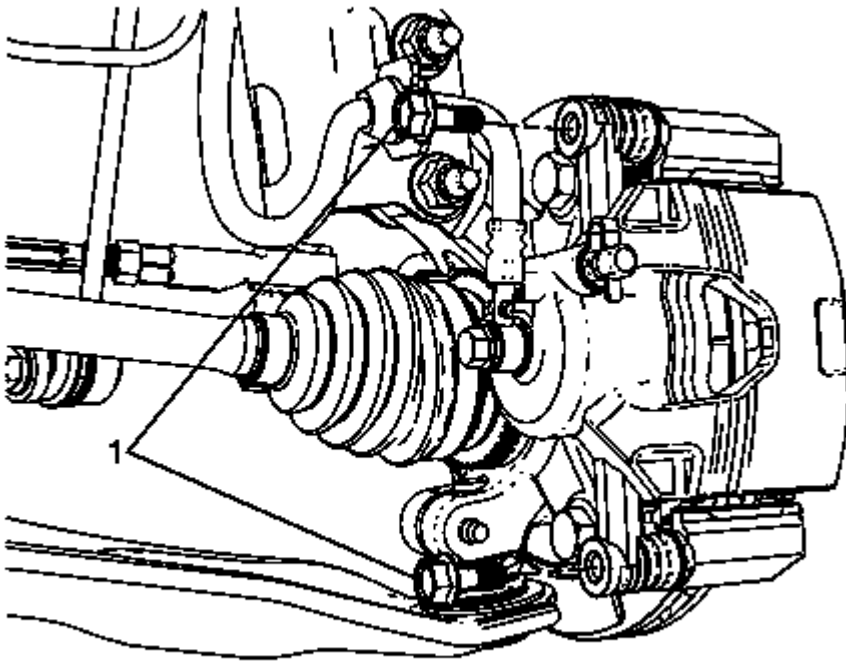


Fig. 40: Brake Caliper Bracket Bolts

Courtesy of GENERAL MOTORS COMPANY

6. Remove the support, and install the brake caliper and the brake caliper bracket as an assembly to the steering knuckle and install the brake caliper bracket bolts (1). Refer to **Front Brake Caliper Bracket Replacement**.
7. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
8. Lower the vehicle.
9. If the brake rotor was refinished or replaced, or if new brake pads were installed, burnish the pads and rotors. Refer to **Brake Pad and Rotor Burnishing**.

FRONT BRAKE SHIELD REPLACEMENT

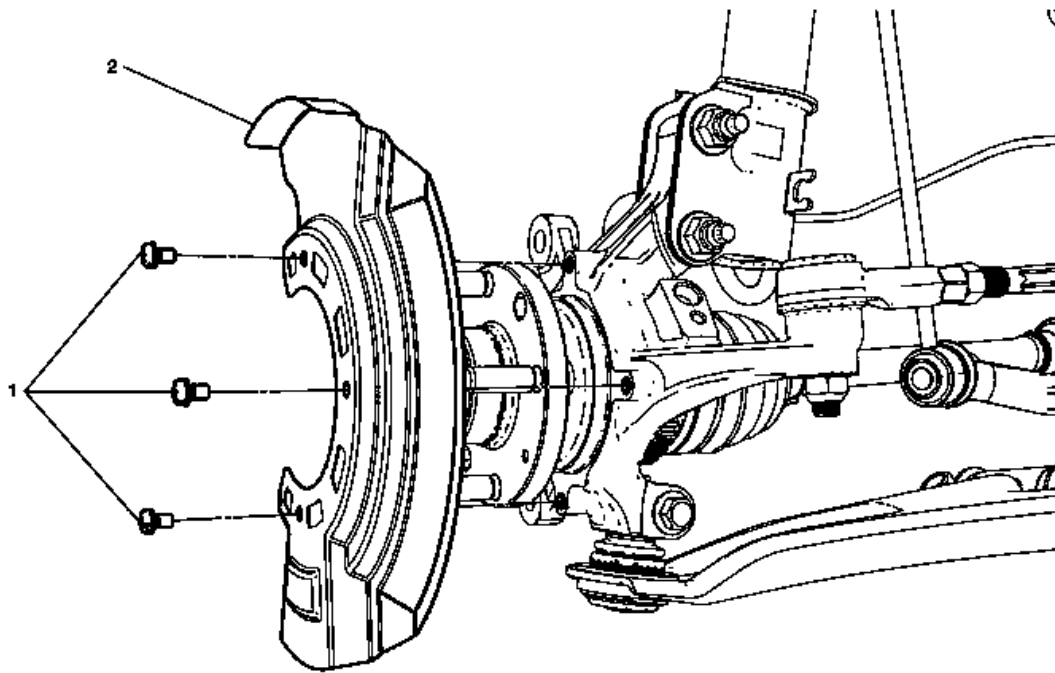


Fig. 41: Front Brake Shield
 Courtesy of GENERAL MOTORS COMPANY

Front Brake Shield Replacement

Callout	Component Name
WARNING: Refer to <u>Brake Dust Warning</u> .	
Preliminary Procedures 1. Raise the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> 2. Remove the tire and wheel. Refer to <u>Tire and Wheel Removal and Installation</u> . 3. Without disconnecting the brake caliper hose, remove the brake caliper and bracket as an assembly and support with heavy mechanics wire or equivalent. Refer to <u>Front Brake Caliper Bracket Replacement</u>. 4. Remove the front brake rotor. Refer to <u>Front Brake Rotor Replacement</u>.	
1	Disc Brake Splash Shield Bolt (Qty: 3) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 4 (35 lb in)
2	Disc Brake Splash Shield

BRAKE ROTOR ASSEMBLED LATERAL RUNOUT CORRECTION

NOTE:

- Brake rotor thickness variation **MUST** be checked **BEFORE** checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to [Brake Rotor Thickness Variation Measurement](#).
- Brake rotor assembled lateral runout (LRO) exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4, 800-11, 300 km (3, 000-7, 000 mi). Refer to [Brake Rotor Assembled Lateral Runout Measurement](#).

Review the following acceptable methods for bringing the brake disc assembled LRO to within specifications. Determine which method to use for the vehicle being repaired.

- The indexing method of correcting assembled LRO is most effective when the LRO specification is only exceeded by a relatively small amount: 0.025-0.127 mm (0.001-0.005 in). Indexing is used to achieve the best possible match of high spots to low spots between related components. Refer to [Brake Rotor Assembled Lateral Runout Correction - Indexing](#).
- The on-vehicle brake lathe method is used to bring the LRO to within specifications through compensating for LRO while refinishing the brake rotor. Refer to [Brake Rotor Assembled Lateral Runout Correction - On Vehicle Lathe](#).

If the assembled LRO cannot be corrected using these methods, then other components must be suspected as causing and/or contributing to the LRO concern.

BRAKE ROTOR ASSEMBLED LATERAL RUNOUT CORRECTION - INDEXING

Special Tools

CH-45101-100 Conical Brake Rotor Washers

For equivalent regional tools, refer to [Special Tools](#).

WARNING: Refer to [Brake Dust Warning](#) .

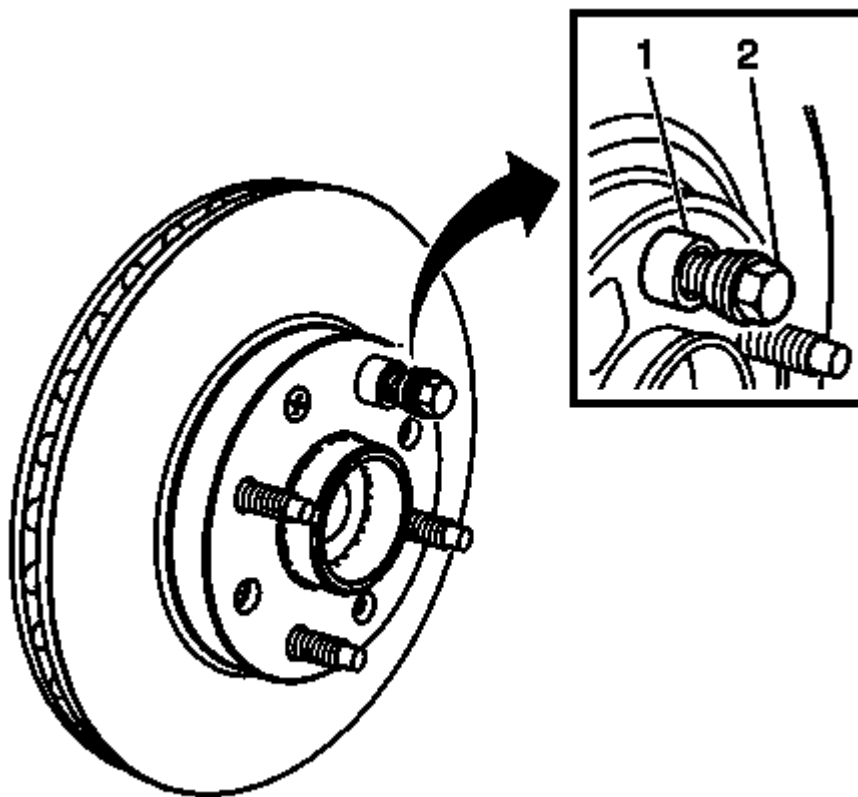


Fig. 42: One Lug Nut & Conical Brake Rotor Washers
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- Brake rotor thickness variation **MUST** be checked **BEFORE** checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to Brake Rotor Thickness Variation Measurement.
- Brake rotor assembled LRO exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4, 800-11, 300 km (3, 000-7, 000 mi). Refer to Brake Rotor Assembled Lateral Runout Measurement.

1. Remove the **CH-45101-100** conical brake rotor washers and the lug nuts that were installed during the assembled LRO measurement procedure.
2. Inspect the mating surface of the hub/axle flange and the brake rotor to ensure that there are no foreign particles or debris remaining.
3. Index the brake rotor in a different orientation to the hub/axle flange.
4. Hold the rotor firmly in place against the hub/axle flange and install one of the **CH-45101-100** conical brake rotor washers (1) and one lug nut (2) onto the upper-most wheel stud.
5. Continue to hold the rotor secure and tighten the lug nut firmly by hand.

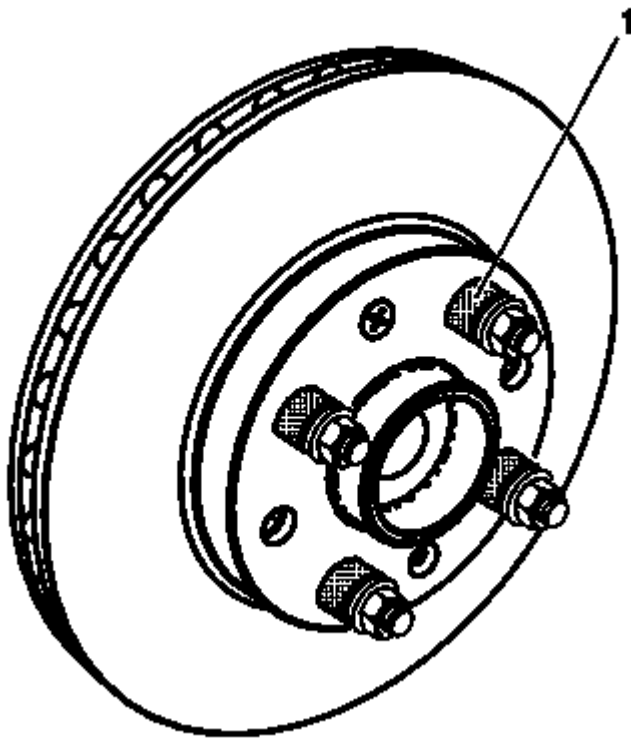


Fig. 43: Wheel Studs

Courtesy of GENERAL MOTORS COMPANY

6. Install the remaining **CH-45101-100** conical brake rotor washers and lug nuts onto the wheel studs (1) and tighten the nuts firmly by hand in the tightening sequence.
7. Tighten the lug nuts in sequence, in order to properly secure the rotor. Refer to **Tire and Wheel Removal and Installation**.
8. Measure the assembled LRO of the brake rotor. Refer to **Brake Rotor Assembled Lateral Runout Measurement**.
9. Compare the amount of change between this measurement and the original measurement.
10. If this measurement is within specifications, proceed to step 14.
11. If this measurement still exceeds specifications, repeat steps 1-9 until the best assembled LRO measurement is obtained.
12. Matchmark the final location of the rotor to the wheel studs if the orientation is different than it was originally.
13. If the brake rotor assembled LRO measurement still exceeds the maximum allowable specification, refer to **Brake Rotor Assembled Lateral Runout Correction**.
14. If the brake rotor assembled LRO is within specification, install the brake caliper and depress the brake pedal several times to secure the rotor in place before removing the **CH-45101-100** conical brake rotor washers and the lug nuts.

BRAKE ROTOR ASSEMBLED LATERAL RUNOUT CORRECTION - ON VEHICLE LATHE

Special Tools

CH-45101-100 Conical Brake Rotor Washers

For equivalent regional tools, refer to **Special Tools**.

WARNING: Refer to **Brake Dust Warning** .

NOTE:

- Brake rotor thickness variation **MUST** be checked before checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to **Brake Rotor Thickness Variation Measurement**.
- Brake rotor assembled LRO exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4, 800-11, 300 km (3, 000-7, 000 mi). Refer to **Brake Rotor Assembled Lateral Runout Measurement**.

1. Ensure that the brake caliper and brake caliper bracket that are already being supported, are clear from contacting any rotating components, such as the brake rotor.
2. Remove the **CH-45101-100** conical brake rotor washers and the lug nuts that were installed during the assembled LRO measurement procedure and/or the indexing correction procedure.
3. Inspect the mounting surface of the hub/axle flange and the brake rotor to ensure that there are no foreign particles or debris remaining.
4. Set up the lathe, following the manufacturer instructions.
5. Refinish the brake rotor, following the brake lathe manufacturers instructions.
6. After each successive cut, inspect the brake rotor thickness. Refer to **Brake Rotor Thickness Measurement**.
7. If at any time the brake rotor exceeds the minimum allowable thickness after refinish specification, the brake rotor must be replaced. After replacing the brake rotor, proceed to step 10.
8. After refinishing the brake rotor, use the following procedure in order to obtain the desired non-directional finish:
 1. Follow the brake lathe manufacturer recommended speed setting for applying a non-directional finish.
 2. Using moderate pressure, apply the non-directional finish:
 - If the lathe is equipped with a non-directional finishing tool, apply the finish with 120-grit aluminum oxide sandpaper.
 - If the lathe is not equipped with a non-directional finishing tool, apply the finish with a sanding block and 150-grit aluminum oxide sandpaper.
 3. After applying a non-directional finish, clean each friction surface of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.

9. Remove the lathe from the vehicle.
10. Measure the assembled LRO of the brake rotor. Refer to **Brake Rotor Assembled Lateral Runout Measurement**.
11. If the brake rotor assembled LRO measurement still exceeds the maximum allowable specification, refer to **Brake Rotor Assembled Lateral Runout Correction**.
12. If the brake rotor assembled LRO is within specification, install the brake caliper and depress the brake pedal several times to secure the brake rotor in place before removing the **CH-45101-100** conical brake rotor washers and the lug nuts.

BRAKE ROTOR REFINISHING

Special Tools

- **CH-41013** Rotor Resurfacing Kit
- **CH-42450-A** Wheel Hub Resurfacing Kit

For equivalent regional tools, refer to **Special Tools**.

NOTE:

- **The disc brake rotors do not require refinishing as part of routine brake system service. New disc brake rotors do not require refinishing.**

Do not refinish disc brake rotors in an attempt to correct the following conditions:

- **Brake system noise - squeal, growl, groan**
- **Uneven and/or premature brake pad wear**
- **Superficial or cosmetic corrosion/rust of the disc brake rotor friction surface**
- **Scoring of the disc brake rotor friction surface less than the maximum allowable specification**
- **Before refinishing a brake rotor, the brake rotor must first be checked for adequate thickness to allow the brake rotor to be refinished and remain above the minimum allowable thickness after refinish specification. Refer to [Brake Rotor Thickness Measurement](#).**

Disc brake rotors should only be refinished if they have adequate thickness to be refinished and if one or more of the following conditions exist:

- **Thickness variation in excess of the maximum allowable specification**
- **Excessive corrosion/rust and/or pitting**
- **Cracks and/or heat spots**

- Excessive blueing, discoloration
- Scoring of the disc brake rotor surface in excess of the maximum allowable specification
- Disc brake rotors may need to be refinished as part of the process for correcting brake rotor assembled lateral runout (LRO) that exceeds the maximum allowable specification.

NOTE: If the vehicle is equipped with cross-drilled rotors, use a lathe with positive rake tooling. This setup requires less cutting pressure, which will result in less vibration, and a better surface finish. Also, use a vibration dampener when cutting. Otherwise, refinish according to the following instructions.

NOTE: Whenever the brake rotor has been separated from the hub/axle flange, clean any rust or contaminants from the hub/axle flange and the brake rotor mating surfaces. Failure to do this may result in increased assembled lateral runout (LRO) of the brake rotor, which could lead to brake pulsation.

1. Using the **CH-42450-A** wheel hub resurfacing kit, thoroughly clean any rust or corrosion from the mating surface of the hub/axle flange.
2. Using the **CH-41013** rotor resurfacing kit, thoroughly clean any rust or corrosion from the mating surface and mounting surface of the brake rotor.
3. Inspect the mating surfaces of the hub/axle flange and the brake rotor to ensure that there are no foreign particles or debris remaining.
4. Mount the brake rotor to the brake lathe according to the lathe manufacturer's instructions, ensuring that all mounting attachments and adapters are clean and free of debris.
5. Ensure that any vibration dampening attachments are securely in place.
6. With the brake lathe running, slowly bring in the cutting tools until they just contact the brake rotor friction surfaces.
7. Observe the witness mark on the brake rotor. If the witness mark extends approximately three-quarters or more of the way around the brake rotor friction surface on each side, the brake rotor is correctly mounted to the lathe.
8. If the witness mark does not extend three-quarters or more of the way around the brake rotor, re-mount the brake rotor to the lathe.
9. Following the brake lathe manufacturer's instructions, refinish the brake rotor.
10. After each successive cut, inspect the brake rotor thickness. Refer to **Brake Rotor Thickness Measurement**.
11. If at any time the brake rotor exceeds the minimum allowable thickness after refinish specification, the brake rotor must be replaced.
12. After refinishing the brake rotor, use the following procedure in order to obtain the desired non-directional finish:
 1. Follow the brake lathe manufacturer's recommended speed setting for applying a non-directional

finish.

2. Using moderate pressure, apply the non-directional finish:
 - If the lathe is equipped with a non-directional finishing tool, apply the finish with 120-grit aluminum oxide sandpaper.
 - If the lathe is not equipped with a non-directional finishing tool, apply the finish with a sanding block and 150-grit aluminum oxide sandpaper.
3. After applying a non-directional finish, clean each friction surface of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner and wipe each friction surface using a clean shop towel to remove metal particles remaining from machining. Repeat the cleaning process if necessary to remove all metal particles.
13. Remove the brake rotor from the brake lathe.
14. Measure the assembled LRO of the brake rotor to ensure optimum performance of the disc brakes. Refer to **Brake Rotor Assembled Lateral Runout Measurement**.
15. If the brake rotor assembled LRO measurement exceeds the specification, bring the LRO to within specifications. Refer to **Brake Rotor Assembled Lateral Runout Correction**.

DESCRIPTION AND OPERATION

DISC BRAKE SYSTEM DESCRIPTION AND OPERATION

System Component Description

The disc brake system consists of the following components:

Disc Brake Pads

Applies mechanical output force from the hydraulic brake calipers to friction surfaces of brake rotors.

Disc Brake Rotors

Uses mechanical output force applied to friction surfaces from the disc brake pads to slow speed of tire and wheel assembly rotation.

Disc Brake Pad Hardware

Secures disc brake pads firmly in proper relationship to the hydraulic brake calipers. Enables a sliding motion of brake pads when mechanical output force is applied.

Disc Brake Caliper Hardware

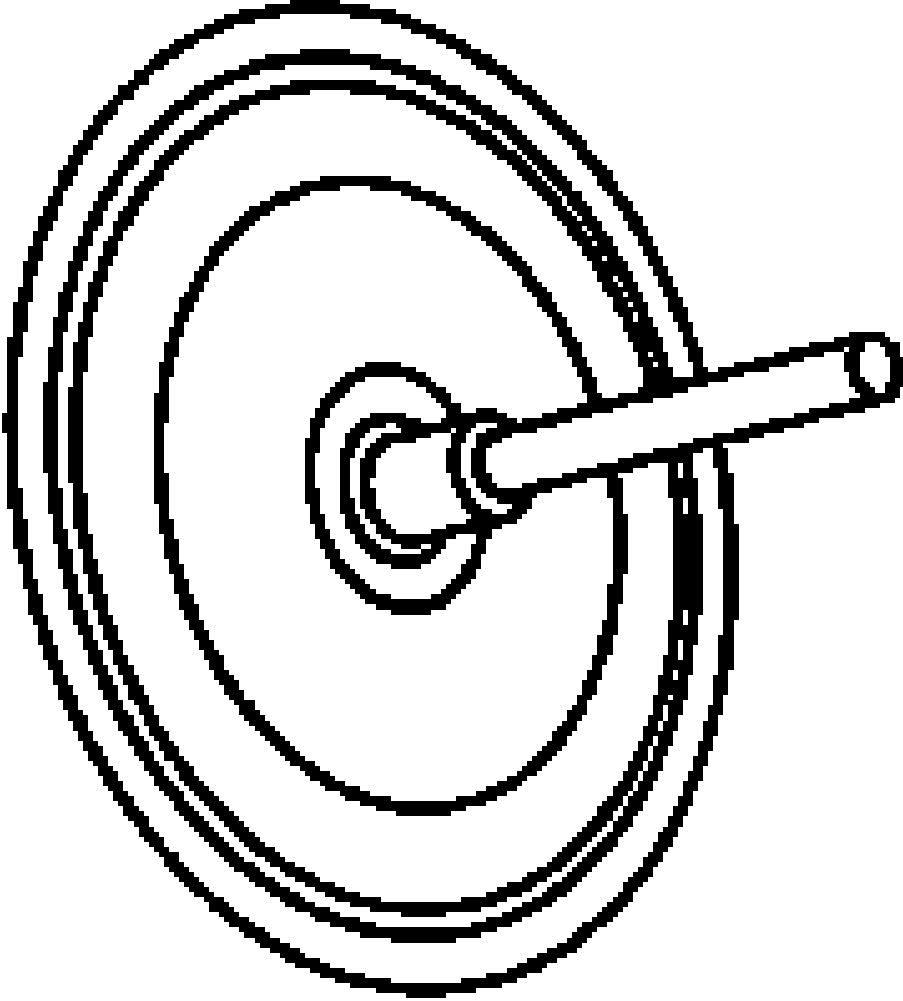
Provides mounting for hydraulic brake caliper and secures the caliper firmly in proper relationship to caliper bracket. Enables a sliding motion of the brake caliper to the brake pads when mechanical output force is applied.

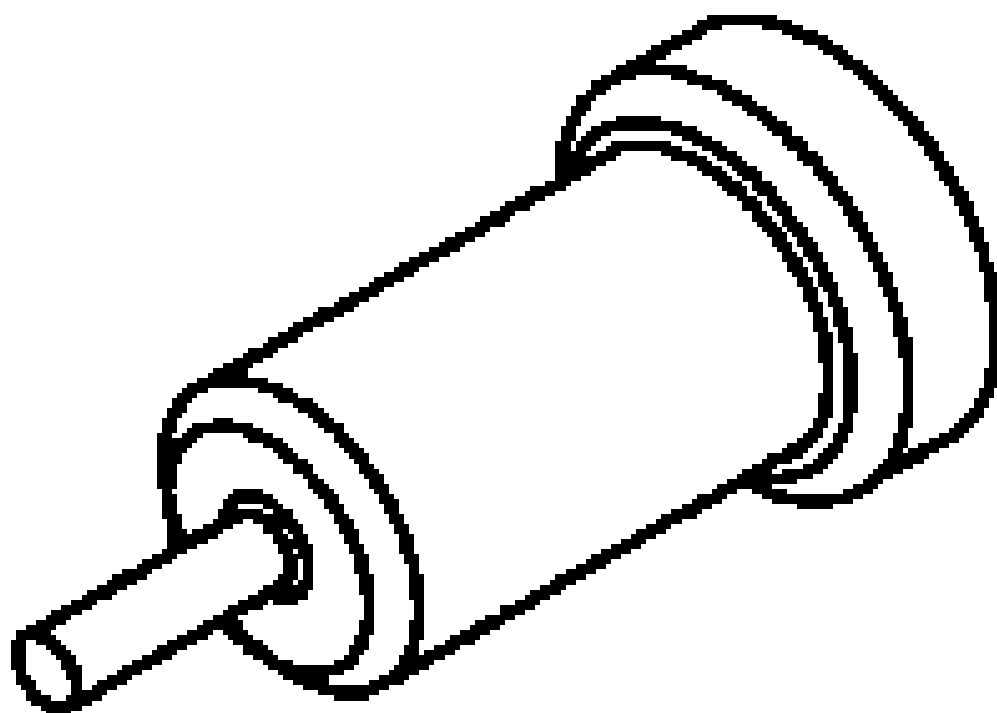
System Operation

Mechanical output force is applied from the hydraulic brake caliper pistons to the inner brake pads. As the pistons press the inner brake pads outward, the caliper housings draw the outer brake pads inward. This allows the output force to be equally distributed. The brake pads apply the output force to the friction surfaces on both sides of the brake rotors, which slows the rotation of the tire and wheel assemblies. The correct function of both the brake pad and brake caliper hardware is essential for even distribution of braking force.

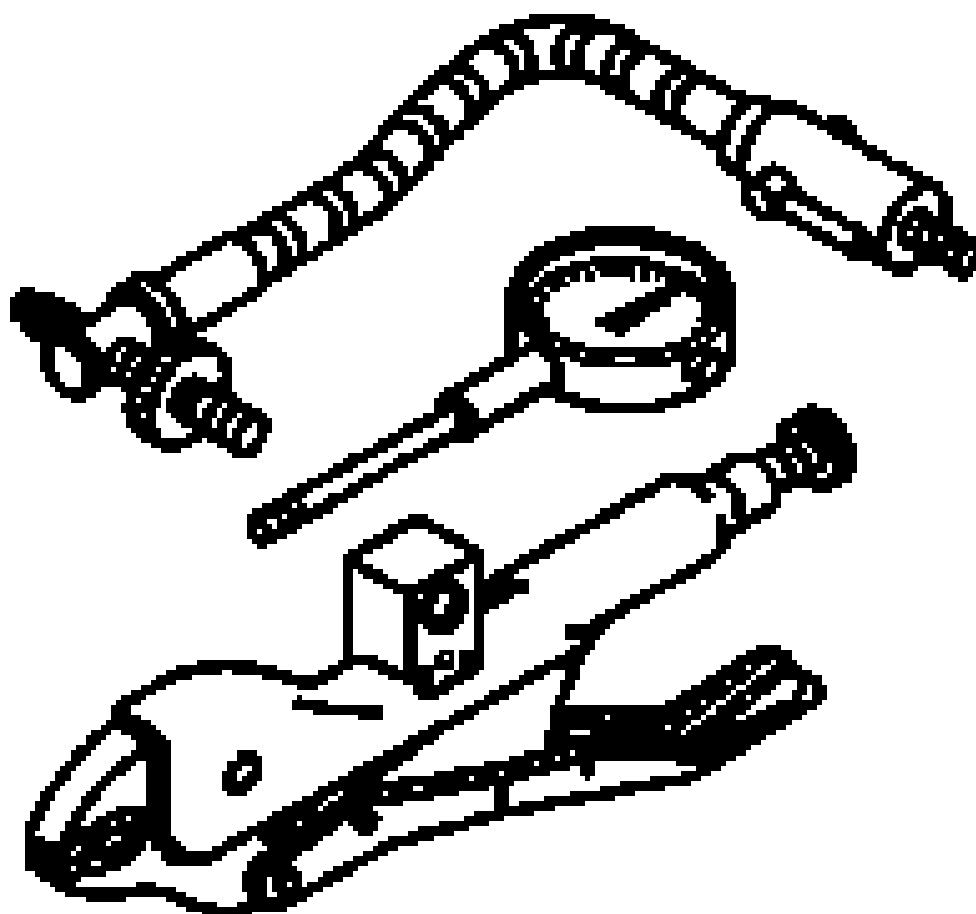
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

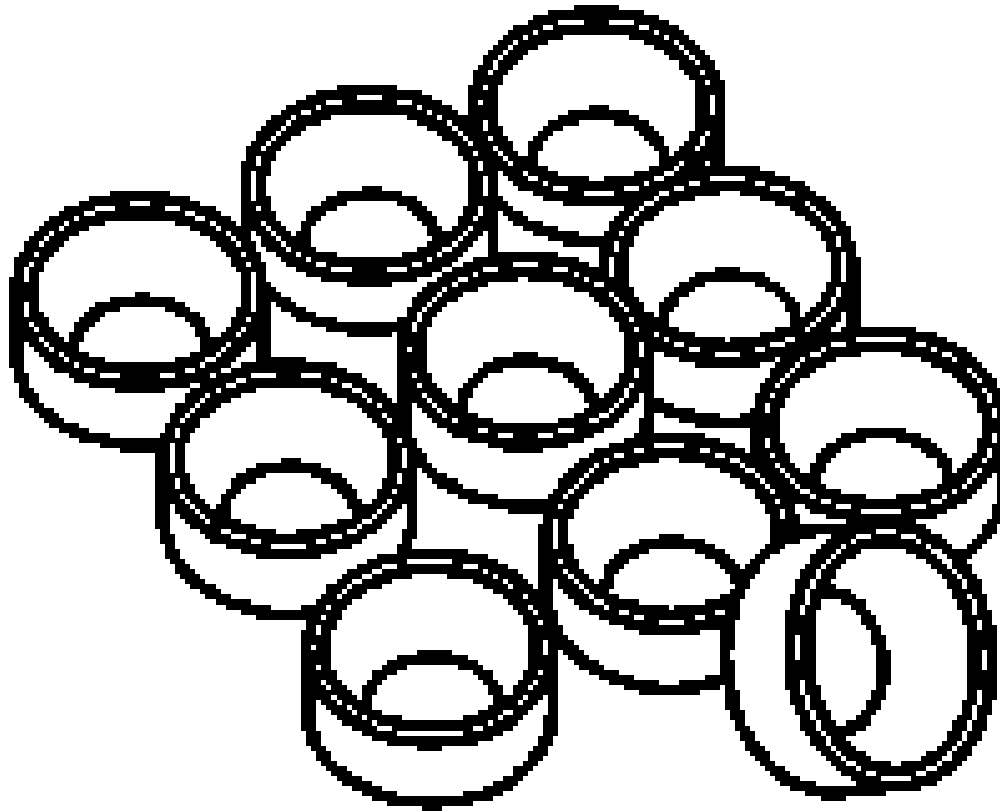
Illustration	Tool Number/Descrip
	CH-41013 J 41013 Rotor Resurfaci Kit



CH-42450-A
J 42450-A
Wheel Hub
Resurfacing Ki



CH-45101
J 45101
Hub and Wheel
Runout Gauge



CH-45101-100
J 45101-100
Conical Brake R
Washers

BRAKES

Drum Brakes - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Brake Drum Screw	4 N.m	35 lb in
Brake Pipe Fitting	18 N.m	13 lb ft
Drum Brake Wheel Cylinder Bleeder Valve	8.5 N.m	75 lb in
Wheel Cylinder Mounting Bolt	10 N.m	89 lb in

DRUM BRAKE COMPONENT SPECIFICATIONS

Drum Brake Component Specifications

Application	Specification	
	Metric	English
Brake Drum Diameter- New	200.00 mm	7.874 in
Brake Drum Discard Diameter	201.00 mm	7.913 in
Brake Drum Maximum Allowable Radial Runout	0.03 mm	0.001 in
Brake Drum Maximum Allowable Scoring	0.50 mm	0.020 in
Brake Drum Maximum Diameter After Refinish	200.75 mm	7.904 in
Brake Shoe Lining Minimum Thickness	1.40 mm	0.055 in
Brake Shoe Lining Thickness- New	5.00 mm	0.197 in
Brake Shoe Lining-to-Drum Clearance	0.4-1.09 mm	0.016-0.043 in

DIAGNOSTIC INFORMATION AND PROCEDURES

BRAKE DRUM DIAMETER MEASUREMENT

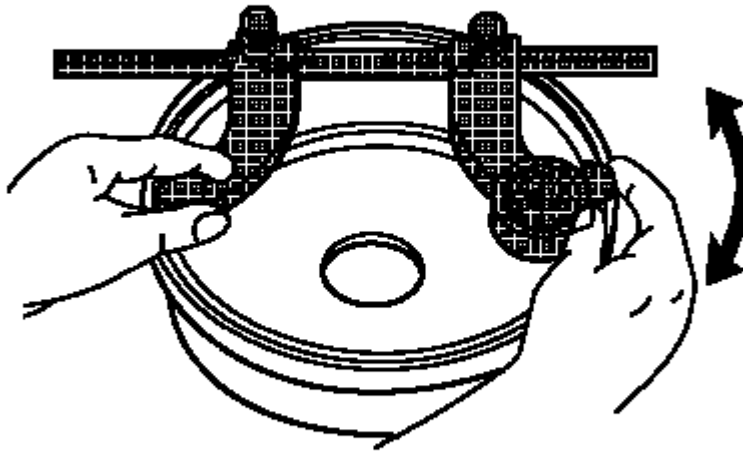


Fig. 1: Drum Brake Micrometer
Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to Brake Dust Warning .

1. Clean the brake shoe lining contact surface of the brake drum with denatured alcohol or an equivalent approved brake cleaner.
2. Using a brake drum micrometer calibrated in thousandths-of-an-inch, measure and record the largest diameter of the brake drum at four or more points, equally spaced around the drum.

Ensure the measurements are only taken within the brake shoe lining contact area. The micrometer must be positioned the same distance from the outside edge of the drum for each measurement.

3. Compare the largest diameter measurement recorded to the following specifications:

Specification

- Brake drum maximum allowable diameter after refinishing: 200.75 mm (7.904 in)
 - Brake drum discard diameter: 201.00 mm (7.91 in)
4. If the largest diameter measurement of the brake drum is less than the maximum allowable inside

diameter after refinishing specification, the drum may be refinished, depending upon surface and wear conditions.

5. If the largest diameter measurement of the brake drum is equal to or greater than the maximum allowable diameter after refinishing specification, the drum may not be refinished.
6. If the largest diameter measurement of the brake drum is equal to or greater than the discard diameter specification, the drum requires replacement.

BRAKE DRUM SURFACE AND WEAR INSPECTION

Special Tools

CH-8001 Dial Indicator Set

For equivalent regional tools, refer to **Special Tools**.

WARNING: Refer to Brake Dust Warning .

1. With the brake drum removed, clean the brake shoe lining contact surface of the brake drum with denatured alcohol or an equivalent approved brake cleaner.

2. Inspect the braking surface of the brake drum for the following braking surface conditions:

- Heavy rust and/or pitting

Light surface rust can be removed with an abrasive disc; heavy surface rust and/or pitting must be removed by refinishing the drum.

- Cracks and/or heat spots
- Excessive blueing discoloration
- Missing balance weights

3. If the braking surface of the brake drum exhibits one or more of the braking surface conditions listed, the drum requires refinishing or replacement.

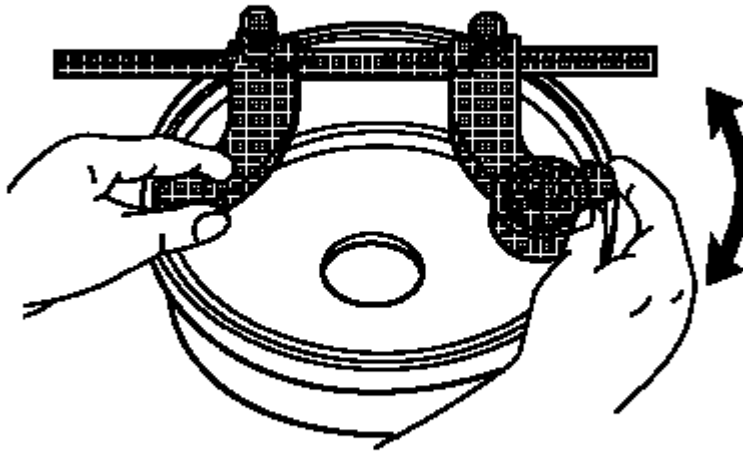


Fig. 2: Drum Brake Micrometer

Courtesy of GENERAL MOTORS COMPANY

4. Using a brake drum micrometer calibrated in thousandths-of-an-inch, measure and record any grooves present on the drum braking surface.

Ensure that the measurements are only taken within the brake shoe lining contact area.

5. Compare the groove, or scoring depth recorded to the following specification:

Specification

Brake drum maximum allowable scoring: 0.50 mm (0.020 in)

6. If the brake drum scoring depth exceeds the specification, or if an excessive amount of scoring is present, the drum requires refinishing or replacement.
7. Mount the brake drum on a brake lathe.

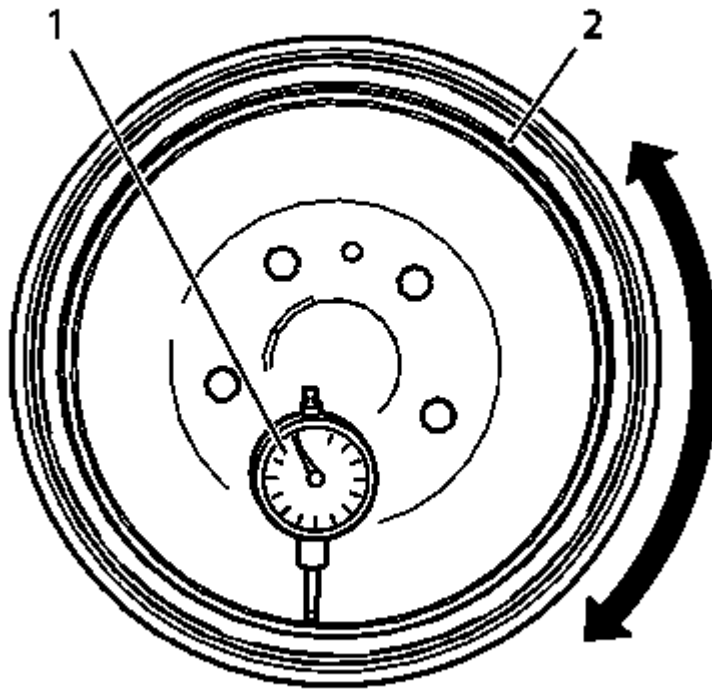


Fig. 3: Dial Indicator And Brake Drum

Courtesy of GENERAL MOTORS COMPANY

8. Mount a dial indicator, **CH-8001** indicator (1), or equivalent, and position the indicator button so it contacts the braking surface of the brake drum (2) at a 90 degree angle, approximately 19 mm (0.75 in) from the outer edge of the drum.
9. Measure and record the radial runout of the brake drum.
 1. Rotate the drum until the lowest reading is displayed on the indicator dial, then zero the dial.
 2. Rotate the drum until the highest reading is displayed on the dial.
10. Compare the radial runout of the brake drum to the following specification:

Specification

Brake drum maximum allowable radial runout: 0.03 mm (0.001 in)

11. If the brake drum radial runout exceeds the specification, the drum requires refinishing or replacement.

DRUM BRAKE HARDWARE INSPECTION

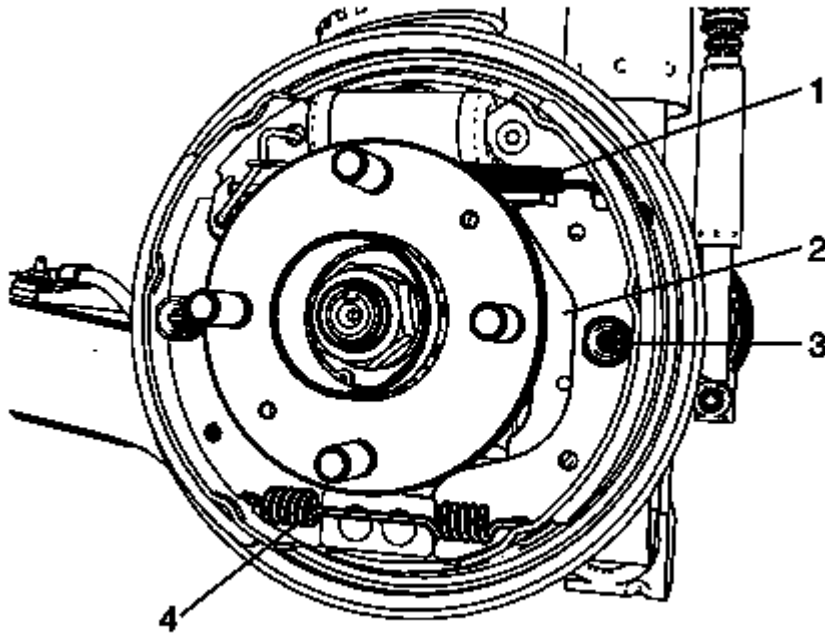


Fig. 4: Drum Brake Hardware
Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to Brake Dust Warning .

1. Visually inspect the drum brake upper return spring (1) for the following conditions:
 - Excessive corrosion
 - Excessive stretching
 - Broken
 - Missing
2. If any of the conditions listed were found, the drum brake upper return spring requires replacement.
3. Visually inspect the park brake apply lever (2) for the following conditions:
 - Bent
 - Broken
 - Missing
4. If any of the conditions listed were found, the park brake shoes require replacement.
5. Visually inspect the drum brake shoe hold down springs and cups (3) and pins for the following conditions:

- Excessive corrosion
 - Broken
 - Missing
 - Bent pins
6. If any of the conditions listed were found, the hold down springs, cups, and pins require replacement.
 7. Visually inspect the drum brake lower return spring (4) for the following conditions:
 - Excessive corrosion
 - Excessive stretching
 - Broken
 - Missing
 8. If any of the conditions listed were found, the drum brake lower spring requires replacement.

DRUM BRAKE ADJUSTING HARDWARE INSPECTION

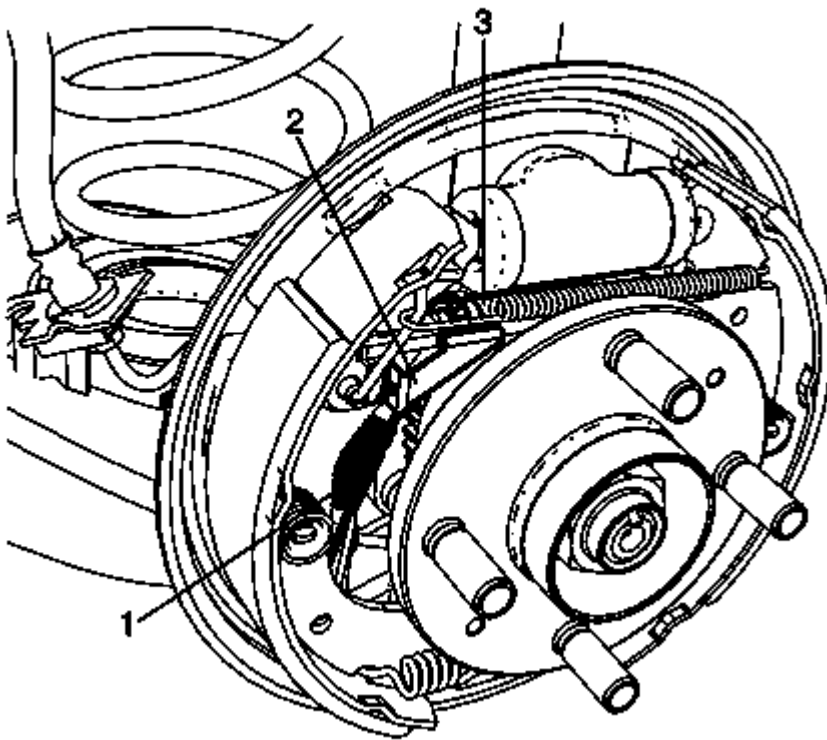


Fig. 5: Drum Brake Adjusting Hardware
Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to Brake Dust Warning .

1. Visually inspect the adjuster actuator spring (1) for the following conditions:
 - Excessive stretching
 - Excessive bending
 - Excessive corrosion
 - Broken
 - Missing
2. If any of the conditions listed were found, the adjuster actuator spring requires replacement.
3. Visually inspect the adjuster actuator lever (2) for the following conditions:
 - Bent
 - Broken
 - The lever engagement surface excessively worn
 - Excessively bent or broken spring attachment tab
 - Missing
4. If any of the conditions listed were found, the adjuster actuator lever requires replacement.
5. Visually inspect the adjuster assembly (3) for the following conditions:
 - Bent
 - Broken
 - Seized adjuster wheel threads
 - Excessively worn, damaged, or missing teeth
6. If any of the conditions listed were found, the adjuster assembly requires replacement.

REPAIR INSTRUCTIONS

BRAKE DRUM REPLACEMENT

Special Tools

- **CH-41013** Rotor Resurfacing Kit
- **CH-42450-A** Wheel Hub Resurfacing Kit

For equivalent regional tools, refer to **Special Tools**.

Removal Procedure

WARNING: Refer to **Brake Dust Warning** .

1. Check to ensure that the park brake is fully released.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
3. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .

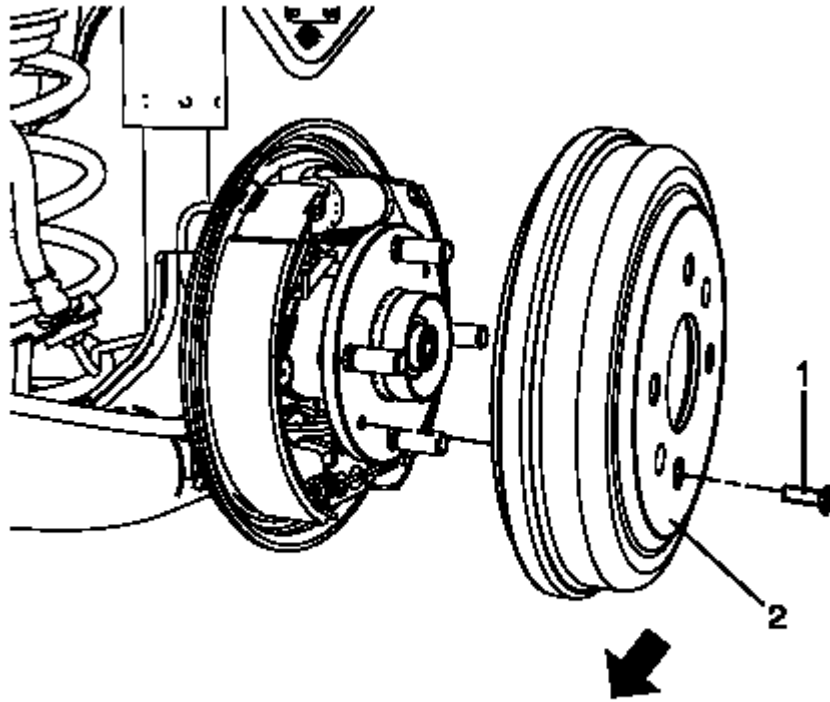


Fig. 6: Brake Drum Screw

Courtesy of GENERAL MOTORS COMPANY

4. Remove the brake drum screw (1).
5. Remove the brake drum (2).
6. If reinstalling the brake drum, use the **CH-41013** rotor resurfacing kit to clean the wheel hub flange mating surface of the brake drum of any corrosion.

Installation Procedure

1. Using the **CH-42450-A** wheel hub resurfacing kit to clean the wheel hub flange of any corrosion.

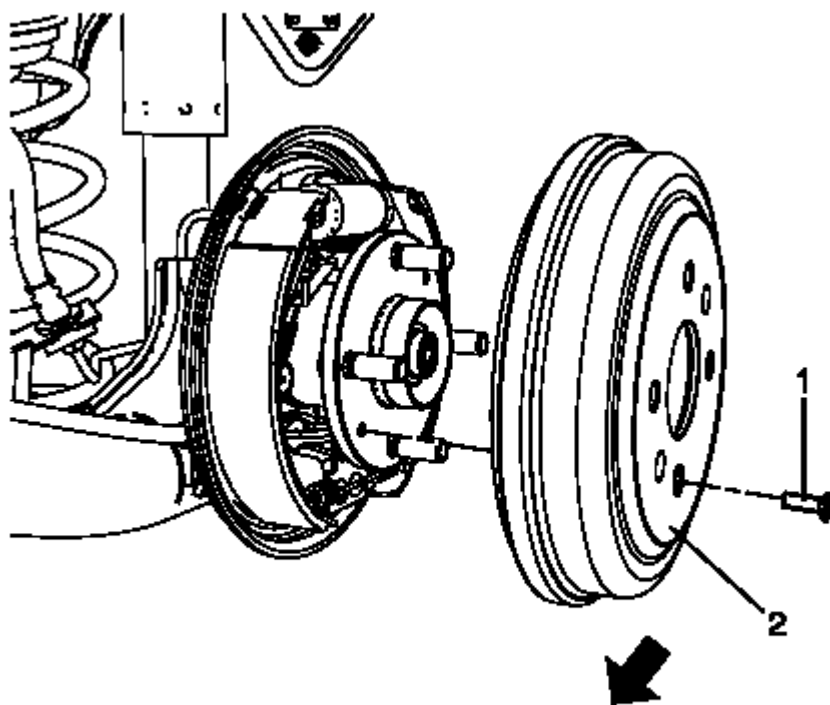


Fig. 7: Brake Drum Screw

Courtesy of GENERAL MOTORS COMPANY

2. Install the brake drum (2).
3. Adjust the drum brakes. Refer to **Drum Brake Adjustment**.

CAUTION: Refer to **Fastener Caution** .

4. Install the brake drum screw (1) and tighten to 4 N.m (35 lb in).
5. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
6. Apply the brakes 2 or 3 times to seat and center the brake shoes on the brake drum.

BRAKE DRUM REFINISHING

Special Tools

- **CH-41013** Rotor Resurfacing Kit
- **CH-42450-A** Wheel Hub Resurfacing Kit

For equivalent regional tools, refer to **Special Tools**.

WARNING: Refer to Brake Dust Warning .

1. The brake drums do not require refinishing as part of routine brake system service. Do not refinish brake drums in an attempt to correct the following conditions:
 - Brake system noise (squeal, growl, groan)
 - Uneven and/or premature brake lining wear
 - Superficial or cosmetic corrosion/rust of the brake drum surface
 - Scoring of the brake drum surface (less than the maximum allowable specification)
2. Brake drums should only be refinished if the following conditions exist:
 - Excessive corrosion/rust and/or pitting
 - Cracks and/or heat spots
 - Excessive blueing discoloration
 - Scoring of the brake drum surface (in excess of the maximum allowable specification)
 - Radial runout in excess of the maximum allowable specification
3. Inspect each of the brake drums and determine if the brake drums can be refinished and remain within the maximum allowable diameter after refinish specification:
 1. With the tire and wheel assemblies removed, measure the diameter of each of the brake drums. Refer to **Brake Drum Diameter Measurement**.
 2. Inspect each of the brake drums for excessive surface wear and/or radial runout. Refer to **Brake Drum Surface and Wear Inspection**.
4. If the brake drums can be refinished, proceed with the rotor refinishing procedure.
5. If necessary, use the **CH-41013** rotor resurfacing kit in order to thoroughly clean any corrosion/rust from the brake drum flange.
6. Mount the brake drum to the brake lathe according to the lathe manufacturer instructions.
7. Ensure that any vibration dampening attachments are securely in place.
8. With the brake lathe running, slowly bring in the cutting tool until it just contacts the brake drum friction surface.
9. Observe the witness mark on the brake drum. If the witness mark extends approximately three-quarters or more of the way around the brake drum surface, the brake drum is properly mounted to the lathe.
10. If the witness mark does not extend three-quarters or more of the way around the brake drum, re-mount the brake drum to the lathe.
11. Following the brake lathe manufacturer instructions, refinish the brake drum.
12. After each successive cut, inspect the brake drum diameter. Refer to **Brake Drum Diameter Measurement**.
13. If at any time the brake drum exceeds the maximum allowable diameter after refinish specification, the brake drum must be replaced.
14. After refinishing the brake drum, use the following procedure in order to obtain the desired non-directional finish:
 1. Follow the brake lathe manufacturer's recommended speed setting for applying non-directional

finish.

2. Using the moderate pressure, apply the non-directional finish:
 - If the lathe is equipped with a non-directional finishing tool, apply the finish with 120-grit aluminum oxide sandpaper.
 - If the lathe is not equipped with a non-directional finishing tool, apply the finish with a sanding block and 150-grit aluminum oxide sandpaper.
 3. After applying a non-directional finish, clean the friction surface of the brake drum with denatured alcohol or an equivalent brake cleaner and wipe the friction surface using a clean shop towel to remove metal particles remaining from machining. Repeat the cleaning process if necessary to remove all metal particles.
15. Remove the brake drum from the brake lathe.
 16. If necessary, use the **CH-42450-A** wheel hub resurfacing kit in order to thoroughly clean any corrosion from the wheel bearing flange.

BRAKE SHOE REPLACEMENT

Removal Procedure

WARNING: Refer to Brake Dust Warning .

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
2. Remove the tire and wheel assembly. Refer to Tire and Wheel Removal and Installation .
3. Remove the brake drum. Refer to Brake Drum Replacement.

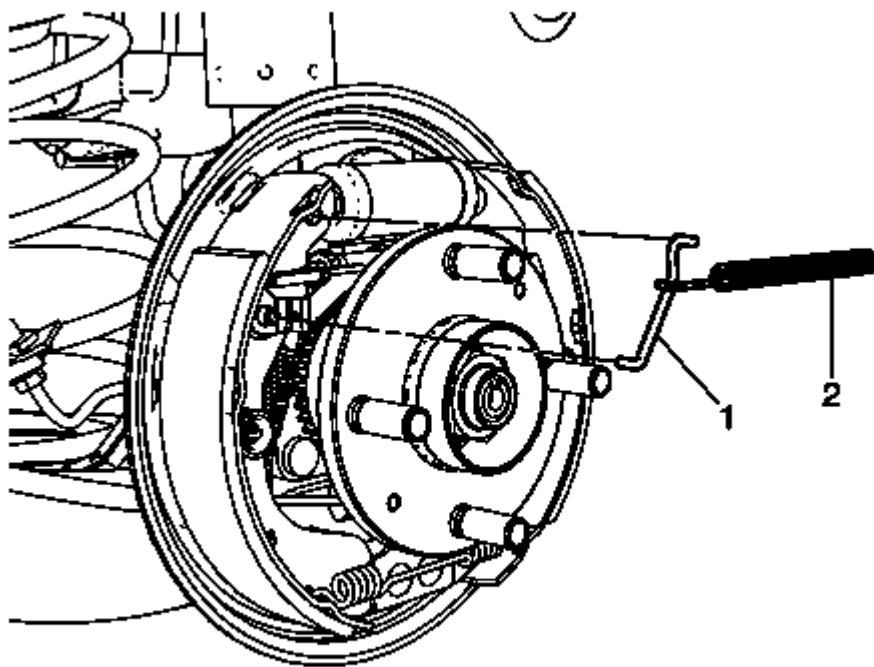


Fig. 8: Spring Fastener And Upper Brake Shoe Return Spring
Courtesy of GENERAL MOTORS COMPANY

4. Remove the spring fastener (1) and upper brake shoe return spring (2).

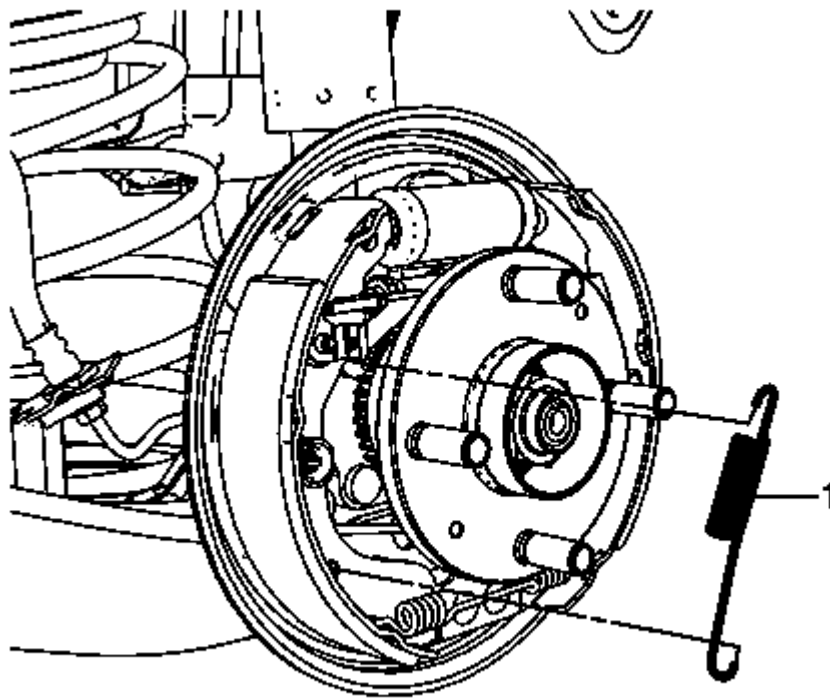


Fig. 9: Brake Adjuster Actuator Lever Spring
Courtesy of GENERAL MOTORS COMPANY

5. Remove brake adjuster actuator lever spring (1).

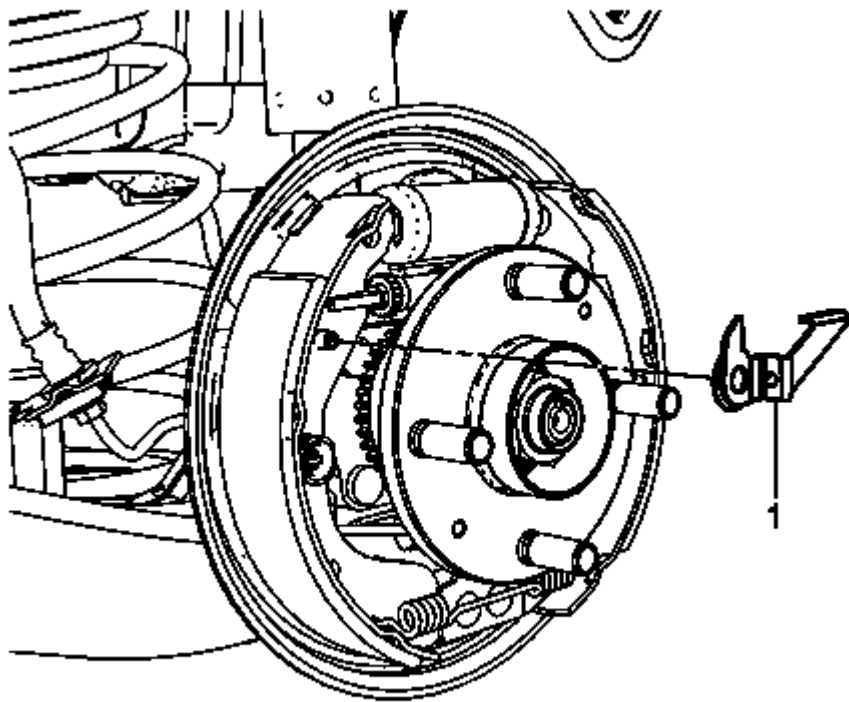


Fig. 10: Brake Adjuster Actuator Lever
Courtesy of GENERAL MOTORS COMPANY

6. Remove the brake adjuster actuator lever (1).

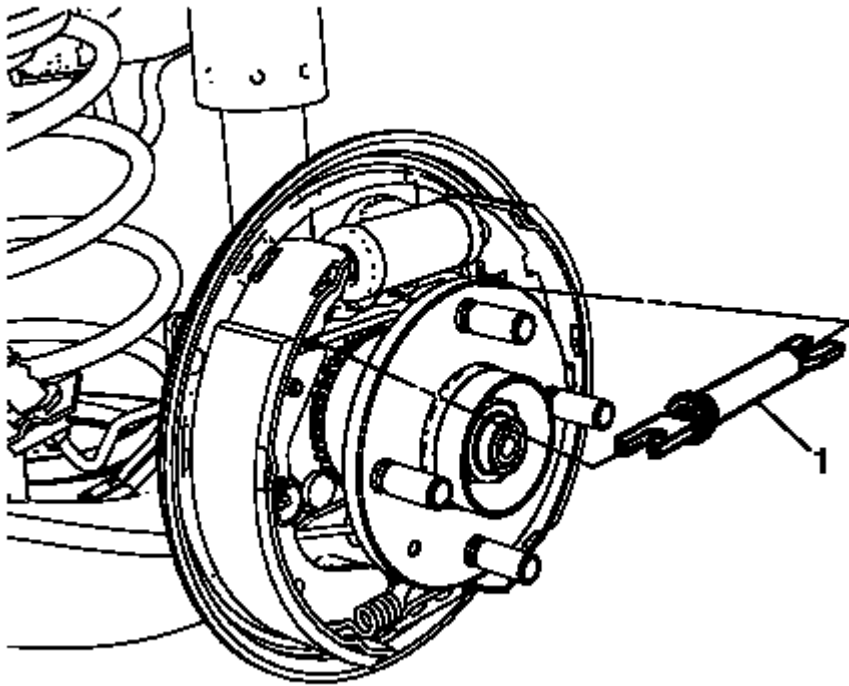


Fig. 11: Brake Shoe Adjuster

Courtesy of GENERAL MOTORS COMPANY

7. Spread the top of the brake shoes apart slightly and remove the brake shoe adjuster (1).

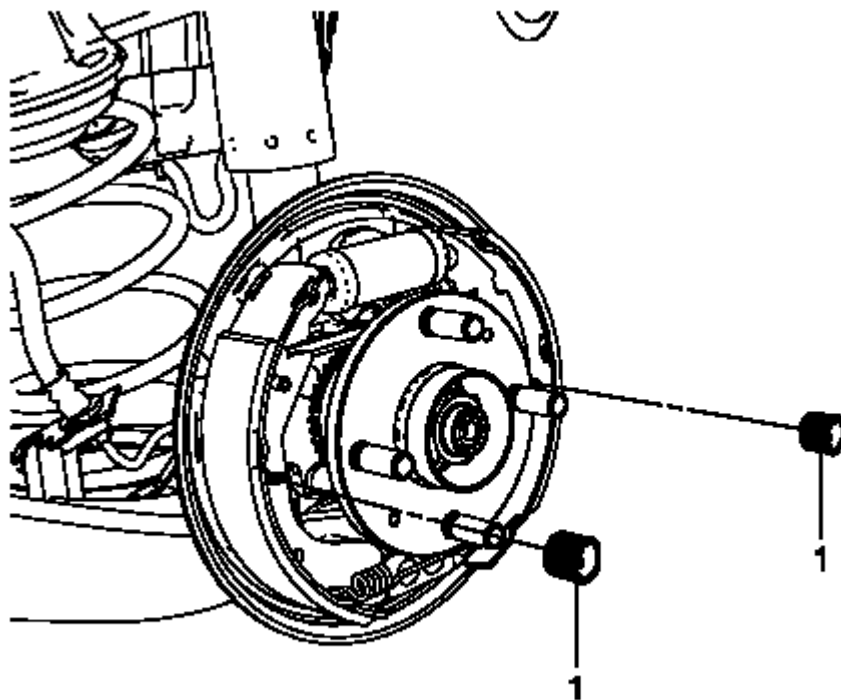


Fig. 12: Cup Assemblies

Courtesy of GENERAL MOTORS COMPANY

8. Remove the brake shoe hold down spring and cup assemblies (1) by compressing the spring and rotating the assembly 1/4 turn.
9. Remove the 2 hold-down spring and cup assembly pins.

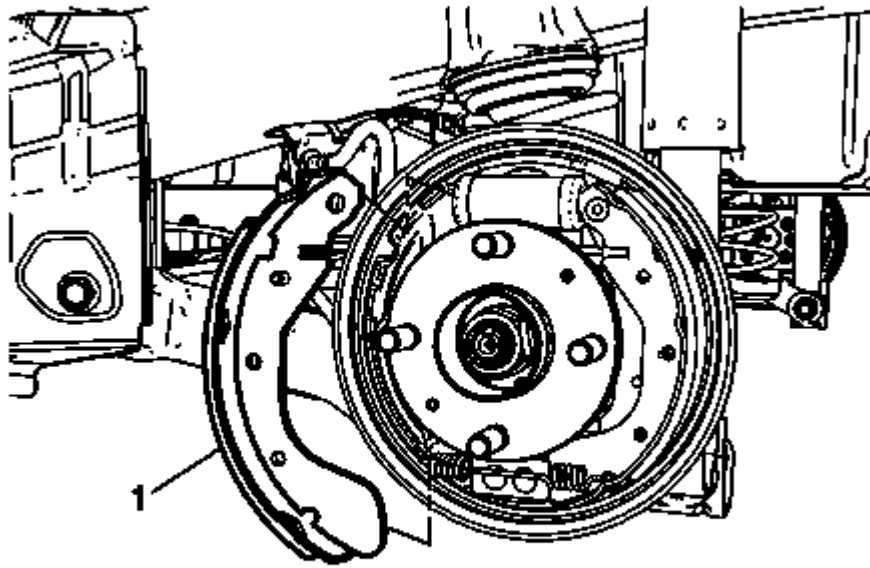


Fig. 13: Primary Brake Shoe

Courtesy of GENERAL MOTORS COMPANY

10. Rotate the primary brake shoe (1) toward the wheel hub assembly and release the brake shoe from the lower brake shoe return spring.

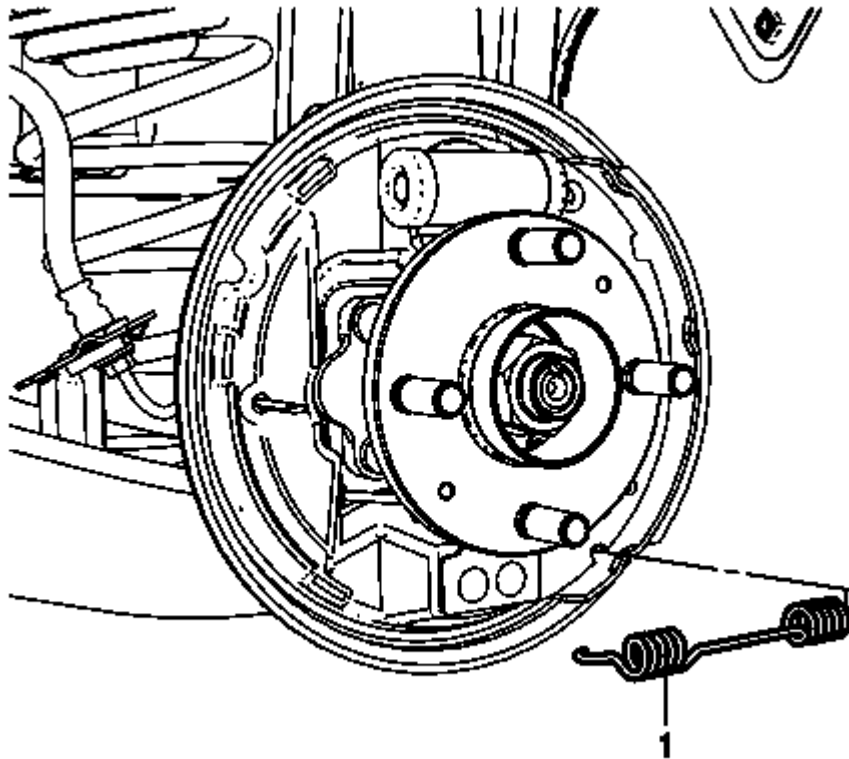


Fig. 14: Lower Brake Shoe Return Spring
Courtesy of GENERAL MOTORS COMPANY

11. Remove the lower brake shoe return spring (1).
12. Inspect the drum brake hardware and replace any components, as necessary. Refer to **Drum Brake Hardware Inspection**.

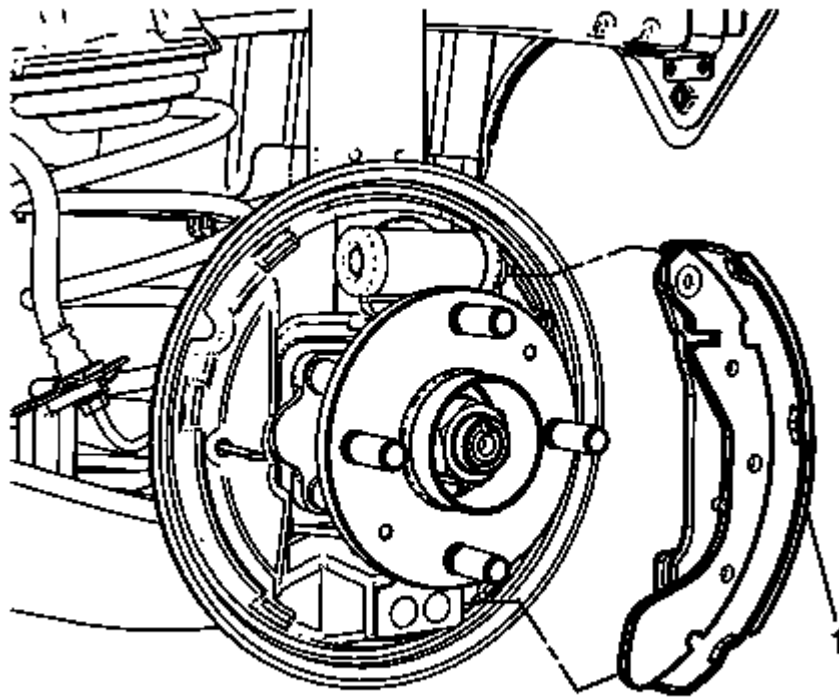


Fig. 15: Brake Shoe

Courtesy of GENERAL MOTORS COMPANY

13. Compress the park brake cable return spring and release the park brake cable fitting from the park brake apply lever and remove the brake shoe (1).

Installation Procedure

1. Clean the drum brake backing plate of any dirt and debris.
2. Apply a light coat of high temperature brake lubricant to the brake drum backing plate shoe contact surfaces.

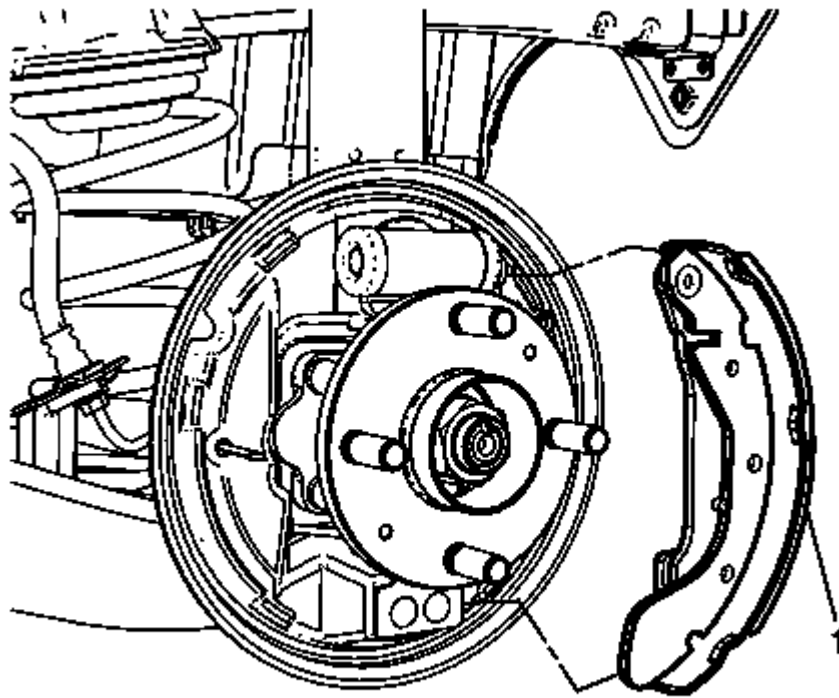


Fig. 16: Brake Shoe

Courtesy of GENERAL MOTORS COMPANY

3. Compress the park brake cable return spring and install the park brake cable fitting to the park brake apply lever and position the brake shoe (1) to the drum brake backing plate.

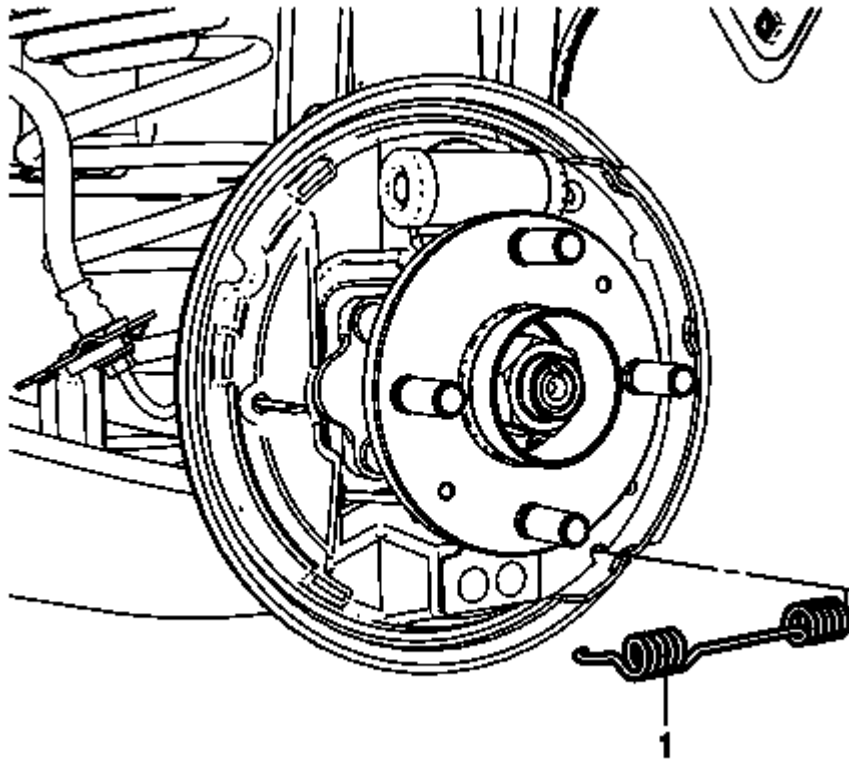


Fig. 17: Lower Brake Shoe Return Spring
Courtesy of GENERAL MOTORS COMPANY

4. Install the lower brake shoe return spring (1).

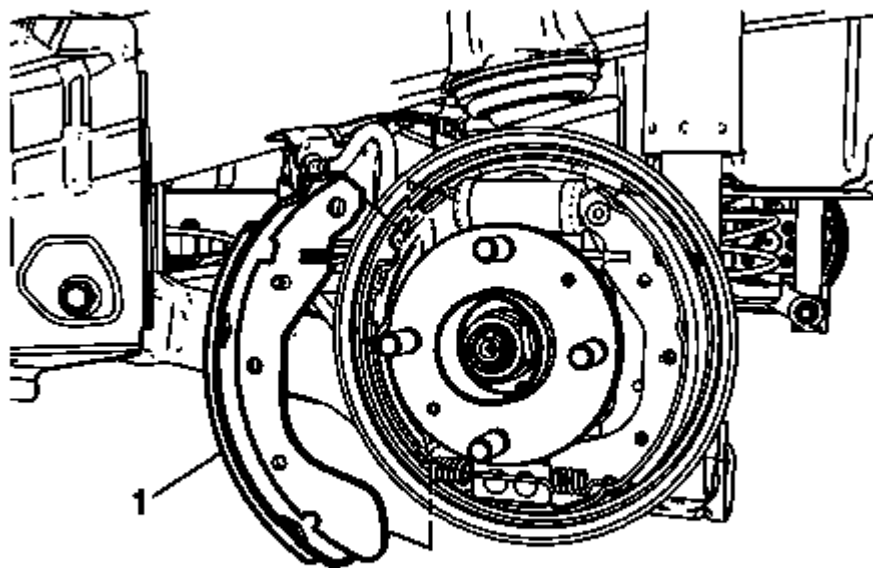


Fig. 18: Primary Brake Shoe

Courtesy of GENERAL MOTORS COMPANY

5. Position the primary brake shoe (1) to the brake drum backing plate and connect the brake shoe to the lower brake shoe return spring.

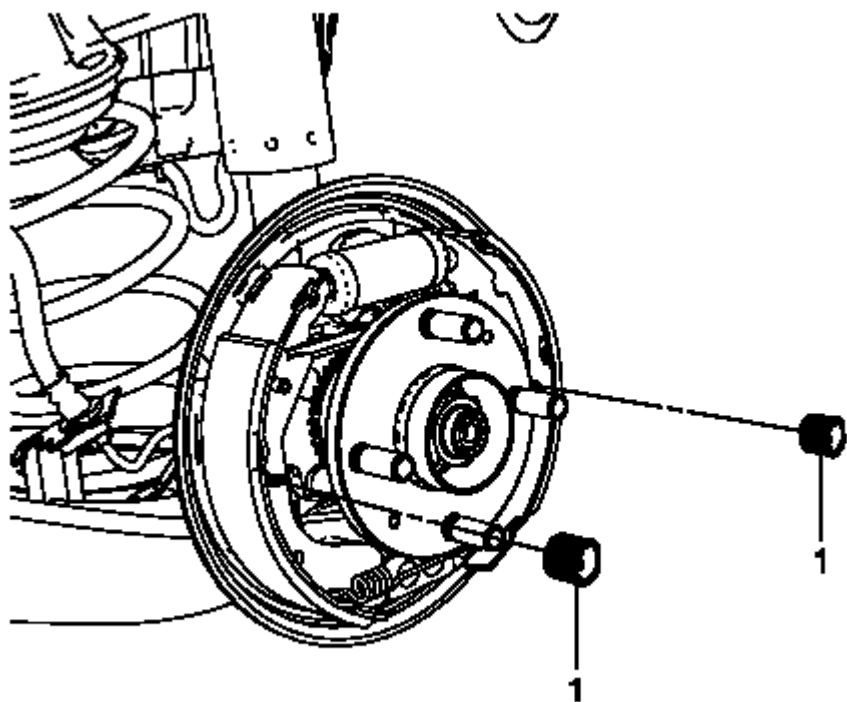


Fig. 19: Cup Assemblies

Courtesy of GENERAL MOTORS COMPANY

6. Install the 2 hold-down spring and cup assembly pins.
7. Install the brake shoe hold down spring and cup assemblies (1) by compressing the spring and rotating the assembly 1/4 turn.

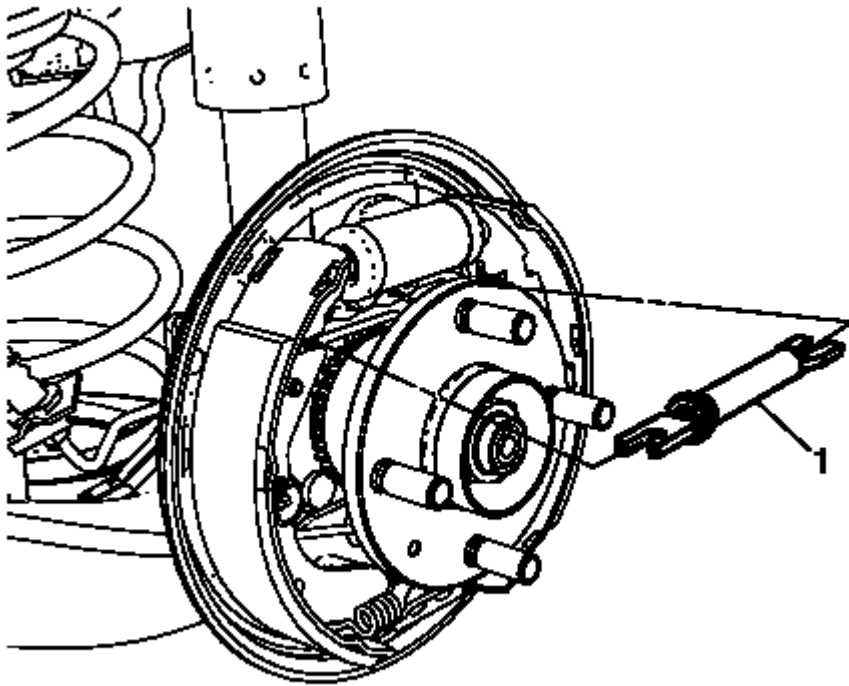


Fig. 20: Brake Shoe Adjuster

Courtesy of GENERAL MOTORS COMPANY

8. Spread the top of the brake shoes apart slightly and install the brake shoe adjuster (1).

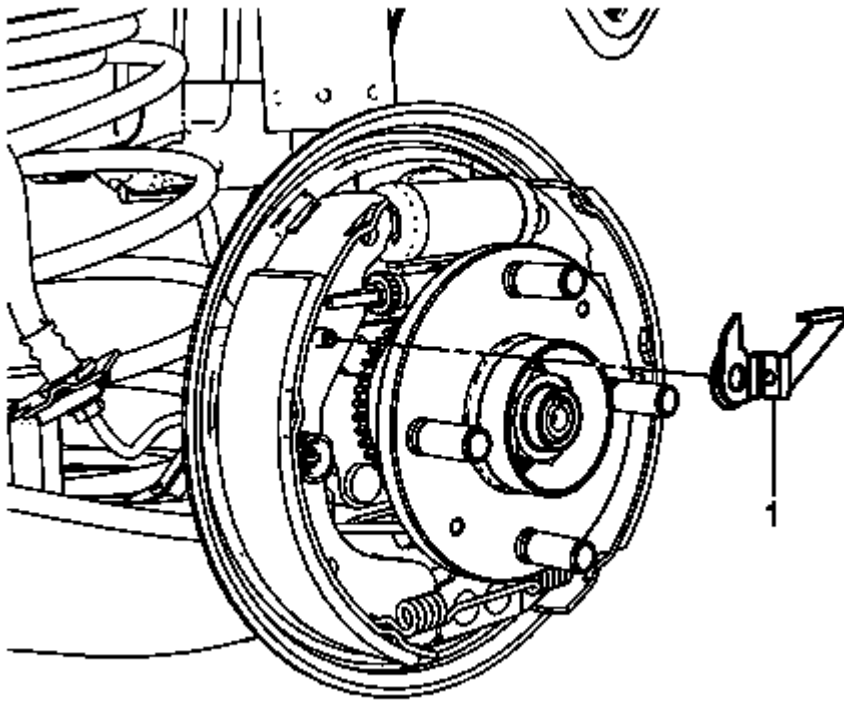


Fig. 21: Brake Adjuster Actuator Lever
Courtesy of GENERAL MOTORS COMPANY

9. Install the brake adjuster actuator lever (1).

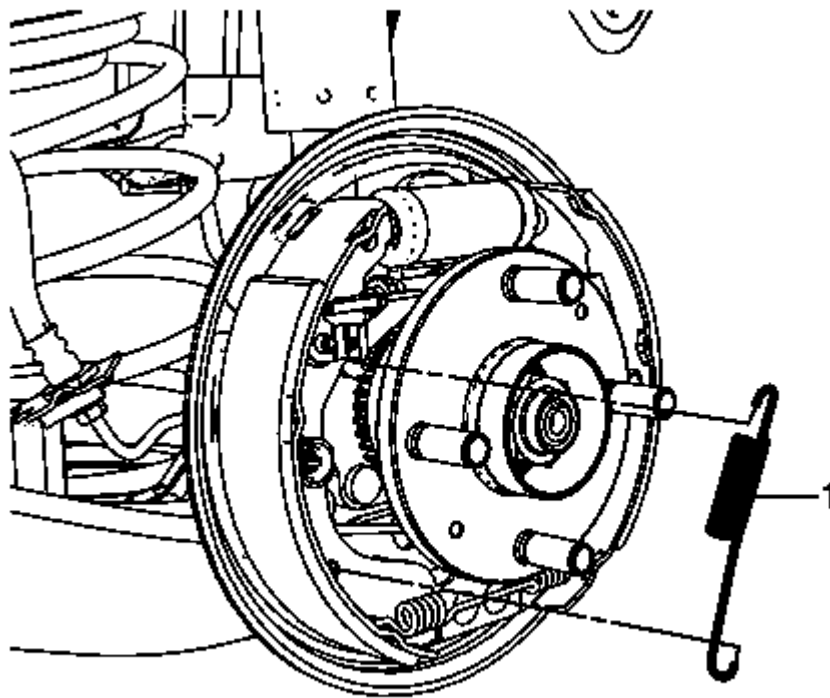


Fig. 22: Brake Adjuster Actuator Lever Spring
Courtesy of GENERAL MOTORS COMPANY

10. Install the brake adjuster actuator lever spring (1).

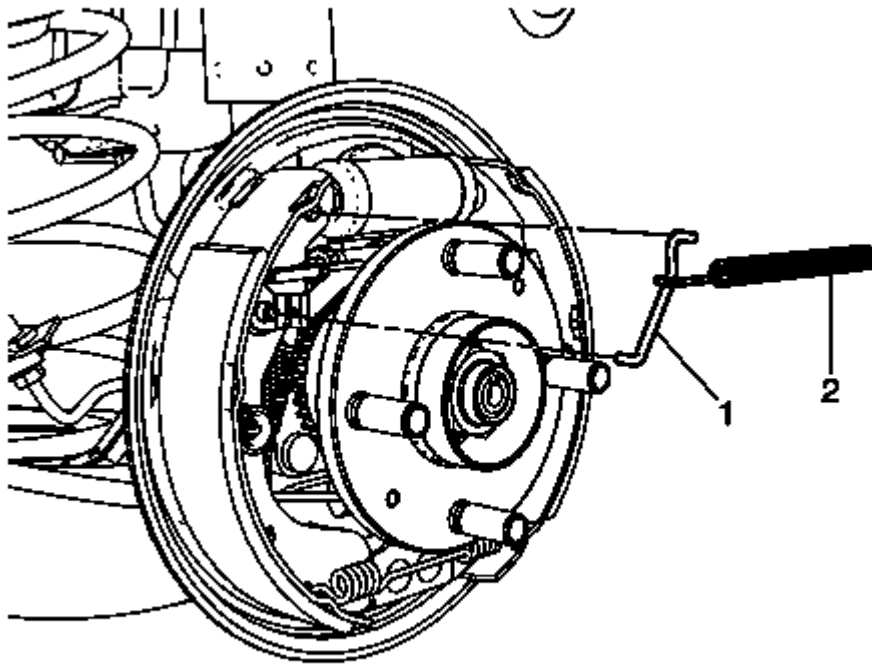


Fig. 23: Spring Fastener And Upper Brake Shoe Return Spring
Courtesy of GENERAL MOTORS COMPANY

11. Install the spring fastener (1) and upper brake shoe return spring (2).
12. Adjust the drum brakes. Refer to **Drum Brake Adjustment**.
13. Install the brake drum. Refer to **Brake Drum Replacement**.
14. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation**.
15. Lower the vehicle.

REAR BRAKE BACKING PLATE REPLACEMENT

Removal Procedure

WARNING: Refer to **Brake Dust Warning** .

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
3. Remove the brake drum. Refer to **Brake Drum Replacement**.
4. Remove the rear wheel speed sensor, if equipped. Refer to **Rear Wheel Speed Sensor Replacement** .

5. Remove the brake shoes. Refer to **Brake Shoe Replacement**.
6. Remove the wheel cylinder. Refer to **Rear Brake Cylinder Replacement**.

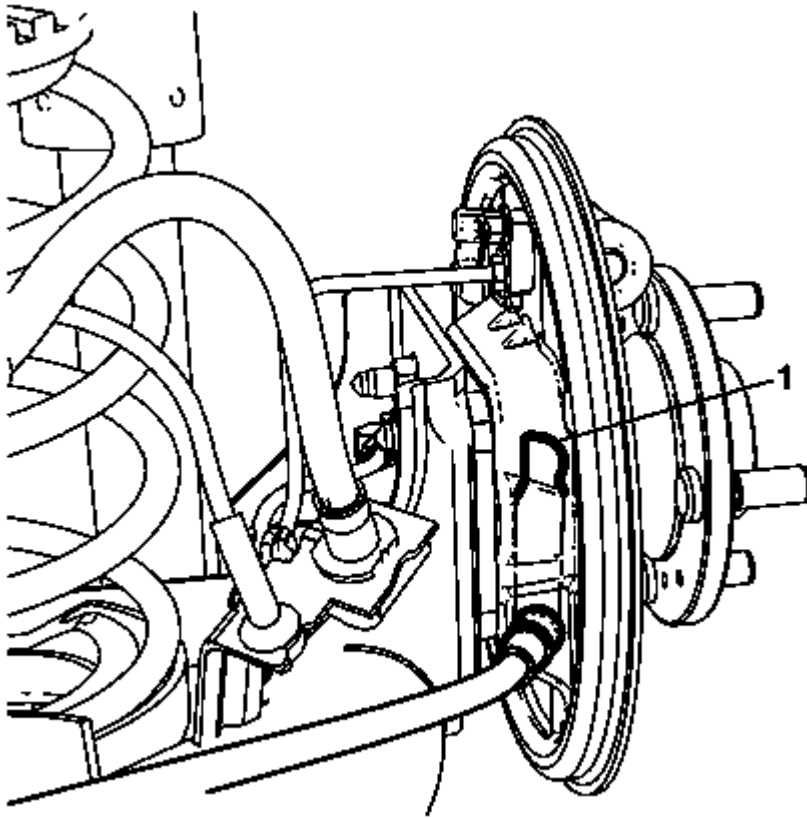


Fig. 24: Rear Park Brake Cable Retaining Clip
Courtesy of GENERAL MOTORS COMPANY

7. Remove the park brake cable retaining clip (1) from the drum brake backing plate.

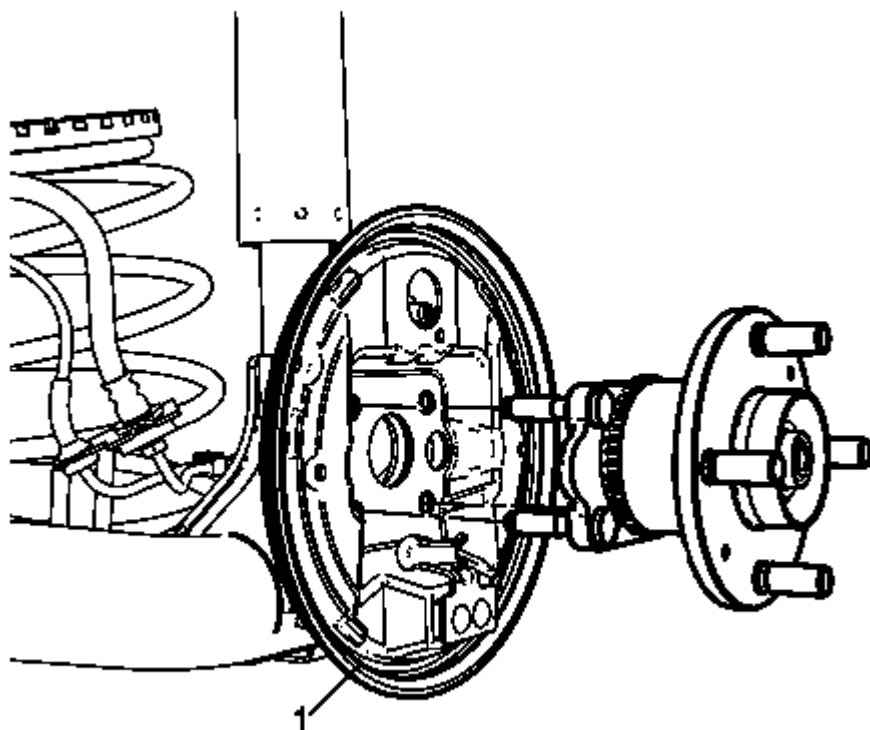


Fig. 25: Rear Brake Backing Plate
Courtesy of GENERAL MOTORS COMPANY

8. Remove the rear wheel bearing and hub assembly. Refer to **Rear Wheel Bearing and Hub Replacement** .
9. Remove the rear brake backing plate (1) from the rear axle assembly.

Installation Procedure

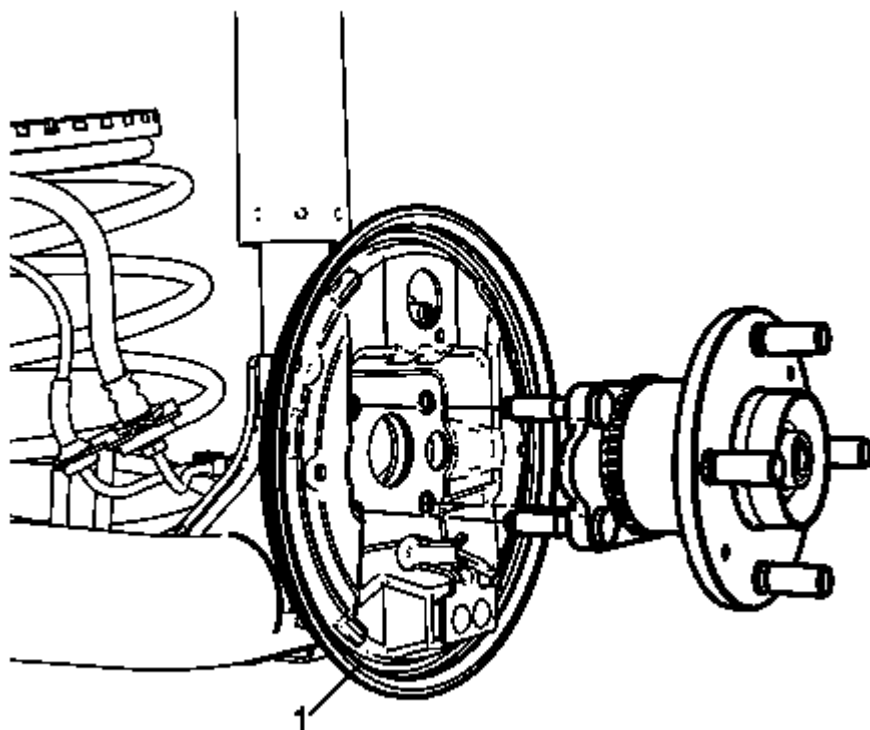


Fig. 26: Rear Brake Backing Plate
Courtesy of GENERAL MOTORS COMPANY

1. Install the rear brake backing plate (1) to the rear axle assembly.
2. Install the rear wheel bearing and hub assembly. Refer to **Rear Wheel Bearing and Hub Replacement** .
3. Install the wheel cylinder. Refer to **Rear Brake Cylinder Replacement**.
4. Install the brake shoes. Refer to **Brake Shoe Replacement**.

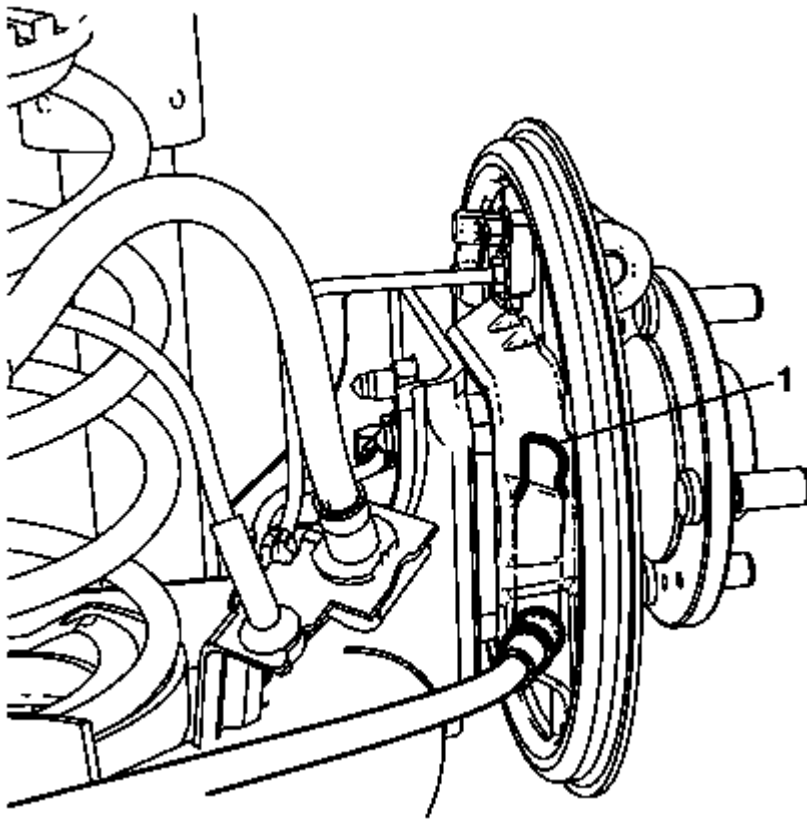


Fig. 27: Rear Park Brake Cable Retaining Clip
Courtesy of GENERAL MOTORS COMPANY

5. Install the park brake cable retaining clip (1) to the drum brake backing plate.
6. Install the rear wheel speed sensor, if equipped. Refer to **Rear Wheel Speed Sensor Replacement** .
7. Adjust the drum brakes. Refer to **Drum Brake Adjustment**.
8. Install the brake drum. Refer to **Brake Drum Replacement**.
9. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** , **Hydraulic Brake System Bleeding (Pressure)** .
10. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
11. Lower the vehicle.

DRUM BRAKE HARDWARE REPLACEMENT

Removal Procedure

WARNING: Refer to **Brake Dust Warning** .

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
3. Remove the brake drum. Refer to **Brake Drum Replacement**.

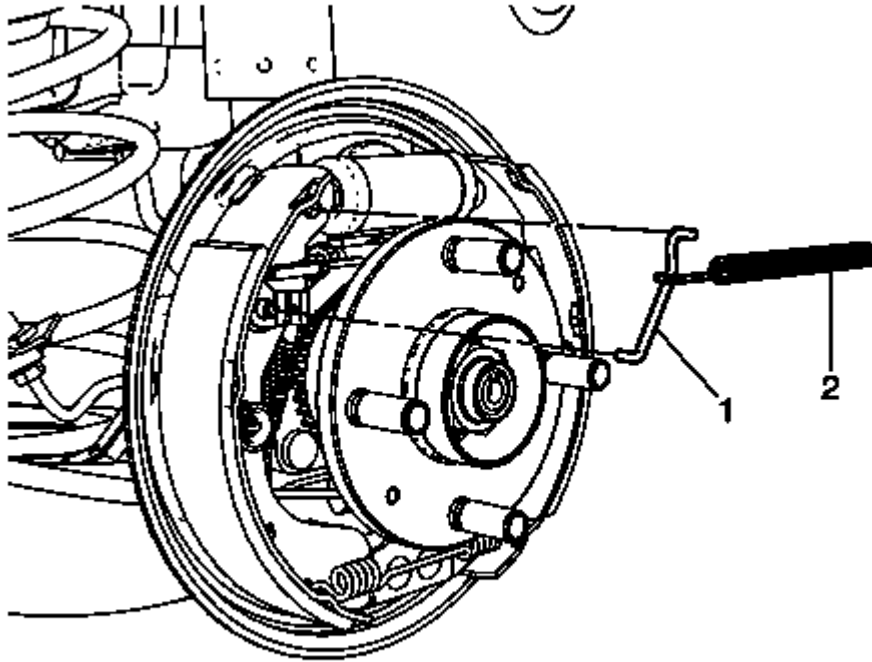


Fig. 28: Spring Fastener And Upper Brake Shoe Return Spring
Courtesy of GENERAL MOTORS COMPANY

4. Remove the spring fastener (1) and upper brake shoe return spring (2).

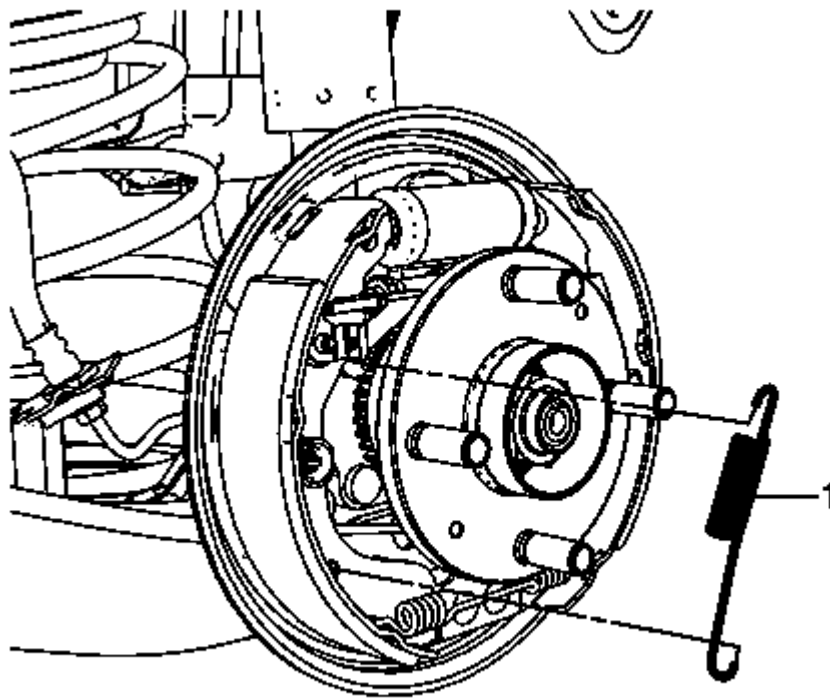


Fig. 29: Brake Adjuster Actuator Lever Spring
Courtesy of GENERAL MOTORS COMPANY

5. Remove brake adjuster actuator lever spring (1).

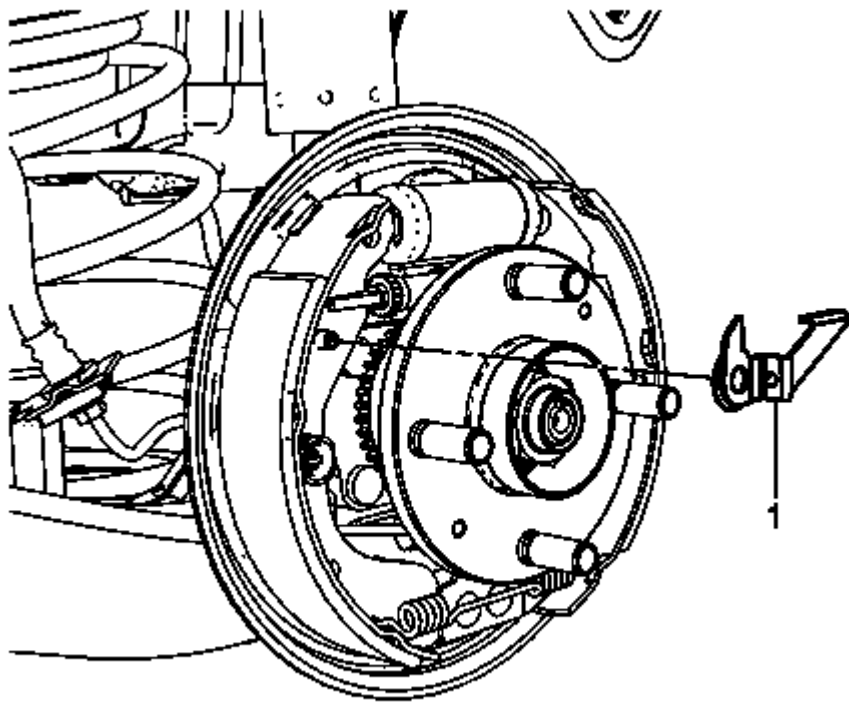


Fig. 30: Brake Adjuster Actuator Lever
Courtesy of GENERAL MOTORS COMPANY

6. Remove the brake adjuster actuator lever (1).

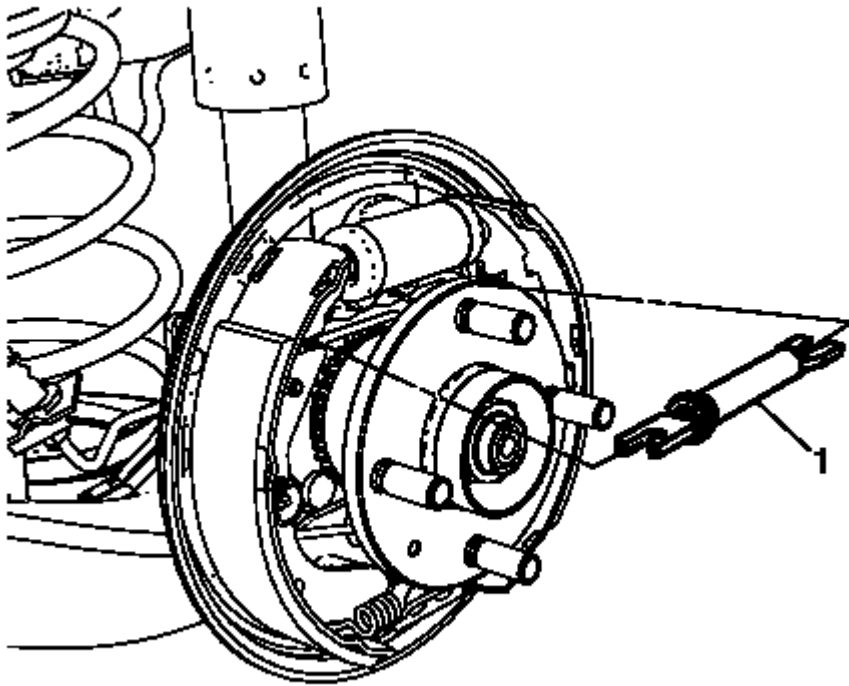


Fig. 31: Brake Shoe Adjuster

Courtesy of GENERAL MOTORS COMPANY

7. Spread the top of the brake shoes apart slightly and remove the brake shoe adjuster (1).

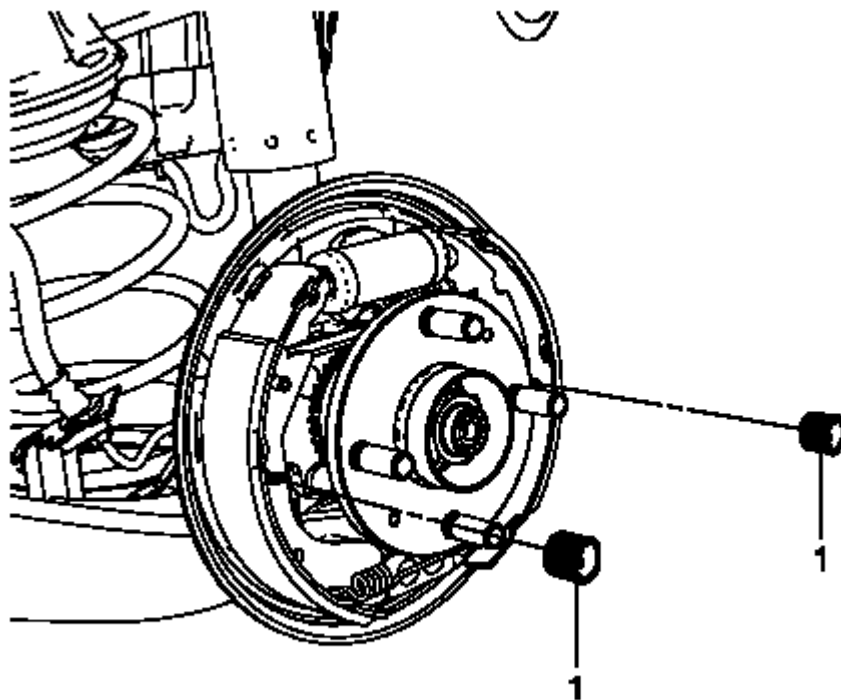


Fig. 32: Cup Assemblies

Courtesy of GENERAL MOTORS COMPANY

8. Remove the brake shoe hold down spring and cup assemblies (1) by compressing the spring and rotating the assembly 1/4 turn.
9. Remove the 2 hold-down spring and cup assembly pins.

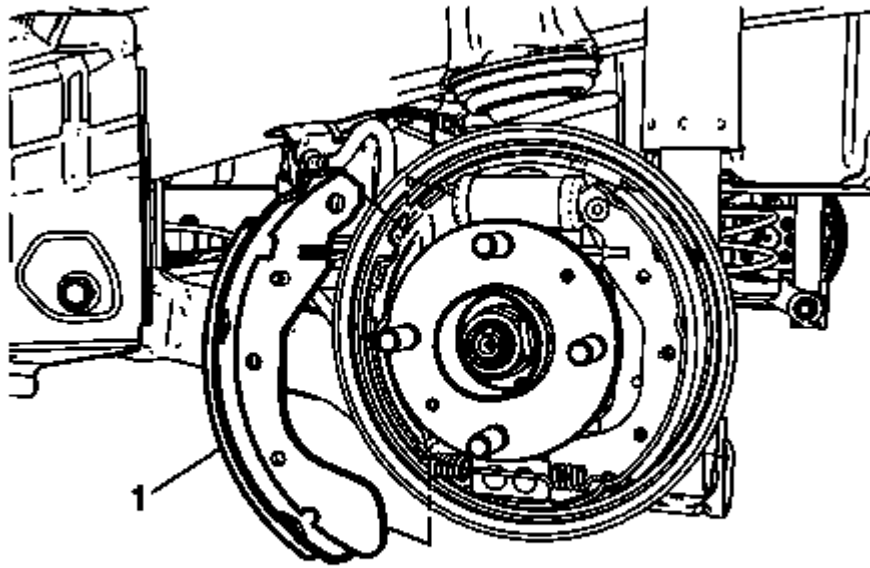


Fig. 33: Primary Brake Shoe

Courtesy of GENERAL MOTORS COMPANY

10. Rotate the primary brake shoe (1) toward the wheel hub assembly and release the brake shoe from the lower brake shoe return spring.

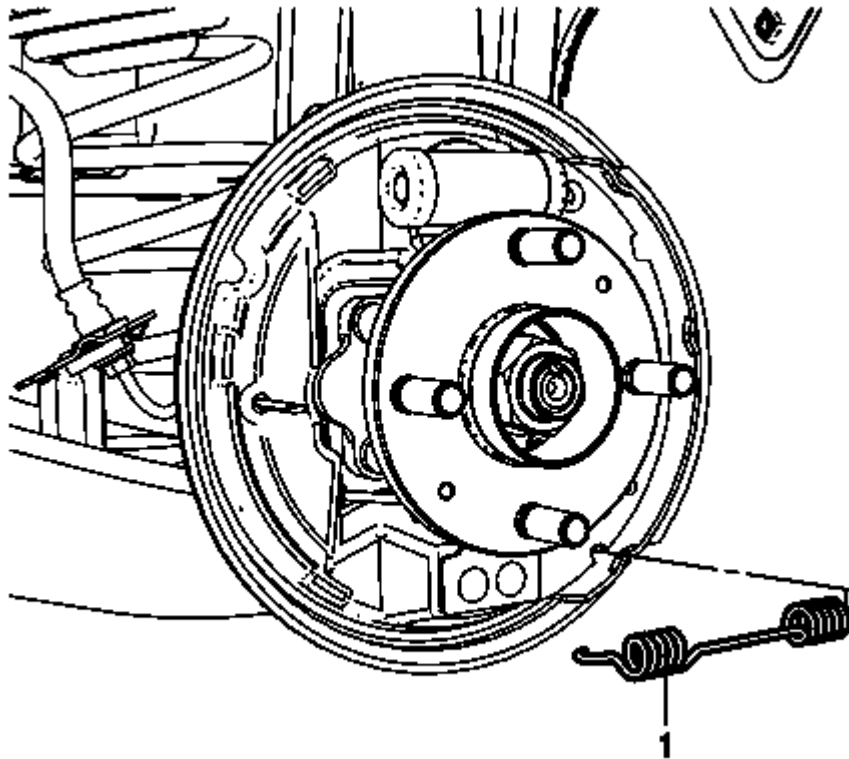


Fig. 34: Lower Brake Shoe Return Spring
Courtesy of GENERAL MOTORS COMPANY

11. Remove the lower brake shoe return spring (1).
12. Inspect the drum brake hardware and replace any components, as necessary. Refer to **Drum Brake Hardware Inspection**.

Installation Procedure

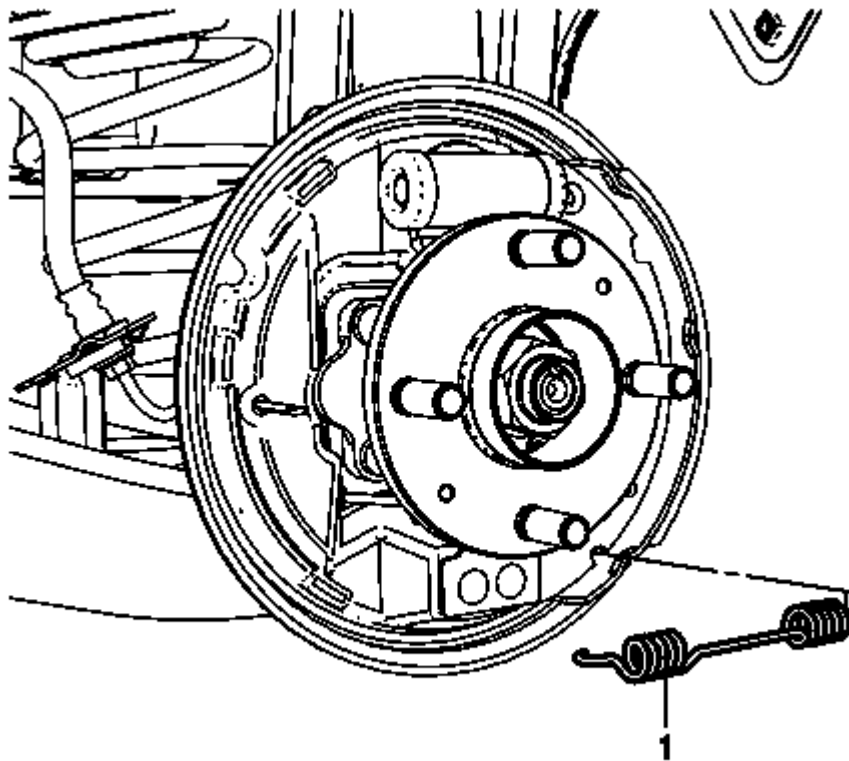


Fig. 35: Lower Brake Shoe Return Spring
Courtesy of GENERAL MOTORS COMPANY

1. Install the lower brake shoe return spring (1).

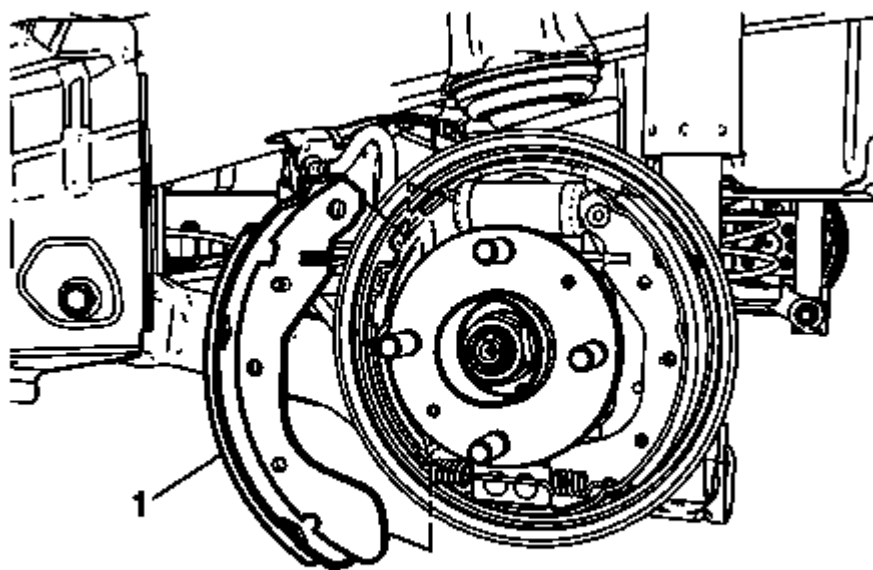


Fig. 36: Primary Brake Shoe

Courtesy of GENERAL MOTORS COMPANY

2. Position the primary brake shoe (1) to the brake drum backing plate and connect the brake shoe to the lower brake shoe return spring.

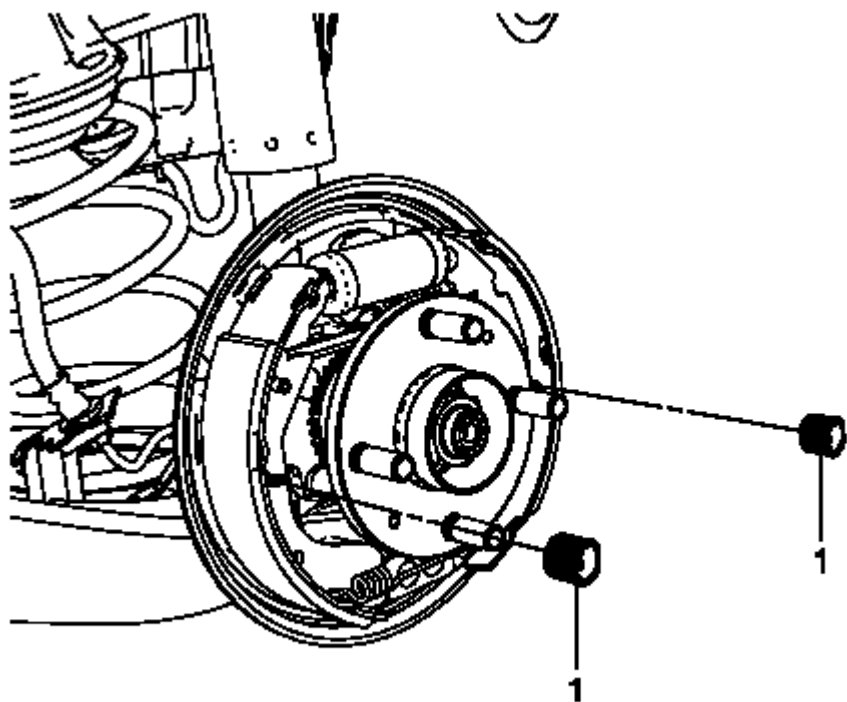


Fig. 37: Cup Assemblies

Courtesy of GENERAL MOTORS COMPANY

3. Install the 2 hold-down spring and cup assembly pins.
4. Install the brake shoe hold down spring and cup assemblies (1) by compressing the spring and rotating the assembly 1/4 turn.

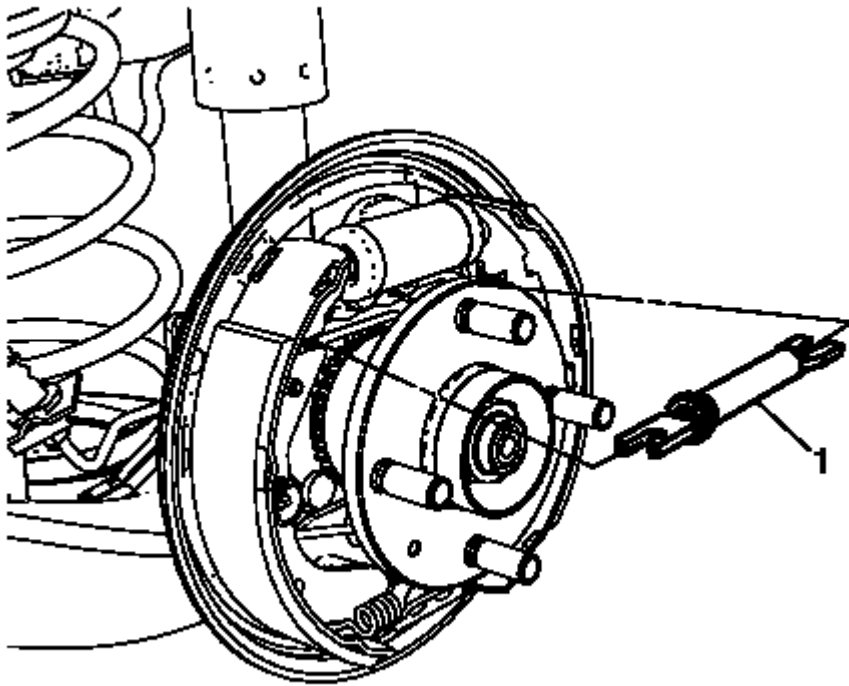


Fig. 38: Brake Shoe Adjuster

Courtesy of GENERAL MOTORS COMPANY

5. Spread the top of the brake shoes apart slightly and install the brake shoe adjuster (1).

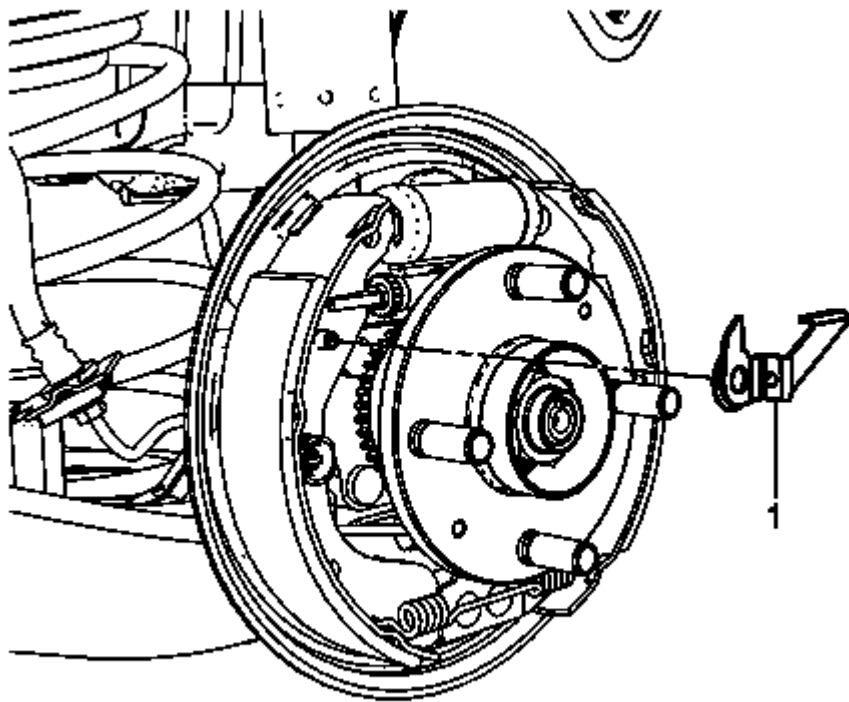


Fig. 39: Brake Adjuster Actuator Lever
Courtesy of GENERAL MOTORS COMPANY

6. Install the brake adjuster actuator lever (1).

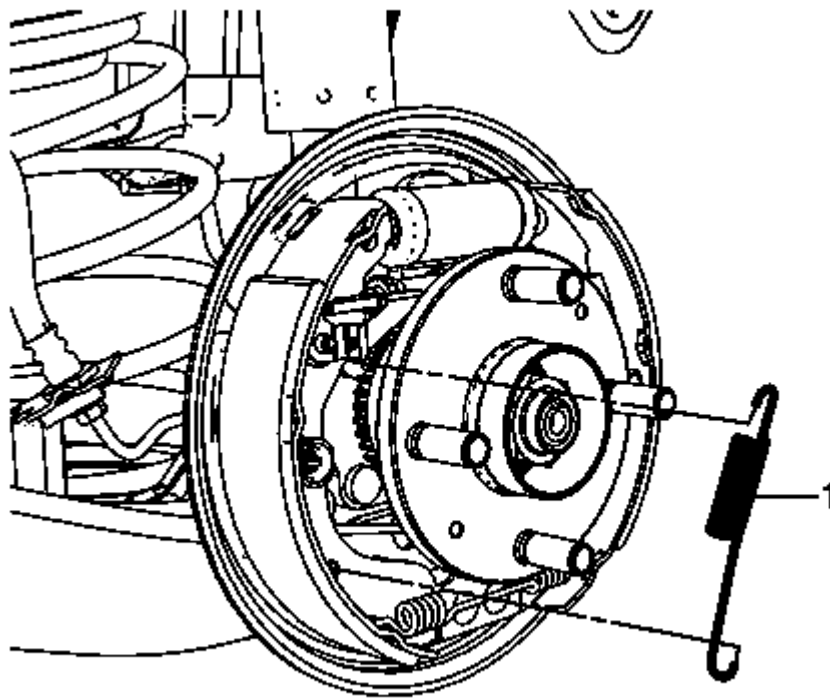


Fig. 40: Brake Adjuster Actuator Lever Spring
Courtesy of GENERAL MOTORS COMPANY

7. Install the brake adjuster actuator lever spring (1).

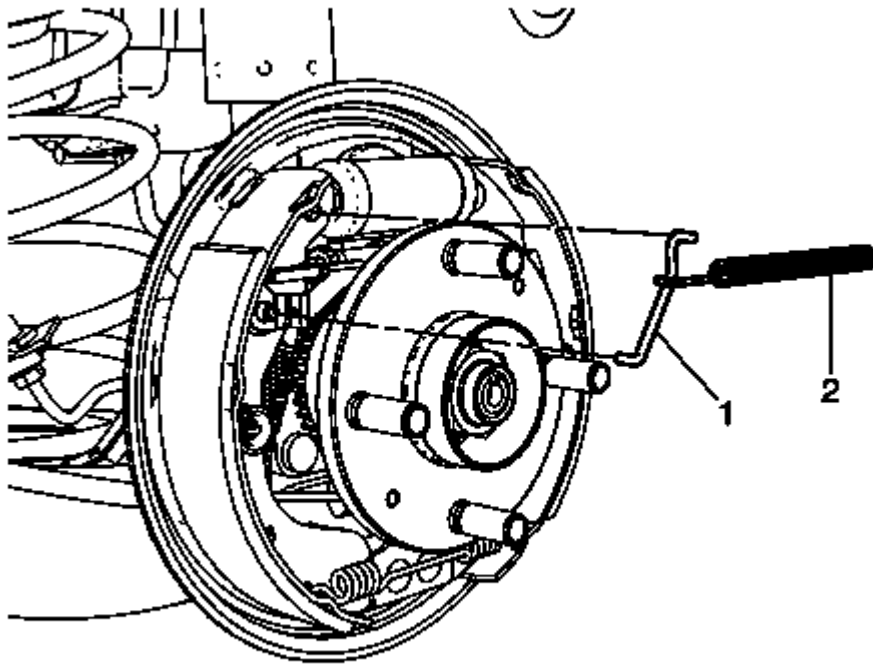


Fig. 41: Spring Fastener And Upper Brake Shoe Return Spring
Courtesy of GENERAL MOTORS COMPANY

8. Install the spring fastener (1) and upper brake shoe return spring (2).
9. Adjust the drum brakes. Refer to **Drum Brake Adjustment**.
10. Install the brake drum. Refer to **Brake Drum Replacement**.
11. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation**.
12. Lower the vehicle.

DRUM BRAKE ADJUSTING HARDWARE REPLACEMENT

Removal Procedure

WARNING: Refer to **Brake Dust Warning** .

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the tire and wheel. Refer to **Tire and Wheel Removal and Installation** .
3. Remove the brake drum. Refer to **Brake Drum Replacement**.

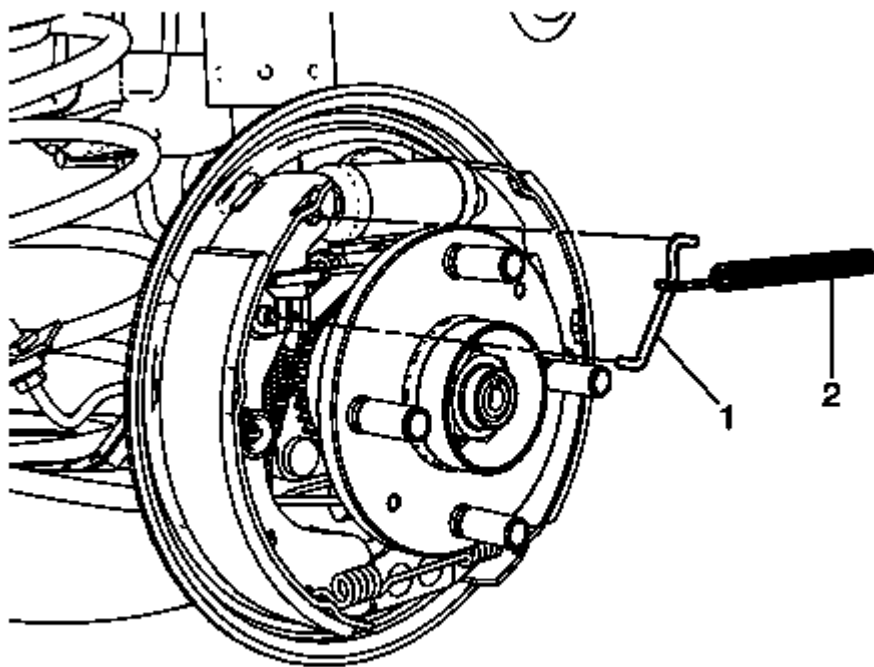


Fig. 42: Spring Fastener And Upper Brake Shoe Return Spring
Courtesy of GENERAL MOTORS COMPANY

4. Remove the spring fastener (1) and upper brake shoe return spring (2).

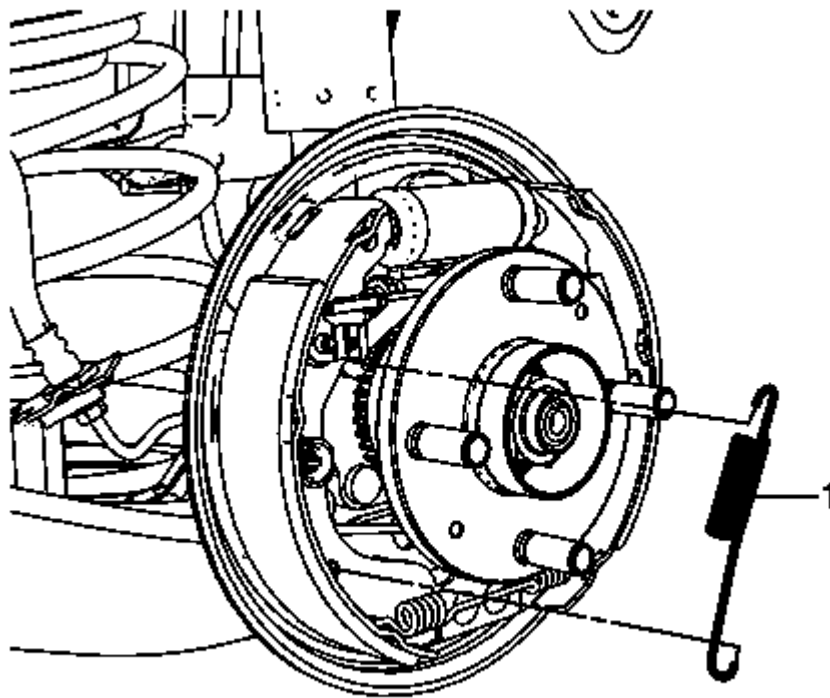


Fig. 43: Brake Adjuster Actuator Lever Spring
Courtesy of GENERAL MOTORS COMPANY

5. Remove brake adjuster actuator lever spring (1).

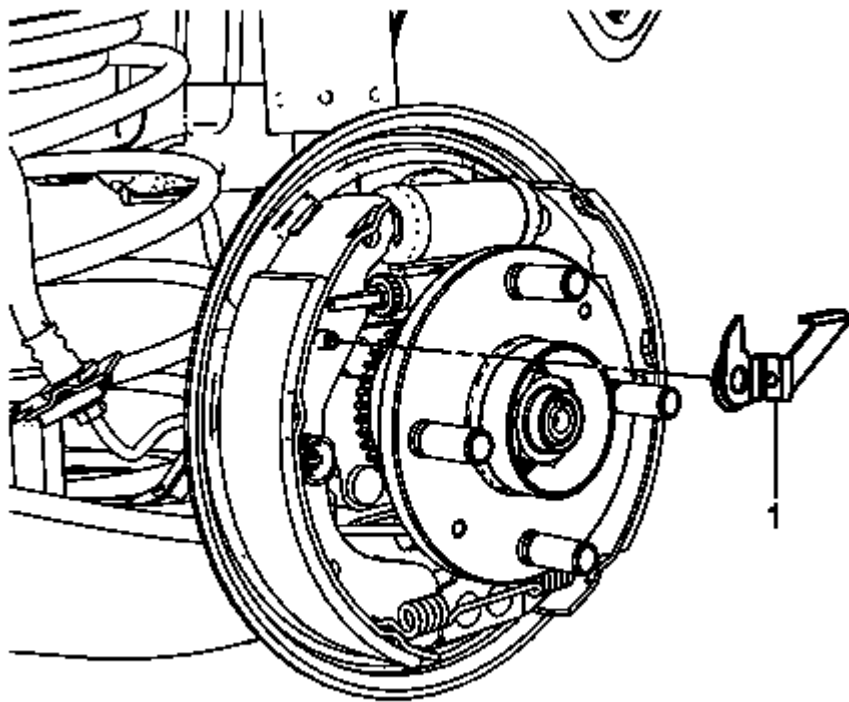


Fig. 44: Brake Adjuster Actuator Lever
Courtesy of GENERAL MOTORS COMPANY

6. Remove the brake adjuster actuator lever (1).

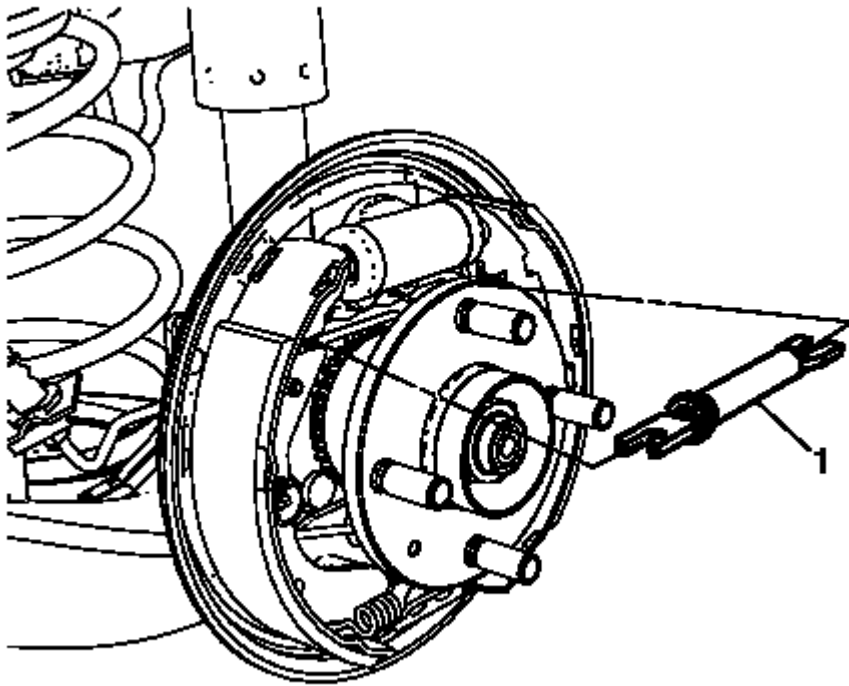


Fig. 45: Brake Shoe Adjuster

Courtesy of GENERAL MOTORS COMPANY

7. Spread the top of the brake shoes apart slightly and remove the brake shoe adjuster (1).
8. Inspect the drum brake adjusting hardware and replace any damaged components as necessary. Refer to **Drum Brake Adjusting Hardware Inspection.**
9. Disassemble the brake shoe adjuster and thoroughly clean the adjuster screw threads of any corrosion.

Installation Procedure

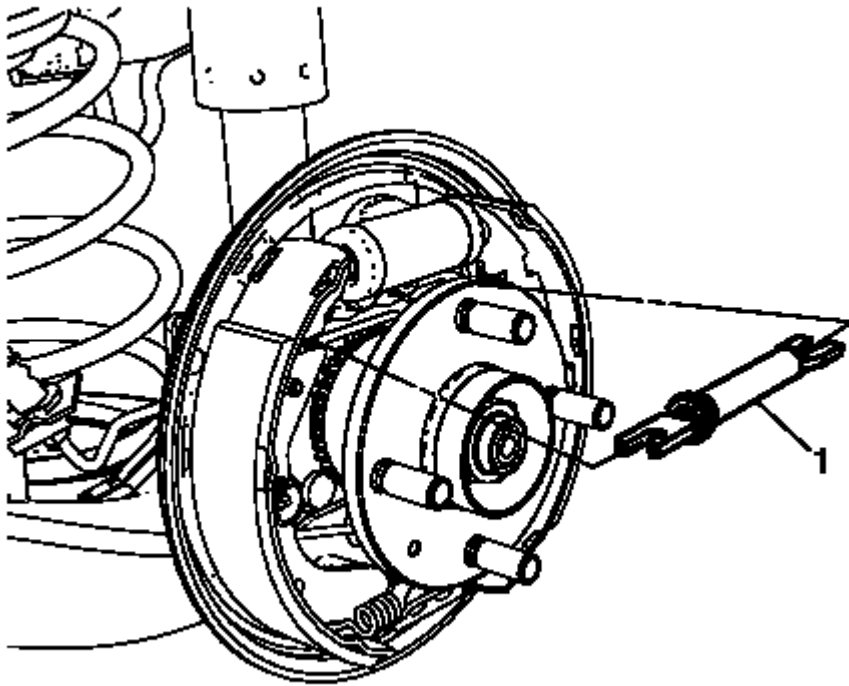


Fig. 46: Brake Shoe Adjuster

Courtesy of GENERAL MOTORS COMPANY

1. Apply a light coat of high temperature brake lubricant to the brake shoe adjuster screw threads.
2. Assemble the brake shoe adjuster, setting the adjuster to the fully retracted position.
3. Spread the top of the brake shoes apart slightly and install the brake shoe adjuster (1).

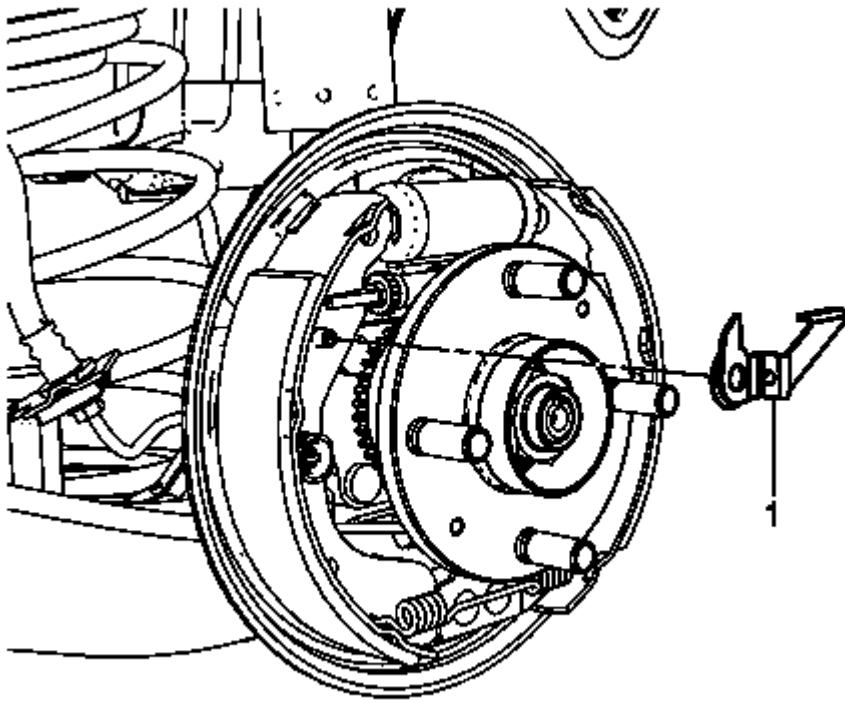


Fig. 47: Brake Adjuster Actuator Lever
Courtesy of GENERAL MOTORS COMPANY

4. Install the brake adjuster actuator lever (1).

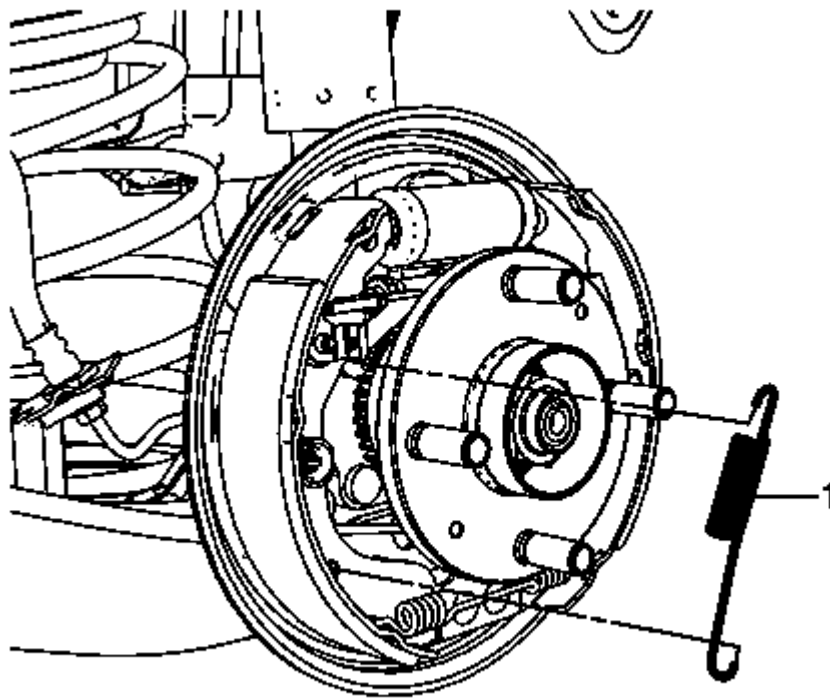


Fig. 48: Brake Adjuster Actuator Lever Spring
Courtesy of GENERAL MOTORS COMPANY

5. Install the brake adjuster actuator lever spring (1).

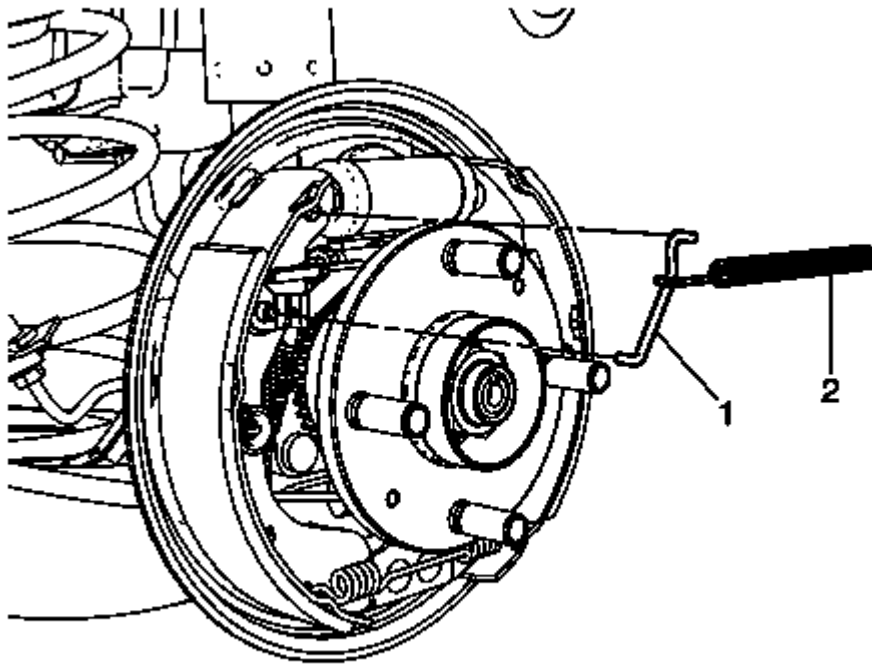


Fig. 49: Spring Fastener And Upper Brake Shoe Return Spring
Courtesy of GENERAL MOTORS COMPANY

6. Install the spring fastener (1) and upper brake shoe return spring (2).
7. Adjust the drum brakes. Refer to **Drum Brake Adjustment**.
8. Install the brake drum. Refer to **Brake Drum Replacement**.
9. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation**.
10. Lower the vehicle.

REAR BRAKE CYLINDER REPLACEMENT

Removal Procedure

WARNING: Refer to **Brake Dust Warning** .

WARNING: Refer to **Brake Fluid Irritant Warning** .

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

2. Remove the tire and wheel. Refer to **Tire and Wheel Removal and Installation** .
3. Remove the brake drum. Refer to **Brake Drum Replacement**.
4. Remove the drum brake adjusting hardware. Refer to **Drum Brake Adjusting Hardware Replacement**.
5. Clean the area surrounding the wheel cylinder of dirt and debris.
6. Remove the wheel cylinder bleeder valve to get tool access to the brake pipe fitting.

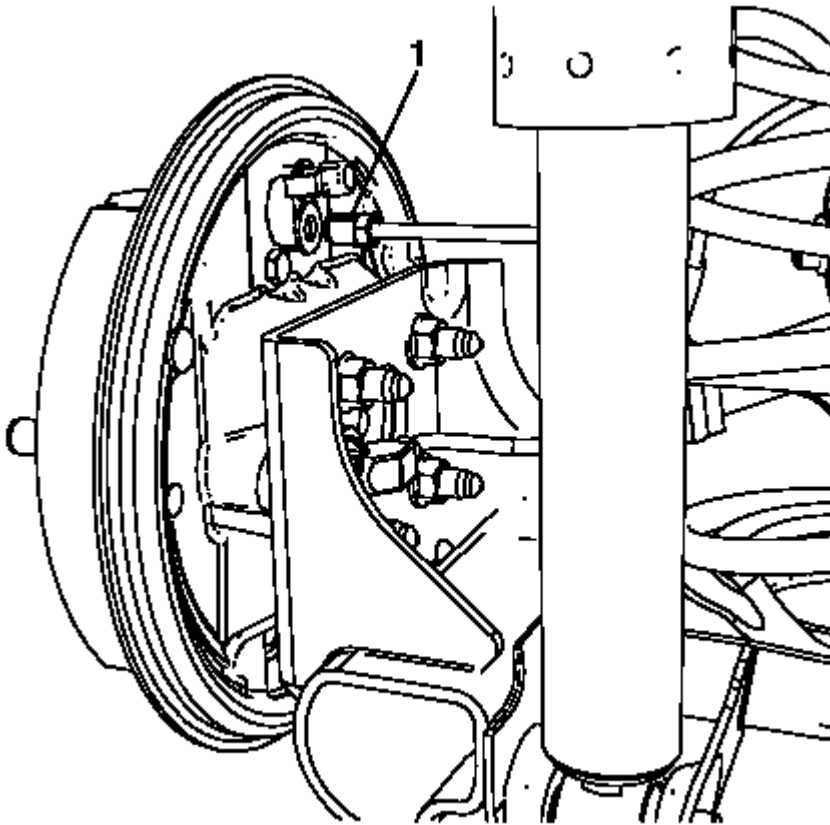


Fig. 50: Wheel Cylinder Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

7. Disconnect the wheel cylinder brake pipe fitting (1).

Cap the brake pipe fitting to prevent brake fluid loss and contamination.

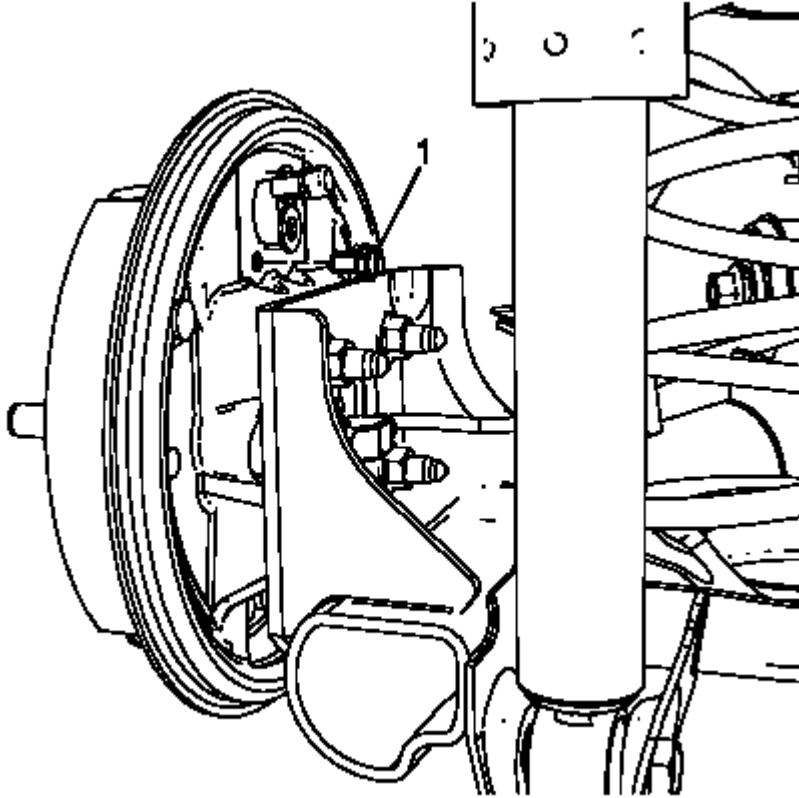


Fig. 51: Wheel Cylinder Bolts

Courtesy of GENERAL MOTORS COMPANY

8. Remove the wheel cylinder bolts (1).

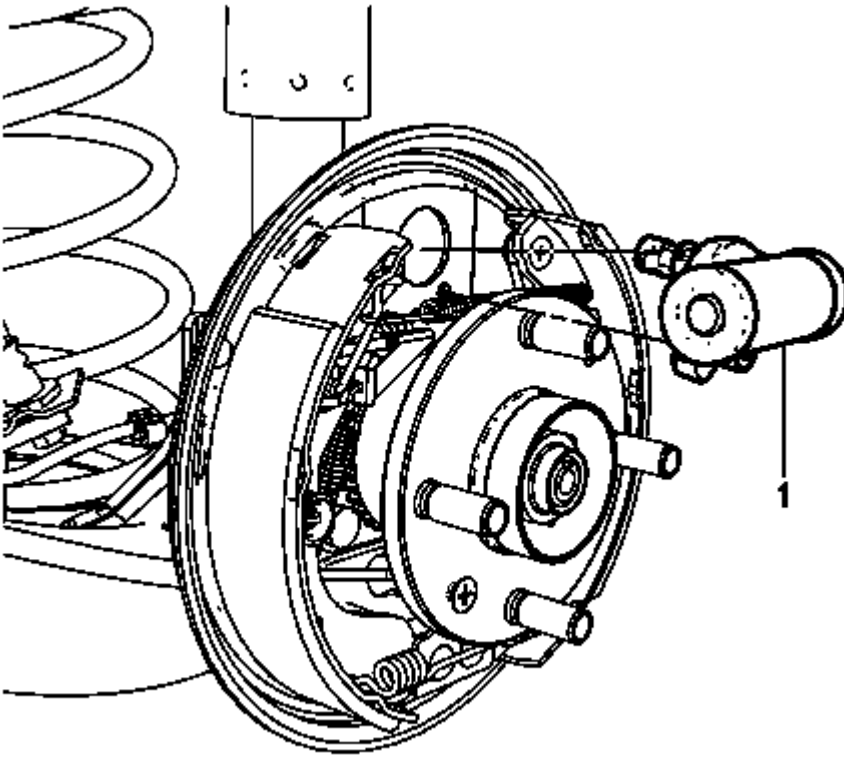


Fig. 52: Wheel Cylinder

Courtesy of GENERAL MOTORS COMPANY

9. Spread the top of the brake shoes slightly and remove the wheel cylinder (1) from the backing plate.

Installation Procedure

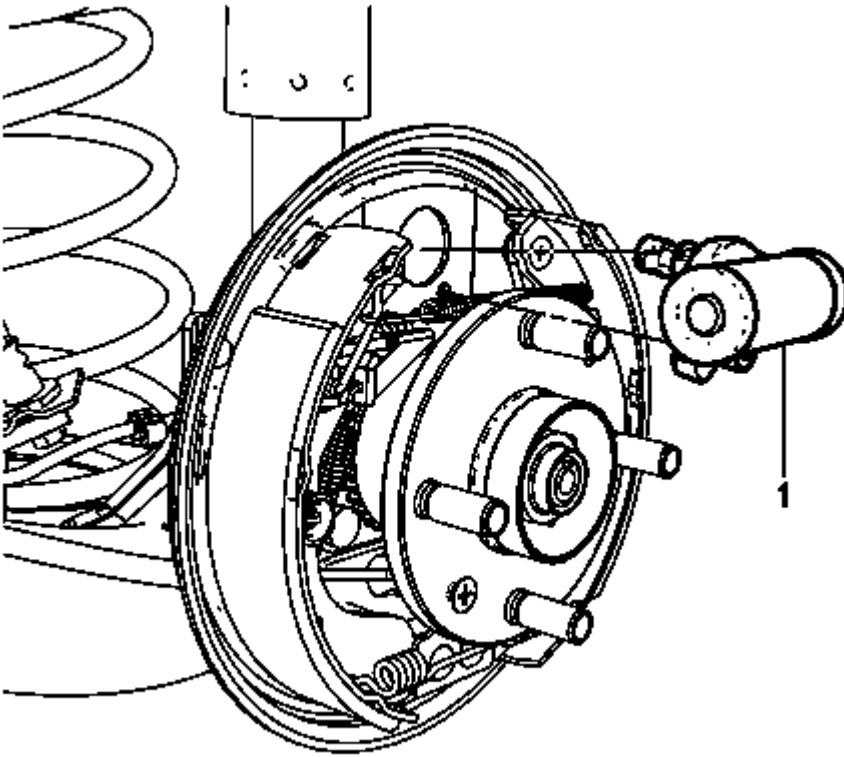


Fig. 53: Wheel Cylinder

Courtesy of GENERAL MOTORS COMPANY

1. Spread the top of the brake shoes slightly and install the wheel cylinder (1) to the backing plate.

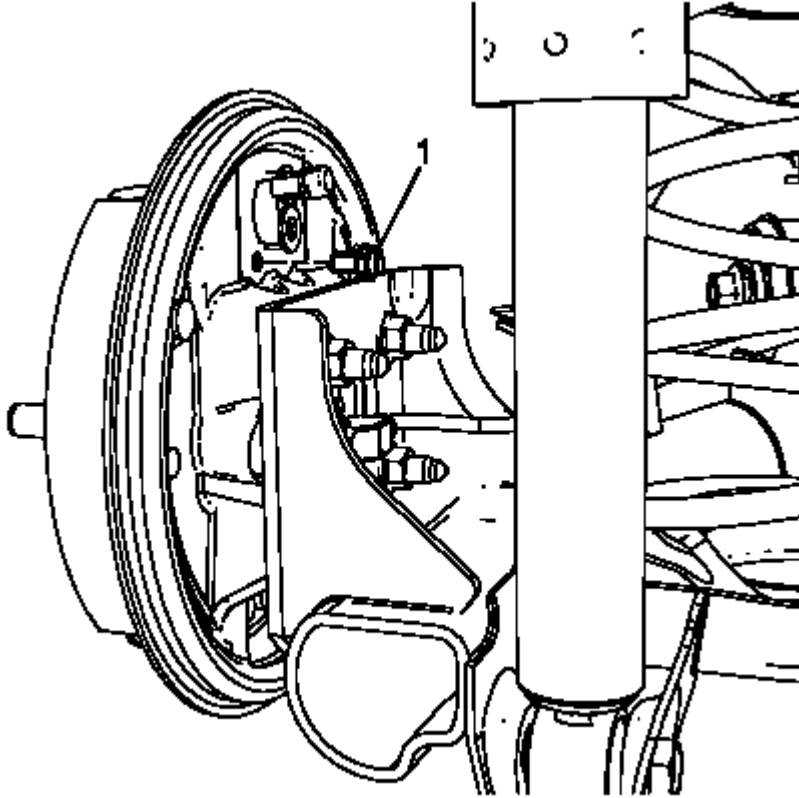


Fig. 54: Wheel Cylinder Bolts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

2. Install the wheel cylinder bolt (1) and tighten to 10 N.m (89 lb in).
3. Install the wheel cylinder bleeder valve and tighten to 8.5 N.m (75 lb in).

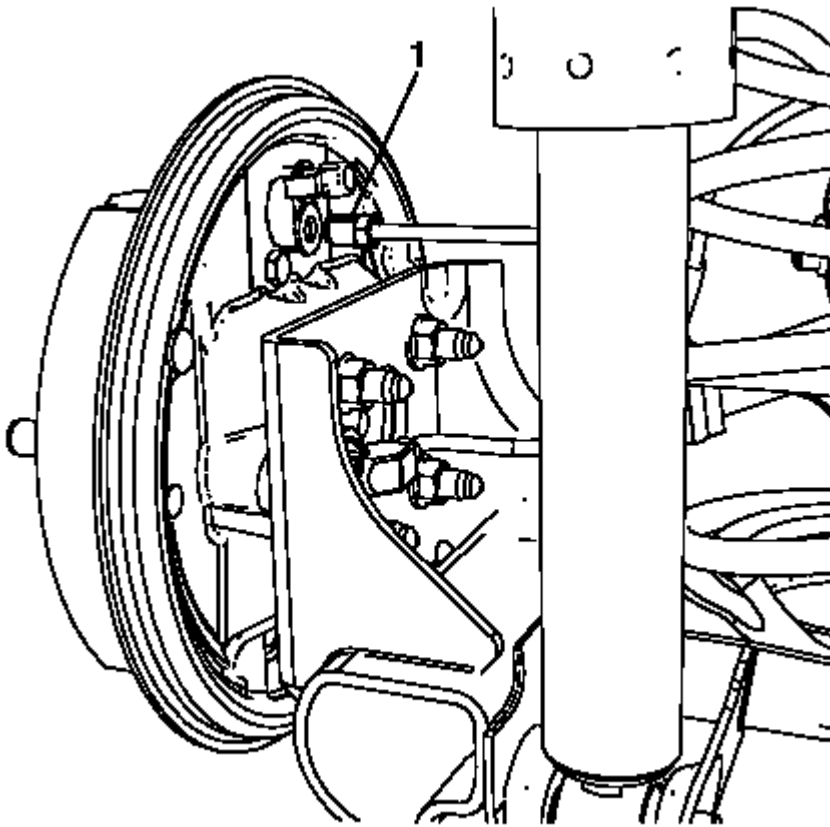


Fig. 55: Wheel Cylinder Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

4. Install the wheel cylinder brake pipe fitting (1) to the wheel cylinder and tighten to 18 N.m (13 lb ft).
5. Install the drum brake adjusting hardware. Refer to **Drum Brake Adjusting Hardware Replacement**.
6. Adjust the drum brakes. Refer to **Drum Brake Adjustment**.
7. Install the brake drum. Refer to **Brake Drum Replacement**.
8. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation**.
9. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** , **Hydraulic Brake System Bleeding (Pressure)** .
10. Lower the vehicle.

DRUM BRAKE ADJUSTMENT

Special Tools

CH-21177-A Drum to Brake Shoe Clearance Gauge

For equivalent regional tools, refer to **Special Tools**.

WARNING: Refer to **Brake Dust Warning** .

NOTE: Use **ONLY HAND TOOLS** when loosening or tightening the adjusting nut.

1. Ensure the park brake lever is in the fully released position.
2. Release the park brake lever boot from the floor console by applying light pressure inward on the sides of the boot retainer.

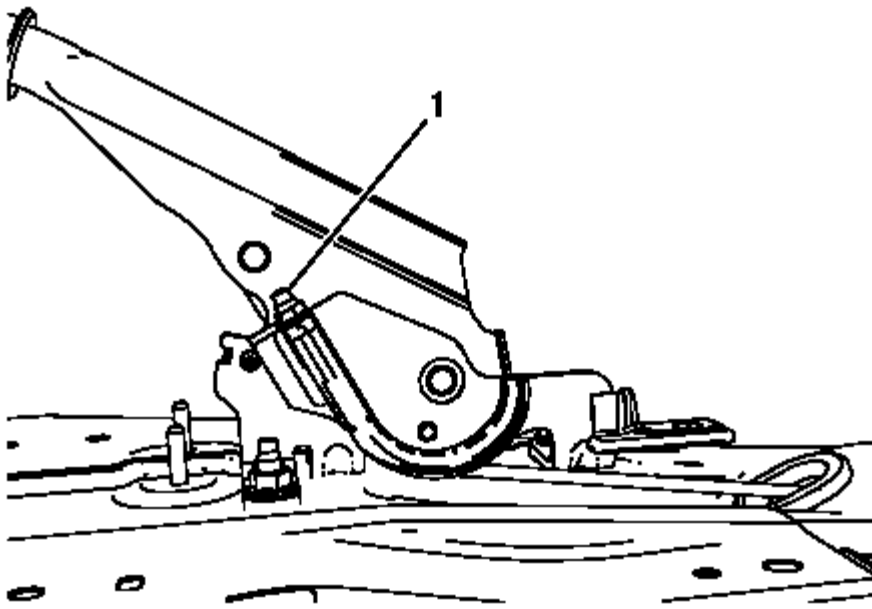


Fig. 56: Front Park Brake Cable Adjusting Nut
Courtesy of GENERAL MOTORS COMPANY

3. Pull the boot away from the console to expose the front park brake cable adjusting nut (1).
4. Release the tension from the park brake cable system at the front cable adjusting nut.

Using **ONLY HAND TOOLS**, loosen the adjusting nut (1) completely to the end of the front cable threaded rod.

5. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
6. Remove the rear tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** .
7. Remove the brake drums. Refer to **Brake Drum Replacement**.

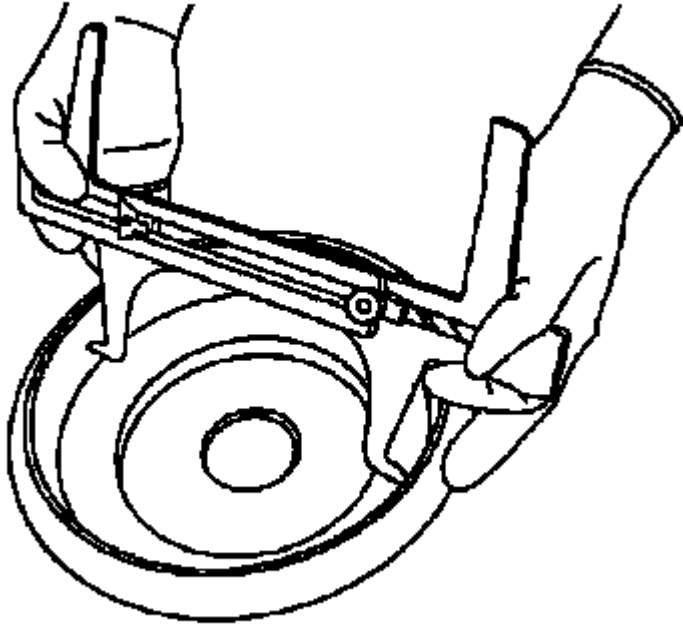


Fig. 57: Position CH-21177-A Gauge
Courtesy of GENERAL MOTORS COMPANY

8. Position the **CH-21177-A** gauge to the widest point of the brake drum inside diameter.
9. Firmly hand tighten the set screw on the **CH-21177-A** gauge.

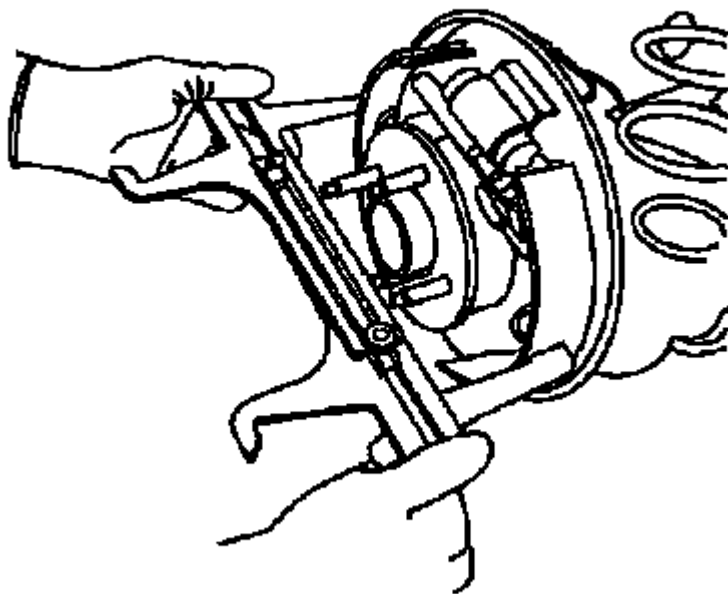


Fig. 58: Remove CH-21177-A Gauge
Courtesy of GENERAL MOTORS COMPANY

10. Remove the **CH-21177-A** gauge from the brake drum and position it over the corresponding brake shoe assembly at its widest point.
11. While holding the **CH-21177-A** gauge drum to brake shoe clearance gauge in position, insert a proper feeler gauge between one side of the **CH-21177-A** drum to brake shoe clearance gauge drum to brake shoe clearance gauge, and the corresponding brake shoe lining.
12. Rotate the brake shoe adjuster screw until the brake shoe linings contact the **CH-21177-A** gauge and the feeler gauge.

Specification

Brake shoe lining-to-drum clearance: 0.4-1.09 mm (0.016-0.043 in)

13. Repeat the above steps for the opposite brake drum and brake shoe assembly.
14. Install the brake drums. Refer to **Brake Drum Replacement**.
15. Adjust the park brake. Refer to **Parking Brake Adjustment**.
16. Install the rear tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation**.
17. Lower the vehicle.
18. Position the park brake lever boot to the floor console and press the boot retainer into place to secure.

DESCRIPTION AND OPERATION

DRUM BRAKE SYSTEM DESCRIPTION AND OPERATION

System Component Description

The drum brake system consists of the following:

Drum Brake Shoes

Applies mechanical output force, from hydraulic brake wheel cylinders, to friction surfaces of brake drums.

Brake Drums

Uses mechanical output force applied to friction surface from drum brake shoes to slow speed of tire and wheel assembly rotation.

Brake Drum Hardware

Secures drum brake shoes firmly in proper relationship to hydraulic brake wheel cylinders. Enables sliding motion of brake shoes needed to expand toward friction surface of drums when mechanical output force is applied. Provides return of brake shoes when mechanical output force is relieved.

Brake Drum Adjusting Hardware

Provides automatic adjustments of brake shoes to brake drum friction surface whenever brake apply occurs.

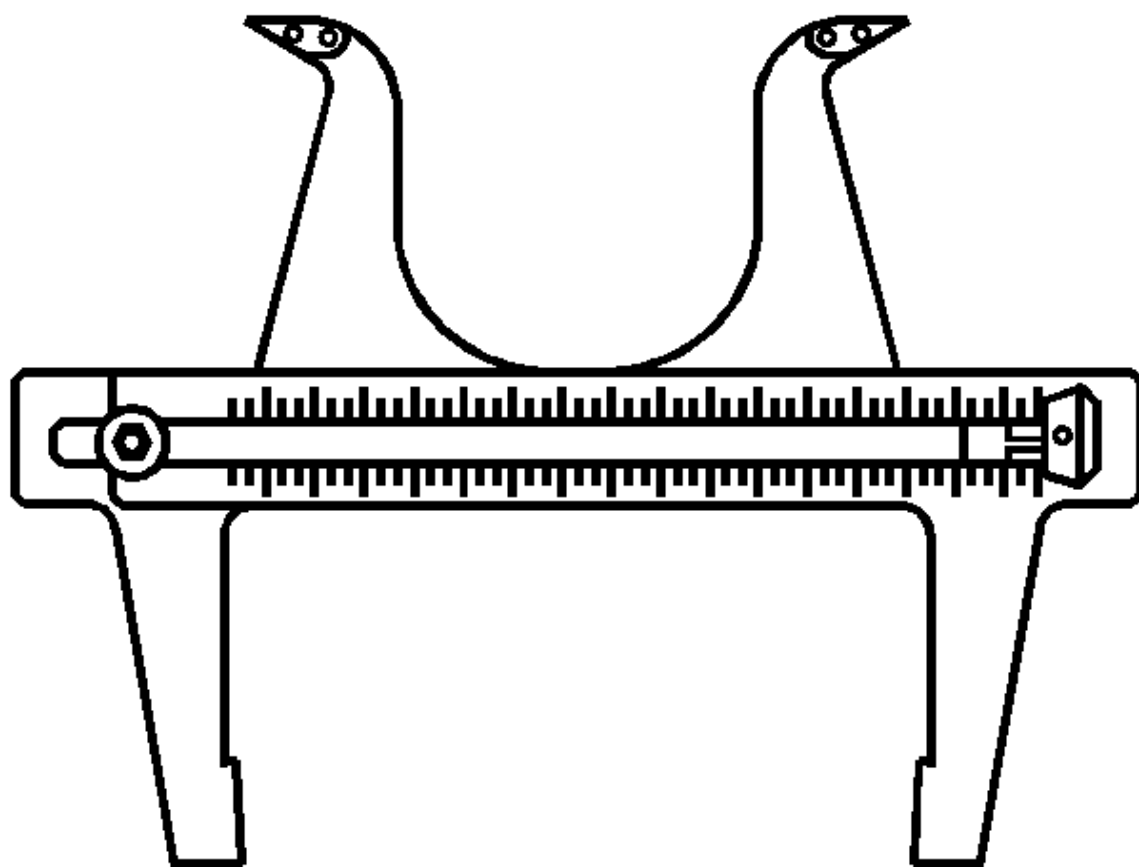
System Operation

Mechanical output force is applied from the hydraulic brake wheel cylinder pistons to the top of the drum brake shoes. The output force is then distributed between the primary and secondary brake shoes as the shoes expand toward the friction surface of the brake drums. The brake shoes apply the output force to the friction surface of the brake drums, which slows the rotation of the tire and wheel assemblies. The proper friction of both the drum brake hardware and adjusting hardware is essential to the proper distribution of braking force.

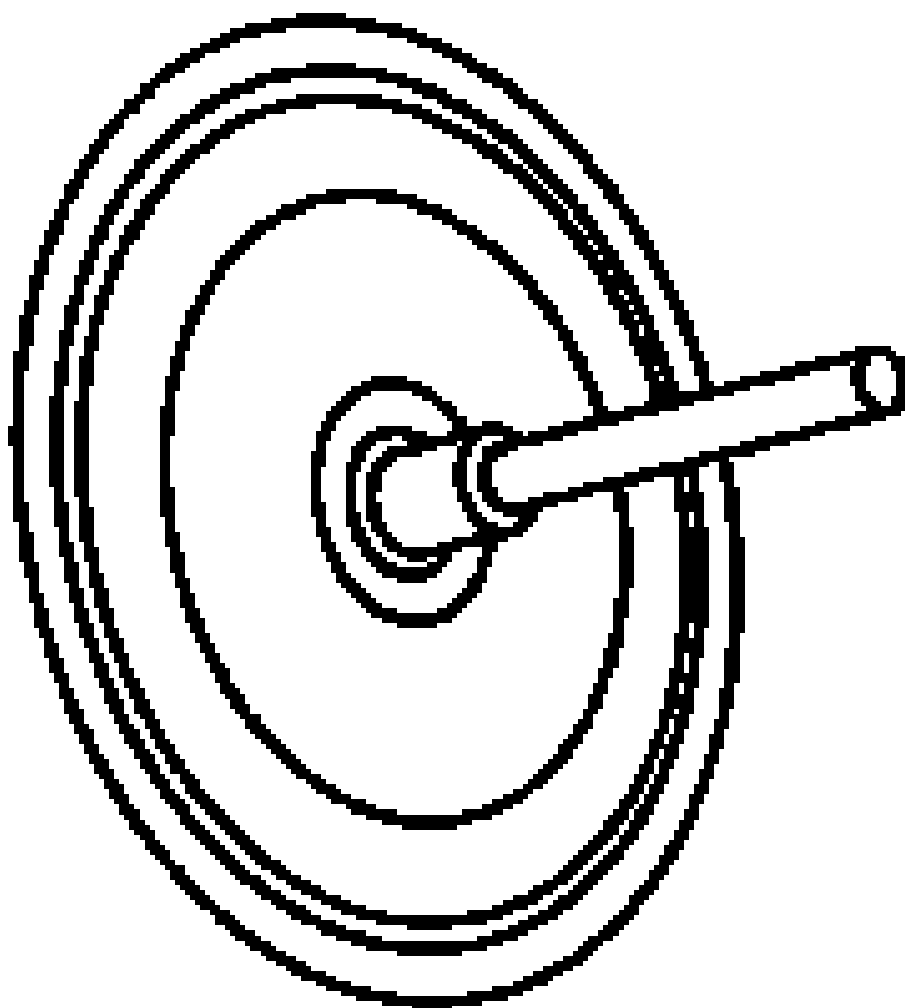
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

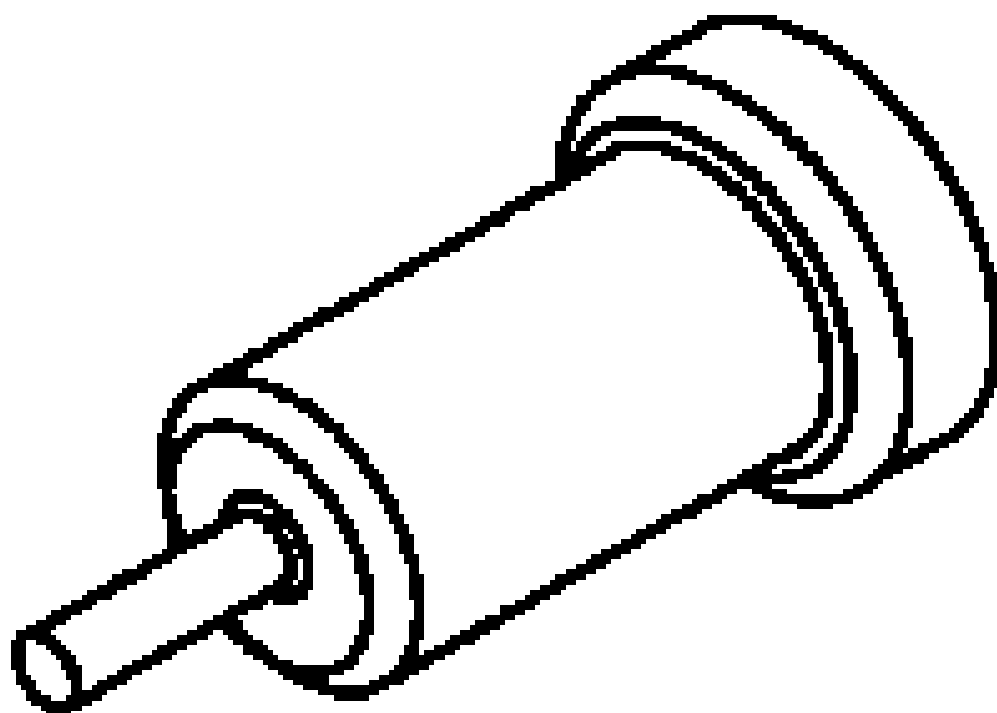
Illustration	Tool Number/Descrip



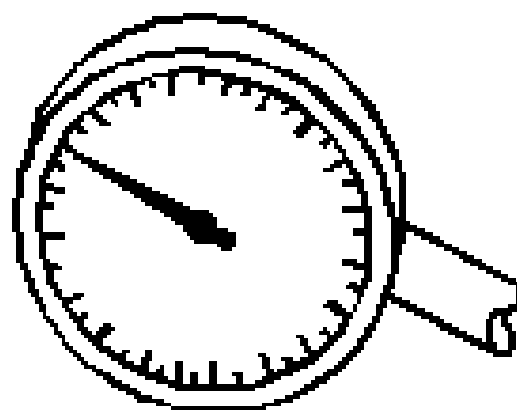
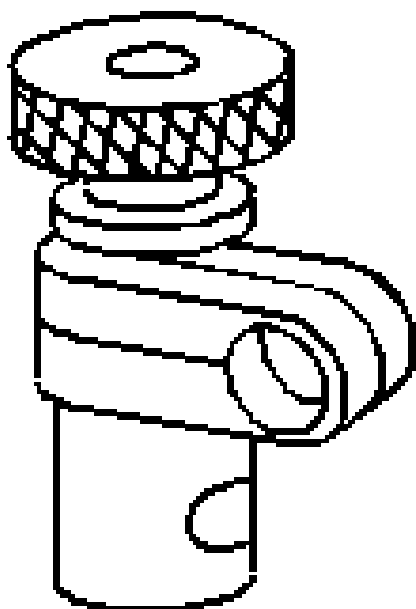
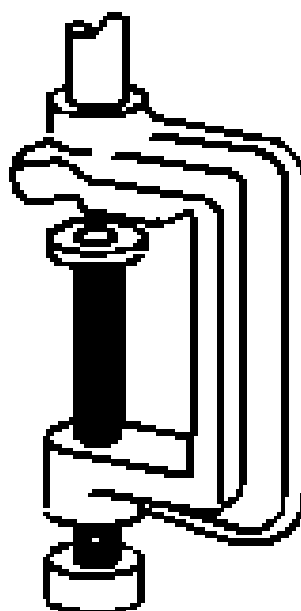
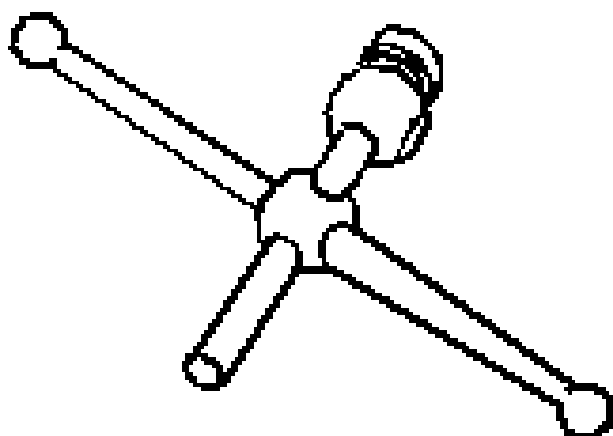
CH-21177
J-21177-A
Drum to Brake S.
Clearance Gauge



CH-41013
J-41013
Rotor Resurfaci
Kit



CH-42450-A
J-42450-A
Wheel Hub
Resurfacing Ki



CH-8001
J-8001
Dial Indicator S

DTC INDEX

Spark

ANTILOCK BRAKE SYSTEM - DIAGNOSTIC TROUBLE CODES

ANTILOCK BRAKE SYSTEM - DIAGNOSTIC TROUBLE CODES

DTC	Description
<u>DTC B2745</u>	Traction Control Switch
<u>DTC C0035, C0040, C0045, or C0050</u>	Wheel Speed Sensor
<u>DTC C0110</u>	Pump Motor
<u>DTC C0131</u>	Traction Control System Pressure
<u>DTC C0161</u>	Antilock Brake System Brake Switch
<u>DTC C0186, C0187, C0196, or C0287</u>	Lateral Acceleration Sensor/Multi-Axis Acceleration Sensor/Yaw Rate Signal/Longitudinal Acceleration Sensor
<u>DTC C0201</u>	Antilock Braking System Enable Relay
<u>DTC C0242 or P0856</u>	Powertrain Control Module Indicated Traction Control/Traction Control Torque Request
<u>DTC C0277</u>	Brake Pedal Position Sensor
<u>DTC C027C</u>	Front Brake Discs High Temperature
<u>DTC C0292</u>	Multi-Axis Acceleration Sensor Module
<u>DTC C0561</u>	System Disabled Information Stored
<u>DTC C056D</u>	Electronic Control Unit Hardware
<u>DTC C056E</u>	Electronic Control Unit Software
<u>DTC C0710</u>	Steering Wheel Angle Signal

AUTOMATIC TRANSMISSION - AISIN 80-40LE - DIAGNOSTIC TROUBLE CODES

AUTOMATIC TRANSMISSION - AISIN 80-40LE - DIAGNOSTIC TROUBLE CODES

DTC	Description
<u>DTC P0562 or P0563</u>	System Voltage
<u>DTC P057B-P057D</u>	Brake Pedal Position Sensor
<u>DTC P0601, P0602, P0604, or P062F</u>	Control Module Memory
<u>DTC P0705 or P0706</u>	Transmission Range (TR) Switch
<u>DTC P0711-P0713</u>	Transmission Fluid Temperature (TFT) Sensor
<u>DTC P0717, P07BF, or P07C0</u>	Input Speed Sensor
<u>DTC P0722, P077C, or P077D</u>	Output Speed Sensor
<u>DTC P0731</u>	1st Gear Ratio
<u>DTC P0741 or P0742</u>	Torque Converter Clutch (TCC)
<u>DTC P0746 or P0747</u>	Pressure Control Solenoid Valve 1

<u>DTC P0748, P0962, or P0963</u>	Pressure Control Solenoid Valve 1
<u>DTC P0751</u>	Shift Solenoid Valve 1
<u>DTC P0776 or P0777</u>	Pressure Control Solenoid Valve 2
<u>DTC P0778, P0966, or P0967</u>	Pressure Control Solenoid Valve 2
<u>DTC P0796 or P0797</u>	Pressure Control Solenoid Valve 3
<u>DTC P0798, P0970, or P0971</u>	Pressure Control Solenoid Valve 3
<u>DTC P0851 or P0852</u>	Park/Neutral Position Switch
<u>DTC P0973 or P0974</u>	Shift Solenoid Valve 1
<u>DTC P2534</u>	Ignition On/Start Switch
<u>DTC P2537</u>	Ignition Accessory Switch
<u>DTC P2761, P2763, or P2764</u>	Torque Converter Clutch (TCC) Pressure Control Solenoid

AUTOMATIC TRANSMISSION - JATCO CVT- DIAGNOSTIC TROUBLE CODES

AUTOMATIC TRANSMISSION - JATCO CVT- DIAGNOSTIC TROUBLE CODES

DTC	Description
<u>DTC P0603</u>	Control Module Long Term Memory
<u>DTC P0705, P0706 or P0851</u>	Transmission Range Switch/Park/Neutral Position Switch
<u>DTC P0711-P0713</u>	Transmission Fluid Temperature Senso
<u>DTC P0717</u>	Input Speed Sensor
<u>DTC P0721</u>	Output Speed Sensor
<u>DTC P0741</u>	Torque Converter Clutch
<u>DTC P0792</u>	Intermediate Shaft Speed Sensor
<u>DTC P0796 or P0797</u>	Pressure Control Solenoid Valve 3
<u>DTC P0841-P0843</u>	Transmission Fluid Pressure Switch
<u>DTC P0863</u>	Transmission Control Module
<u>DTC P0871</u>	Transmission Fluid Pressure Switch
<u>DTC P0885</u>	Transmission Control Module
<u>DTC P0961-P0963</u>	Line Pressure Control Solenoid
<u>DTC P0965-P0967</u>	Pressure Control Solenoid Valve 2
<u>DTC P0970 or P0971</u>	Pressure Control Solenoid Valve 3
<u>DTC P1790</u>	Transmission Control Module
<u>DTC P2714 or P2715</u>	Pressure Control Solenoid Valve 4
<u>DTC P2720 or P2721</u>	Pressure Control Solenoid 4
<u>DTC P2763 or P2764</u>	Torque Converter Clutch (TCC) Pressure Control Solenoid

BATTERY, CHARGING SYSTEM AND STARTING SYSTEM - DIAGNOSTIC

TROUBLE CODES

BATTERY, CHARGING SYSTEM AND STARTING SYSTEM - DIAGNOSTIC TROUBLE CODES

<u>DTC</u>	<u>Description</u>
<u>DTC B1325, B1330, B1517, C0800, P0560, P0562, or P0563</u>	System Voltage
<u>DTC B1516</u>	Battery Current Senso
<u>DTC B151A</u>	Battery Capacity Performance
<u>DTC B1527</u>	Parasitic Load
<u>DTC P0615, P0616, or P0617</u>	Starter Relay
<u>DTC P0621</u>	Generator L-Terminal
<u>DTC P0622</u>	Generator F-Terminal

BOLTED EXTERIOR BODY PANELS AND CLOSURES - DIAGNOSTIC TROUBLE CODES

BOLTED EXTERIOR BODY PANELS AND CLOSURES - DIAGNOSTIC TROUBLE CODES

<u>DTC</u>	<u>Description</u>
<u>DTC B3006</u>	Hood Ajar Circuit

CELLULAR SYSTEM, ENTERTAINMENT SYSTEM, AND NAVIGATION SYSTEM - DIAGNOSTIC TROUBLE CODES

CELLULAR SYSTEM, ENTERTAINMENT SYSTEM, AND NAVIGATION SYSTEM - DIAGNOSTIC TROUBLE CODES

<u>DTC</u>	<u>Description</u>
<u>DTC B1025, B1035, B1045, or B1055</u>	Audio Output
<u>DTC B125A</u>	Antenna Signal Circuit
<u>DTC B125B</u>	Antenna 2 Signal Circuit
<u>DTC B125C</u>	Satellite Antenna Circuit
<u>DTC B1271</u>	Theft Protection Active
<u>DTC B1446 or B1447</u>	Backup Power Source
<u>DTC B2455</u>	Cellular Phone Microphone
<u>DTC B2455</u>	Cellular Phone Microphone (Radio)
<u>DTC B2470</u>	Cellular Phone Antenna
<u>DTC B2476 or B2482</u>	Cellular Phone Select Service Switch
<u>DTC B2485</u>	Wireless Communication (BT) Antenna

CRUISE CONTROL SYSTEM - DIAGNOSTIC TROUBLE CODES

CRUISE CONTROL SYSTEM - DIAGNOSTIC TROUBLE CODES

<u>DTC</u>	<u>Description</u>
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<u>DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C</u>	Cruise Control Malfunction
<u>DTC P0572 or P0573</u>	Brake Switch
<u>DTC P0575</u>	Cruise Control Switch
<u>DTC P0703</u>	Brake Switch Signal Message Counter

DATA COMMUNICATION SYSTEM - DIAGNOSTIC TROUBLE CODES

DATA COMMUNICATION SYSTEM - DIAGNOSTIC TROUBLE CODES

DTC	Description
<u>DTC B1000</u>	Electronic Control Unit
<u>DTC B1001</u>	Option Configuration
<u>DTC B101D</u>	Electronic Control Unit Hardware
<u>DTC B101E</u>	Electronic Control Unit Software
<u>DTC C056D</u>	Electronic Control Unit Hardware
<u>DTC C056E</u>	Electronic Control Unit Software
<u>DTC P0601-P0606, P060A, P062F, or P262B</u>	Control Module Memory
<u>DTC U0001</u>	High Speed CAN Communication Bus
<u>DTC U0020</u>	Low Speed CAN Bus
<u>DTC U0073 or U2100</u>	Control Module Communication Bus A/CAN Bus
<u>DTC U0074</u>	Control Module Communication Bus B
<u>DTC U0078</u>	Control Module Communication Low Speed CAN Bus
<u>DTC U0100-U02FF</u>	Module Error
<u>DTC U0300-U0336</u>	Module Error
<u>DTC U0400-U05FF</u>	Module Error
<u>DTC U1500-U15FF</u>	Module Error
<u>DTC U1814</u>	Powertrain Wake-Up Communication
<u>DTC U18B9-U18BF</u>	High Speed CAN Bus Subnet Configuration List
<u>DTC U2099</u>	High Speed Communication Enable
<u>DTC U2101</u>	CAN Bus Maximum List of Control Modules

ENGINE CONTROLS/FUEL - 1.2L - DIAGNOSTIC TROUBLE CODES

ENGINE CONTROLS/FUEL - 1.2L - DIAGNOSTIC TROUBLE CODES

DTC	Description
<u>DTC P0010, P0013, or P2088-P2091</u>	DTC P0010 Intake Camshaft Position Actuator Solenoid Valve Control Circuit
	DTC P0013 Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit
	DTC P2088 Intake Camshaft Position Actuator Solenoid Control Circuit Low Voltage

	DTC P2089 Intake Camshaft Position Actuator Solenoid Control Circuit High Voltage DTC P2090 Exhaust Camshaft Position Actuator Solenoid Control Circuit Low Voltage DTC P2091 Exhaust Camshaft Position Actuator Solenoid Control Circuit High Voltage
<u>DTC P0011 or P0014</u>	DTC P0011 Intake Camshaft Position System Performance DTC P0014 Exhaust Camshaft Position System Performance
<u>DTC P0016 or P0017</u>	DTC P0016 Crankshaft Position - Intake Camshaft Position Not Plausible DTC P0017 Crankshaft Position - Exhaust Camshaft Position Not Plausible
<u>DTC P0030-P0032, P0036-P0038, P0053, P0054, P0135, or P0141</u>	DTC P0030 HO2S Heater Control Circuit Sensor 1 DTC P0031 HO2S Heater Control Circuit Low Voltage Sensor 1 DTC P0032 HO2S Heater Control Circuit High Voltage Sensor 1 DTC P0036 HO2S Heater Control Circuit Sensor 2 DTC P0037 HO2S Heater Control Circuit Low Voltage Sensor 2 DTC P0038 HO2S Heater Control Circuit High Voltage Sensor 2 DTC P0053 HO2S Heater Resistance Sensor 1 DTC P0054 HO2S Heater Resistance Sensor 2 DTC P0135 HO2S Heater Performance Sensor 1 DTC P0141 HO2S Heater Performance Sensor 2
<u>DTC P0068 or P1101</u>	DTC P0068 Throttle Body Air Flow Performance DTC P1101 Intake Air Flow System Performance
<u>DTC P0101</u>	DTC P0101 Mass Air Flow (MAF) Sensor Performance
<u>DTC P0102 or P0103</u>	DTC P0102 Mass Air Flow (MAF) Sensor Circuit Low Frequency DTC P0103 Mass Air Flow (MAF) Sensor Circuit High Frequency
<u>DTC P0106</u>	DTC P0106 Manifold Absolute Pressure (MAP) Sensor Performance
<u>DTC P0107 or P0108</u>	DTC P0107 Manifold Absolute Pressure (MAP) Sensor Circuit Low Voltage DTC P0108 Manifold Absolute Pressure (MAP) Sensor Circuit High Voltage
<u>DTC P0111-P0114</u>	DTC P0111 Intake Air Temperature (IAT) Sensor Performance DTC P0112 Intake Air Temperature (IAT) Sensor Circuit Low Voltage DTC P0113 Intake Air Temperature (IAT) Sensor Circuit High Voltage DTC P0114 Intake Air Temperature (IAT) Sensor Circuit Intermittent
<u>DTC P0117, P0118, or P0119</u>	DTC P0117 Engine Coolant Temperature (ECT) Sensor Circuit Low Voltage DTC P0118 Engine Coolant Temperature (ECT) Sensor Circuit High Voltage DTC P0119 Engine Coolant Temperature (ECT) Sensor Circuit Intermittent
<u>DTC P0121-P0123, P0222, P0223, or P2135</u>	DTC P0121 Throttle Position Sensor 1 Performance DTC P0122 Throttle Position Sensor 1 Circuit Low Voltage DTC P0123 Throttle Position Sensor 1 Circuit High Voltage DTC P0222 Throttle Position Sensor 2 Circuit Low Voltage DTC P0223 Throttle Position Sensor 2 Circuit High Voltage DTC P2135 Throttle Position Sensor 1-2 Not Plausible
<u>DTC P0128</u>	DTC P0128 Engine Coolant Temperature (ECT) Below Thermostat

	Regulating Temperature
<u>DTC P0131, P0132, P0134, P0137, P0138, P0140, or P2A00</u>	DTC P0131 HO2S Circuit Low Voltage Sensor 1 DTC P0132 HO2S Circuit High Voltage Sensor 1 DTC P0134 HO2S Circuit Insufficient Activity Sensor 1 DTC P0137 HO2S Circuit Low Voltage Sensor 2 DTC P0138 HO2S Circuit High Voltage Sensor 2 DTC P0140 HO2S Circuit Insufficient Activity Sensor 2 DTC P2A00 HO2S Performance Sensor 1
<u>DTC P0133, P013A, P013B, P013E, P013F, P015A, P015B, P2270, or P2271</u>	DTC P0133 HO2S Slow Response Sensor 1 DTC P013A HO2S Slow Response Rich to Lean Sensor 2 DTC P013B HO2S Slow Response Lean to Rich Sensor 2 DTC P013E HO2S Delayed Response Rich to Lean Sensor 2 DTC P013F HO2S Delayed Response Lean to Rich Sensor 2 DTC P015A HO2S Delayed Response Rich to Lean Sensor 1 DTC P015B HO2S Delayed Response Lean to Rich Sensor 1 DTC P2270 HO2S Signal Stuck Lean Sensor 2 DTC P2271 HO2S Signal Stuck Rich Sensor 2
<u>DTC P0171 or P0172 (LL0)</u>	DTC P0171 Fuel Trim System Lean DTC P0172 Fuel Trim System Rich
<u>DTC P0201, P0202, P0203, P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, or P0271</u>	DTC P0201 Cylinder 1 Injector Control Circuit DTC P0202 Cylinder 2 Injector Control Circuit DTC P0203 Cylinder 3 Injector Control Circuit DTC P0204 Cylinder 4 Injector Control Circuit DTC P0261 Cylinder 1 Injector Control Circuit Low Voltage DTC P0262 Cylinder 1 Injector Control Circuit High Voltage DTC P0264 Cylinder 2 Injector Control Circuit Low Voltage DTC P0265 Cylinder 2 Injector Control Circuit High Voltage DTC P0267 Cylinder 3 Injector Control Circuit Low Voltage DTC P0268 Cylinder 3 Injector Control Circuit High Voltage DTC P0270 Cylinder 4 Injector Control Circuit Low Voltage DTC P0271 Cylinder 4 Injector Control Circuit High Voltage
<u>DTC P0300-P0304</u>	DTC P0300 Engine Misfire Detected DTC P0301 Cylinder 1 Misfire Detected DTC P0302 Cylinder 2 Misfire Detected DTC P0303 Cylinder 3 Misfire Detected DTC P0304 Cylinder 4 Misfire Detected
<u>DTC P0315</u>	
<u>DTC P0324, P0326, or P06B6</u>	DTC P0324 Knock Sensor Module Performance DTC P0326 Knock Sensor Performance DTC P06B6 Control Module Knock Sensor Processor Performance
<u>DTC P0325, P0327, or P0328</u>	DTC P0325 Knock Sensor Circuit DTC P0327 Knock Sensor Circuit Low Voltage DTC P0328 Knock Sensor Circuit High Voltage
<u>DTC P0335 or P0336</u>	DTC P0335 Crankshaft Position Sensor Circuit DTC P0336 Crankshaft Position Sensor Performance
<u>DTC P0340, P0341,</u>	DTC P0340 Intake Camshaft Position Sensor Circuit

<u>P0365, or P0366</u>	DTC P0341 Intake Camshaft Position Sensor Performance DTC P0365 Exhaust Camshaft Position Sensor Circuit DTC P0366 Exhaust Camshaft Position Sensor Performance
<u>DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310</u>	DTC P0351 Ignition Coil 1 Control Circuit DTC P0352 Ignition Coil 2 Control Circuit DTC P0353 Ignition Coil 3 Control Circuit DTC P0354 Ignition Coil 4 Control Circuit DTC P2300 Ignition Coil 1 Control Circuit Low Voltage DTC P2301 Ignition Coil 1 Control Circuit High Voltage DTC P2303 Ignition Coil 2 Control Circuit Low Voltage DTC P2304 Ignition Coil 2 Control Circuit High Voltage DTC P2306 Ignition Coil 3 Control Circuit Low Voltage DTC P2307 Ignition Coil 3 Control Circuit High Voltage DTC P2309 Ignition Coil 4 Control Circuit Low Voltage DTC P2310 Ignition Coil 4 Control Circuit High Voltage
<u>DTC P0420 (LLO)</u>	DTC P0420 Catalyst System Low Efficiency
<u>DTC P0442</u>	DTC P0442 Evaporative Emission (EVAP) System Small Leak Detected
<u>DTC P0443, P0458, or P0459</u>	DTC P0443 Evaporative Emission (EVAP) Purge Solenoid Valve Control Circuit DTC P0458 Evaporative Emission (EVAP) Purge Solenoid Valve Control Circuit Low Voltage DTC P0459 Evaporative Emission (EVAP) Purge Solenoid Valve Control Circuit High Voltage
<u>DTC P0446</u>	DTC P0446 Evaporative Emission (EVAP) Vent System Performance
<u>DTC P0449, P0498, or P0499</u>	DTC P0449 Evaporative Emission (EVAP) Vent Solenoid Valve Control Circuit DTC P0498 Evaporative Emission (EVAP) Vent Solenoid Valve Control Circuit Low Voltage DTC P0499 Evaporative Emission (EVAP) Vent Solenoid Valve Control Circuit High Voltage
<u>DTC P0451-P0454</u>	DTC P0451 Fuel Tank Pressure Sensor Performance DTC P0452 Fuel Tank Pressure Sensor Circuit Low Voltage DTC P0453 Fuel Tank Pressure Sensor Circuit High Voltage DTC P0454 Fuel Tank Pressure Sensor Circuit Intermittent
<u>DTC P0455</u>	DTC P0455 Evaporative Emission (EVAP) System Large Leak Detected
<u>DTC P0496</u>	DTC P0496 Evaporative Emission (EVAP) System Flow During Non-Purge
<u>DTC P0506 or P0507</u>	DTC P0506 Idle Speed Low DTC P0507 Idle Speed High
<u>DTC P057B-P057D</u>	DTC P057B Brake Pedal Position Sensor Performance DTC P057C Brake Pedal Position Sensor Circuit Low Voltage DTC P057D Brake Pedal Position Sensor Circuit High Voltage
<u>DTC P05CC or P05CE</u>	DTC P05CC Cold Start Intake Camshaft Position System Performance DTC P05CE Cold Start Exhaust Camshaft Position System Performance
<u>DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P2610 (ECM,</u>	DTC P0601 Control Module Read Only Memory Performance DTC P0602 Control Module Not Programmed DTC P0603 Control Module Long Term Memory Reset

<u>E83)</u>	DTC P0604 Control Module Random Access Memory Performance DTC P0606 Control Module Processor Performance DTC P062F Control Module Long Term Memory Performance DTC P0630 VIN Not Programmed or Mismatched - Engine Control Module (ECM) DTC P16F3 Control Module Redundant Memory Performance DTC P2610 Control Module Ignition Off Timer Performance
<u>DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B (ECM, E78)</u>	DTC P0601 Control Module Read Only Memory Performance DTC P0602 Control Module Not Programmed DTC P0603 Control Module Long Term Memory Reset DTC P0604 Control Module Random Access Memory Performance DTC P0606 Control Module Processor Performance DTC P062F Control Module Long Term Memory Performance DTC P0630 VIN Not Programmed or Mismatched - Engine Control Module (ECM) DTC P16F3 Control Module Redundant Memory Performance DTC P262B Control Module Power Off Timer Performance
<u>DTC P0627-P0629</u>	DTC P0627 Fuel Pump Relay Control Circuit Open DTC P0628 Fuel Pump Relay Control Circuit Low Voltage DTC P0629 Fuel Pump Relay Control Circuit High Voltage
<u>DTC P0628</u>	DTC P0628 Fuel Pump Relay Control Circuit Low Voltage
<u>DTC P0641, P0651, P0697, or P06A3</u>	DTC P0641 5V Reference 1 Circuit DTC P0651 5V Reference 2 Circuit DTC P0697 5V Reference 3 Circuit DTC P06A3 5V Reference 4 Circuit
<u>DTC P0650, P263A, or P263B (LFM, LL0 with 3 Face Mounted Connectors)</u>	DTC P0650 Malfunction Indicator Lamp (MIL) Control Circuit Open DTC P263A Malfunction Indicator Lamp (MIL) Control Circuit Low Voltage DTC P263B Malfunction Indicator Lamp (MIL) Control Circuit High Voltage
<u>DTC P0650, P263A, or P263B (LL0 with 2 Face Mounted ECM Connectors)</u>	DTC P0650 Malfunction Indicator Lamp (MIL) Control Circuit Open DTC P263A Malfunction Indicator Lamp (MIL) Control Circuit Low Voltage DTC P263B Malfunction Indicator Lamp (MIL) Control Circuit High Voltage
<u>DTC P1400</u>	DTC P1400 Cold Start Emission Reduction Control System
<u>DTC P0685-P0687, P0689, P0690, or P1682 (E78)</u>	DTC P0685 Engine Controls Ignition Relay Control Circuit DTC P0686 Engine Controls Ignition Relay Control Circuit Low Voltage DTC P0687 Engine Controls Ignition Relay Control Circuit High Voltage DTCP0689 Engine Controls Ignition Relay Feedback Circuit Low Voltage DTC P0690 Engine Controls Ignition Relay Feedback Circuit High Voltage DTC P1682 Ignition 1 Switch Circuit 2
<u>DTC P0685-P0687, P0689, P0690, or P1682 (E83)</u>	DTC P0687 Engine Controls Ignition Relay Control Circuit High Voltage DTCP0689 Engine Controls Ignition Relay Feedback Circuit Low Voltage DTC P0690 Engine Controls Ignition Relay Feedback Circuit High Voltage DTC P1682 Ignition 1 Switch Circuit 2

<u>DTC P0700 (LFM, LL0)</u>	DTC P0700 Transmission Control Module Requested MIL Illumination
<u>DTC P111E</u>	DTC P111E Engine Coolant Temperature Sensor Not Plausible
<u>DTC P150C (LL0)</u>	DTC P150C Transmission Control Module Engine Speed Request Signal Message Counter Incorrect
<u>DTC P1516, P2101, P2119, or P2176</u>	DTC P1516 Throttle Actuator Control (TAC) Module Throttle Actuator Position Performance DTC P2101 Throttle Actuator Position Performance DTC P2119 Throttle Closed Position Performance DTC P2176 Minimum Throttle Position Not Learned
<u>DTC P2096 or P2097</u>	DTC P2096 Post Catalyst Fuel Trim System Low Limit Bank 1 DTC P2097 Post Catalyst Fuel Trim System High Limit Bank 1
<u>DTC P2122, P2123, P2127, P2128, or P2138</u>	DTC P2122 Accelerator Pedal Position (APP) Sensor 1 Circuit Low Voltage DTC P2123 Accelerator Pedal Position (APP) Sensor 1 Circuit High Voltage DTC P2127 Accelerator Pedal Position (APP) Sensor 2 Circuit Low Voltage DTC P2128 Accelerator Pedal Position (APP) Sensor 2 Circuit High Voltage DTC P2138 Accelerator Pedal Position (APP) Sensors 1-2 Not Plausible
<u>DTC P219A</u>	DTC P219A Fuel Trim Cylinder Balance
<u>DTC P2544 (LL0)</u>	DTC P2544 Transmission Torque Request Signal Message Counter Incorrect

ENGINE COOLING SYSTEM - DIAGNOSTIC TROUBLE CODES

ENGINE COOLING SYSTEM - DIAGNOSTIC TROUBLE CODES

DTC	Description
<u>DTC P00B3 or P00B4</u>	Radiator Coolant Temperature (RCT) Sensor
<u>DTC P00B7</u>	Radiator Coolant Temperature (RCT) Insufficient Flow
<u>DTC P0480, P0481, P0691, P0692, P0693 or P0694</u>	Cooling Fan Relay
<u>DTC P0597-P0599</u>	Engine Coolant Thermostat Heater
<u>DTC P112F</u>	Radiator Coolant Temperature Sensor
<u>DTC P2181</u>	Engine Cooling System Performance

FIXED AND MOVEABLE WINDOWS - DIAGNOSTIC TROUBLE CODES

FIXED AND MOVEABLE WINDOWS - DIAGNOSTIC TROUBLE CODES

DTC	Description
<u>DTC B0283</u>	Rear Defrost Circuit
<u>DTC B0969</u>	Rear Defog Indicator

HORN SYSTEM - DIAGNOSTIC TROUBLE CODES

HORN SYSTEM - DIAGNOSTIC TROUBLE CODES

DTC	Description
<u>DTC B2750</u>	Horn Relay

HVAC SYSTEM - MANUAL - DIAGNOSTIC TROUBLE CODES

HVAC SYSTEM - MANUAL - DIAGNOSTIC TROUBLE CODES

DTC	Description
<u>DTC B3933</u>	Evaporator Temperature Sensor
<u>DTC B393D</u>	Air Conditioning Indicator Circuit
<u>DTC P0532 or P0533</u>	Air Conditioning (A/C) Refrigerant Pressure Sensor
<u>DTC P0645, P0646, or P0647</u>	Air Conditioning (A/C) Compressor Clutch Relay

HYDRAULIC BRAKE SYSTEM - DIAGNOSTIC TROUBLE CODES

HYDRAULIC BRAKE SYSTEM - DIAGNOSTIC TROUBLE CODES

DTC	Description
<u>DTC C0267</u>	Low Brake Fluid

IMMOBILIZER SYSTEM - DIAGNOSTIC TROUBLE CODES

IMMOBILIZER SYSTEM - DIAGNOSTIC TROUBLE CODES

DTC	Description
<u>DTC B2955</u>	Security Sensor
<u>DTC B302A</u>	Mobile Telephone Communications Interface
<u>DTC B3031</u>	Security Controller In Learn Mode
<u>DTC B3055</u>	No Transponder Modulation
<u>DTC B305C</u>	Immobilizer Transponder of Wrong Type Programmed
<u>DTC B3060</u>	Unprogrammed Transponder Identification Code Received
<u>DTC B389A</u>	Environment Identification
<u>DTC B3902</u>	Incorrect Immobilizer Identifier Received
<u>DTC B3935</u>	Transponder Authentication
<u>DTC B3976</u>	Unconfigured Transponder
<u>DTC B3984</u>	Device 1 Environment Identification
<u>DTC P0513</u>	Immobilizer Key Incorrect
<u>DTC P0633</u>	Immobilizer Key Not Programmed
<u>DTC P162B</u>	Remote Vehicle Speed Limiting Signal Message Counter
<u>DTC P1631</u>	Immobilizer Fuel Enable Signal
<u>DTC P1649</u>	Immobilizer Security Code Not Programmed

INSTRUMENT PANEL SYSTEM DISPLAYS AND GAUGES - DIAGNOSTIC TROUBLE CODES

INSTRUMENT PANEL SYSTEM DISPLAYS AND GAUGES - DIAGNOSTIC TROUBLE CODES

DTC	Description
<u>DTC B0158</u>	Outside Air Temperature Display Malfunction
<u>DTC B0550</u>	Odometer Circuit General Memory
<u>DTC B1370</u>	Control Module Ignition On and Start Circuit
<u>DTC P0461-P0464</u>	Fuel Gauge Malfunction
<u>DTC P0520</u>	Engine Oil Pressure Switch
<u>DTC P0521</u>	Engine Oil Pressure Sensor

KEYLESS ENTRY SYSTEM AND REMOTE FUNCTIONS - DIAGNOSTIC TROUBLE CODES

KEYLESS ENTRY SYSTEM AND REMOTE FUNCTIONS - DIAGNOSTIC TROUBLE CODES

DTC	Description
<u>DTC B3101</u>	Keyless Entry Data Link
<u>DTC B3105</u>	Keyless Entry Transmitters
<u>DTC B3106</u>	Keyless Entry Data Link
<u>DTC B3109-B3113</u>	Keyless Entry Transmitter 1-5 Battery
<u>DTC B310D-B310F</u>	Keyless Entry Transmitter 6-8 Battery

LIGHTING SYSTEM - DIAGNOSTIC TROUBLE CODES

LIGHTING SYSTEM - DIAGNOSTIC TROUBLE CODES

DTC	Description
<u>DTC B1395</u>	Control Module Voltage Reference
<u>DTC B1480</u>	Battery Rundown Protection Circuit
<u>DTC B2530</u>	Front Fog Lamps Control Circuit
<u>DTC B2545</u>	Backup Lamps Circuit
<u>DTC B2570</u>	Trunk Lamp Control Circuit
<u>DTC B2575 or B2699</u>	Headlamps Control Circuit
<u>DTC B257A</u>	Headlamp Switch Input Signals
<u>DTC B2580</u>	Headlamp High Beam Control Circuit
<u>DTC B2585 or B3867</u>	Park Lamps Control Circuit
<u>DTC B2610</u>	Passenger Compartment Dimming 1
<u>DTC B2615</u>	Passenger Compartment Dimming
<u>DTC B2625</u>	Display Dimming Pulse Width Modulation
<u>DTC B2652</u>	Passenger Compartment Dimming 3
<u>DTC B3596</u>	Hazard Lamps Request

<u>DTC B3600</u>	Passenger Compartment Dimming Request Signal
<u>DTC B3650</u>	High Beam Request Signal
<u>DTC B3806</u>	High Beam and Headlamp Flash Select
<u>DTC B3881 or B3882</u>	Tail Lamp Circuit
<u>DTC B3883</u>	License Plate Lamp Circuit
<u>DTC B3884</u>	Center High Mounted Brake Lamp
<u>DTC B3948 or B3949</u>	Front Turn Signal Circuit
<u>DTC B3950 or B3951</u>	Rear Turn Signal Circuit
<u>DTC C0277 or C0890</u>	Brake Pedal Position Sensor
<u>DTC C0297</u>	Brake Applied Output Circuit

MANUAL TRANSMISSION - Y4A/Y4M - DIAGNOSTIC TROUBLE CODES

MANUAL TRANSMISSION - Y4A/Y4M - DIAGNOSTIC TROUBLE CODES

<u>DTC</u>	<u>Description</u>
<u>DTC P0501</u>	Vehicle Speed Sensor
<u>DTC P0502 or P0503</u>	Vehicle Speed Sensor
<u>DTC P0502 or P0503</u>	Vehicle Speed Sensor (LL0 Engine)
<u>DTC P0806-P0808</u>	Clutch Pedal Position (CPP) Sensor (LL0 Engine)
<u>DTC P0806-P0808</u>	Clutch Pedal Position (CPP) Sensor (LMT)
<u>DTC P080A</u>	Clutch Pedal Position (CPP) Sensor
<u>DTC P0812</u>	Reverse Position Switch
<u>DTC P0812</u>	Reverse Position Switch (LL0 Engine)

POWER DOOR LOCK SYSTEM AND RELEASE SYSTEMS - DIAGNOSTIC TROUBLE CODES

POWER DOOR LOCK SYSTEM AND RELEASE SYSTEMS - DIAGNOSTIC TROUBLE CODES

<u>DTC</u>	<u>Description</u>
<u>DTC B3125, B3130 or B3135</u>	Driver Door Only Unlock/All Doors Lock And Unlock (With AU3)
<u>DTC B3125, B3130 or B3135</u>	Driver Door Only Unlock/All Doors Lock And Unlock (Without AU3)
<u>DTC B3140 or B3150</u>	Driver Door Lock/Unlock Switch (With AU3)
<u>DTC B3140 or B3150</u>	Driver Door Lock/Unlock Switch (Without AU3)

POWER STEERING SYSTEM - DIAGNOSTIC TROUBLE CODES

POWER STEERING SYSTEM - DIAGNOSTIC TROUBLE CODES

<u>DTC</u>	<u>Description</u>
<u>DTC C0176</u>	Control Module Temperature Sensor
<u>DTC C0460</u>	Steering Wheel Angle Sensor

DTC C0475

Electric Steering Motor

SEAT BELT SYSTEM - DIAGNOSTIC TROUBLE CODES**SEAT BELT SYSTEM - DIAGNOSTIC TROUBLE CODES**

DTC	Description
<u>DTC B0072 or B0073</u>	Seat Belt Switch
<u>DTC B0082</u>	Seat Belt Reminder Sensor

**SECONDARY AND CONFIGURABLE CUSTOMER CONTROL SYSTEM -
DIAGNOSTIC TROUBLE CODES****SECONDARY AND CONFIGURABLE CUSTOMER CONTROL SYSTEM - DIAGNOSTIC
TROUBLE CODES**

DTC	Description
<u>DTC B1405</u>	Control Module Voltage Reference 2
<u>DTC B1529</u>	Control Module Voltage Reference Output 5
<u>DTC B3622</u>	Steering Wheel Controls

SHIFT LOCK CONTROL SYSTEM - DIAGNOSTIC TROUBLE CODES**SHIFT LOCK CONTROL SYSTEM - DIAGNOSTIC TROUBLE CODES**

DTC	Description
<u>DTC B270A</u>	Park Lock Solenoid Actuator

**SUPPLEMENTAL INFLATABLE RESTRAINT SYSTEM - DIAGNOSTIC
TROUBLE CODES****SUPPLEMENTAL INFLATABLE RESTRAINT SYSTEM - DIAGNOSTIC TROUBLE CODES**

DTC	Description
<u>DTC B0012 or B0013</u>	Driver Steering Wheel Air Bag Deployment Loop
<u>DTC B0014, B0021, B0031, or B0038</u>	Seat Side Air Bag Deployment Loop
<u>DTC B0015, B001A, B001B, or B0022</u>	Seat Belt Retractor Pretensioner Deployment Loop/Seat Belt Anchor Pretensioner Deployment Loop
<u>DTC B0016, B0018, B0023, or B0025</u>	Roof Rail Air Bag Deployment Loop
<u>DTC B0017 or B0024</u>	Knee Air Bag Deployment Loop
<u>DTC B0019 or B0020</u>	Passenger Instrument Panel Air Bag Deployment Loop
<u>DTC B0052</u>	Deployment Commanded
<u>DTC B0071</u>	Passenger Seat Belt Tension Sensor
<u>DTC B0074</u>	Passenger Presence Sensor

<u>DTC B0081</u>	Passenger Presence Module (Inflatable Restraint Sensing and Diagnostic Module)
<u>DTC B0081</u>	Passenger Presence Module (Passenger Presence System)
<u>DTC B0083-B0088</u>	Front/Side Impact Sensor
<u>DTC B0091</u>	Front Impact Sensor
<u>DTC B1001</u>	Option Configuration
<u>DTC B1019</u>	System Configuration Error

TIRE PRESSURE MONITORING SYSTEM - DIAGNOSTIC TROUBLE CODES

TIRE PRESSURE MONITORING SYSTEM - DIAGNOSTIC TROUBLE CODES

<u>DTC</u>	<u>Description</u>
<u>DTC C0569</u>	System Configuration Malfunction
<u>DTC C0750, C0755, C0760, or C0765</u>	Tire Pressure Sensor
<u>DTC C0775</u>	Tire Pressure Monitoring System Sensors

WIPER SYSTEM AND WASHER SYSTEM - DIAGNOSTIC TROUBLE CODES

WIPER SYSTEM AND WASHER SYSTEM - DIAGNOSTIC TROUBLE CODES

<u>DTC</u>	<u>Description</u>
<u>DTC B370B</u>	Rear Wiper Function Control
<u>DTC B3715 or B3875</u>	Windshield Wiper Relay
<u>DTC B3811</u>	Rear Washer Relay
<u>DTC B3873</u>	Front Washer Relay

WIRING SYSTEMS AND POWER MANAGEMENT - DIAGNOSTIC TROUBLE CODES

WIRING SYSTEMS AND POWER MANAGEMENT - DIAGNOSTIC TROUBLE CODES

<u>DTC</u>	<u>Description</u>
<u>DTC B1370 (Instrument Cluster)</u>	DTC B1370 Control Module Ignition On and Start Circuit
<u>DTC B1370-B1379, B1380-B1389, or B1440-B1443 (Body Control Module)</u>	DTC B1370 Control Module Ignition ON and Start Circuit DTC B1380 Control Module Ignition Accessory Circuit DTC B1441 Control Module Ignition OFF, Run, and Start Circuit
<u>DTC B1445</u>	DTC B1445 02 Control Module Voltage Output Circuit Short to Ground
<u>DTC B144A</u>	DTC B144A RUN Power Relay Circuit
<u>DTC B144B</u>	DTC B144B Run/Crank Power Relay Circuit
<u>DTC B147E or B147F</u>	DTC B147E Battery Saver Relay Set Secondary Circuit DTC B147F Battery Saver Relay Reset Secondary Circuit
<u>DTC P2534 or P2535</u>	DTC P2534 Ignition On/Start Switch Circuit Low Voltage

	DTC P2535 Ignition On/Start Switch Circuit High Voltage
<u>DTC P2537</u>	DTC P2537 Ignition Accessory Switch Circuit Low Voltage

ENGINE PERFORMANCE

Engine Controls and Fuel - 1.0L, 1.19L, or 1.2L - Schematic and Routing Diagrams - Spark

SCHEMATIC WIRING DIAGRAMS

ENGINE CONTROLS WIRING SCHEMATICS (LL0-M4M)

Module Power, Ground, Serial Data, and MIL Wiring Schematics

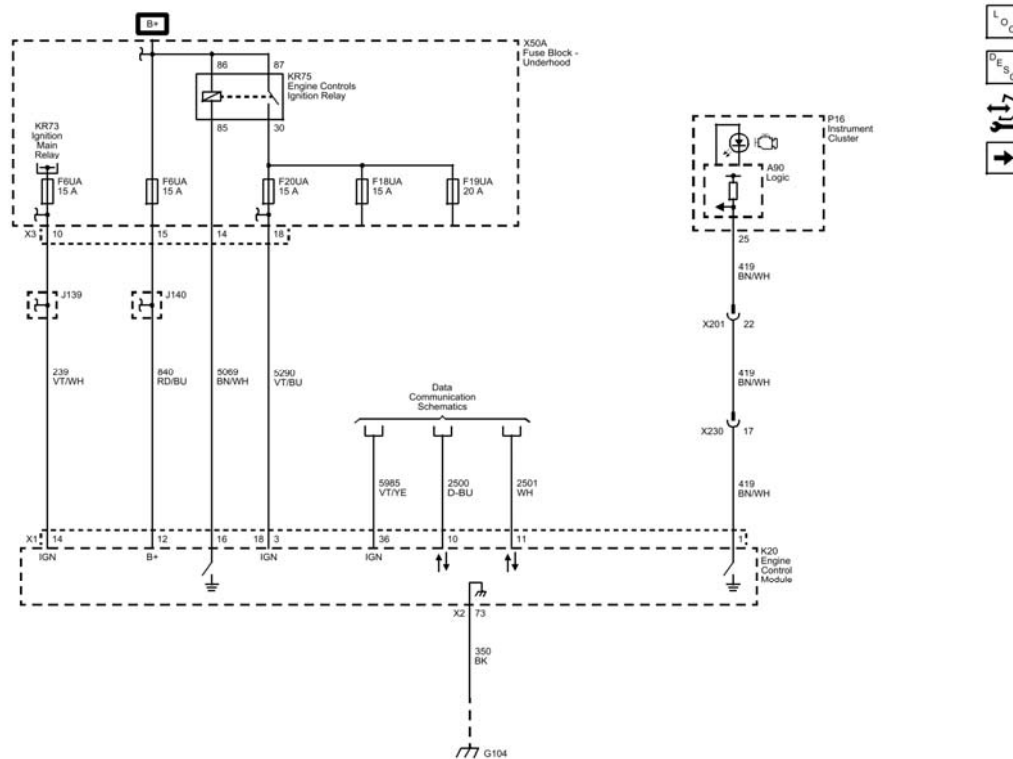


Fig. 1: Module Power, Ground, Serial Data, and MIL Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

5V and Low Reference Bus (1 of 2) Wiring Schematics

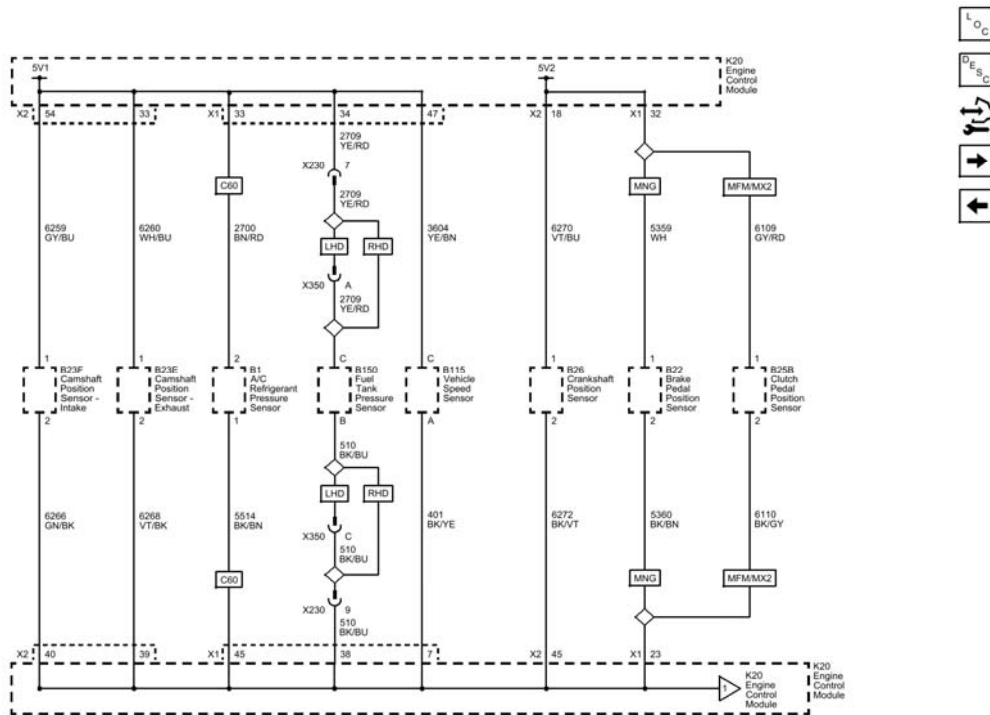


Fig. 2: 5V and Low Reference Bus (1 of 2) Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Low Reference Bus (2 of 2) Wiring Schematics

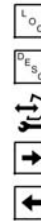
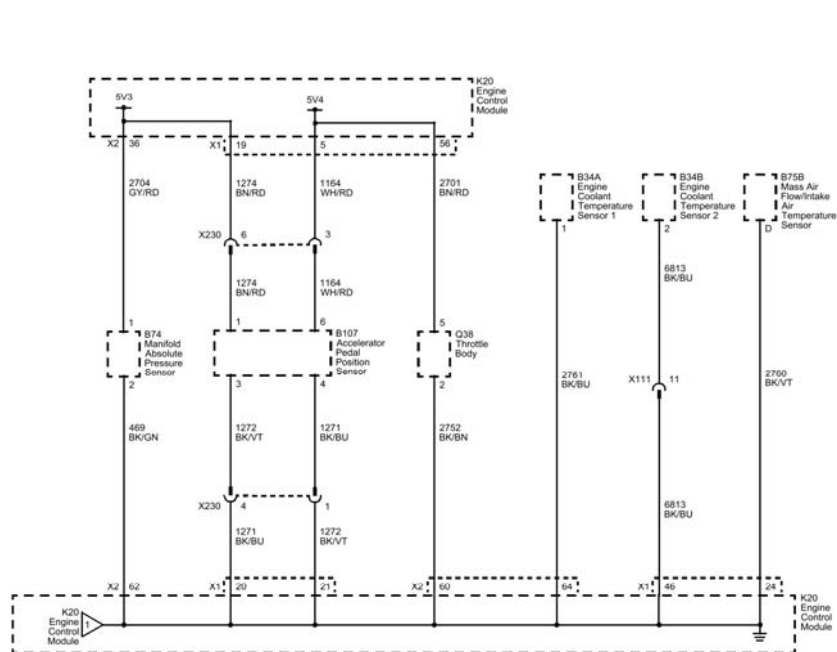


Fig. 3: Low Reference Bus (2 of 2) Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Engine Data Sensors - Pressure and Temperature Wiring Schematics

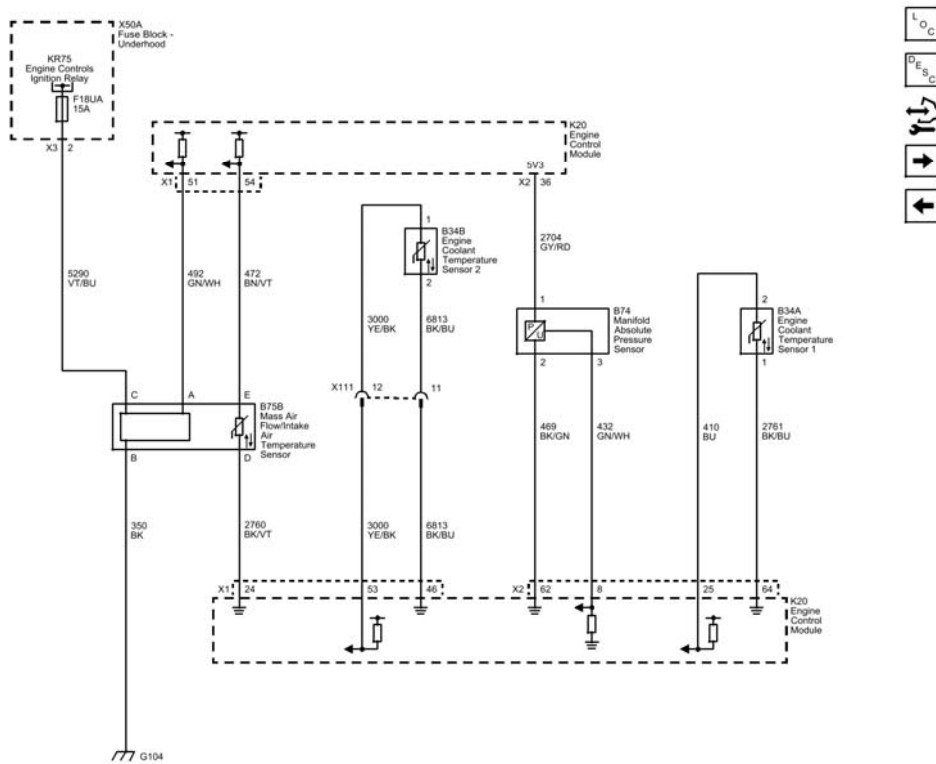


Fig. 4: Engine Data Sensors - Pressure and Temperature Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

Engine Data Sensors - Oxygen Sensors Wiring Schematics

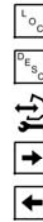
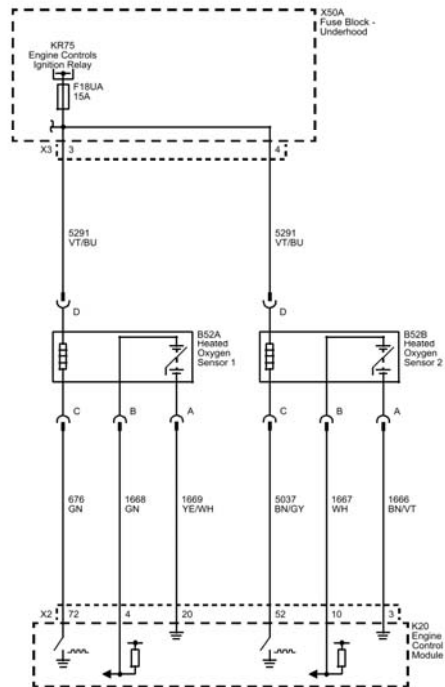


Fig. 5: Engine Data Sensors - Oxygen Sensors Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

Engine Data Sensors - Throttle Controls Wiring Schematics

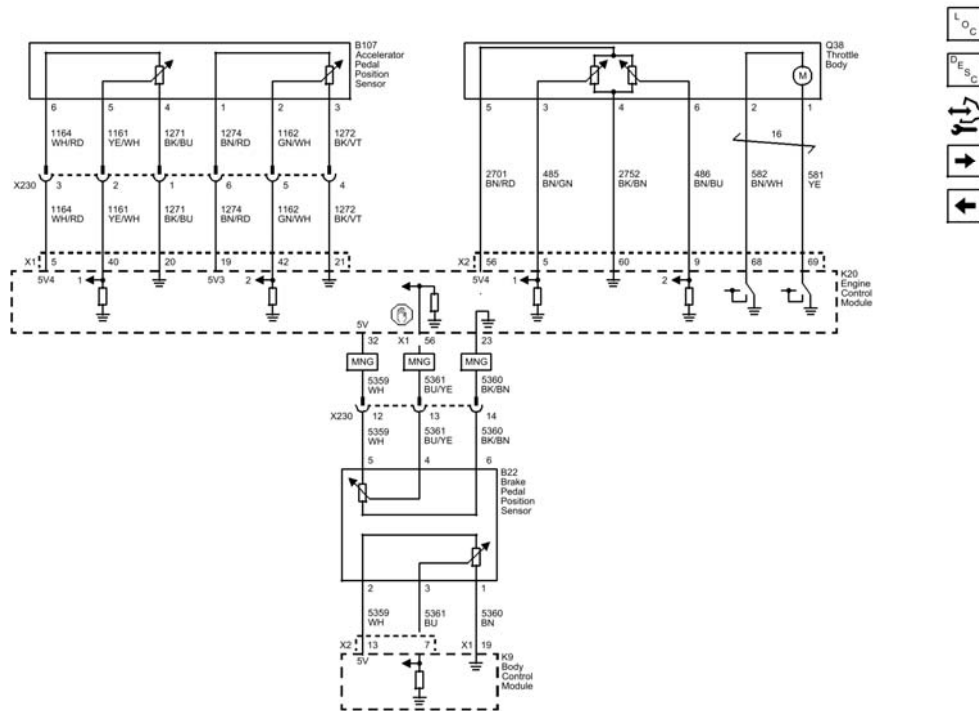


Fig. 6: Engine Data Sensors - Throttle Controls Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

Ignition Controls - Camshaft, Crankshaft, and Knock Sensors, and Camshaft Actuators Wiring Schematics

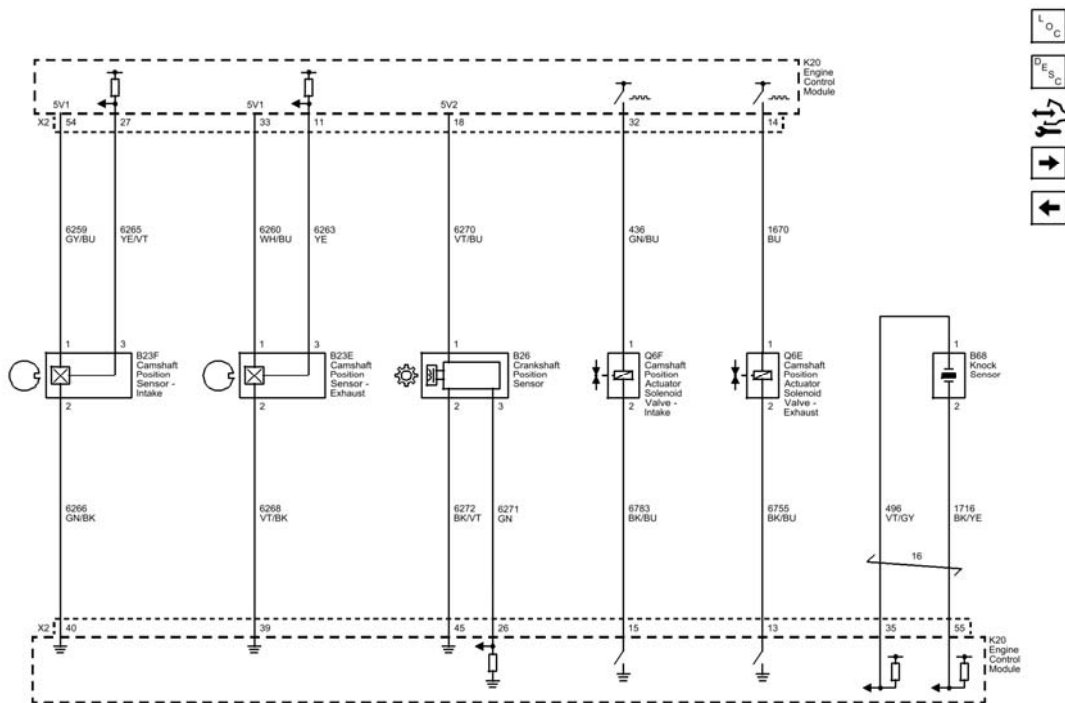


Fig. 7: Ignition Controls - Camshaft, Crankshaft, and Knock Sensors, and Camshaft Actuators Wiring Schematic

Courtesy of GENERAL MOTORS COMPANY

Ignition Controls - Ignition System Wiring Schematics

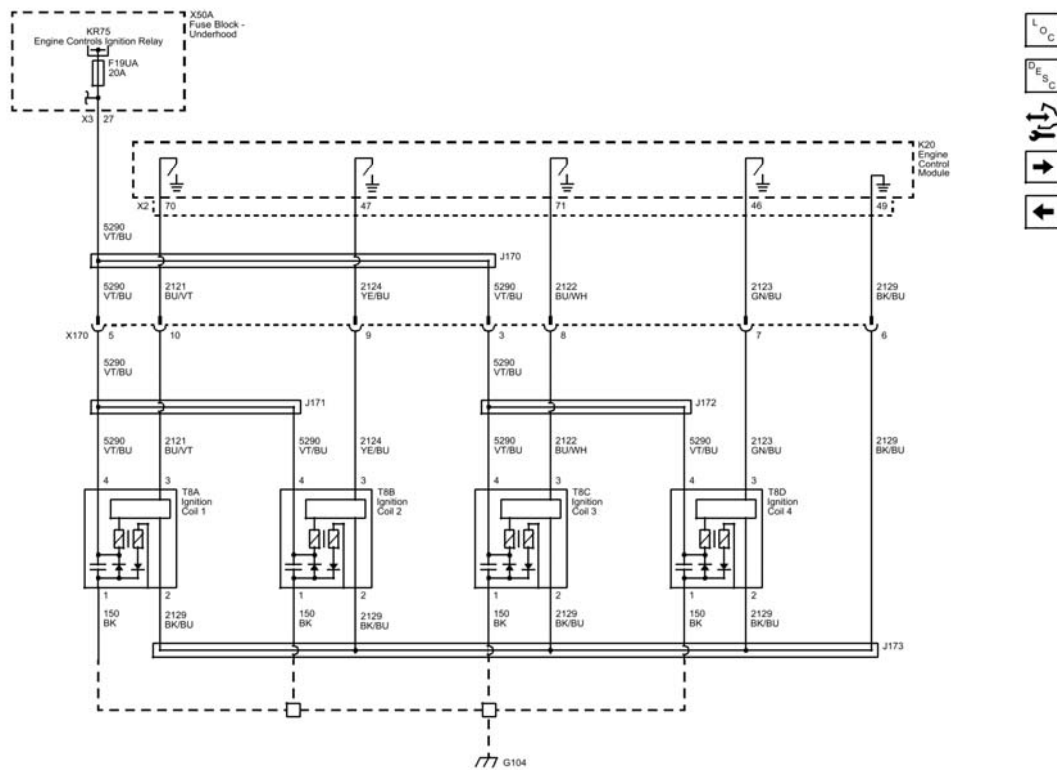


Fig. 8: Ignition Controls - Ignition System Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

Fuel Controls - Fuel Pump and Evaporative Emission Controls Wiring Schematics

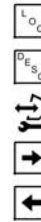
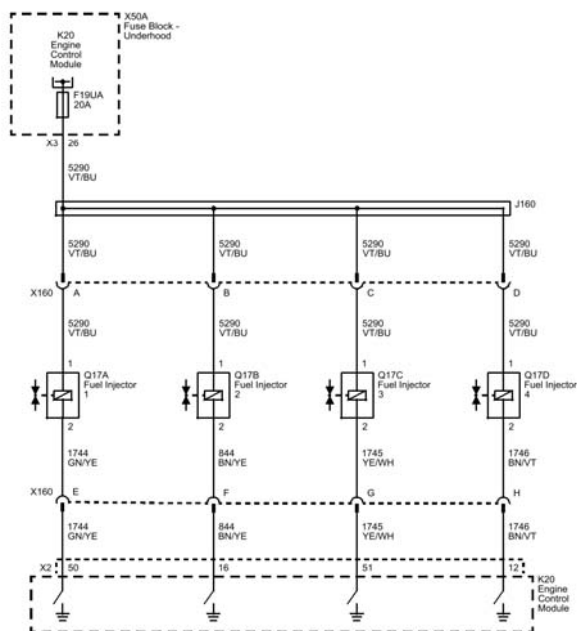


Fig. 10: Fuel Controls - Fuel Injectors Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

Controlled/Monitored Subsystem References Wiring Schematics

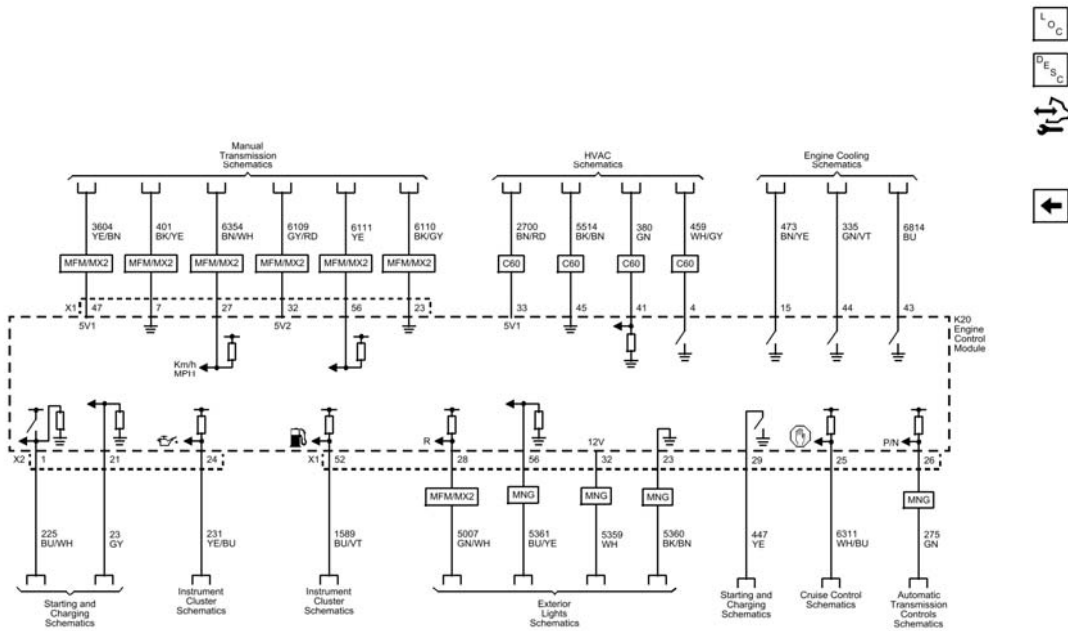


Fig. 11: Controlled/Monitored Subsystem References Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

ENGINE CONTROLS WIRING SCHEMATICS (LFM/LL0+M4M)

Module Power, Ground, Serial Data, and MIL Wiring Schematics



5V and Low Reference Bus (1 of 2) Wiring Schematics

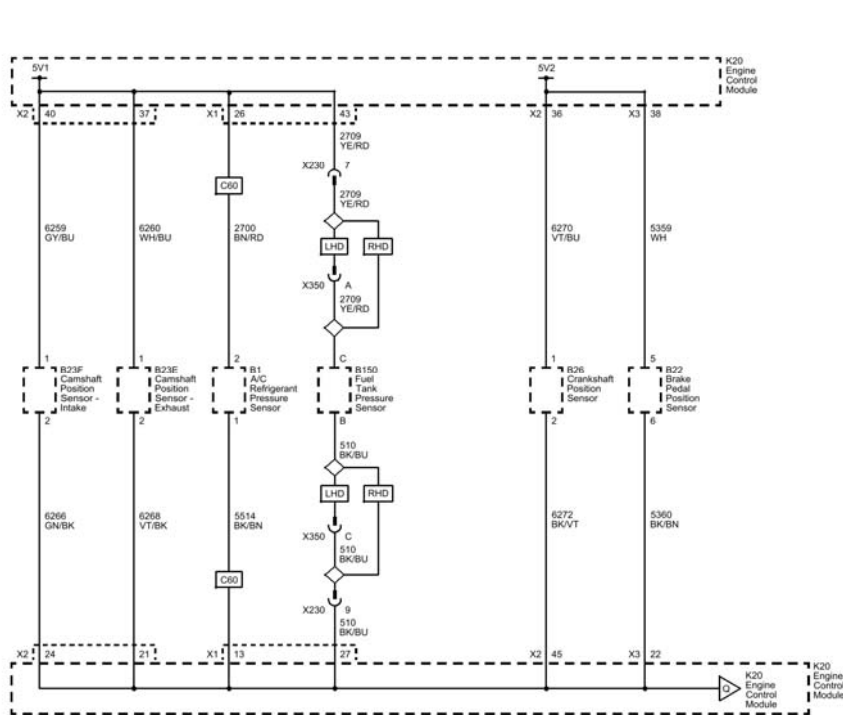


Fig. 13: 5V and Low Reference Bus (1 of 2) Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Low Reference Bus (2 of 2) Wiring Schematics

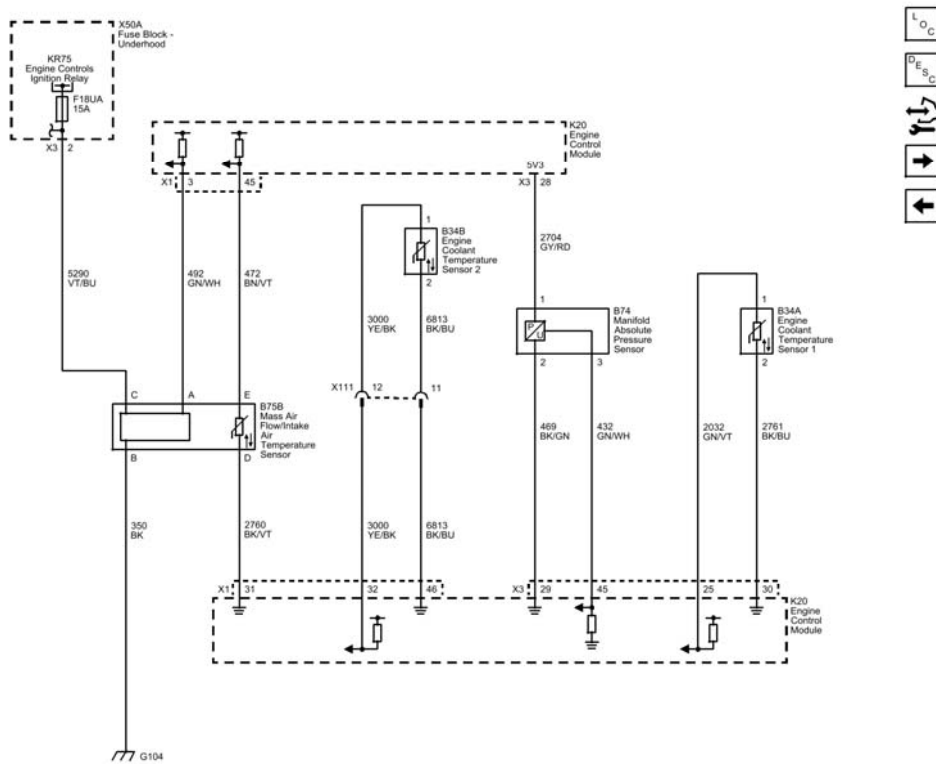


Fig. 15: Engine Data Sensors - Pressure and Temperature Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Engine Data Sensors - Oxygen Sensors Wiring Schematics

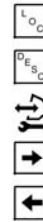
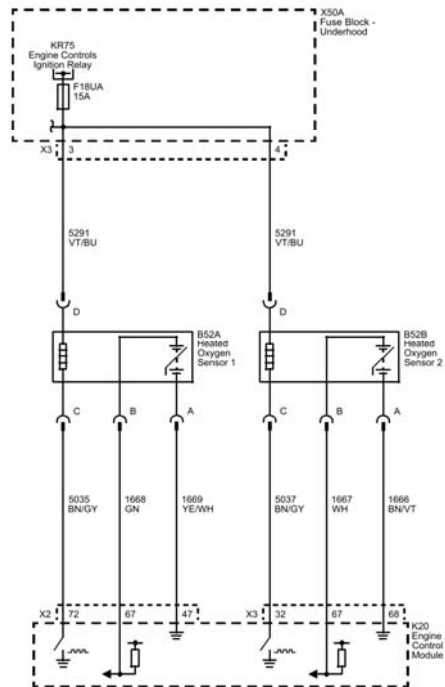


Fig. 16: Engine Data Sensors - Oxygen Sensors Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

Engine Data Sensors - Throttle Controls Wiring Schematics

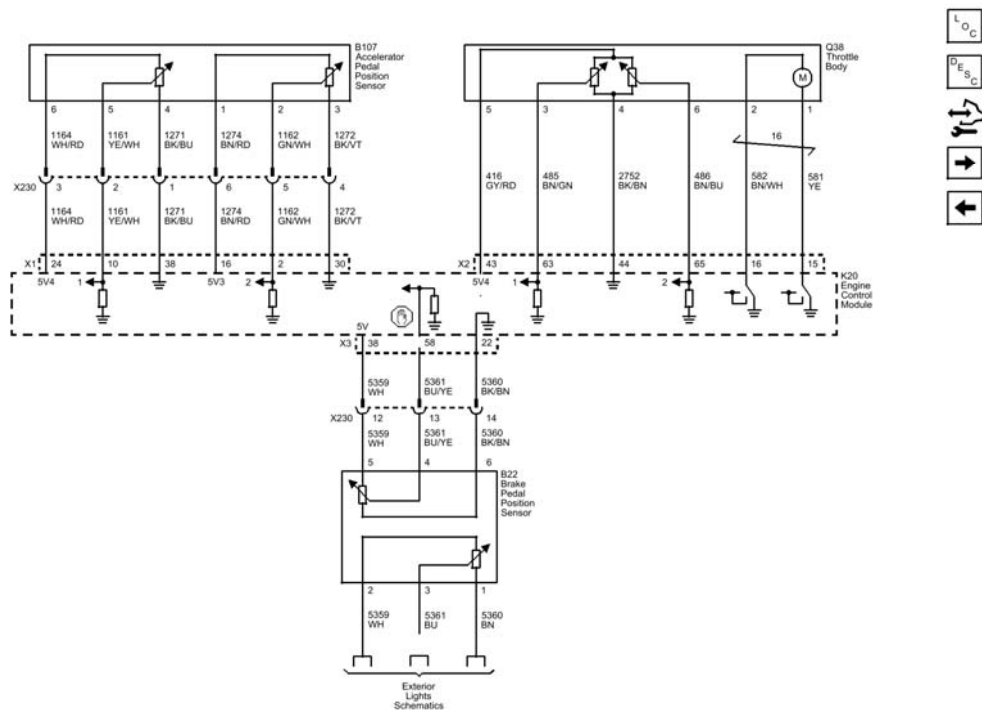


Fig. 17: Engine Data Sensors - Throttle Controls Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

Ignition Controls - Camshaft, Crankshaft, and Knock Sensors, and Camshaft Actuators Wiring Schematics

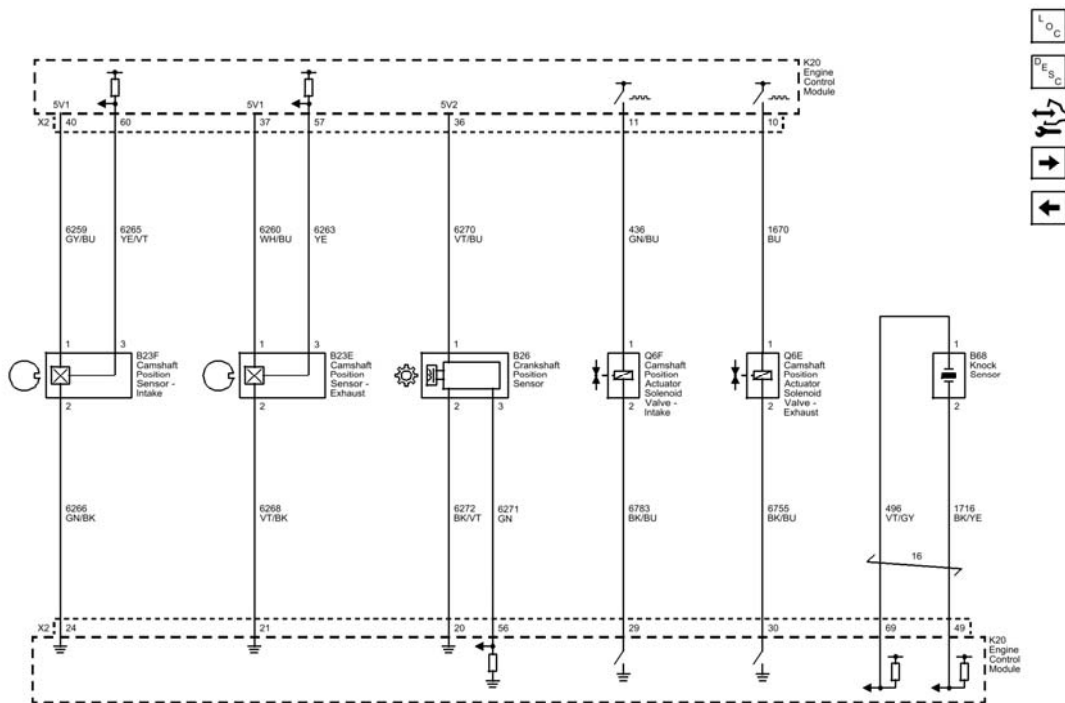


Fig. 18: Ignition Controls - Camshaft, Crankshaft, and Knock Sensors, and Camshaft Actuators Wiring Schematic

Courtesy of GENERAL MOTORS COMPANY

Ignition Controls - Ignition System Wiring Schematics

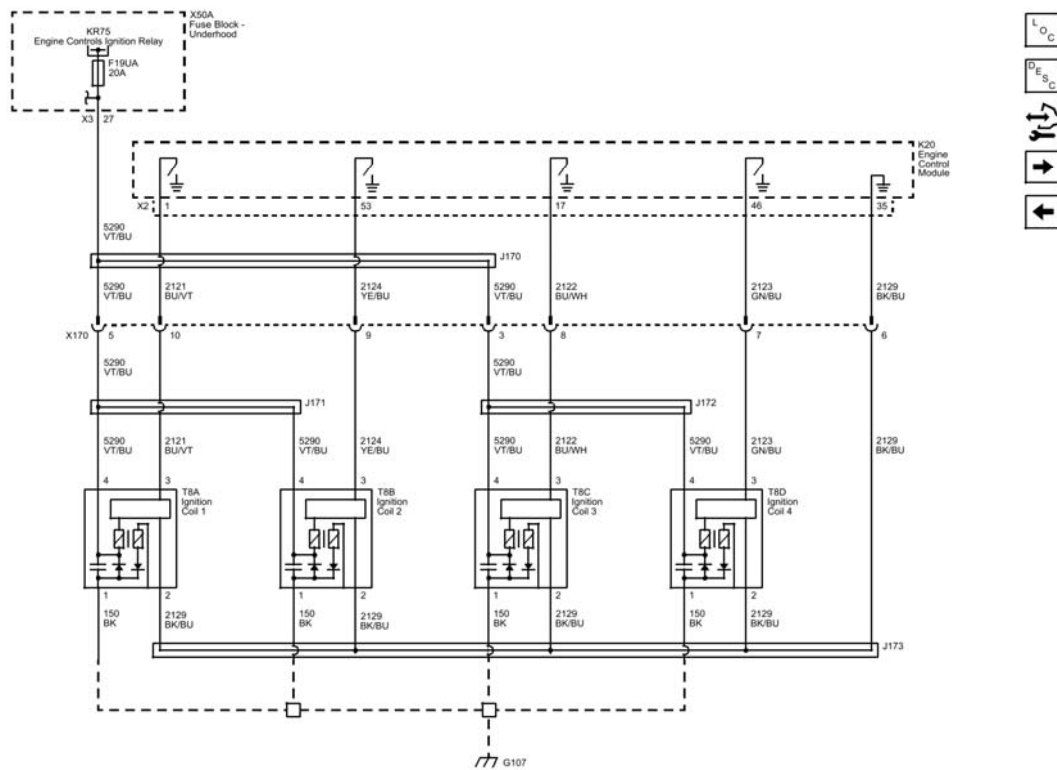


Fig. 19: Ignition Controls - Ignition System Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Fuel Controls - Fuel Pump and Evaporative Emission Controls (EF7/Z49) Wiring Schematics

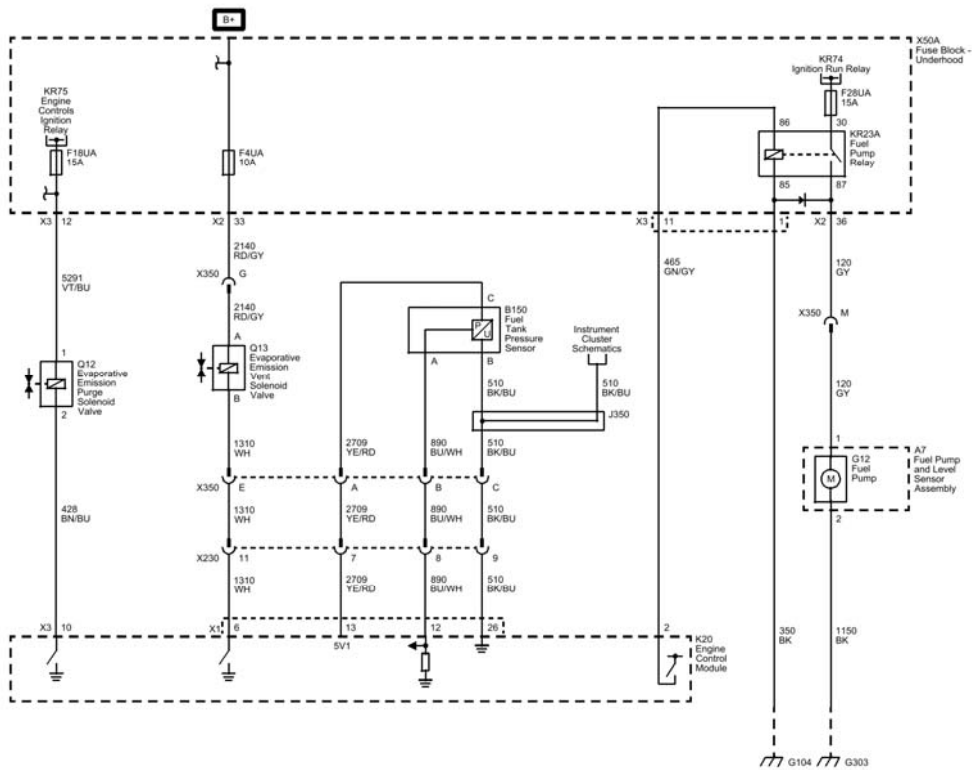


Fig. 20: Fuel Controls - Fuel Pump and Evaporative Emission Controls (EF7/Z49) Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

Fuel Controls - Fuel Pump and Evaporative Emission Controls (CW1) Wiring Schematics

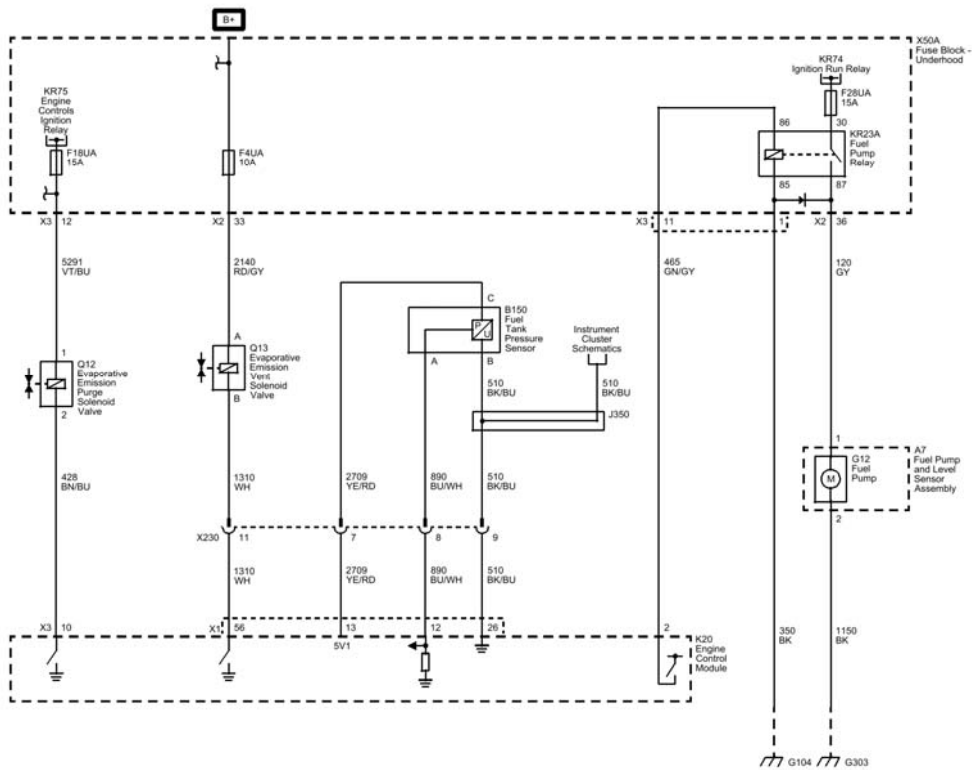


Fig. 21: Fuel Controls - Fuel Pump and Evaporative Emission Controls (CW1) Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Fuel Controls - Fuel Injectors Wiring Schematics

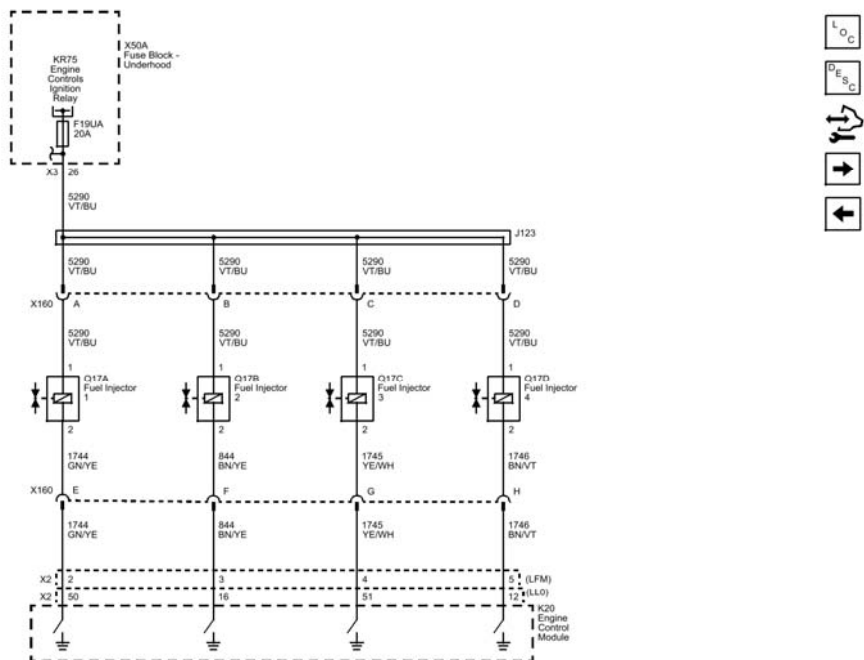


Fig. 22: Fuel Controls - Fuel Injectors Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

Controlled/Monitored Subsystem References Wiring Schematics

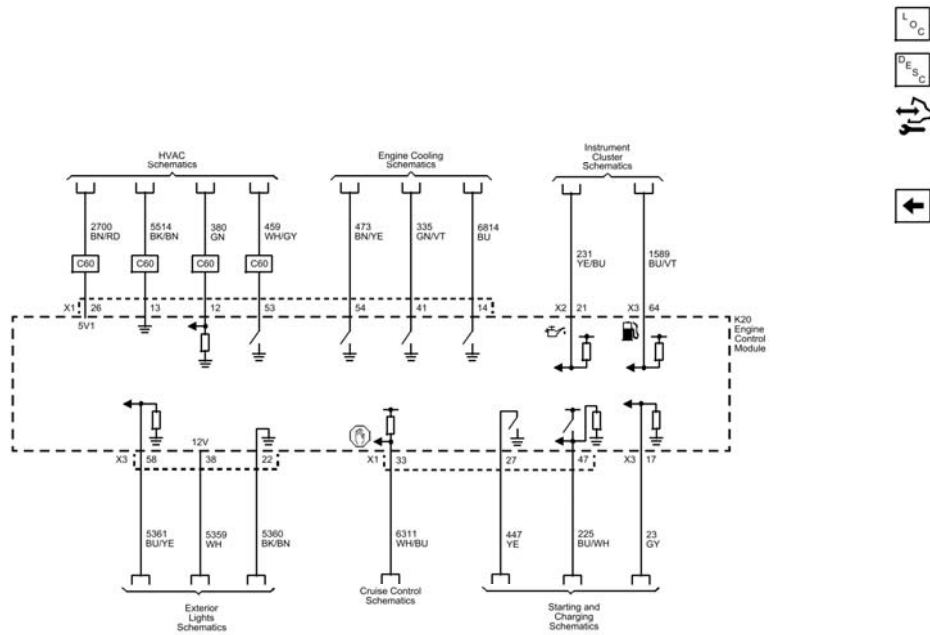


Fig. 23: Controlled/Monitored Subsystem References Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

ENGINE PERFORMANCE

Engine Controls and Fuel - 1.0L, 1.19L or 1.2L - Repair Instructions - Spark

REPAIR INSTRUCTIONS

BRAKE PEDAL POSITION SENSOR LEARN

Calibration Criteria

NOTE: Do not apply the brake pedal during the brake pedal position sensor calibration procedure. Any movement of the brake pedal during this procedure will cause the calibration procedure to fail. If this occurs, the brake pedal position sensor calibration must be repeated.

Brake pedal position sensor calibration must be performed after the brake pedal position sensor, body control module (BCM) or engine control module (ECM) have been serviced. The calibration procedure will set the brake pedal position sensor home value. This value is used by the BCM and ECM to determine the action of the driver applying the brake system and to provide this information to the vehicle subsystems via serial data.

Calibration Procedure

1. Apply the parking brake.
2. Ignition ON, engine OFF, place the transmission in the PARK position for automatic transmission or NEUTRAL position for manual transmission.
3. Install a scan tool.
4. Clear all DTCs before proceeding.
5. Navigate to the Configuration/Reset Functions menu of the BCM.
6. Select the Brake Pedal Position Sensor Learn procedure and follow the directions displayed on the screen.
7. Navigate to the Configuration/Reset Functions menu of the ECM.
8. Select the Learn Functions menu.
9. Select the Brake Pedal Position Sensor Learn procedure and follow the directions displayed on the screen.

ENGINE CONTROL MODULE REPLACEMENT

Pre-Removal Procedure

- CAUTION:**
- Turn the ignition OFF when installing or removing the control module connectors and disconnecting or reconnecting the power to the control module (battery cable, powertrain control module (PCM)/engine control module (ECM)/transaxle control module (TCM) pigtail, control module fuse, jumper cables, etc.) in order to prevent internal control module damage.
 - Control module damage may result when the metal case contacts

battery voltage. DO NOT contact the control module metal case with battery voltage when servicing a control module, using battery booster cables or when charging the vehicle battery.

- In order to prevent any possible electrostatic discharge damage to the control module, do not touch the connector pins or the soldered components on the circuit board.
- Remove any debris from around the control module connector surfaces before servicing the control module. Inspect the control module connector gaskets when diagnosing or replacing the control module. Ensure that the gaskets are installed correctly. The gaskets prevent contaminant intrusion into the control module.
- The replacement control module must be programmed.

Removal Procedure

WARNING: Unless directed otherwise, the ignition and start switch must be in the OFF or LOCK position and all electrical loads must be OFF before servicing any electrical component. Disconnect the negative battery cable to prevent an electrical spark should a tool or equipment come in contact with an exposed electrical terminal. Failure to follow these precautions may result in personal injury and/or damage to the vehicle or its components.

For Vehicles equipped with OnStar® (UE1) with Back Up Battery:

The Back Up Battery is a redundant power supply to allow limited OnStar® functionality in the event of a main vehicle battery power disruption to the VCIM (OnStar® module). Do not disconnect the main vehicle battery or remove the OnStar® fuse with the ignition key in any position other than OFF. Retained accessory power should be allowed to time out or be disabled (simply opening the driver door should disable retained accessory power) before disconnecting power. Disconnecting power to the OnStar® module in any way while the ignition is On or with retained accessory power activated may cause activation of the OnStar® Back-Up Battery system and will discharge and permanently damage the back-up battery. Once the Back-Up Battery is activated it will stay on until it has completely discharged. The back-up battery is not rechargeable and once activated the back-up battery must be replaced.

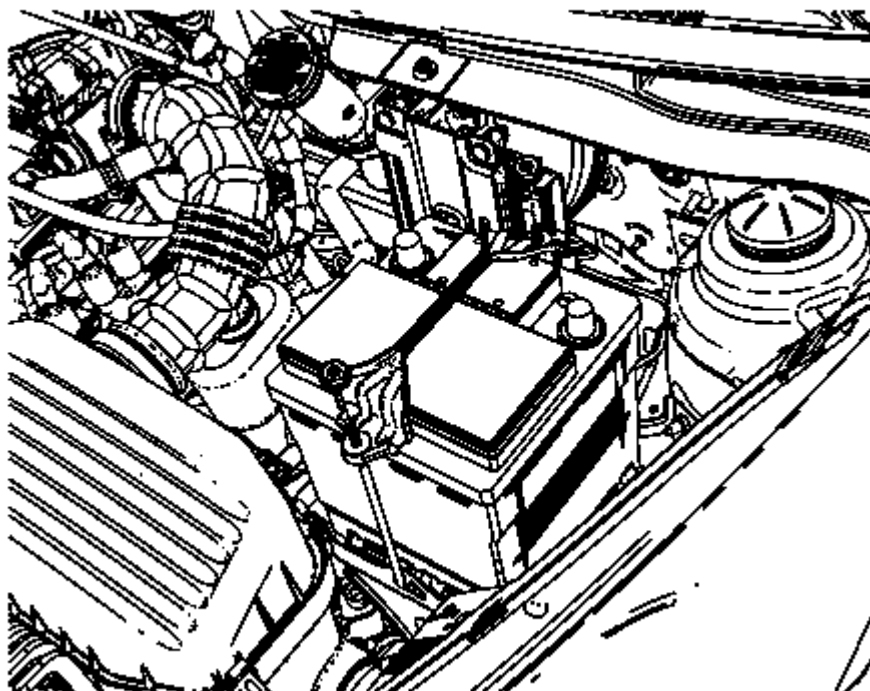


Fig. 1: Engine Control Module (Ecm) Bracket Retaining Bolt
Courtesy of GENERAL MOTORS COMPANY

1. Turn the ignition OFF.
2. Remove the battery. Refer to **Battery Replacement** .

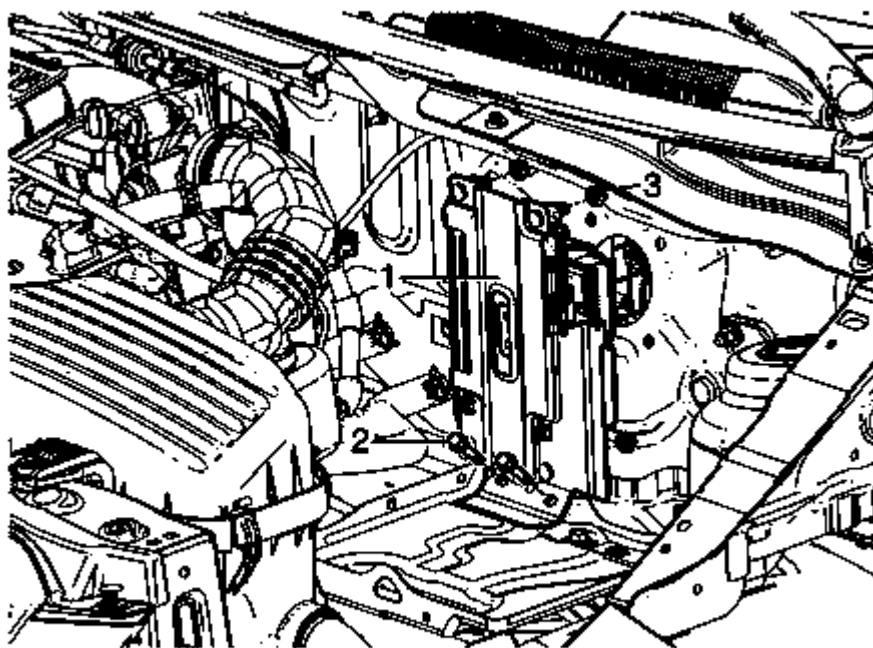


Fig. 2: ECM Retaining Nut

Courtesy of GENERAL MOTORS COMPANY

3. Remove the engine control module (ECM) bracket retaining bolt (2).
4. Release the ECM connector locking lever and disconnect the ECM connector.
5. Remove the ECM retaining nut (3) from the ECM bracket (1) and remove the ECM.

Installation Procedure

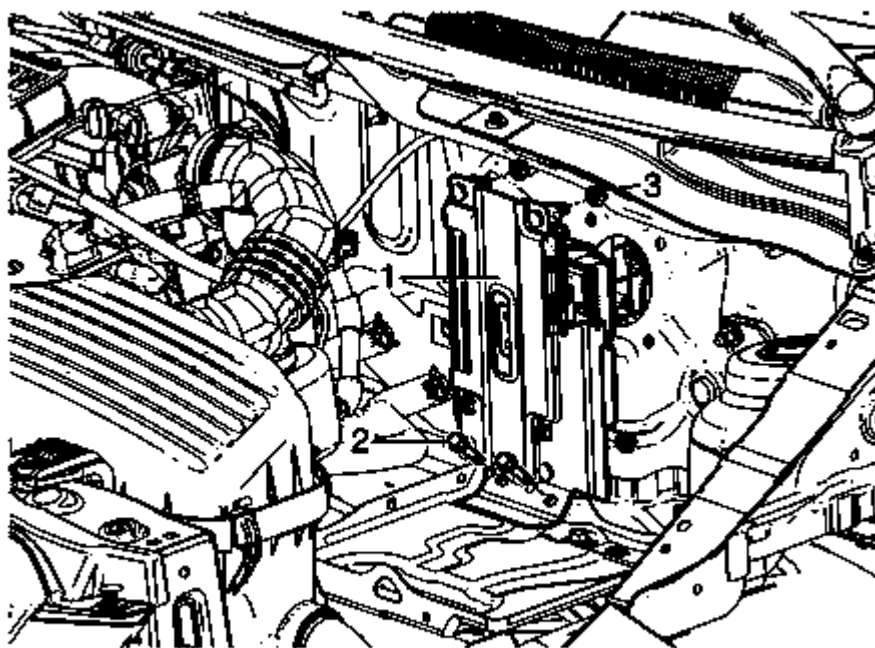


Fig. 3: ECM Retaining Nut

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

1. Install the ECM retaining nut (3) and tighten to 10 (89 lb in).

NOTE: **Connect the front electrical connector to the ECM first.**

2. Connect the ECM connector and lock the ECM connector locking lever.
3. Install the ECM bracket (1) to the battery tray and tighten the ECM bracket retaining bolt (2) to 10 (89 lb in).
4. Install the battery. Refer to Battery Replacement .

Q38 THROTTLE BODY: THROTTLE/IDLE LEARN

Description

The engine control module (ECM) learns the airflow through the throttle body to ensure the correct idle. The learned airflow values are stored within the ECM. These values are learned to adjust for production variation

and will continuously learn during the life of the vehicle to compensate for reduced airflow due to throttle body coking. Anytime the throttle body airflow rate changes, for example due to cleaning or replacing, the values must be relearned.

An engine that had a heavily coked throttle body that has been cleaned or replaced may take several drive cycles to unlearn the coking. To accelerate the process, the scan tool has the ability to reset all learned values back to zero. A new ECM will also have values set to zero.

The idle may be unstable or a DTC may set if the learned values do not match the actual airflow.

Conditions for Running the Throttle Learn Procedure

Scan tool Idle Learn or Idle Learn Reset Procedure

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0116, P0117, P0118, P0120, P0122, P0123, P0128, P0171, P0172, P0174, P0175, P0201-P0208, P0220, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P0279, P0280, P0282, P0283, P0300-P0308, P0351-P0358, P0496, P0601, P0604, P0606, P060D, P0641, P0651, P1516, P2101, P2119, P2120, P2122, P2123, P2125, P2127, P2128, P2135, P2138 or P2176 are not set.
- Ignition ON, engine OFF.
- The vehicle speed sensor (VSS) is 0 km/h (0 mph).

Service Bay/On Road Learn Procedure

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0116, P0117, P0118, P0120, P0122, P0123, P0128, P0171, P0172, P0174, P0175, P0201-P0208, P0220, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P0279, P0280, P0282, P0283, P0300-P0308, P0351-P0358, P0496, P0601, P0604, P0606, P060D, P0641, P0651, P1516, P2101, P2119, P2120, P2122, P2123, P2125, P2127, P2128, P2135, P2138 or P2176 are not set.
- The engine speed is between 450-4,000 RPM.
- The manifold absolute pressure (MAP) is greater than 5 kPa.
- The mass air flow (MAF) is greater than 2 g/s.
- The ignition voltage is greater than 10 volts.

Throttle Learn

Scan Tool Idle Learn or Idle Learn Reset Procedure - Performed after the throttle body is cleaned or replaced

1. Ignition ON, engine OFF, perform the Idle Learn or Idle Learn Reset in Configuration/Reset or Module Setup.
2. Engine idling, observe the scan tool Throttle Body Idle Airflow Compensation parameter. The Throttle Body Idle Airflow Compensation value should equal 0 % and the engine should be idling at a normal idle speed.
3. Clear the DTCs and return to the diagnostic that referred you here.

Service Bay/On Road Idle Learn Procedure - Performed after the ECM is programmed or replaced

NOTE: Do NOT perform this procedure if DTCs are set. Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

1. Engine idling for 3 min.
2. Observe the scan tool Desired Idle Speed and the actual Engine Speed parameters.
3. The ECM will start to learn the new idle cells and the Desired Idle Speed should start to decrease.
4. Ignition OFF for 60 s.
5. Start and idle the engine for 3 min.
6. After the 3 min run time the engine should be idling normal.

NOTE: During the drive cycle the check engine light may come on with idle speed DTCs. If idle speed codes are set, clear codes so the ECM can continue to learn.

- If the engine idle speed has not been learned the vehicle will need to be driven at speeds above 70 km/h (44 mph) with several decelerations and extended idles.
7. After the drive cycle, the engine should be idling normally.
 - If the engine idle speed has not been learned, turn OFF the ignition for 60 s and repeat step 6.
 8. Once the engine speed has returned to normal, clear DTCs and return to the diagnostic that referred you here.

THROTTLE BODY INSPECTION AND CLEANING

NOTE: Over extended time and mileage, deposits may accumulate on the back of the throttle valve plate. The source of the deposit is exhaust gas. Typically these deposits pose no problem. Occasionally the deposit may accumulate to a point where perceived pedal effort or throttle valve movement is affected. This procedure should not be performed on vehicles with mileage under 80, 450 km (50, 000 mi).

1. Remove the air cleaner outlet duct. Refer to Air Cleaner Assembly Replacement.

WARNING: Turn OFF the ignition before inserting fingers into the throttle bore. Unexpected movement of the throttle blade could cause personal injury.

CAUTION: Do not insert any tools into the throttle body bore in order to avoid damage to the throttle valve plate.

2. Inspect the throttle body bore and the throttle valve plate for deposits. You will need to open the throttle valve in order to inspect all surfaces.

CAUTION: Do not use any solvent that contains Methyl Ethyl Ketone (MEK). This solvent may damage fuel system components.

3. Clean the throttle body bore and the throttle valve plate using a clean shop towel with an appropriate cleaner.
4. Install the air cleaner outlet duct. Refer to **Air Cleaner Assembly Replacement**.
5. Perform the throttle/idle learn procedure. Refer to **Q38 Throttle Body: Throttle/Idle Learn**.

ENGINE COOLANT TEMPERATURE SENSOR REPLACEMENT (RADIATOR)

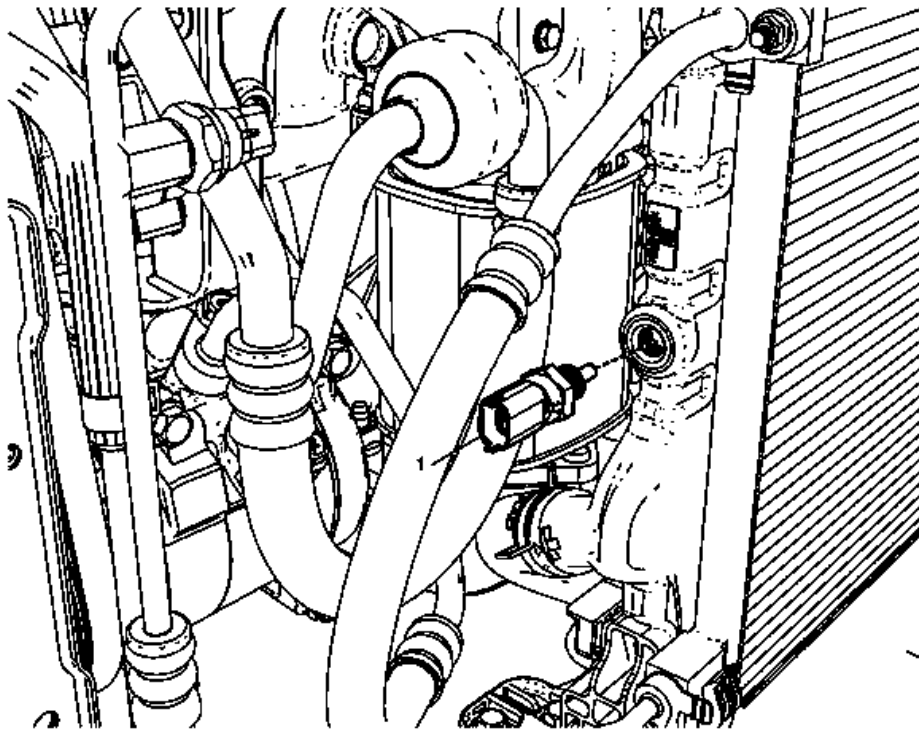


Fig. 4: Engine Coolant Temperature Sensor
Courtesy of GENERAL MOTORS COMPANY

Engine Coolant Temperature Sensor Replacement (Radiator)

Callout	Component Name
WARNING: Allow sufficient time for the engine to cool before removing the ECT sensor. A hot engine may cause an excessive coolant loss or a personal injury.	
Preliminary Procedures 1. Drain the cooling system. Refer to <u>Cooling System Draining and Filling</u> . 2. Disconnect the connector plug.	
	Engine Coolant Temperature Sensor

CAUTION:
Refer to Fastener Caution .

- 1 **Procedure**
Remove the coolant temperature sensor (1).
Tighten
12 (9 lb ft)

ENGINE COOLANT TEMPERATURE SENSOR REPLACEMENT (THERMOSTAT)

Removal Procedure

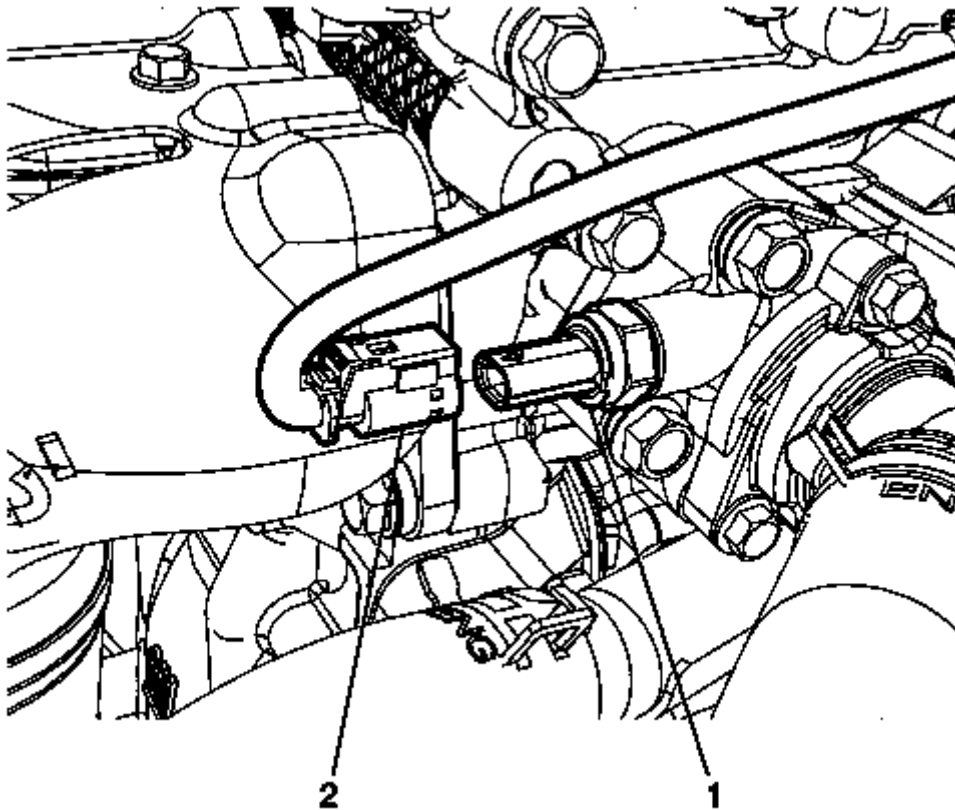


Fig. 5: Engine Coolant Temperature Sensor Connector
Courtesy of GENERAL MOTORS COMPANY

WARNING: Allow sufficient time for the engine to cool before removing the ECT sensor. A hot engine may cause an excessive coolant loss or a personal injury.

1. Drain the engine coolant. Refer to Cooling System Draining and Filling .

2. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
3. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement**.
4. Disconnect the engine coolant temperature sensor connector (2).
5. Remove the engine coolant temperature sensor (1).

Installation Procedure

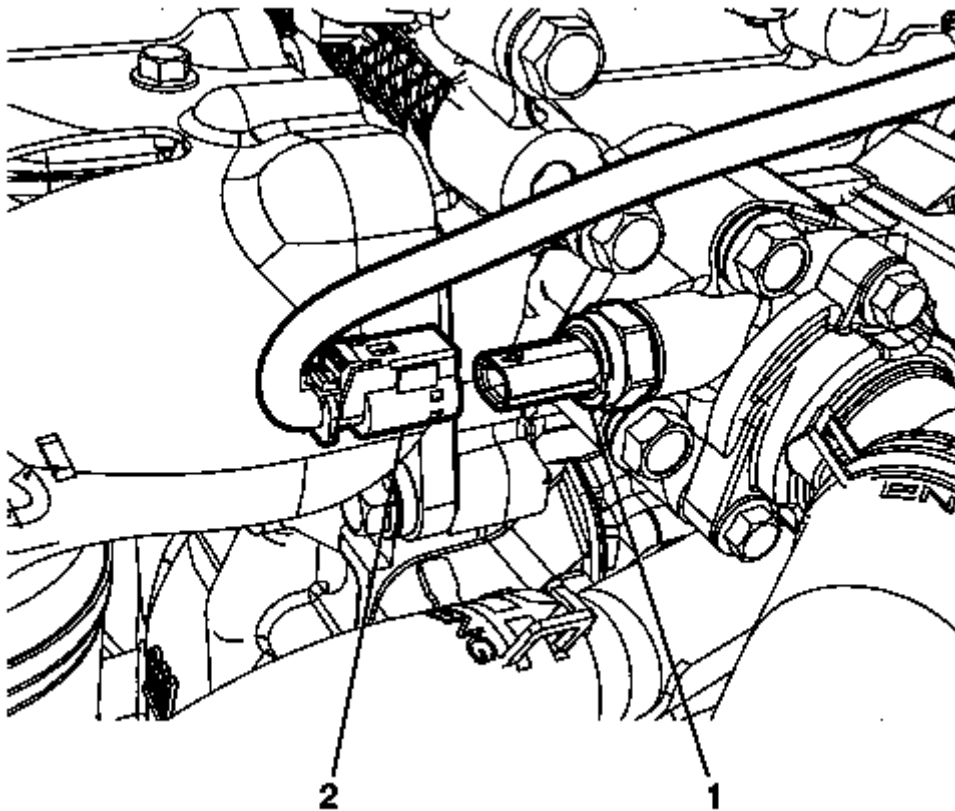


Fig. 6: Engine Coolant Temperature Sensor Connector
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Component Fastener Tightening Caution** .

1. Install the engine coolant temperature sensor (1) and tighten to 33 (24 lb ft).
2. Connect the engine coolant temperature sensor connector (2).
3. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement**.
4. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
5. Refill the engine coolant. Refer to **Cooling System Draining and Filling** .

MASS AIRFLOW SENSOR REPLACEMENT

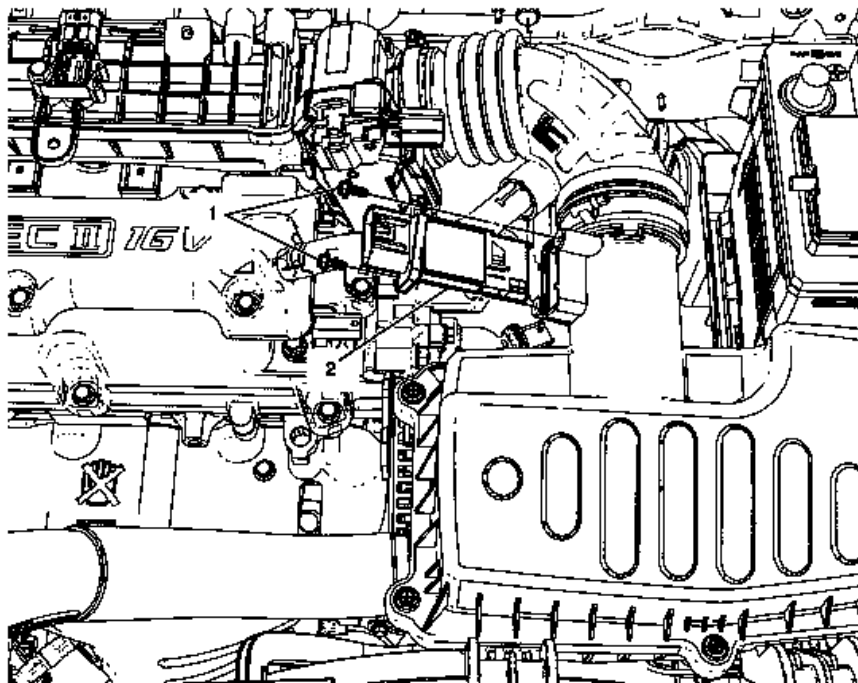


Fig. 7: Mass Airflow Sensor

Courtesy of GENERAL MOTORS COMPANY

Mass Airflow Sensor Replacement

Callout	Component Name
Preliminary Procedure Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> .	
1	Mass Airflow Sensor Bolt (Qty 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2 (18 lb in)
2	Mass Airflow Sensor Procedure Disconnect the electrical wiring harness connector.

MANIFOLD ABSOLUTE PRESSURE SENSOR REPLACEMENT (LL0)

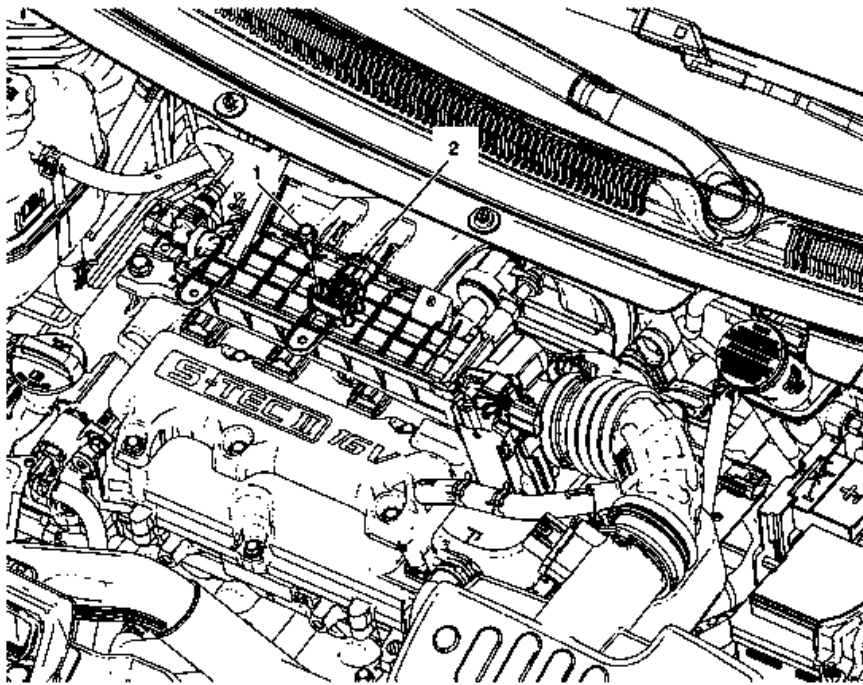


Fig. 8: Manifold Absolute Pressure Sensor
 Courtesy of GENERAL MOTORS COMPANY

Manifold Absolute Pressure Sensor Replacement (LL0)

Callout	Component Name
Preliminary Procedures 1. Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Disconnect the manifold absolute pressure sensor connector.	
1	Manifold Absolute Pressure Sensor Bolt CAUTION: Refer to <u>Fastener Caution</u> . Procedure Remove the manifold absolute pressure sensor bolt Tighten 10 (89 lb in)
2	Manifold Absolute Pressure Sensor

MANIFOLD ABSOLUTE PRESSURE SENSOR REPLACEMENT (LFM)

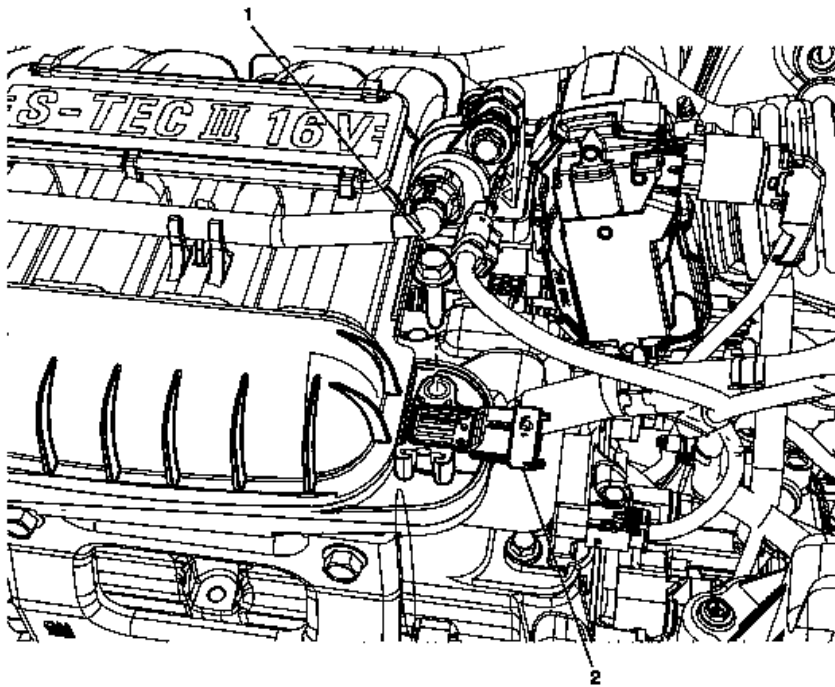


Fig. 9: Manifold Absolute Pressure Sensor (LFM)
 Courtesy of GENERAL MOTORS COMPANY

Manifold Absolute Pressure Sensor Replacement (LFM)

Callout	Component Name
Preliminary Procedures 1. Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Disconnect the manifold absolute pressure sensor connector.	
1	Manifold Absolute Pressure Sensor Bolt CAUTION: Refer to <u>Fastener Caution</u> . Procedure Remove the manifold absolute pressure sensor bolt. Tighten 10 (89 lb in)
2	Manifold Absolute Pressure Sensor

HEATED OXYGEN SENSOR REPLACEMENT - SENSOR 1

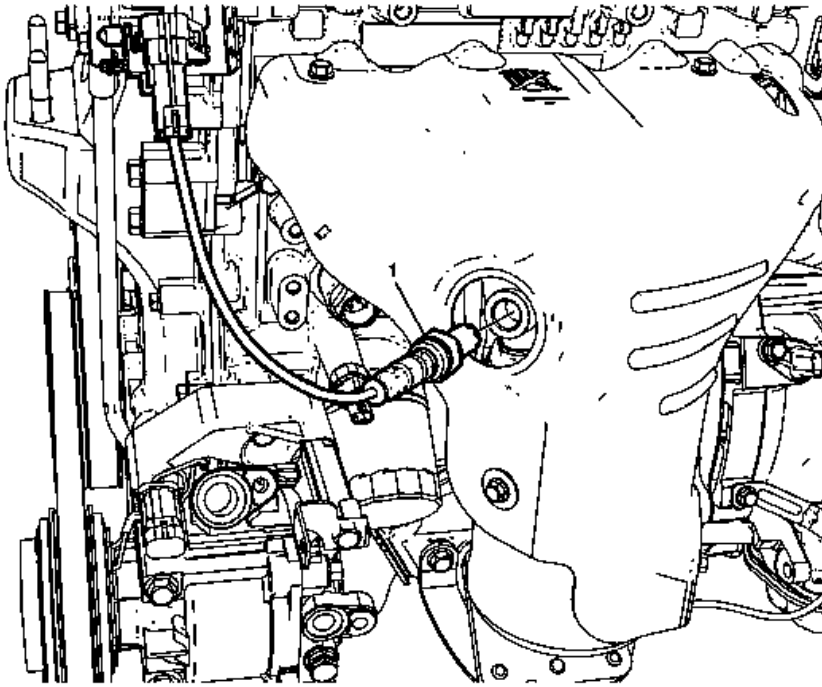


Fig. 10: Heated Oxygen Sensor - Sensor 1
 Courtesy of GENERAL MOTORS COMPANY

Heated Oxygen Sensor Replacement - Sensor 1

Callout	Component Name
Preliminary Procedures 1. Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Raise the vehicle by its full height. Refer to <u>Lifting and Jacking the Vehicle</u> . 3. Disconnect the heated oxygen sensor-1 connector.	
1	Heated Oxygen Sensor-1 CAUTION: Refer to <u>Fastener Caution</u> . Procedure Remove the heated oxygen sensor-1. Tighten 42 (31 lb ft) Special Tools EN-48259 Installer/Remover For equivalent regional tools, refer to <u>Special Tools (Diagnostic Tools)</u> .

HEATED OXYGEN SENSOR REPLACEMENT - SENSOR 2

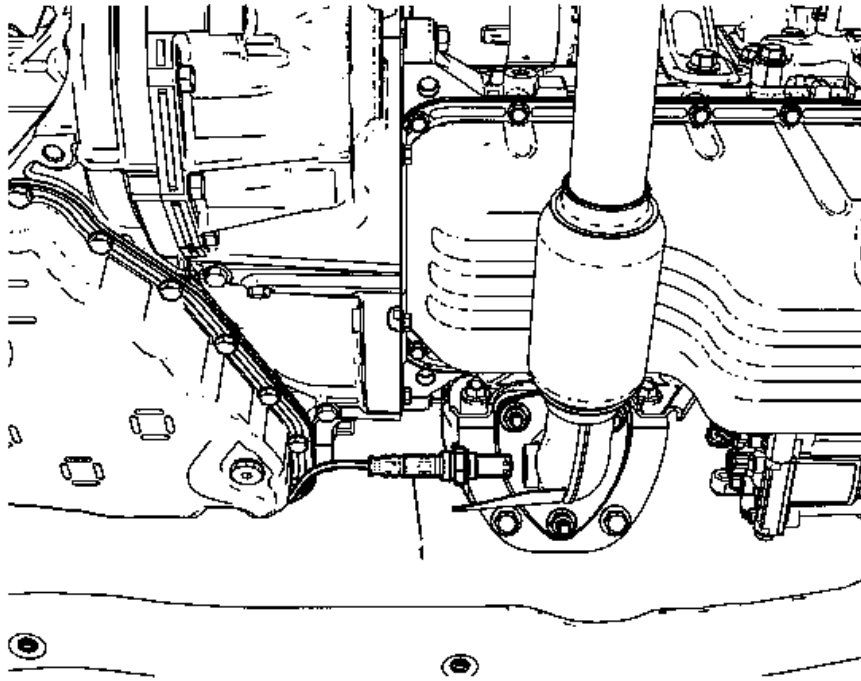


Fig. 11: Heated Oxygen Sensor - Sensor 2
 Courtesy of GENERAL MOTORS COMPANY

Heated Oxygen Sensor Replacement - Sensor 2

Callout	Component Name
Preliminary Procedures	
1. Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Raise the vehicle by its full height. Refer to <u>Lifting and Jacking the Vehicle</u> . 3. Disconnect the heated oxygen sensor-2 connector.	
1	Heated Oxygen Sensor-2 CAUTION: Refer to <u>Fastener Caution</u> . Procedure Remove the heated oxygen sensor-2. Tighten 42 (31 lb ft)

KNOCK SENSOR REPLACEMENT

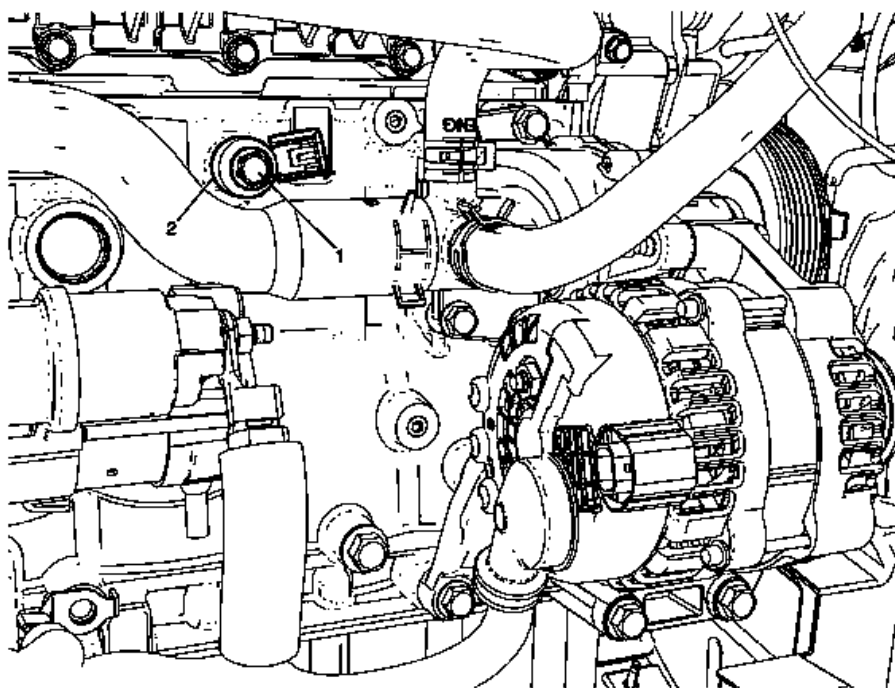


Fig. 12: Knock Sensor
 Courtesy of GENERAL MOTORS COMPANY

Knock Sensor Replacement

Callout	Component Name
Preliminary Procedures 1. Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 3. Disconnect the starter connector. Refer to <u>Starter Replacement</u> . 4. Disconnect the generator connector. Refer to <u>Generator Replacement</u> . 5. Remove the intake manifold rear bracket. Refer to <u>Lower Intake Manifold Replacement (LFM)</u> . 6. Disconnect the knock sensor wiring harness connector.	
1	Knock Sensor Retaining Bolt CAUTION: Refer to <u>Fastener Caution</u> . Procedure Remove the knock sensor retaining bolt. Tighten 25 (18 lb ft)
2	Knock Sensor

THROTTLE BODY ASSEMBLY REPLACEMENT (LL0)

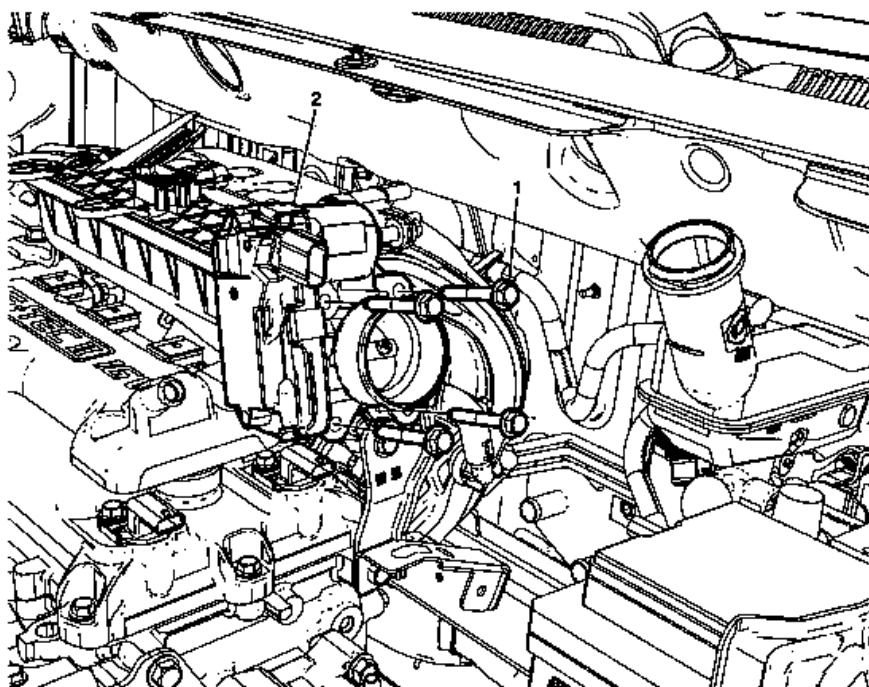


Fig. 13: Throttle Body Assembly

Courtesy of GENERAL MOTORS COMPANY

Throttle Body Assembly Replacement (LL0)

Callout	Component Name
Preliminary Procedures	
1. Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Remove the air cleaner assembly. Refer to <u>Air Cleaner Assembly Replacement</u>. 3. Disconnect the throttle body connector.	
1	Throttle Body Retaining Bolt (Qty 4) CAUTION: Refer to <u>Fastener Caution</u> . Procedure Remove the throttle body retaining bolts. Tighten 10 (89 lb in)
2	Throttle Body Assembly

THROTTLE BODY ASSEMBLY REPLACEMENT (LFM)

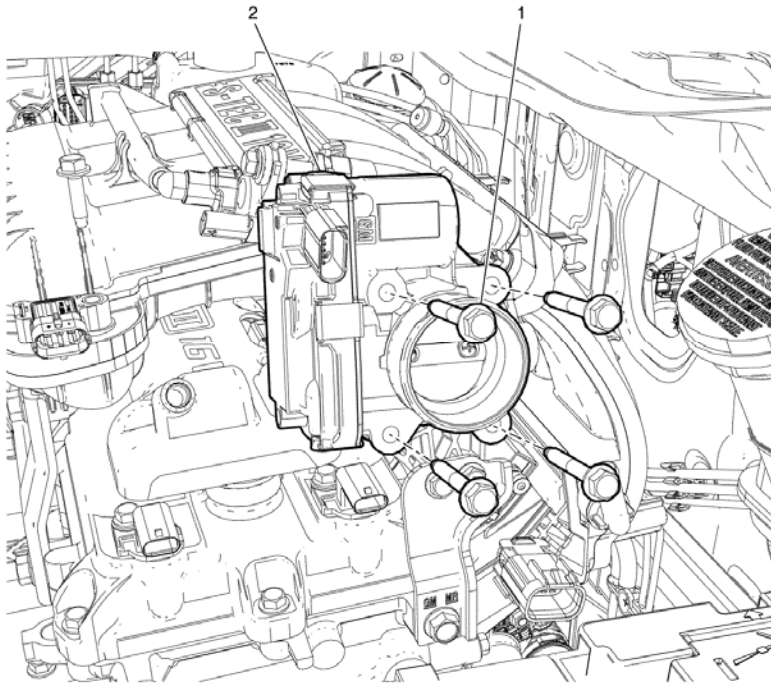


Fig. 14: Throttle Body Assembly (LFM)
 Courtesy of GENERAL MOTORS COMPANY

Throttle Body Assembly Replacement (LFM)

Callout	Component Name
Preliminary Procedures 1. Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Remove the air cleaner assembly. Refer to <u>Air Cleaner Assembly Replacement</u>. 3. Disconnect the throttle body connector.	
1	Throttle Body Retaining Bolt (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . Procedure Remove the throttle body retaining bolts. Tighten 10 (89 lb in)
2	Throttle Body Assembly

FUEL PRESSURE RELIEF

WARNING: Relieve the fuel system pressure before servicing fuel system

components in order to reduce the risk of fire and personal injury.

After relieving the system pressure, a small amount of fuel may be released when servicing the fuel lines or connections. In order to reduce the chance of personal injury, cover the regulator and the fuel line fittings with a shop towel before disconnecting. This will catch any fuel that may leak out. Place the towel in an approved container when the disconnection is complete.

1. Open the fuel cap.
2. Remove the fuel pump fuse from the engine room fuse box.
3. Ignition on and allow the engine to idle until the engine stops.
4. After ignition OFF, crank the engine for 10 seconds to verify that there is no fuel.

FUEL PRESSURE GAUGE INSTALLATION AND REMOVAL

Special Tools

EN-49495 Fuel Pressure Gauge

For equivalent regional tools, refer to **Special Tools (Diagnostic Tools)** .

Installation Procedure

WARNING: Gasoline or gasoline vapors are highly flammable. A fire could occur if an ignition source is present. Never drain or store gasoline or diesel fuel in an open container, due to the possibility of fire or explosion. Have a dry chemical (Class B) fire extinguisher nearby.

WARNING: Wrap a shop towel around the fuel pressure connection in order to reduce the risk of fire and personal injury. The towel will absorb any fuel leakage that occurs during the connection of the fuel pressure gauge. Place the towel in an approved container when the connection of the fuel pressure gauge is complete.

CAUTION: Clean all of the following areas before performing any disconnections in order to avoid possible contamination in the system:

- The fuel pipe connections
- The hose connections
- The areas surrounding the connections

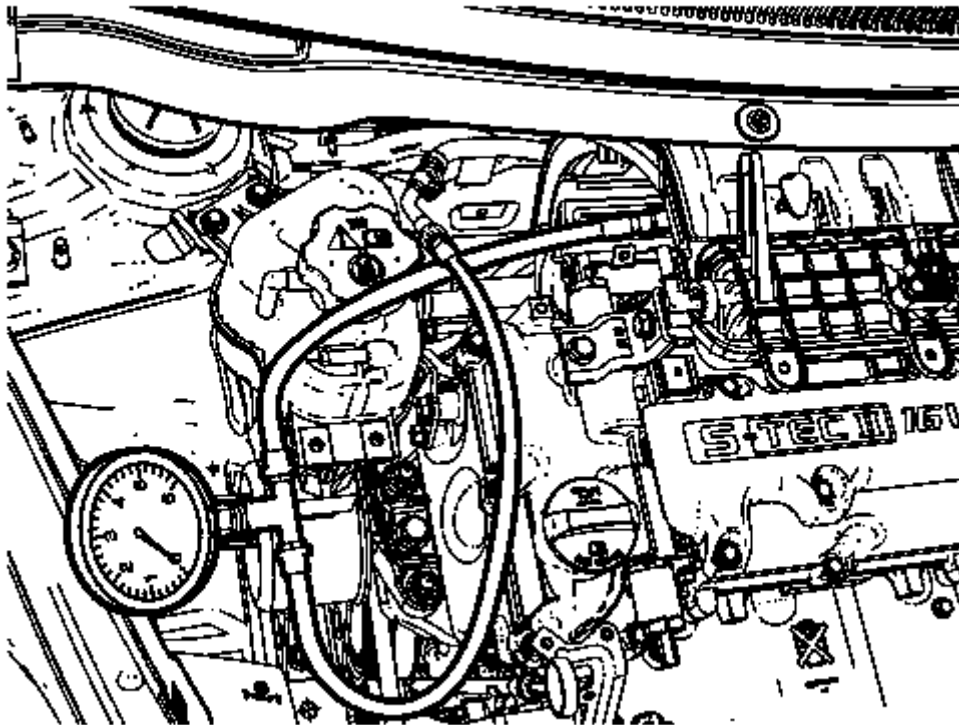


Fig. 15: Fuel Pressure

Courtesy of GENERAL MOTORS COMPANY

1. Relieve the fuel pressure. Refer to **Fuel Pressure Relief**.
2. Attach the **EN-49495** fuel pressure gauge to the fuel feed pipe and fuel rail.
3. Start the engine
4. Read the fuel pressure from the pressure gauge.

Nominal value

380 kPa (3.8 bar)

METAL COLLAR QUICK CONNECT FITTING SERVICE

Special Tools

EN-47831 Fuel Line Disconnect Tool

For equivalent regional tools, refer to **Special Tools (Diagnostic Tools)** .

Removal Procedure

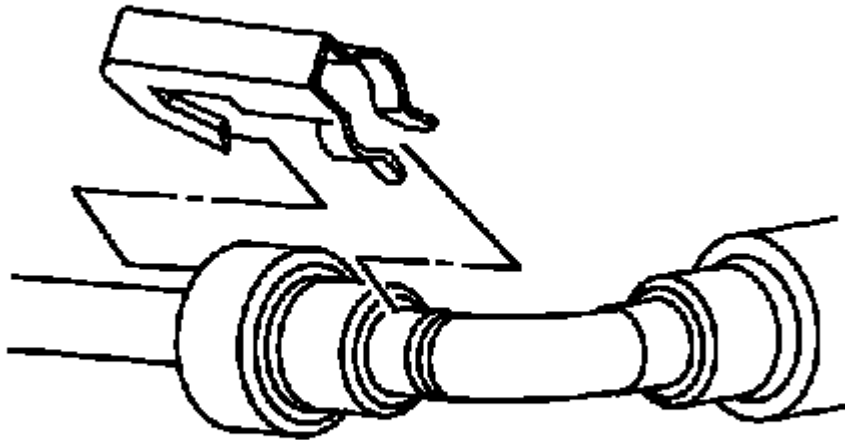


Fig. 16: View Of Quick-Connect Fitting Retainer (Metal Collar)
Courtesy of GENERAL MOTORS COMPANY

1. Relieve the fuel system pressure before servicing any fuel system connection. Refer to **Fuel Pressure Relief**.
2. Remove the retainer from the quick connect fitting.

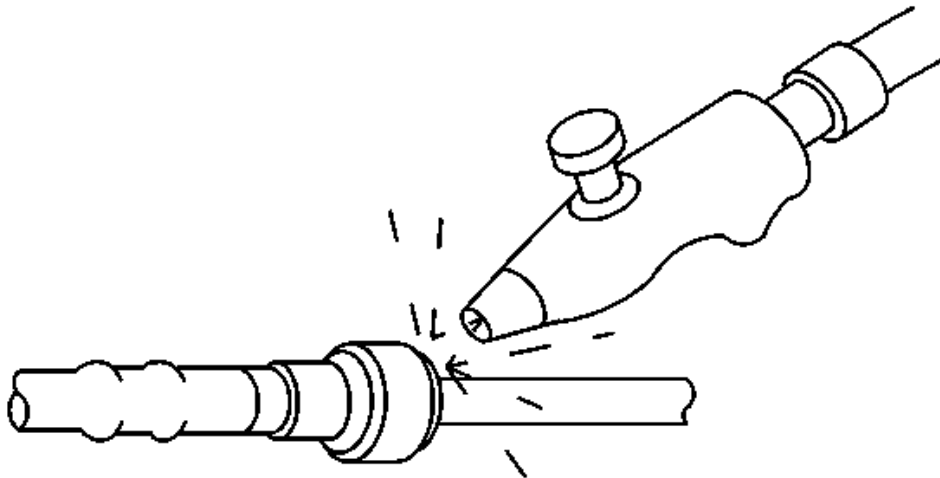


Fig. 17: Blowing Dirt Out Of Fitting (Metal Collar)
Courtesy of GENERAL MOTORS COMPANY

WARNING: Wear safety glasses when using compressed air, as flying dirt particles may cause eye injury.

3. Blow dirt out of the fitting using compressed air.

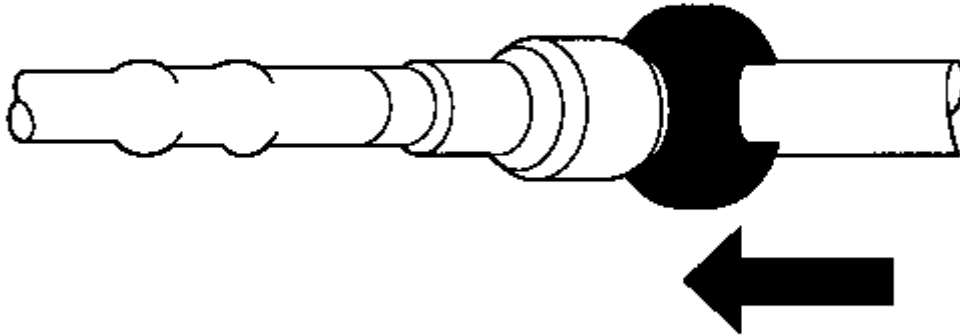


Fig. 18: Inserting En-47831 Tool Into Male Connector
Courtesy of GENERAL MOTORS COMPANY

4. Insert the **EN-47831** tool into the male connector, then push inward in order to release the locking tabs.
5. Pull the connection apart.

CAUTION: If necessary, remove rust or burrs from the fuel pipes with an emery cloth. Use a radial motion with the fuel pipe end in order to prevent damage to the O-ring sealing surface. Use a clean shop towel in order to wipe off the male tube ends. Inspect all the connections for dirt and burrs. Clean or replace the components and assemblies as required.

6. Use a clean shop towel in order to wipe off the male pipe end.
7. Inspect both ends of the fitting for dirt and burrs. Clean or replace the components as required.

Installation Procedure

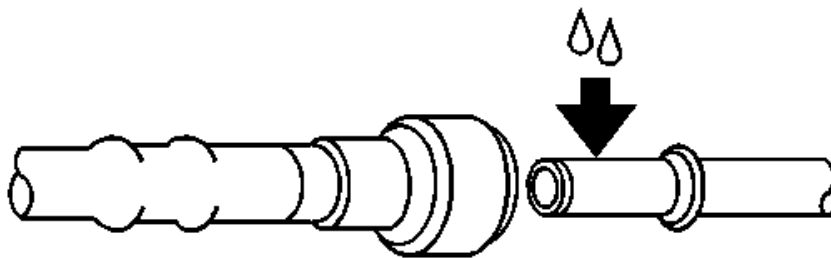


Fig. 19: Oiling Male Pipe Ends (Metal Collar)
Courtesy of GENERAL MOTORS COMPANY

WARNING: In order to reduce the risk of fire and personal injury, before connecting fuel pipe fittings, always apply a few drops of clean engine oil to the male pipe ends.

This will ensure proper reconnection and prevent a possible fuel leak.

During normal operation, the O-rings located in the female connector will swell and may prevent proper reconnection if not lubricated.

1. Apply a few drops of clean engine oil to the male pipe end.

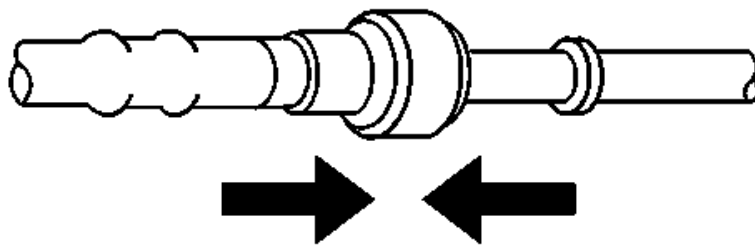


Fig. 20: View Of Connectors (Metal Collar)
Courtesy of GENERAL MOTORS COMPANY

2. Push both sides of the fitting together in order to snap the retaining tabs into place.

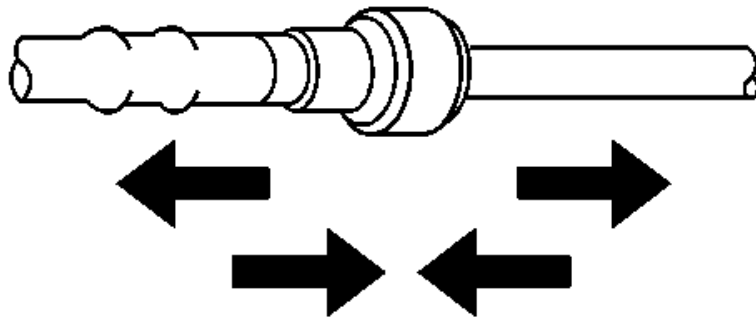


Fig. 21: Ensuring Connection (Metal Collar) Is Secure
Courtesy of GENERAL MOTORS COMPANY

3. Once installed, pull on both sides of the fitting in order to make sure the connection is secure.

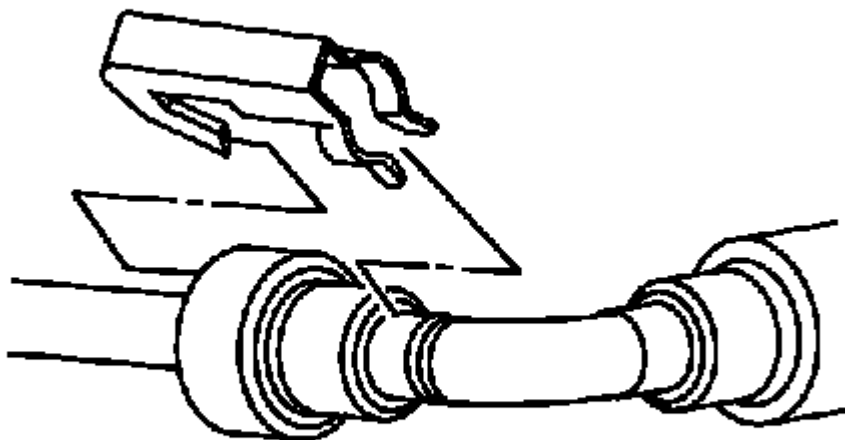


Fig. 22: View Of Quick-Connect Fitting Retainer (Metal Collar)
Courtesy of GENERAL MOTORS COMPANY

4. Install the retainer to the quick connect fitting.

FUEL TANK DRAINING

WARNING: Refer to Gasoline/Gasoline Vapors Warning .

WARNING: Refer to Safety Goggles and Fuel Warning .

WARNING: Refer to .

NOTE: The fuel tank must be drained with a suitable, commercially-available fuel removal unit and suction hose - follow safety regulations and national legislation. The fuel tank is fitted with a refill limit float valve. This is

located on the filler neck in the fuel tank. To prevent damaging the refill limit float valve, a suitable suction hose must be used. In the presence of fuel vapors or escaping fuel - observe safety regulations and national legislation. Store drained fuel in a suitable, sealable container.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
2. Remove the fuel tank filler cap.
3. Insert a suitable suction hose into the fuel tank filler pipe.
4. Attach a suitable suction hose to the hose used with the hand or air operated pump device.
5. Using a hand or air operated pump drain as much fuel from the tank as possible.

FUEL TANK REPLACEMENT (LL0)

Removal Procedure

1. Open the hood.

WARNING: Refer to **Battery Disconnect Warning** .

2. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
3. Relieve the fuel pressure. Refer to **Fuel Pressure Relief**.
4. Ensure that the fuel level in the tank is less than 1/4 full. If necessary, drain the fuel tank to at least this level. Refer to **Fuel Tank Draining**.
5. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
6. Remove the front exhaust muffler assembly. Refer to **Exhaust Muffler Replacement - Front (LL0)** .

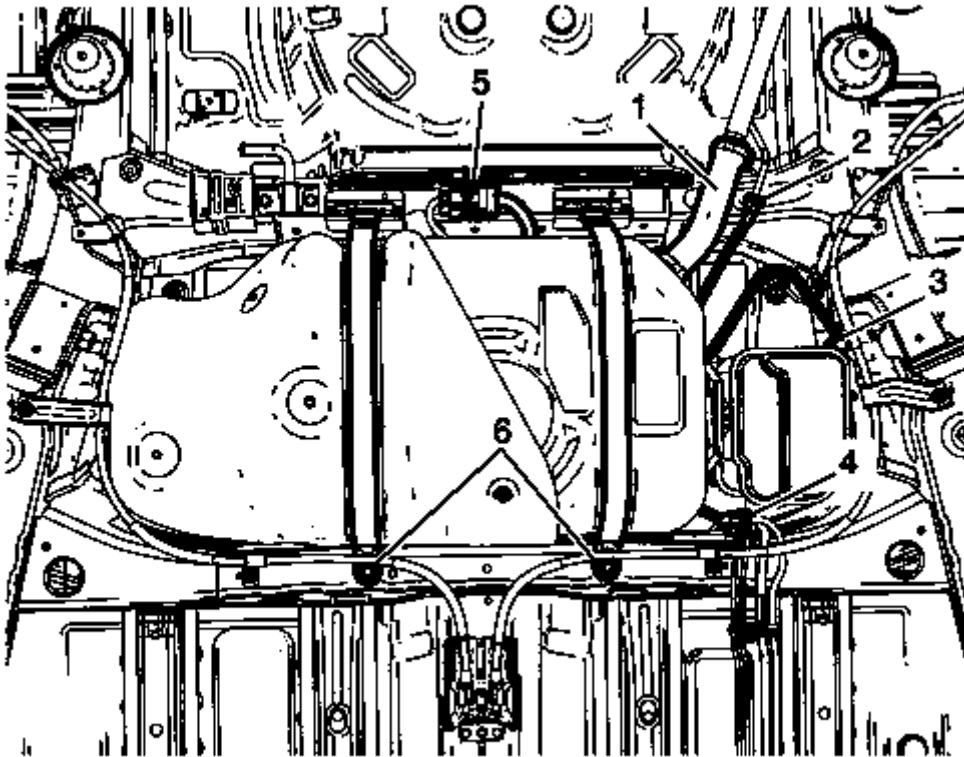


Fig. 23: Fuel Tank Filler Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

7. Disconnect the fuel tank filler hose (1) and clamp.
8. Disconnect the fuel tank vent pipe connector (2).
9. Disconnect the fuel feed pipe connector (3).
10. Disconnect the evaporative emission canister purge pipe connector (4).
11. Disconnect the fuel tank electrical extension connector (5).
12. Place a suitable jack under the fuel tank.
13. Remove the fuel tank strap bolts (6) and straps.
14. If needed, remove the parking brake cable retaining clamp and set it away from the path.
15. Remove the fuel tank.

Disassembly Procedure

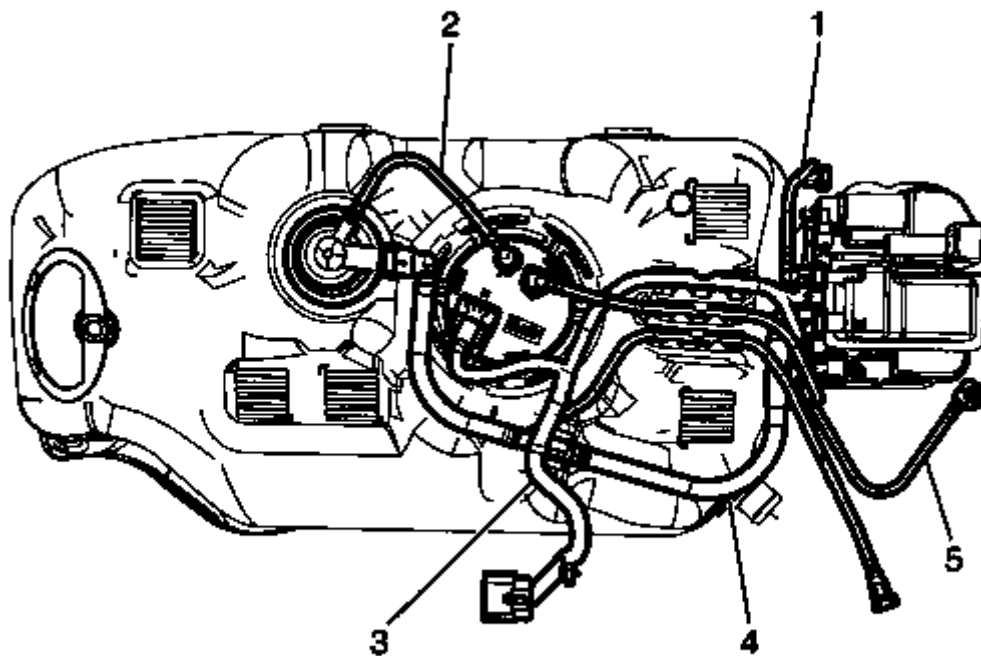


Fig. 24: Evaporative Emission Canister Purge Pipe
Courtesy of GENERAL MOTORS COMPANY

1. Remove the evaporative emission canister purge pipe (1).
2. Disconnect the fuel tank recirculation pipe connector (2).
3. Disconnect the fuel tank wiring harness (3) electrical connectors from the following:
 - Fuel tank pump
 - Fuel tank pressure sensor
 - Evaporative emission canister solenoid valve
4. Remove the fuel tank vent pipe (4).
5. Remove the fuel feed pipe (5).
6. Remove the evaporative emission canister. Refer to **Evaporative Emission Canister Replacement (LL0)**, **Evaporative Emission Canister Replacement (LFM)**.
7. Remove the fuel pump. Refer to .
8. Remove the fuel tank heat shield. Refer to **Fuel Tank Heat Shield Replacement (LL0)** , **Fuel Tank Heat Shield Replacement (LFM)** .

Assembly Procedure

1. Install the fuel tank heat shield. Refer to **Fuel Tank Heat Shield Replacement (LL0)** , **Fuel Tank Heat**

Shield Replacement (LFM) .

2. Install the fuel pump. Refer to .
3. Install the evaporative emission canister. Refer to **Evaporative Emission Canister Replacement (LL0)**, **Evaporative Emission Canister Replacement (LFM)**.

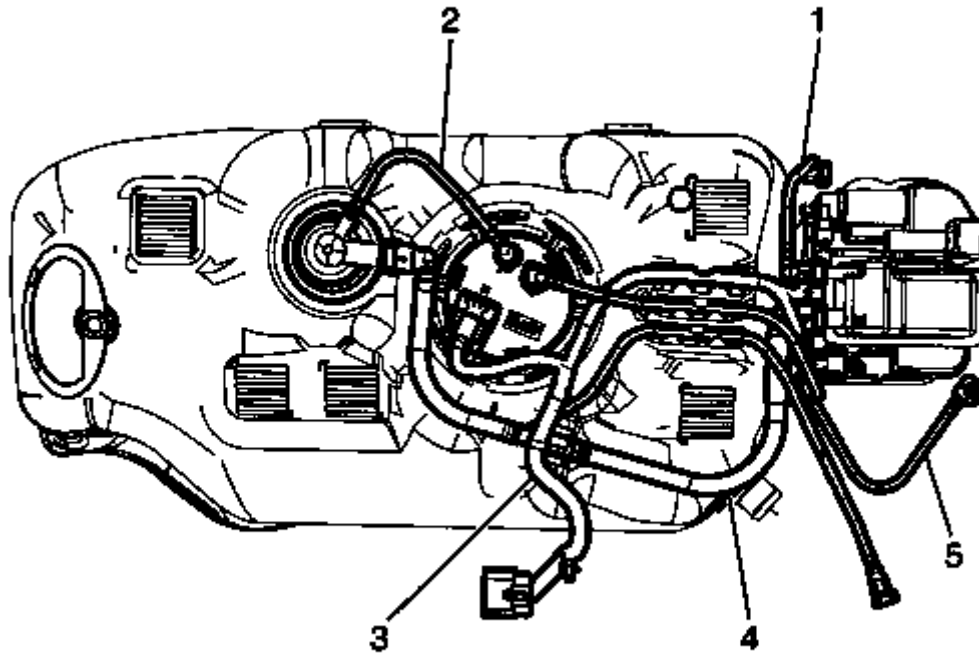


Fig. 25: Evaporative Emission Canister Purge Pipe
Courtesy of GENERAL MOTORS COMPANY

4. Install the fuel tank vent pipe (4).
5. Install the fuel feed pipe (5).
6. Install the evaporative emission canister purge pipe (1).
7. Connect the fuel tank recirculation pipe connector (2).
8. Connect the fuel tank wiring harness (3) electrical connectors to the following:
 - Fuel tank pump
 - Fuel tank pressure sensor
 - Evaporative emission canister solenoid valve

Installation Procedure

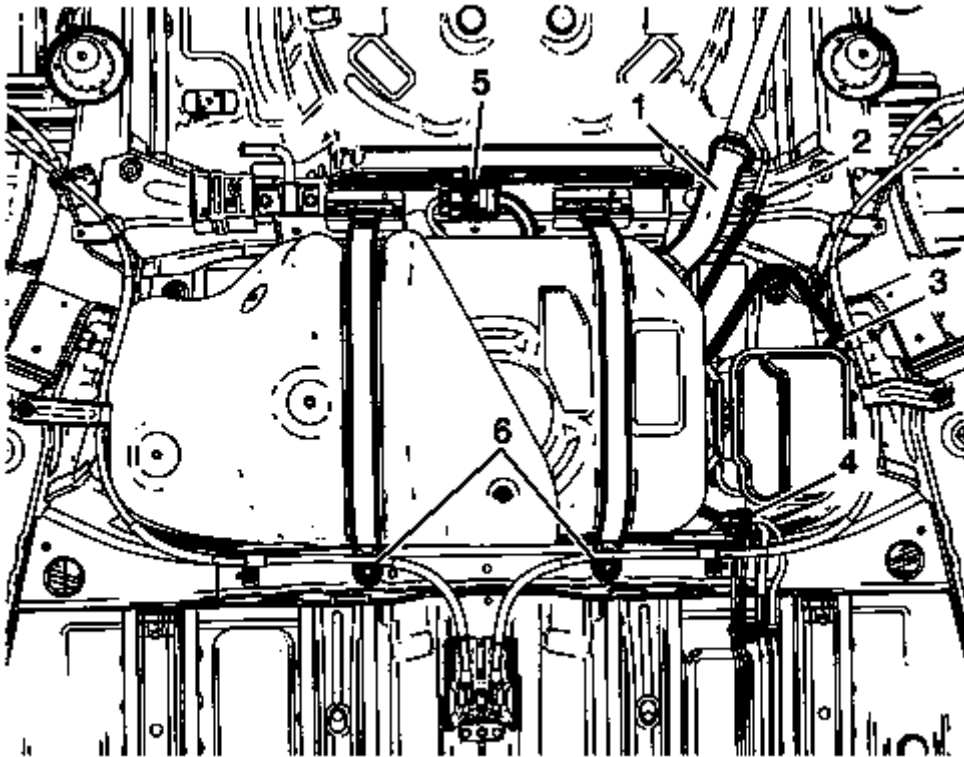


Fig. 26: Fuel Tank Filler Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

1. Using the adjustable jack, slowly raise and reposition the fuel tank in order to install the tank to the vehicle.
2. Install the fuel tank strap and strap bolts (6) and tighten to 20 (15 lb ft).
3. Remove the adjustable jack from under the fuel tank.
4. Connect the fuel tank filler hose (1) and clamp.
5. Connect the fuel tank vent pipe connector (2).
6. Connect the fuel feed pipe connector (3).
7. Connect the evaporative emission canister purge pipe connector (4).
8. Connect the fuel tank electrical extension connector (5).
9. Install the front exhaust muffler assembly. Refer to **Exhaust Muffler Replacement - Front (LL0)** .
10. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
11. Perform the following procedure in order to inspect for leaks:
 1. Turn the ignition ON, with the engine OFF, for 2 seconds.
 2. Turn the ignition OFF for 10 seconds.
 3. Turn the ignition ON, with the engine OFF.
 4. Inspect for fuel leaks.

FUEL TANK REPLACEMENT (LFM)

Removal Procedure

1. Open the hood.

WARNING: Refer to Battery Disconnect Warning .

2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection .
3. Relieve the fuel pressure. Refer to Fuel Pressure Relief.
4. Ensure that the fuel level in the tank is less than 1/4 full. If necessary, drain the fuel tank to at least this level. Refer to Fuel Tank Draining.
5. Disconnect the fuel line and wiring harness connectors. Refer to Fuel Tank Fuel Pump Module Replacement (LL0), Fuel Tank Fuel Pump Module Replacement (LFM).
6. Raise and suitably support the vehicle. Refer to Lifting and Jacking the Vehicle .

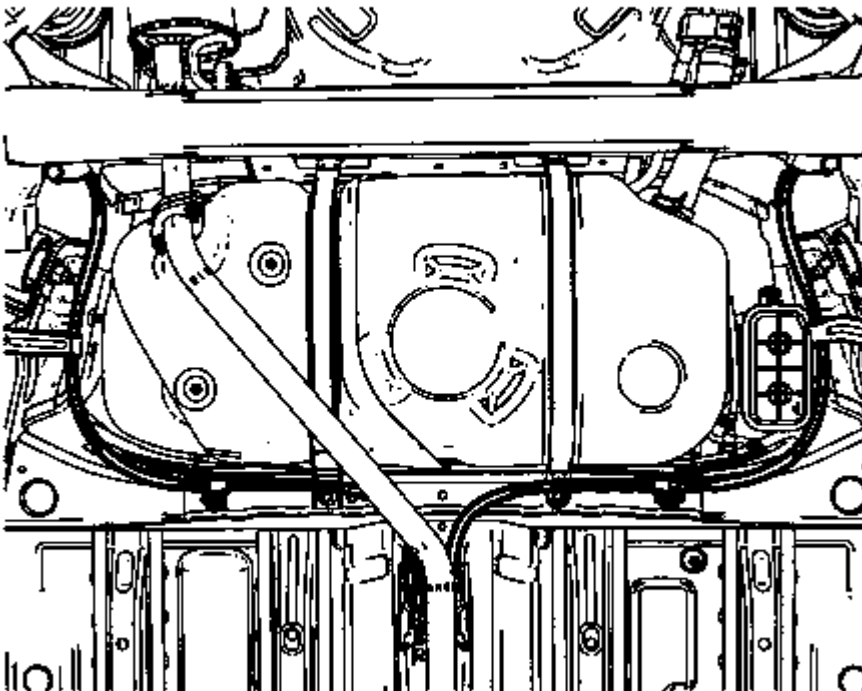


Fig. 27: Exhaust Pipe Assembly

Courtesy of GENERAL MOTORS COMPANY

7. Remove the exhaust pipe assembly. Refer to **Exhaust Pipe Replacement (LFM)** .
8. If needed, remove the parking brake cable retaining clamp and set it away from the path.

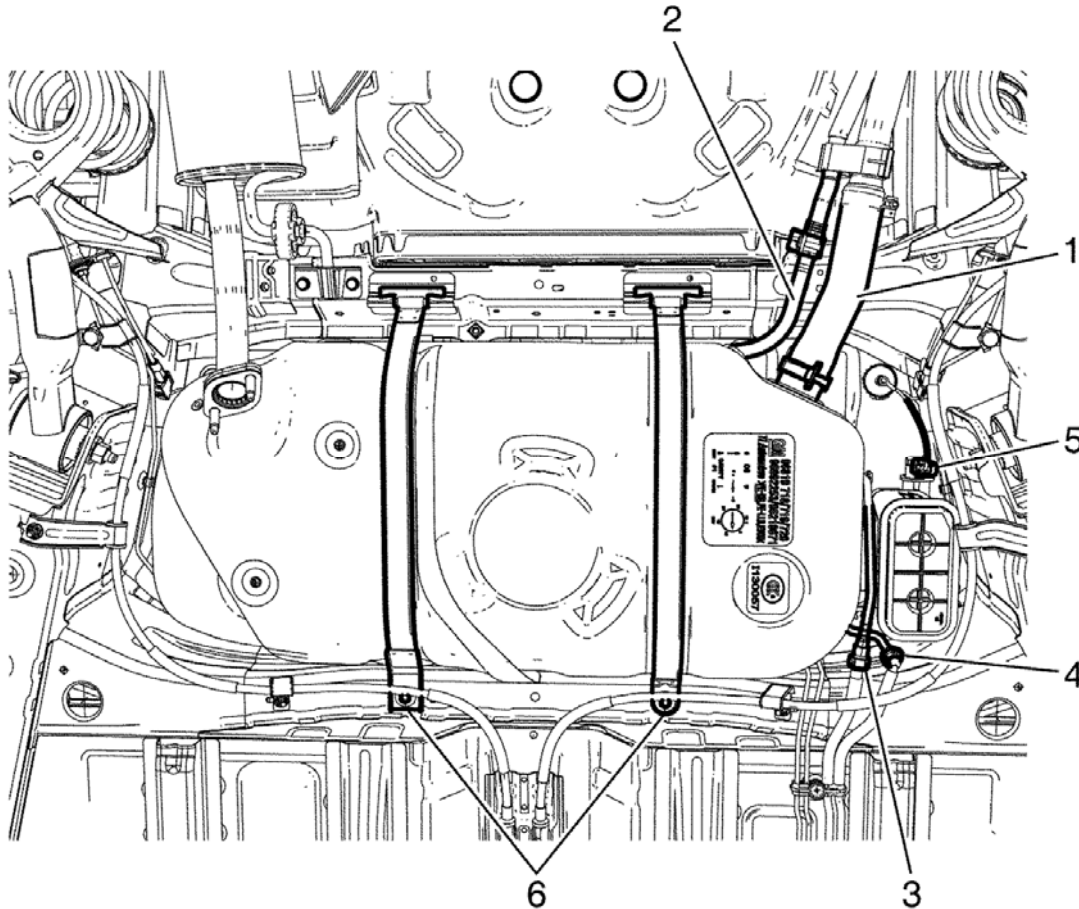


Fig. 28: Fuel Tank Filler Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

9. Disconnect the fuel tank filler hose (1) and clamp.
10. Disconnect the fuel tank vent pipe and clamp (2).
11. Disconnect the fuel feed pipe connector (3).
12. Disconnect the evaporative emission canister purge pipe (4).
13. Disconnect the evaporative emission canister vent solenoid valve electrical connector (5).
14. Place a suitable jack under the fuel tank.
15. Remove the fuel tank strap bolts (6) and straps.
16. Remove the fuel tank.

Disassembly Procedure

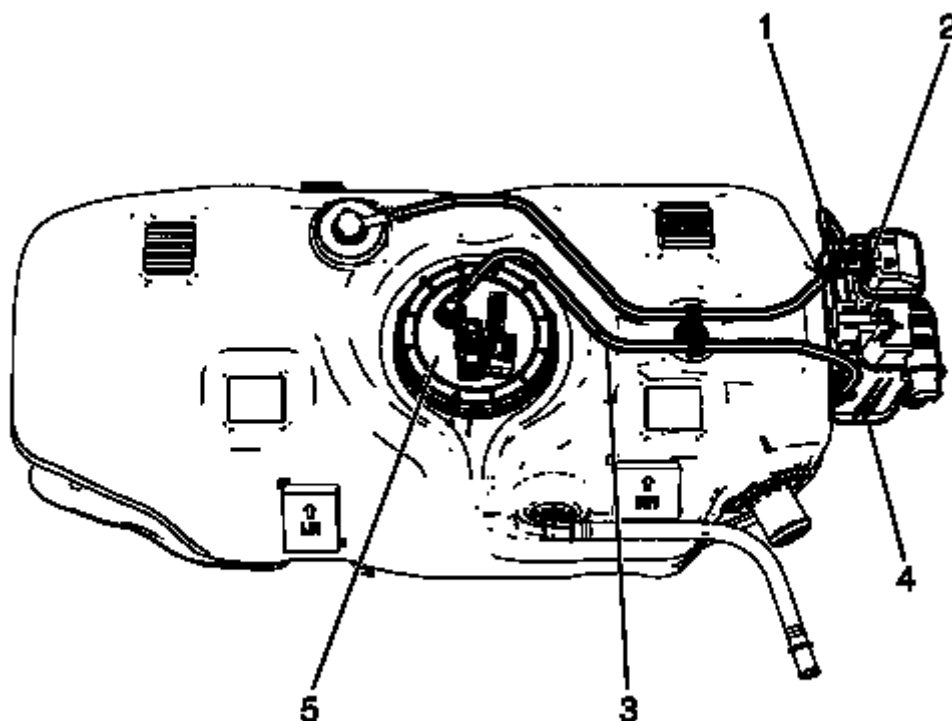


Fig. 29: Evaporative Emission Canister Purge Pipe
Courtesy of GENERAL MOTORS COMPANY

1. Remove the evaporative emission canister purge pipe (1).
2. Disconnect the fuel tank vent pipe connector (2).
3. Remove the fuel tank feed pipe (3).
4. Remove the evaporative emission canister (4). Refer to **Evaporative Emission Canister Replacement (LL0)**, **Evaporative Emission Canister Replacement (LFM)**.
5. Remove the fuel pump (5). Refer to **Fuel Tank Fuel Pump Module Replacement (LL0)**, **Fuel Tank Fuel Pump Module Replacement (LFM)**.
6. Remove the fuel tank heat shield. Refer to **Fuel Tank Heat Shield Replacement (LL0)**, **Fuel Tank Heat Shield Replacement (LFM)**.

Assembly Procedure

1. Install the fuel tank heat shield. Refer to **Fuel Tank Heat Shield Replacement (LL0)**, **Fuel Tank Heat Shield Replacement (LFM)**.
2. Install the fuel pump (5). Refer to **Fuel Tank Fuel Pump Module Replacement (LL0)**, **Fuel Tank Fuel Pump Module Replacement (LFM)**.
3. Install the evaporative emission canister (4). Refer to **Evaporative Emission Canister Replacement (LL0)**, **Evaporative Emission Canister Replacement (LFM)**.

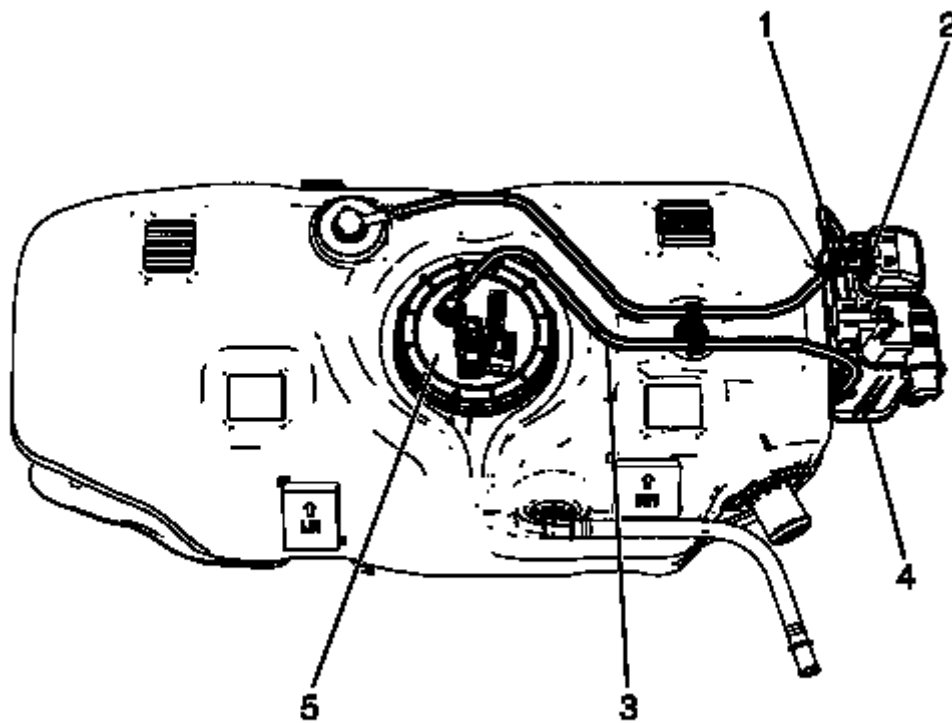


Fig. 30: Evaporative Emission Canister Purge Pipe
Courtesy of GENERAL MOTORS COMPANY

4. Install the fuel tank feed pipe (3).
5. Connect the fuel tank vent pipe connector (2).
6. Install the evaporative emission canister purge pipe (1).

Installation Procedure

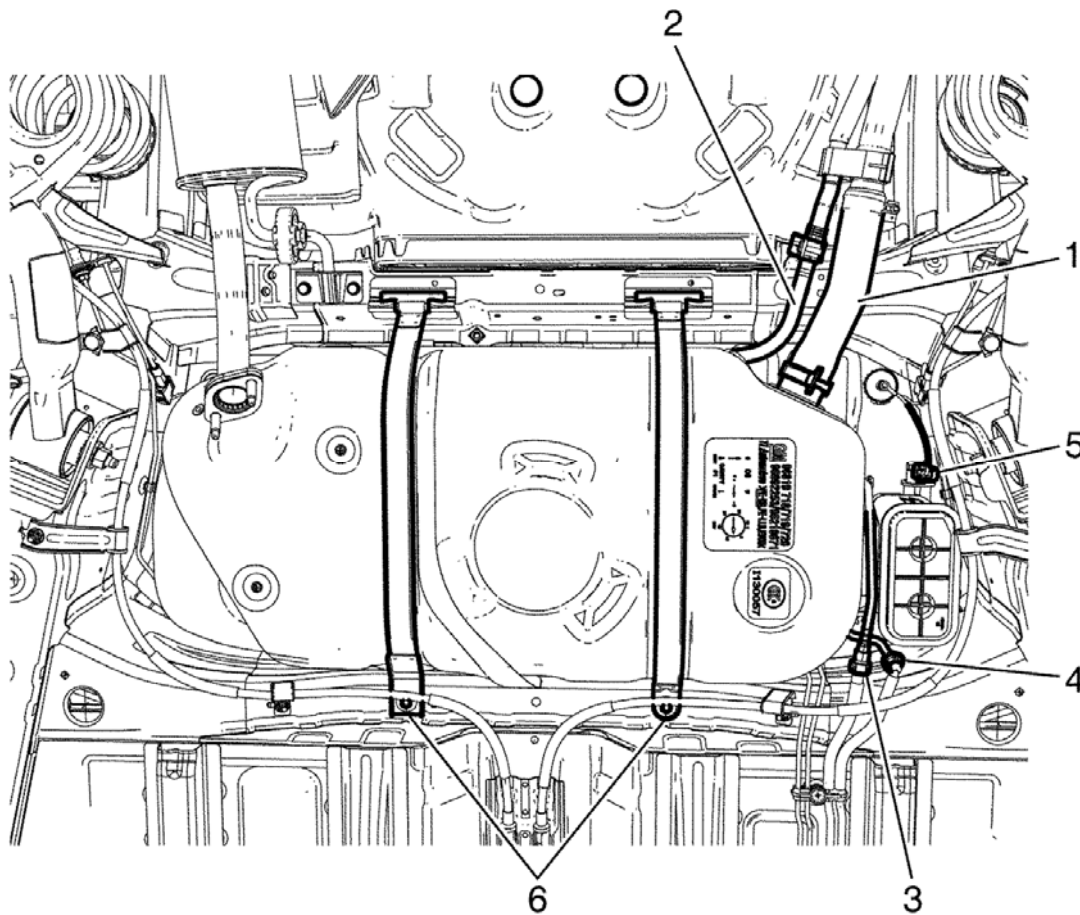


Fig. 31: Fuel Tank Filler Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

1. Using the adjustable jack, slowly raise and reposition the fuel tank in order to install the tank to the vehicle.

CAUTION: Refer to Fastener Caution .

2. Install the fuel tank strap and strap bolts (6) and tighten to 20 (15 lb ft).
3. Remove the adjustable jack from under the fuel tank.
4. Connect the fuel tank filler hose (1) and clamp.
5. Connect the fuel tank vent pipe connector and clamp (2).
6. Connect the fuel feed pipe connector (3).
7. Connect the evaporative emission canister purge pipe connector (4).
8. Connect the evaporative emission canister vent solenoid valve electrical connector (5).

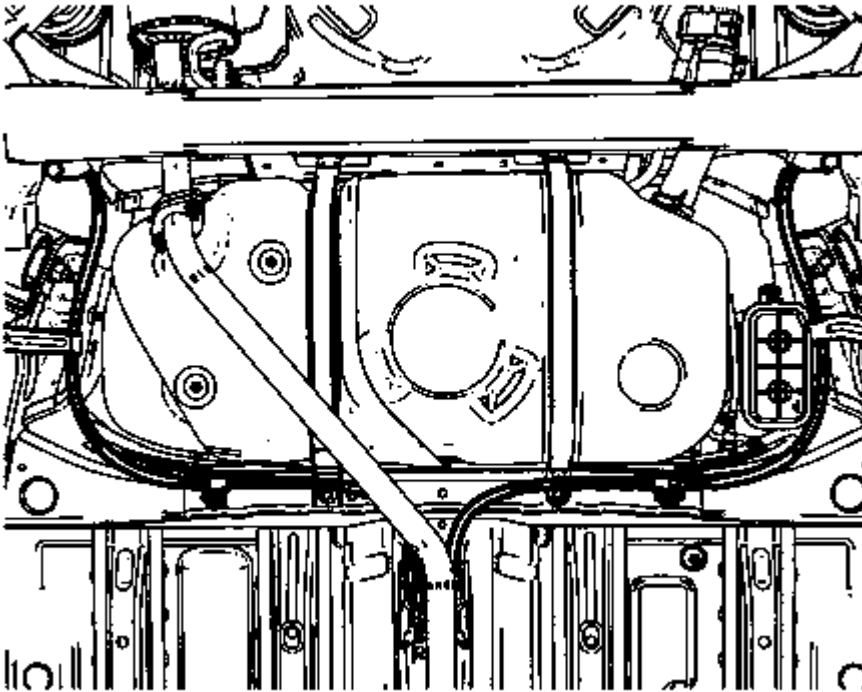


Fig. 32: Exhaust Pipe Assembly

Courtesy of GENERAL MOTORS COMPANY

9. Install the exhaust pipe assembly. Refer to **Exhaust Pipe Replacement (LFM)** .
10. Lower the vehicle. Refer to **Lifting and Jacking the Vehicle** .
11. Connect the fuel line and wiring harness connectors. Refer to **Fuel Tank Fuel Pump Module Replacement (LL0)**, **Fuel Tank Fuel Pump Module Replacement (LFM)**.
12. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
13. Perform the following procedure in order to inspect for leaks:
 1. Turn the ignition ON, with the engine OFF, for 2 seconds.
 2. Turn the ignition OFF for 10 seconds.
 3. Turn the ignition ON, with the engine OFF.
 4. Inspect for fuel leaks.

FUEL LEVEL SENSOR REPLACEMENT (LL0)

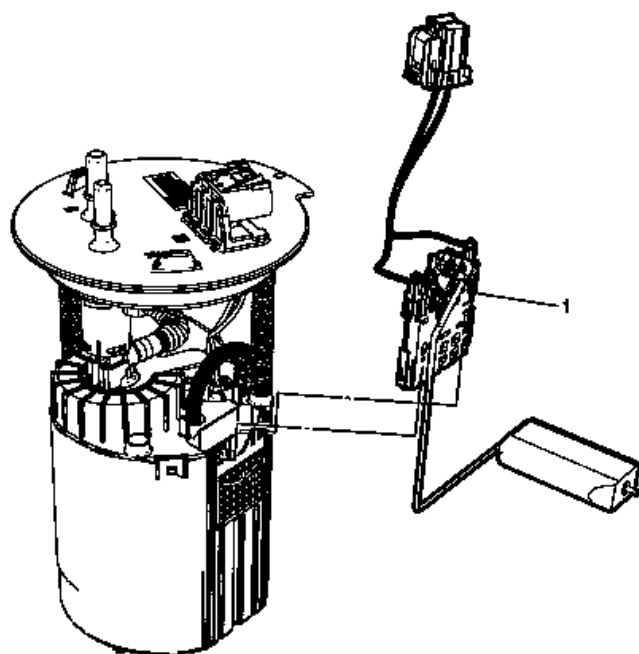


Fig. 33: Fuel Level Sensor

Courtesy of GENERAL MOTORS COMPANY

Fuel Level Sensor Replacement (LL0)

Callout	Component Name
Preliminary Procedures Remove the fuel pump. Refer to Fuel Tank Fuel Pump Module Replacement (LL0) , Fuel Tank Fuel Pump Module Replacement (LFM) .	
1	Fuel Level Sensor Procedure 1. Disconnect the fuel level sensor electrical connector. 2. Remove the fuel level sensor.

FUEL LEVEL SENSOR REPLACEMENT (LFM)

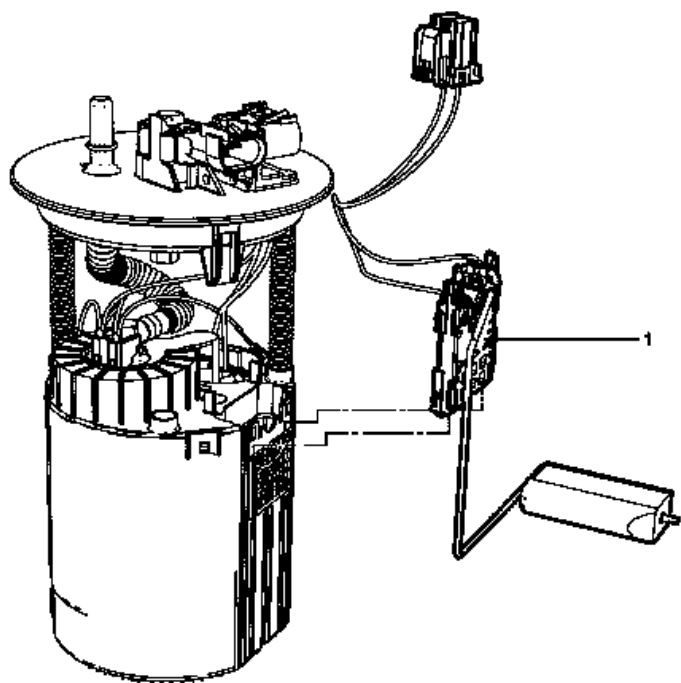


Fig. 34: Fuel Level Sensor (LFM)
 Courtesy of GENERAL MOTORS COMPANY

Fuel Level Sensor Replacement (LFM)

Callout	Component Name
Preliminary Procedure Remove the fuel pump. Refer to Fuel Tank Fuel Pump Module Replacement (LL0) , Fuel Tank Fuel Pump Module Replacement (LFM) .	
1	Fuel Level Sensor Procedure 1. Disconnect the fuel level sensor electrical connector. 2. Remove the fuel level sensor.

FUEL TANK PRESSURE SENSOR REPLACEMENT (LL0)

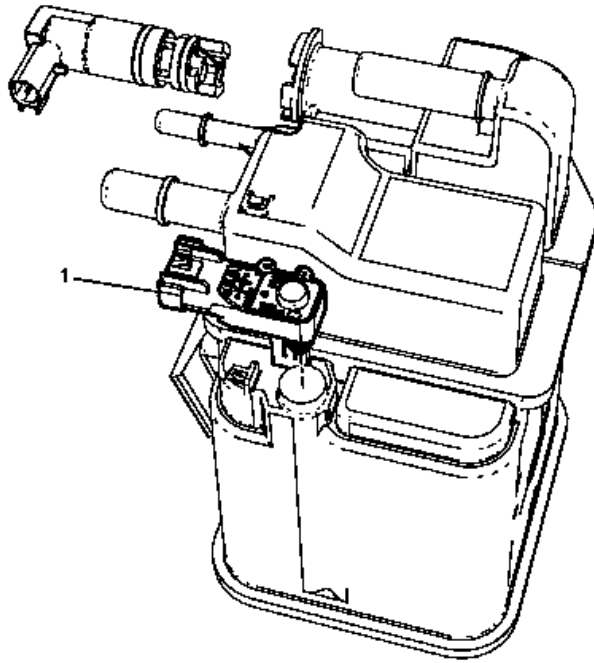


Fig. 35: Fuel Tank Pressure Sensor
 Courtesy of GENERAL MOTORS COMPANY

Fuel Tank Pressure Sensor Replacement (LL0)

Callout	Component Name
Preliminary Procedures	
1. Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Raise the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> .	
1	Fuel Tank Pressure Sensor Procedure 1. Disconnect the fuel tank pressure sensor electrical connector. 2. Remove the fuel tank pressure sensor.

FUEL TANK PRESSURE SENSOR REPLACEMENT (LFM)

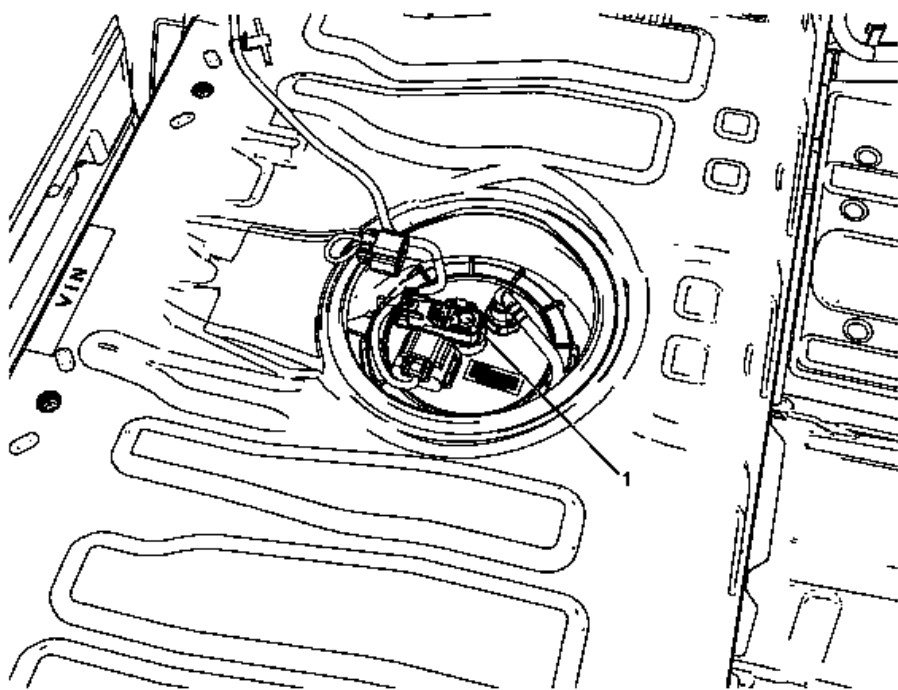


Fig. 36: Fuel Tank Pressure Sensor (LFM)
 Courtesy of GENERAL MOTORS COMPANY

Fuel Tank Pressure Sensor Replacement (LFM)

Callout	Component Name
Preliminary Procedures	
1. Disconnect the battery negative cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Fold the rear seat, remove the fuel pump cover. 3. Disconnect the fuel tank pressure sensor electrical connector.	
1	Fuel Tank Pressure Sensor Procedure Remove the fuel tank pressure sensor from the fuel pump.

FUEL TANK FUEL PUMP MODULE REPLACEMENT (LL0)

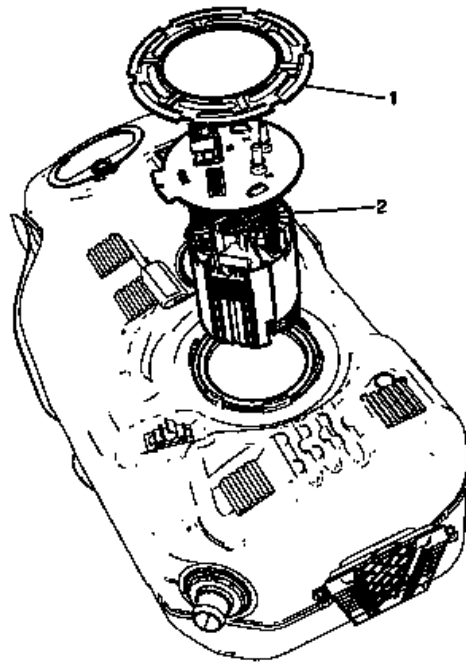


Fig. 37: Fuel Pump

Courtesy of GENERAL MOTORS COMPANY

Fuel Tank Fuel Pump Module Replacement (LL0)

Callout	Component Name
Preliminary Procedures 1. Remove the fuel tank. Refer to <u>Fuel Tank Replacement (LL0)</u>, <u>Fuel Tank Replacement (LFM)</u>. 2. Disconnect the evaporative emission vent pipe connector and fuel feed connector.	
1	Fuel Pump Lock Ring CAUTION: Refer to <u>Fastener Caution</u> . Procedure Remove the fuel pump lock ring using J-45747 fuel sending unit wrench. Special Tools J-45747 Fuel Sending Unit Wrench For equivalent regional tools, refer to <u>Special Tools (Diagnostic Tools)</u> .
2	Fuel Pump

FUEL TANK FUEL PUMP MODULE REPLACEMENT (LFM)

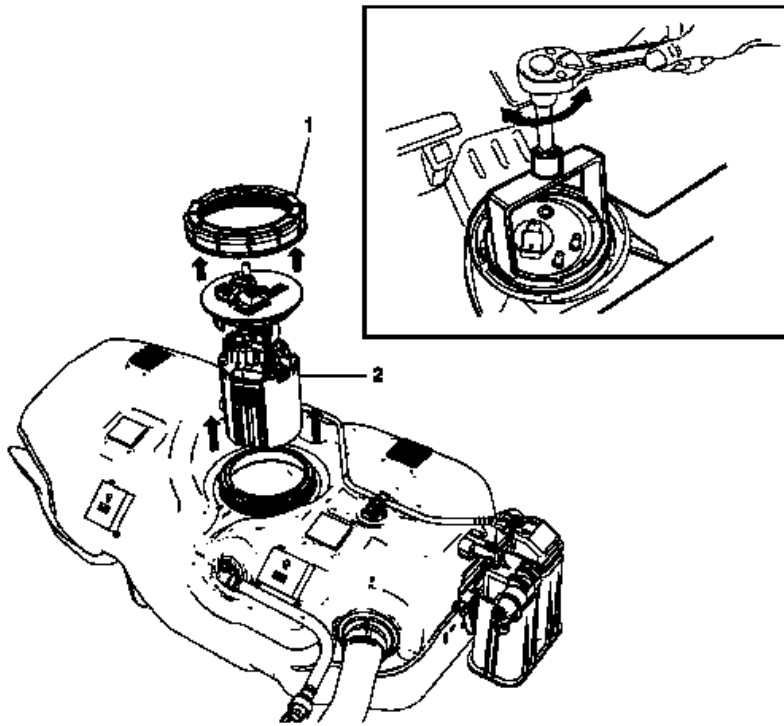


Fig. 38: Fuel Tank Fuel Pump Module (LFM)
 Courtesy of GENERAL MOTORS COMPANY

Fuel Tank Fuel Pump Module Replacement (LFM)

Callout	Component Name
Preliminary Procedures	
1. Relieve the fuel pressure. Refer to <u>Fuel Pressure Relief</u> . 2. Disconnect battery negative cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 3. Fold rear seat, remove fuel pump cover, and disconnect fuel line and wiring harness.	
1	Fuel Pump Lock Ring Procedure Remove fuel pump lock ring using EN-50167 ring. Special Tools EN-50167 Fuel Pump Lock Ring Remover/Installer For equivalent regional tools, refer to <u>Special Tools (Diagnostic Tools)</u> .
2	Fuel Pump Procedure Remove fuel pump assemble above.

FUEL INJECTION FUEL RAIL ASSEMBLY REPLACEMENT (LFM)

Removal Procedure

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
2. Relieve the fuel pressure. Refer to **Fuel Pressure Relief**.
3. Remove the upper intake manifold. Refer to **Upper Intake Manifold Replacement (LFM)** .
4. Remove the 4 ignition coil connectors. Refer to **Ignition Coil Replacement (LL0)**, **Ignition Coil Replacement (LFM)**.
5. Remove the positive crankcase ventilation hose. Refer to **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (LL0)** , **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (LFM)** .
6. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** .
7. Remove the intake manifold rear bracket. Refer to **Lower Intake Manifold Replacement (LFM)** .

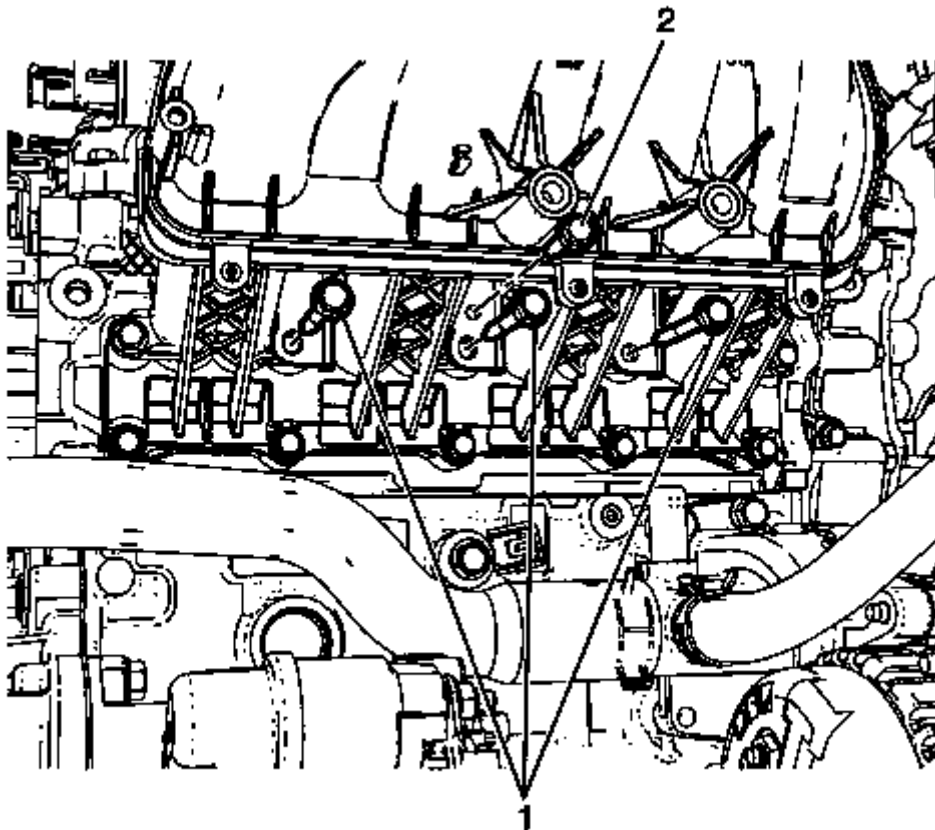


Fig. 39: Fuel Rail Retaining Bolts
Courtesy of GENERAL MOTORS COMPANY

8. Remove the fuel rail retaining bolts (1, 2).
9. Lower the vehicle.

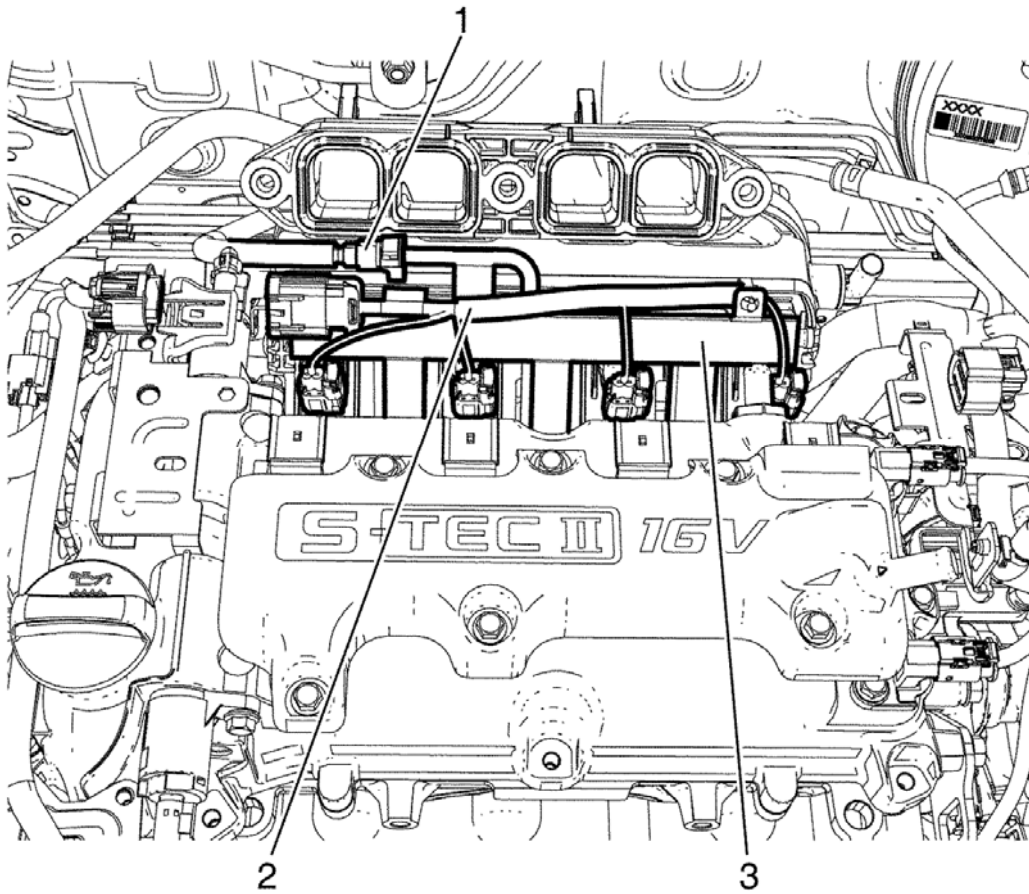


Fig. 40: Fuel Feed Hose Connector
Courtesy of GENERAL MOTORS COMPANY

10. Disconnect the fuel feed hose connector (1) from the fuel rail.
11. Disconnect the 4 fuel injector electrical connectors and remove the fuel injector rail wiring harness (2).
12. Remove the fuel rail and fuel injector (3).

Installation Procedure

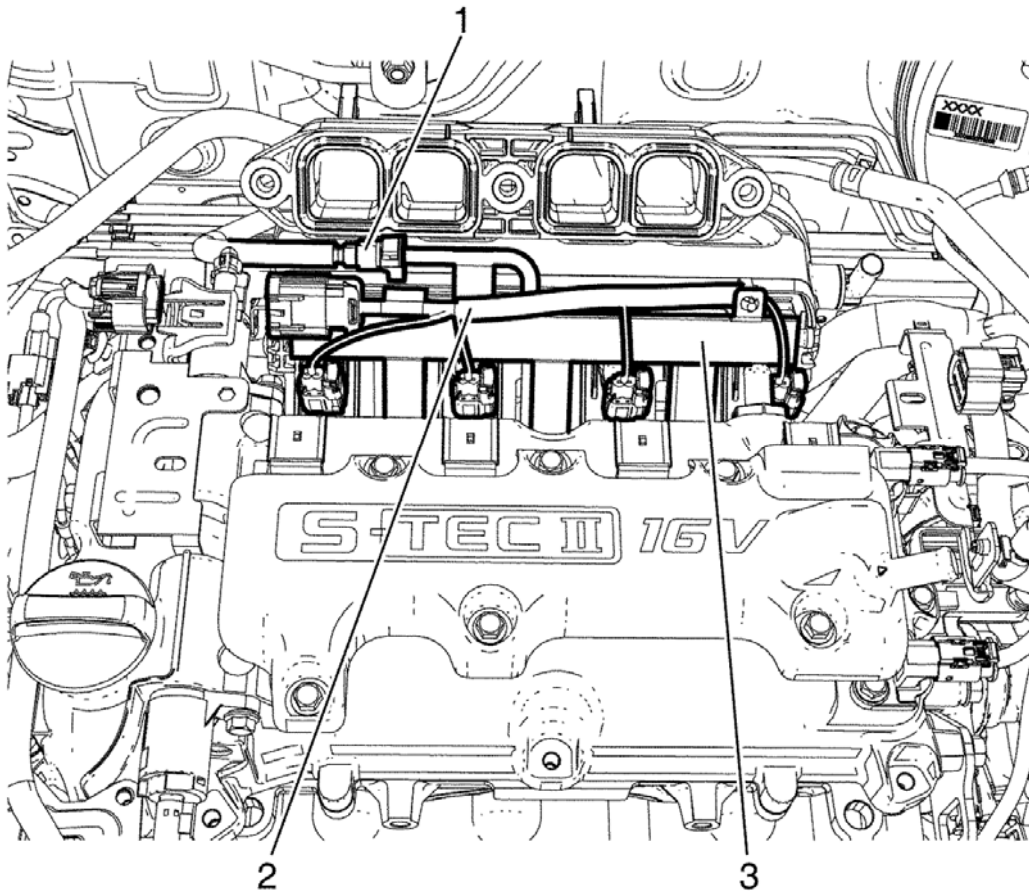


Fig. 41: Fuel Feed Hose Connector
Courtesy of GENERAL MOTORS COMPANY

1. Install the fuel rail and fuel injector (3).
2. Install the fuel injector rail wiring harness (2) and connect the 4 fuel injector electrical connectors.
3. Connect the fuel feed hose connector (1) to the fuel rail.
4. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** .

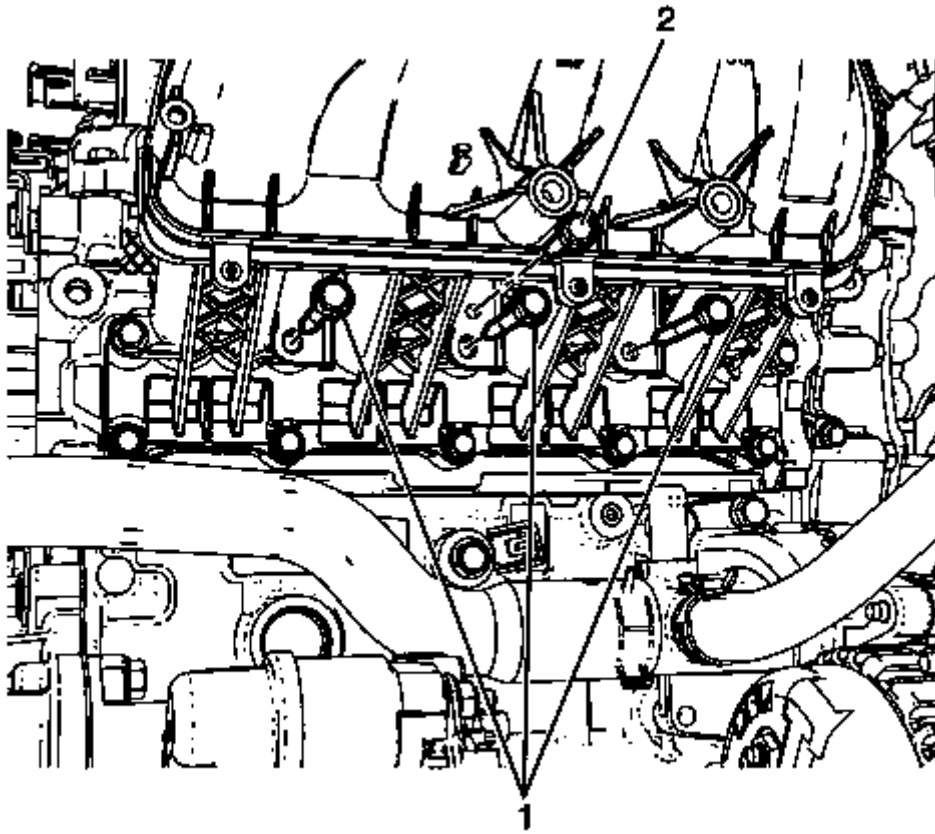


Fig. 42: Fuel Rail Retaining Bolts
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

5. Install the fuel rail retaining bolts (1, 2) and tighten to 10 (89 lb in)
6. Install the intake manifold rear bracket. Refer to Lower Intake Manifold Replacement (LFM) .
7. Lower the vehicle.
8. Install the positive crankcase ventilation hose. Refer to Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (LL0) , Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (LFM) .
9. Install the 4 ignition coil connectors. Refer to Ignition Coil Replacement (LL0), Ignition Coil Replacement (LFM).
10. Install the upper intake manifold. Refer to Upper Intake Manifold Replacement (LFM) .
11. Connect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection .

FUEL INJECTION FUEL RAIL ASSEMBLY REPLACEMENT (LL0)

Removal Procedure

1. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and

Connection .

2. Relieve the fuel pressure. Refer to **Fuel Pressure Relief.**
3. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement.**
4. Remove the positive crankcase ventilation hose. Refer to **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (LL0) , Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (LFM) .**
5. Disconnect the fuel feed line quick connect fitting from the fuel rail. Refer to **Metal Collar Quick Connect Fitting Service.**
6. Disconnect the fuel rail and fuel injector connector.
7. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle .**
8. Remove the exhaust front pipe assembly. Refer to **Exhaust Front Pipe Replacement (LL0) .**

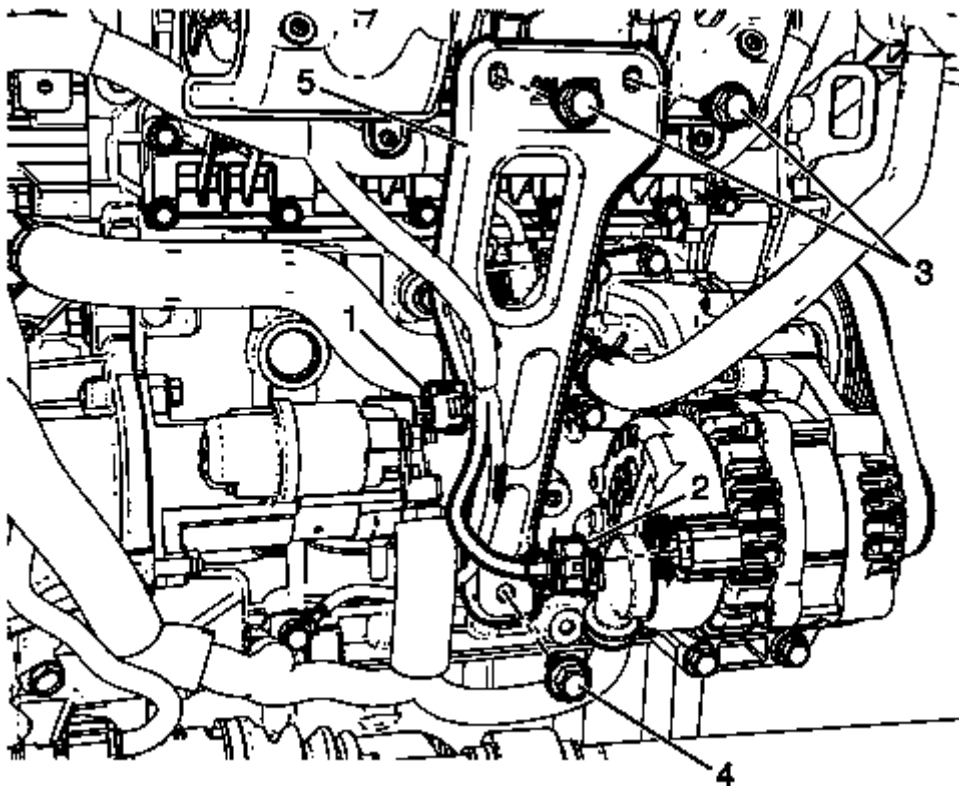


Fig. 43: Starter Connector Wiring Harness Plug
Courtesy of GENERAL MOTORS COMPANY

9. Disconnect the starter connector wiring harness plug (1).
10. Disconnect the generator connector wiring harness plug (2).
11. Remove the 2 intake manifold rear bracket bolts (up) (3).
12. Remove the intake manifold rear bracket bolt (down) (4).
13. Remove the intake manifold bracket (5).

14. Transfer parts as necessary.

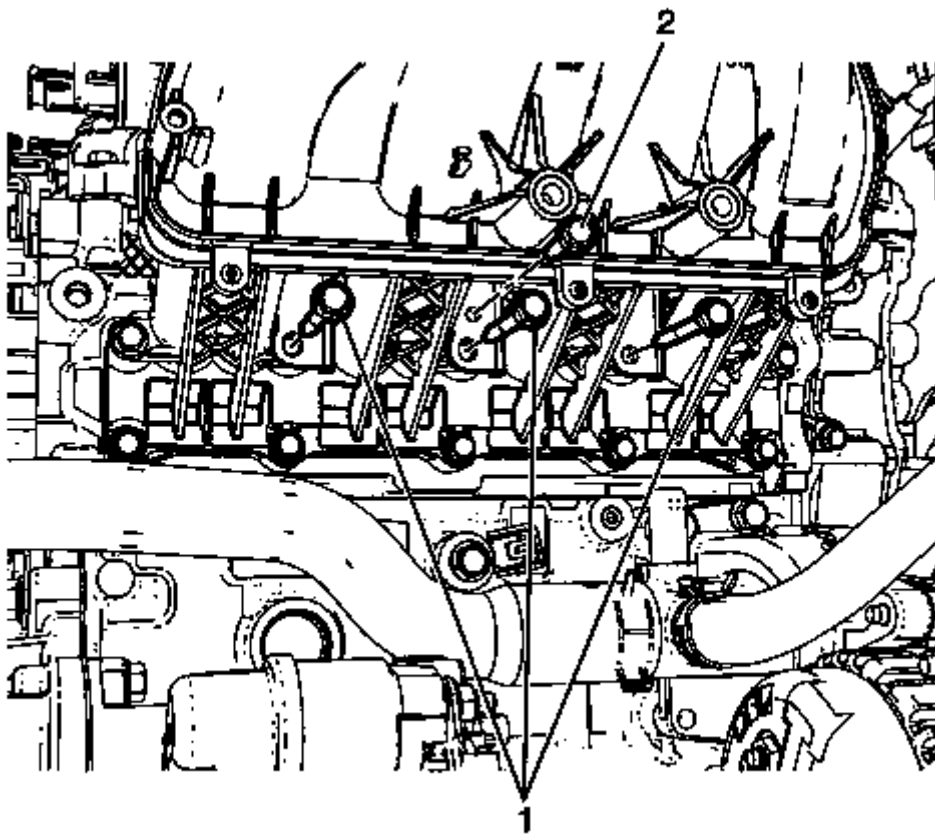


Fig. 44: Fuel Rail Retaining Bolts
Courtesy of GENERAL MOTORS COMPANY

15. Remove the fuel rail retaining bolts (1, 2).
16. Lower the vehicle.

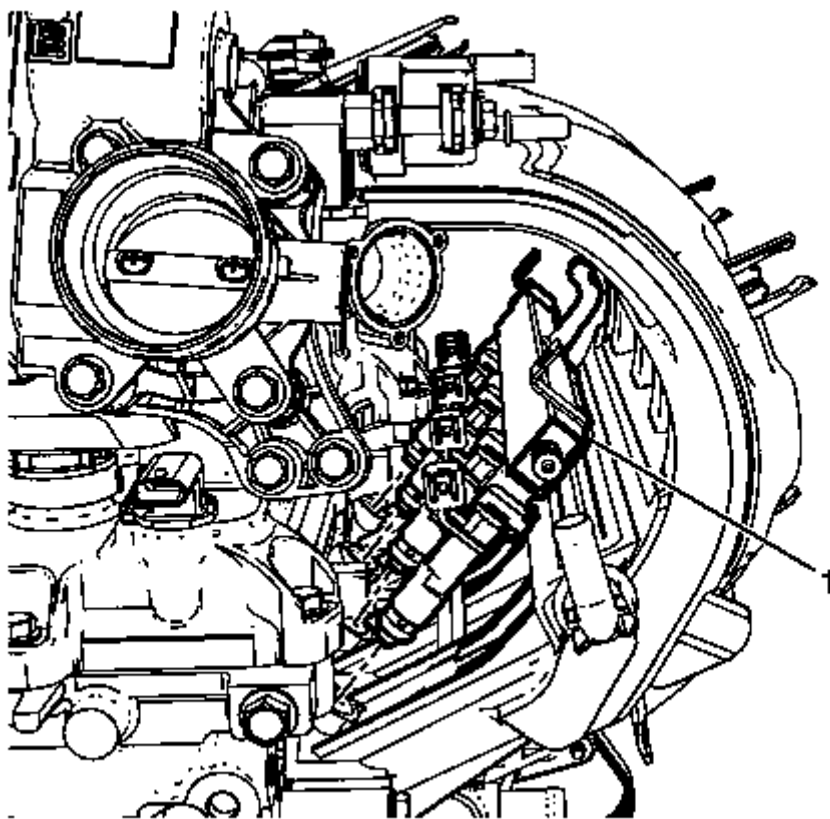


Fig. 45: Fuel Rail And Fuel Injector
Courtesy of GENERAL MOTORS COMPANY

17. Remove the fuel rail and fuel injector connector (1).

Installation Procedure

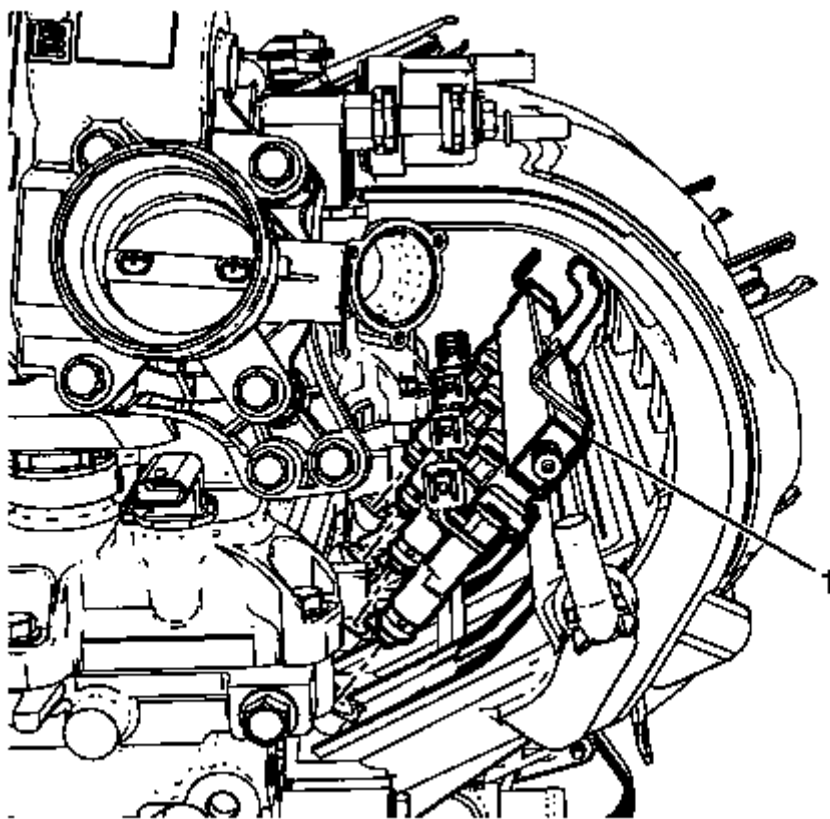


Fig. 46: Fuel Rail And Fuel Injector
Courtesy of GENERAL MOTORS COMPANY

1. Install the fuel rail and fuel injector (1).
2. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** .

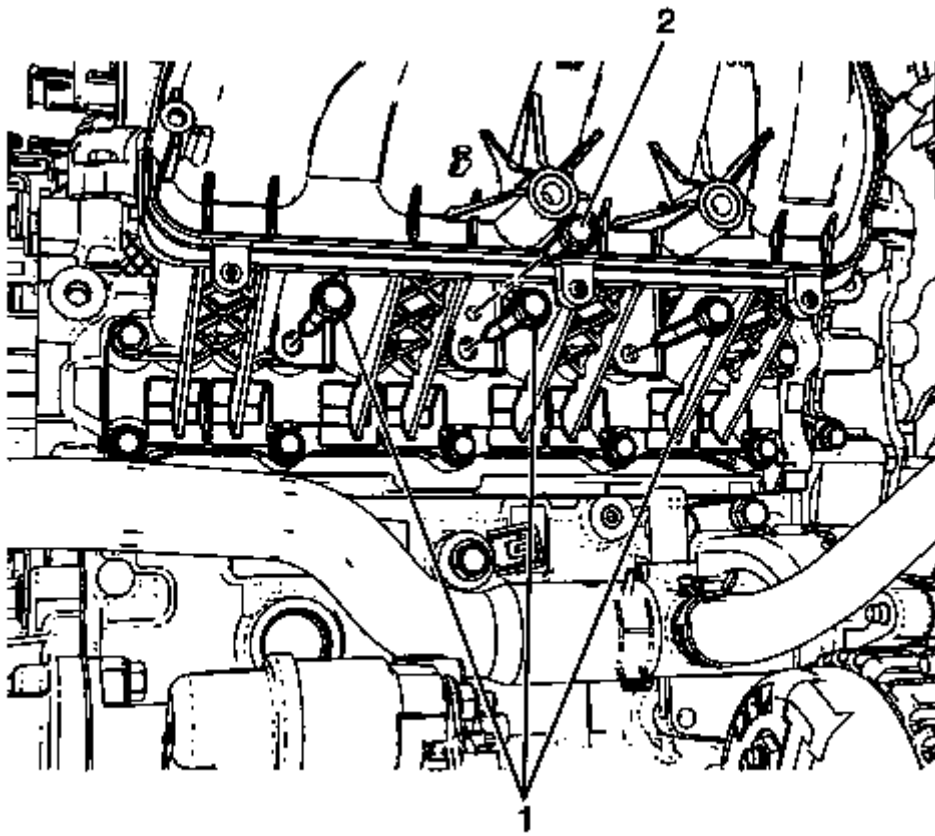


Fig. 47: Fuel Rail Retaining Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

3. Install the fuel rail retaining bolts (1, 2) and tighten to 10 (89 lb in).

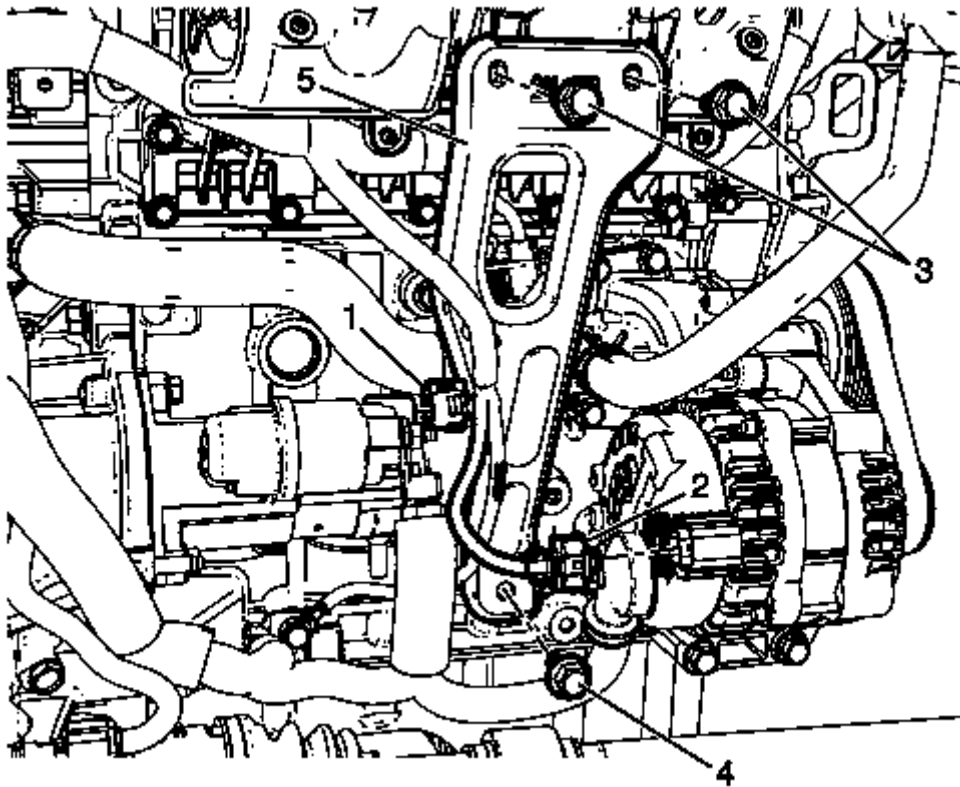


Fig. 48: Starter Connector Wiring Harness Plug
Courtesy of GENERAL MOTORS COMPANY

4. Install the intake manifold bracket (5).
5. Install the 2 intake manifold rear bracket bolts (up) (3) and tighten to 22 (16 lb ft).
6. Install the intake manifold rear bracket bolt (down) (4) and tighten to 58 (42 lb ft).
7. Connect the starter connector wiring harness plug (1).
8. Connect the generator connector wiring harness plug (2).
9. Install the exhaust front pipe assembly. Refer to **Exhaust Front Pipe Replacement (LL0)** .
10. Lower the vehicle.
11. Connect the fuel rail and fuel injector connector.
12. Connect the fuel feed line quick connect fitting to the fuel rail. Refer to **Metal Collar Quick Connect Fitting Service**.
13. Install the positive crankcase ventilation hose. Refer to **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (LL0)** , **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (LFM)** .
14. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement**.
15. Connect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection** .

FUEL INJECTOR REPLACEMENT

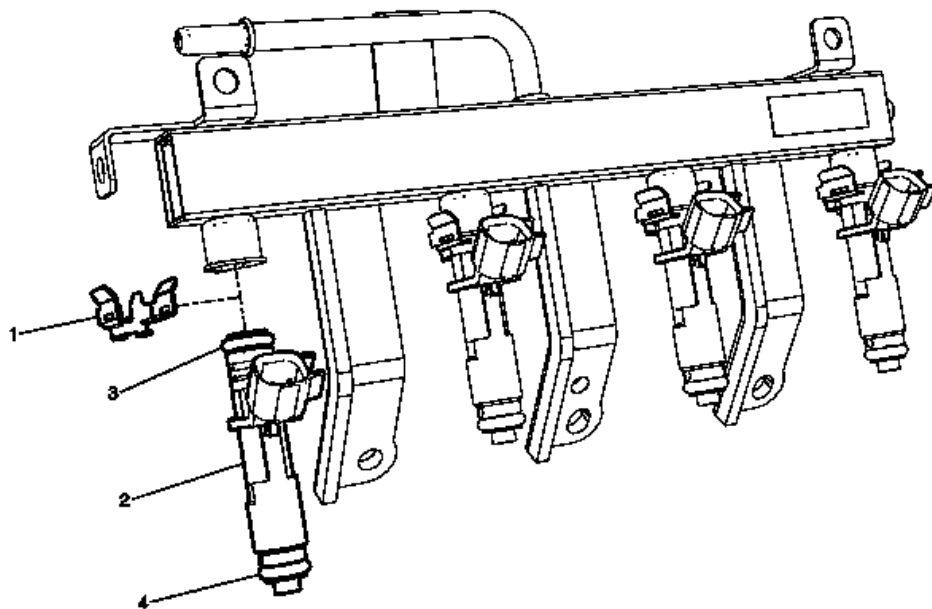


Fig. 49: Fuel Injector
 Courtesy of GENERAL MOTORS COMPANY

Fuel Injector Replacement

Callout	Component Name
Preliminary Procedure Remove the fuel rail. Refer to Fuel Injection Fuel Rail Assembly Replacement (LFM) , Fuel Injection Fuel Rail Assembly Replacement (LL0) .	
1	Fuel Injector Retainer Clip (Qty: 4) Procedure Remove the fuel injector retainer clip.
2	Fuel Injector (Qty: 4) Procedure Disconnect the fuel injector pulling down.
3	Fuel Injector Upper O-ring (Qty: 4) Procedure Replace the fuel injector with the New O-ring.
4	Fuel Injector Lower O-ring (Qty: 4) Procedure Replace the fuel injector with the New O-ring.

FUEL TANK FILLER PIPE REPLACEMENT (LL0)

Removal Procedure

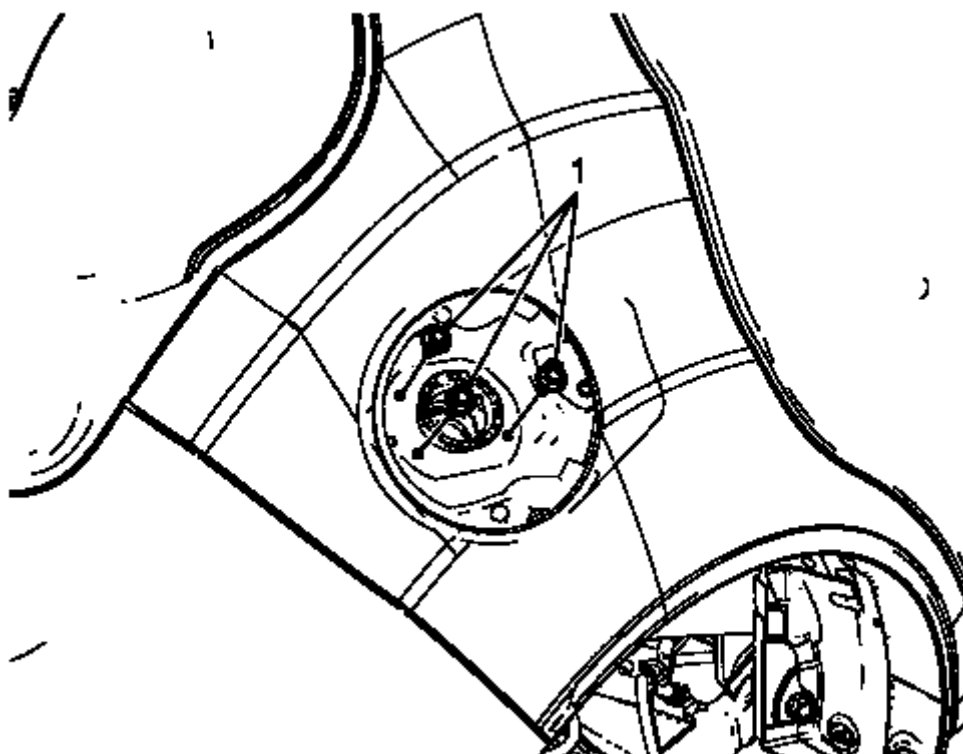


Fig. 50: Fuel Tank Filler Pipe

Courtesy of GENERAL MOTORS COMPANY

1. Open the fuel filler door and filler cap.
2. Remove the fuel filler pipe upper bolts (1).
3. Lift and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

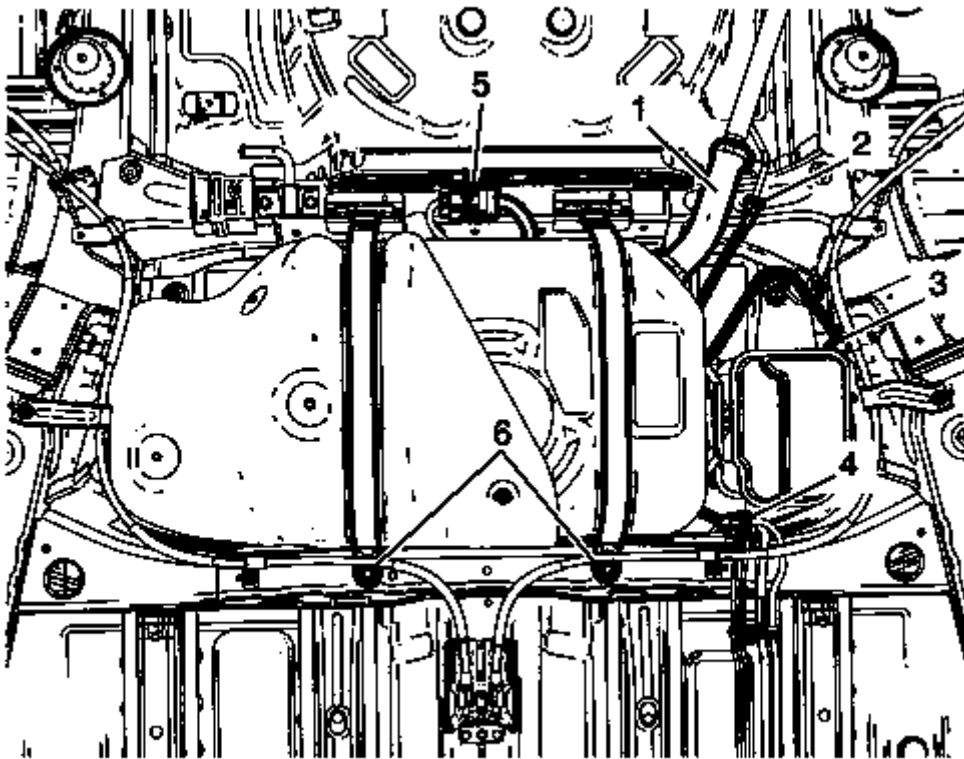


Fig. 51: Fuel Tank Filler Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the fuel tank filler hose (1) and clamp.
5. Disconnect the fuel tank vent pipe connector (2).

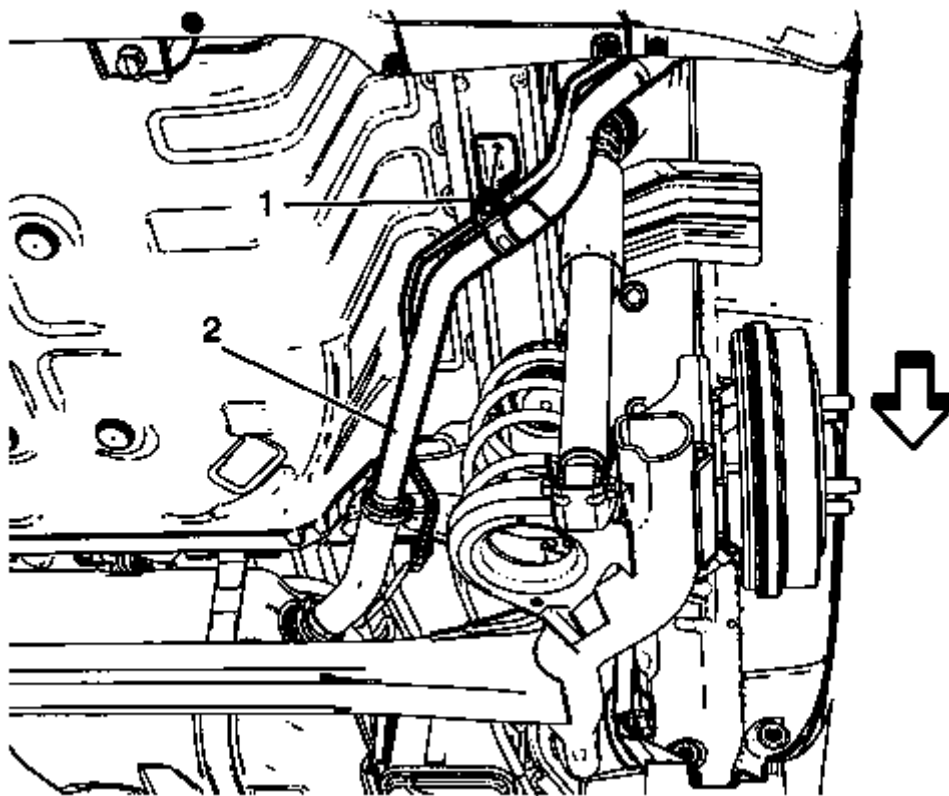


Fig. 52: Fuel Tank Filler Pipe Lower Bolt
Courtesy of GENERAL MOTORS COMPANY

6. Remove the fuel tank filler pipe lower bolt (1).
7. Remove the fuel tank filler pipe assembly (2).

Installation Procedure

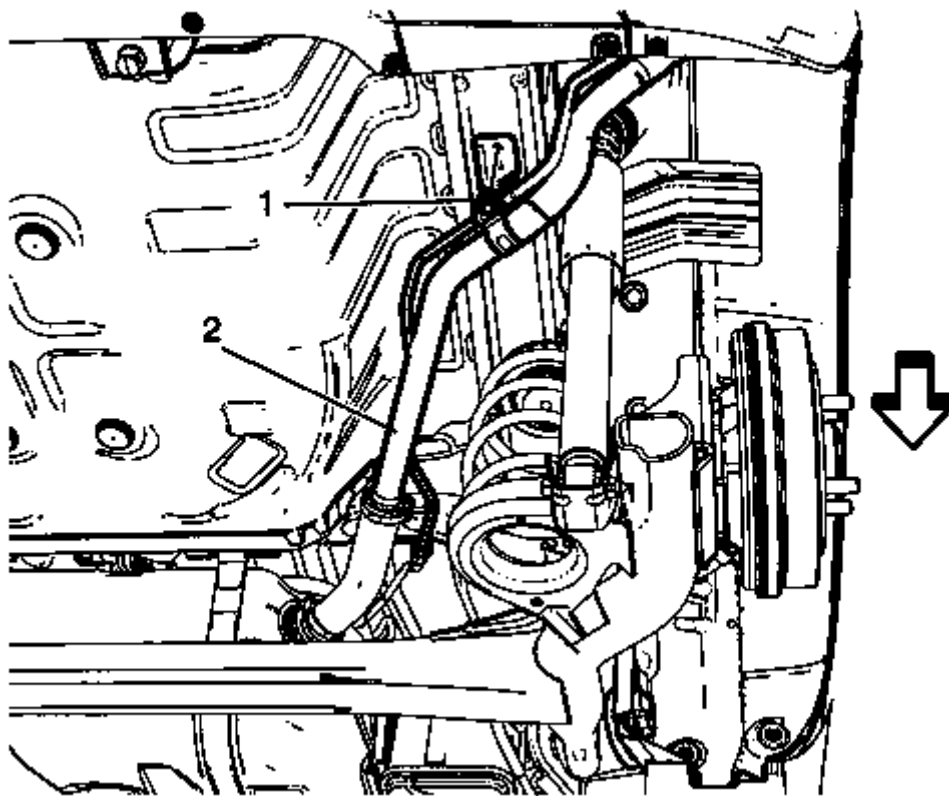


Fig. 53: Fuel Tank Filler Pipe Lower Bolt
Courtesy of GENERAL MOTORS COMPANY

1. Install the fuel tank filler pipe assembly (2).

CAUTION: Refer to Fastener Caution .

2. Install the fuel tank filler pipe lower bolt (1) and tighten to 6 (53 lb in).

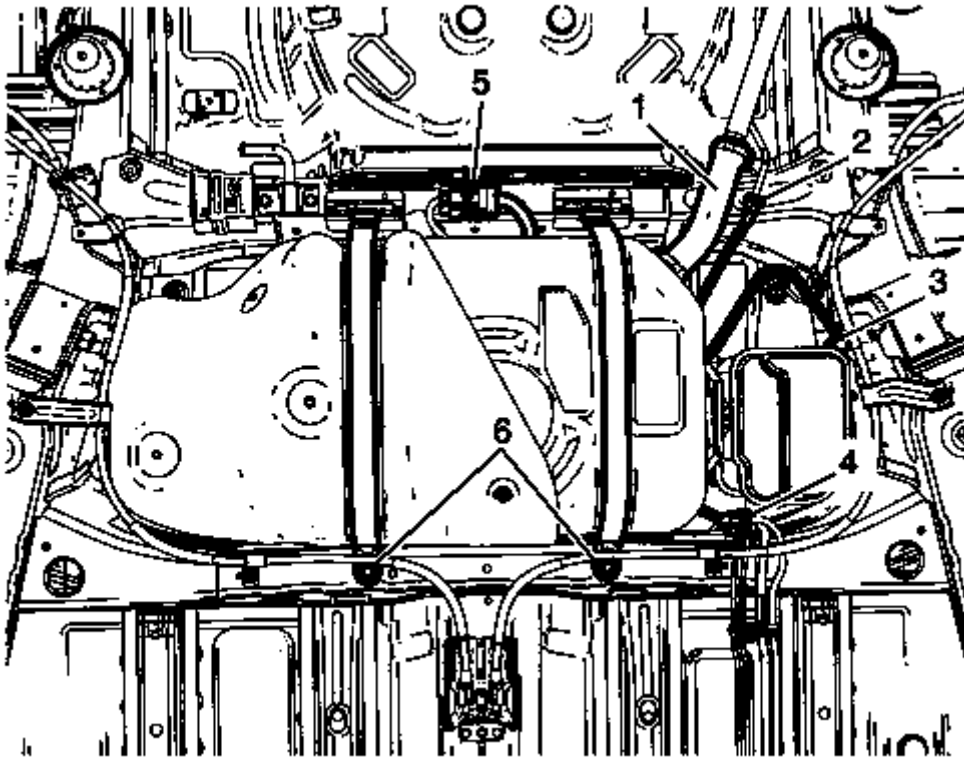


Fig. 54: Fuel Tank Filler Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

3. Connect the fuel tank filler hose (1) and clamp,
4. Tighten fuel tank filler hose clamp to 6 (53 lb in).
5. Connect the fuel tank vent pipe connector (2).
6. Lower the vehicle. Refer to **Lifting and Jacking the Vehicle** .

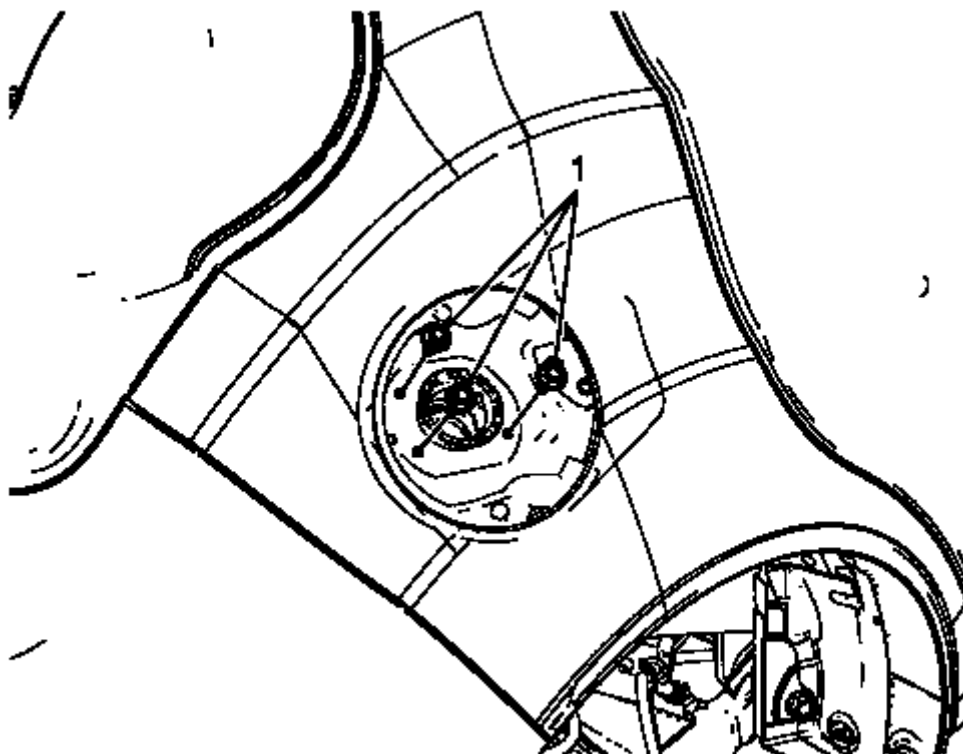


Fig. 55: Fuel Tank Filler Pipe

Courtesy of GENERAL MOTORS COMPANY

7. Install the fuel filler pipe upper bolts (1) and tighten to 6 (53 lb in).
8. Close the fuel filler door and filler cap.

FUEL TANK FILLER PIPE REPLACEMENT (LFM)

Removal Procedure

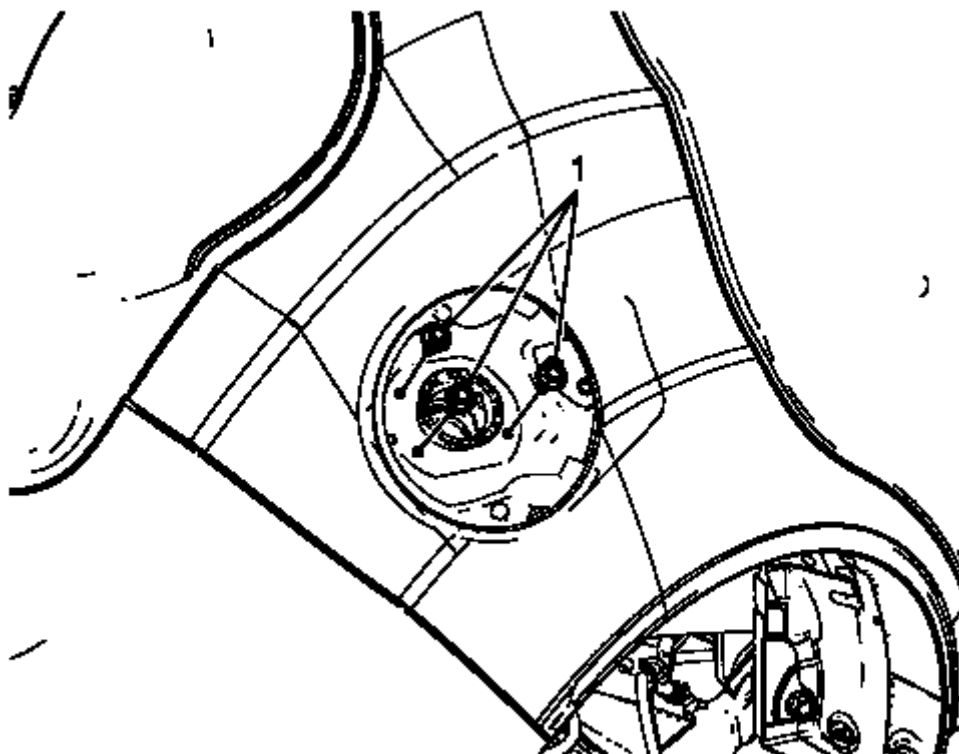


Fig. 56: Fuel Tank Filler Pipe

Courtesy of GENERAL MOTORS COMPANY

1. Open the fuel filler door and filler cap.
2. Remove the fuel filler pipe upper bolts (1).
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

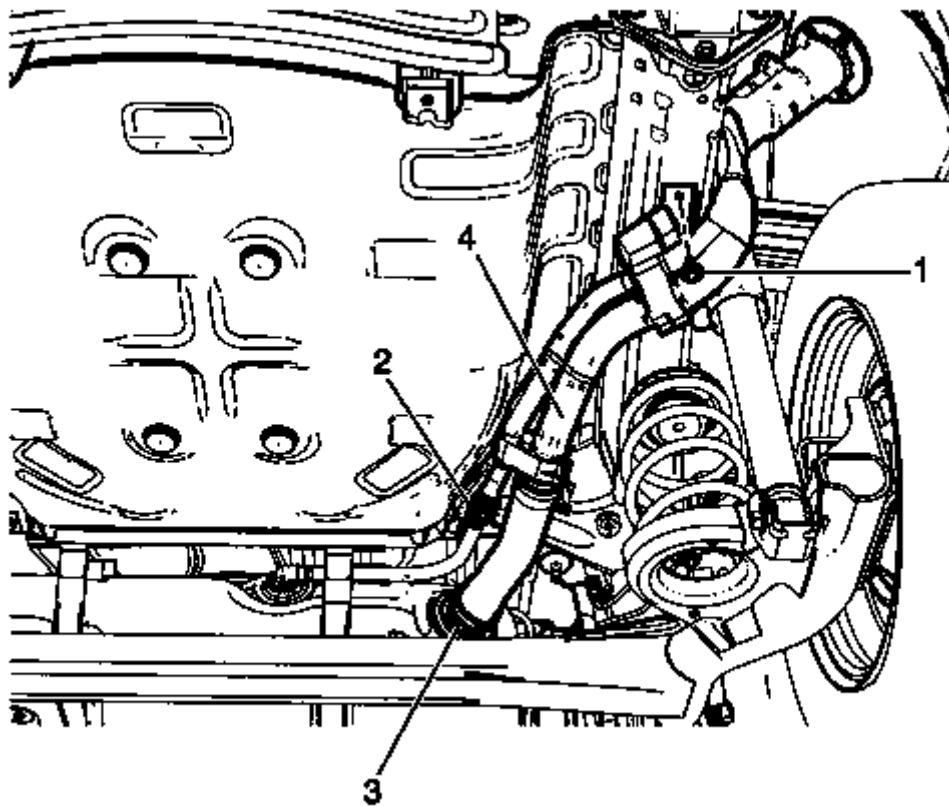


Fig. 57: Fuel Tank Filler Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the fuel tank filler hose (3) and clamp.
5. Disconnect the fuel tank vent pipe (2) and clamp.
6. Remove the fuel tank filler pipe lower bolt (1).
7. Remove the fuel tank filler pipe assembly (4).

Installation Procedure

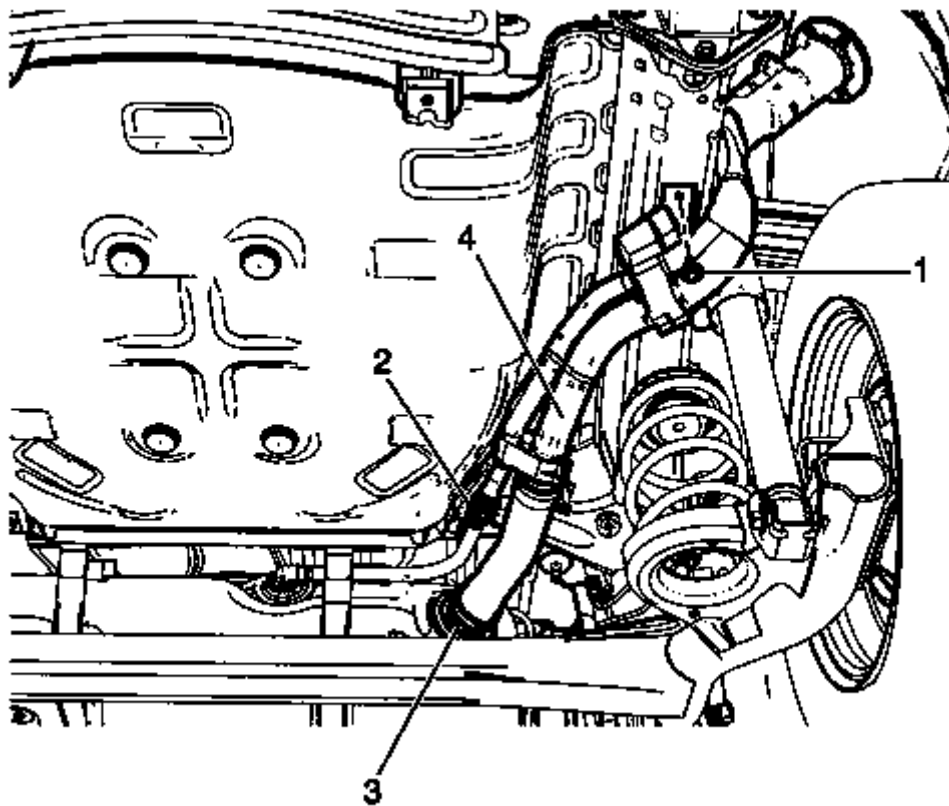


Fig. 58: Fuel Tank Filler Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

1. Install the fuel tank filler pipe assembly (4).

CAUTION: Refer to Fastener Caution .

2. Install the fuel tank filler pipe lower bolt (1) and tighten to 6 (53 lb in).
3. Connect the fuel tank filler hose (3) and clamp.
4. Connect the fuel tank vent pipe (2) and clamp.
5. Lower the vehicle. Refer to Lifting and Jacking the Vehicle .

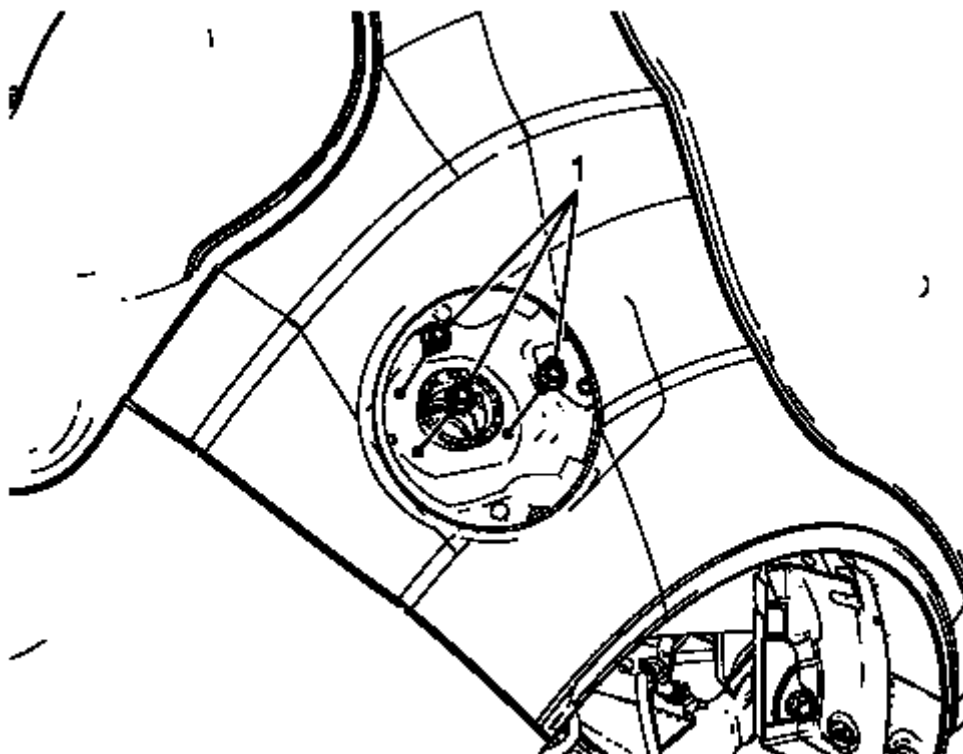


Fig. 59: Fuel Tank Filler Pipe

Courtesy of GENERAL MOTORS COMPANY

6. Install the fuel filler pipe upper bolts (1) and tighten to 6 (53 lb in).
7. Close the fuel filler cap and filler door.

EVAPORATIVE EMISSION CANISTER REPLACEMENT (LL0)

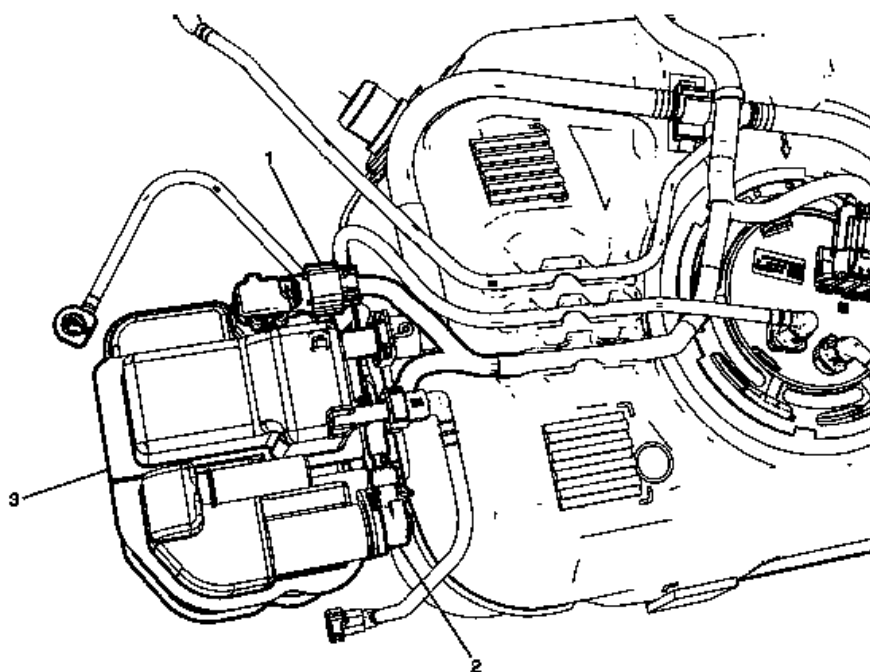


Fig. 60: Evaporative Emission Canister (LL0)
 Courtesy of GENERAL MOTORS COMPANY

Evaporative Emission Canister Replacement (LL0)

Callout	Component Name
Preliminary Procedures	
1. Remove the fuel tank. Refer to <u>Fuel Tank Replacement (LL0)</u> , <u>Fuel Tank Replacement (LFM)</u> . 2. Disconnect the vent pipe connector and evaporative purge connector.	
1	Fuel Tank Pressure Sensor Procedure 1. Disconnect the fuel tank pressure sensor electrical connector. 2. Remove the fuel tank pressure sensor.
2	Evaporative Emission Canister Solenoid Valve Procedure 1. Disconnect the evaporative emission canister solenoid valve electrical connector. 2. Remove the evaporative emission canister solenoid valve.
3	Evaporative Emission Canister Procedure Remove the evaporative emission canister pushing up from the evaporative emission canister bracket.

EVAPORATIVE EMISSION CANISTER REPLACEMENT (LFM)

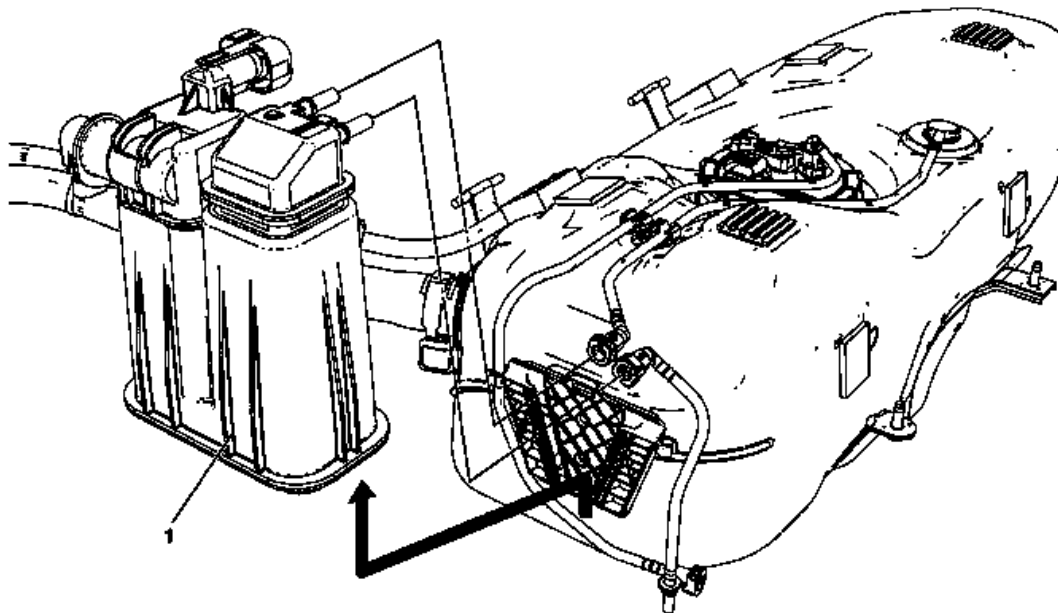


Fig. 61: Evaporative Emission Canister (LFM)
Courtesy of GENERAL MOTORS COMPANY

Evaporative Emission Canister Replacement (LFM)

Callout	Component Name
Preliminary Procedures	
1. Remove the fuel tank. Refer to Fuel Tank Replacement (LL0) , Fuel Tank Replacement (LFM) .	
2. Disconnect the fuel line and purge line.	
1	Evaporative Emission Canister Procedure Remove the canister pushing up from the canister bracket.

EVAPORATIVE EMISSION CANISTER PURGE SOLENOID VALVE REPLACEMENT (LL0)

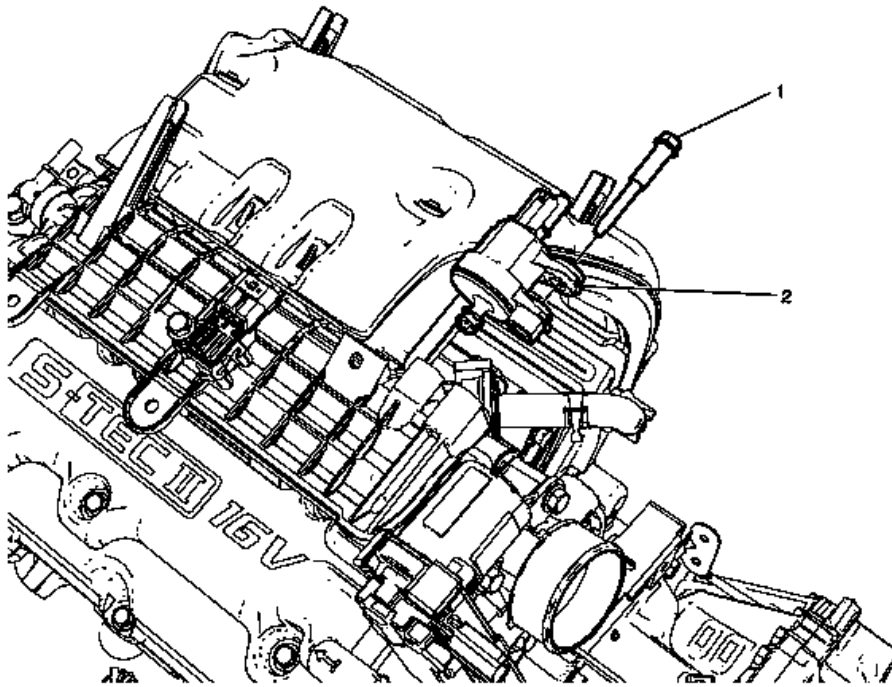


Fig. 62: Evaporative Emission Canister Purge Solenoid Valve
 Courtesy of GENERAL MOTORS COMPANY

Evaporative Emission Canister Purge Solenoid Valve Replacement (LL0)

Callout	Component Name
Preliminary Procedures 1. Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Disconnect the evaporative emission canister purge solenoid valve electrical connector. 3. Disconnect the evaporative emission pipe connector.	
1	Evaporative Emission Canister Purge Solenoid Valve Bolt CAUTION: Refer to <u>Fastener Caution</u> . Procedure Remove the evaporative emission canister purge solenoid valve bolt. Tighten 10 (89 lb in)
2	Evaporative Emission Canister Purge Solenoid Valve

EVAPORATIVE EMISSION CANISTER PURGE SOLENOID VALVE REPLACEMENT (LFM)

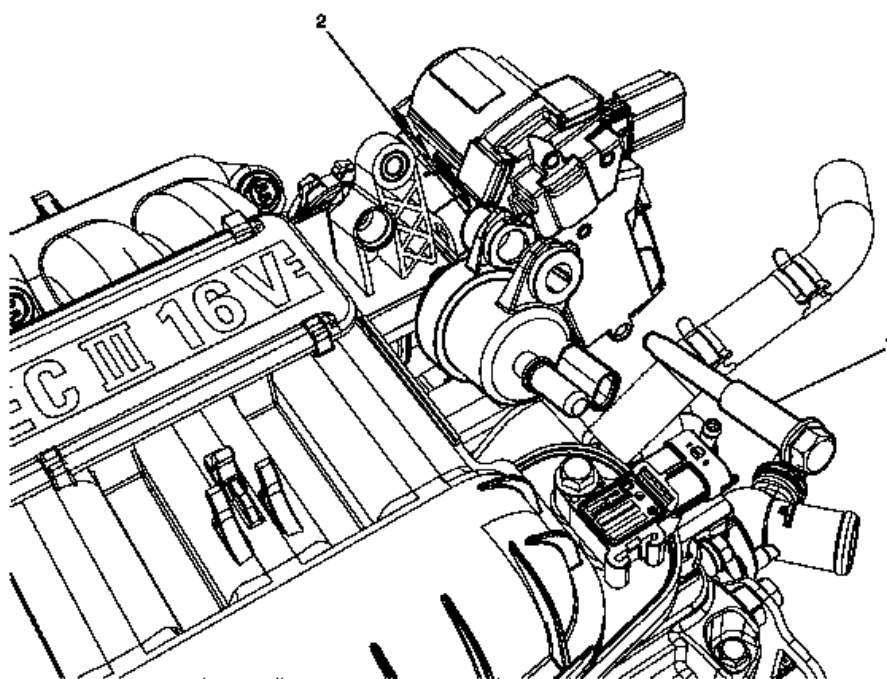


Fig. 63: Evaporative Emission Canister Purge Solenoid Valve
 Courtesy of GENERAL MOTORS COMPANY

Evaporative Emission Canister Purge Solenoid Valve Replacement (LFM)

Callout	Component Name
Preliminary Procedures 1. Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Disconnect the evaporative emission canister purge solenoid valve electrical connector. 3. Disconnect the evaporative emission pipe connector.	
1	Evaporative Emission Canister Purge Solenoid Valve Bolt CAUTION: Refer to <u>Fastener Caution</u> . Procedure Remove the evaporative emission canister purge solenoid valve bolt. Tighten 10 (89 lb in)
2	Evaporative Emission Canister Purge Solenoid Valve

EVAPORATIVE EMISSION CANISTER VENT SOLENOID VALVE REPLACEMENT (LL0)

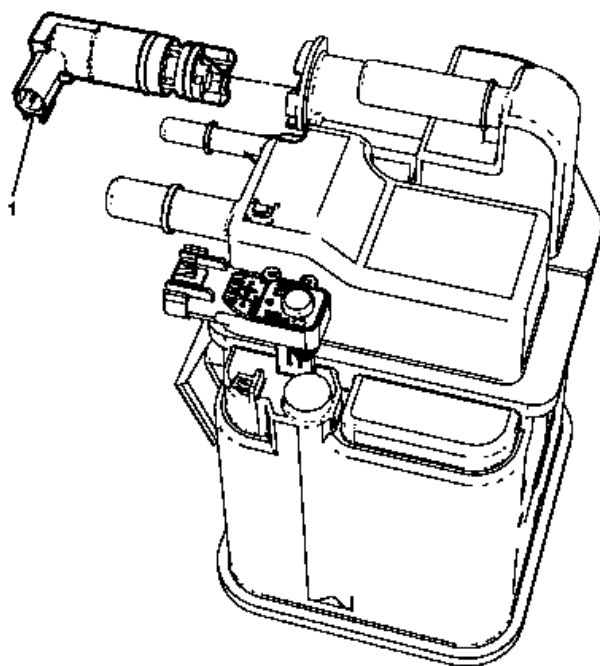


Fig. 64: Evaporative Emission Canister Vent Solenoid Valve
 Courtesy of GENERAL MOTORS COMPANY

Evaporative Emission Canister Vent Solenoid Valve Replacement (LL0)

Callout	Component Name
Preliminary Procedure Remove the evaporative emission canister. Refer to <u>Evaporative Emission Canister Replacement (LL0)</u> , <u>Evaporative Emission Canister Replacement (LFM)</u> .	
1	Evaporative Emission Canister Vent Solenoid Valve Procedure 1. Disconnect the evaporative emission canister vent solenoid valve electrical connector. 2. Remove the evaporative emission canister vent solenoid valve.

EVAPORATIVE EMISSION CANISTER VENT SOLENOID VALVE REPLACEMENT (LFM)

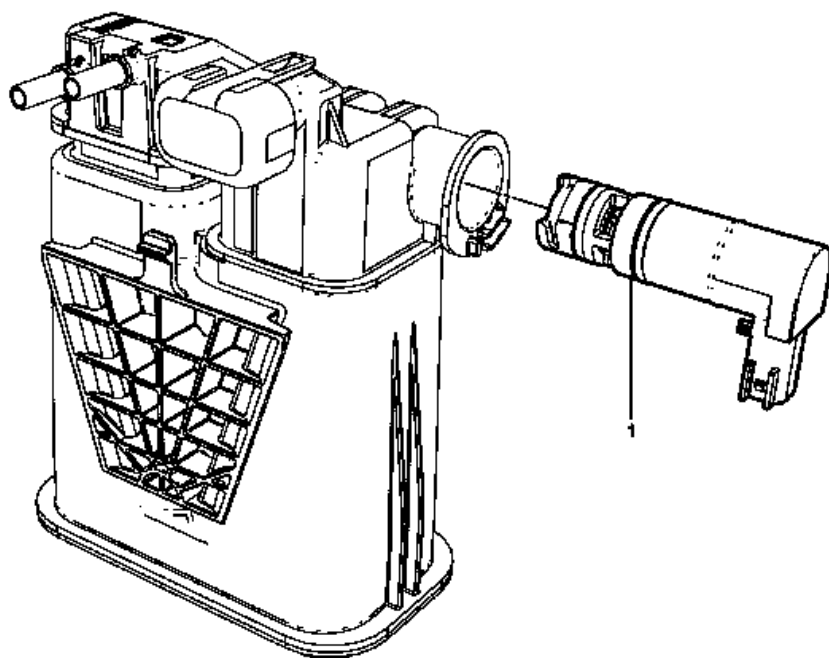


Fig. 65: Evaporative Emission Canister Vent Solenoid Valve
 Courtesy of GENERAL MOTORS COMPANY

Evaporative Emission Canister Vent Solenoid Valve Replacement (LFM)

Callout	Component Name
Preliminary Procedure Remove the evaporative emission canister. Refer to <u>Evaporative Emission Canister Replacement (LL0)</u> , <u>Evaporative Emission Canister Replacement (LFM)</u> .	
1	Evaporative Emission Canister Vent Solenoid Valve Procedure 1. Disconnect the evaporative emission canister vent solenoid valve electrical connector. 2. Remove the evaporative emission canister vent solenoid valve.

IGNITION COIL REPLACEMENT (LL0)

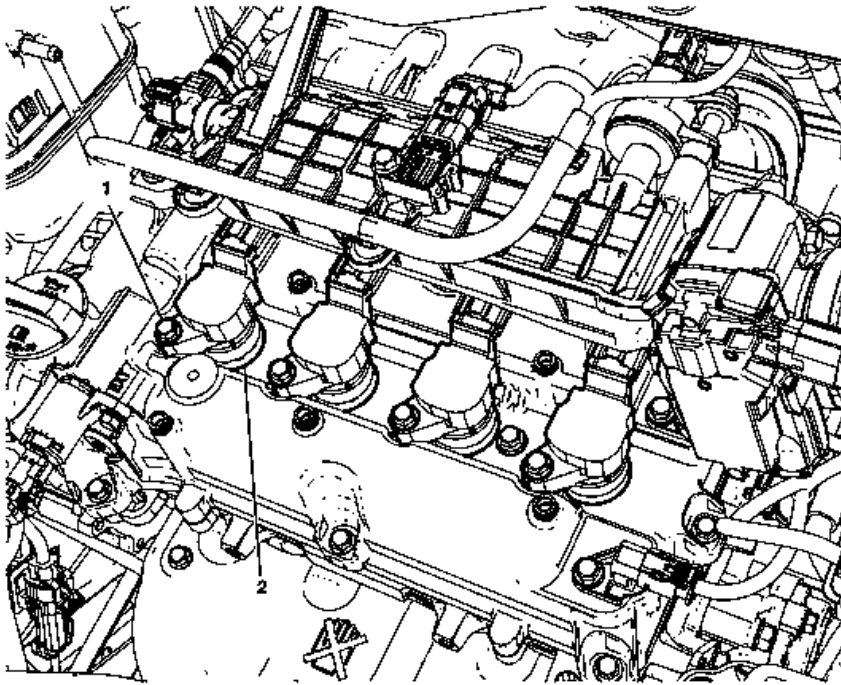


Fig. 66: Ignition Coil
 Courtesy of GENERAL MOTORS COMPANY

Ignition Coil Replacement (LL0)

Callout	Component Name
Preliminary Procedures 1. Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Remove the ignition coil cover. Refer to <u>Ignition Coil Cover Replacement (LL0)</u> , <u>Ignition Coil Cover Replacement (LFM)</u> . 3. Disconnect the 4 ignition coil connectors.	
1	Ignition Coil Cover Bolt (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . Procedure Remove the ignition coil bolts (1). Tighten 10 (89 lb in)
2	Ignition Coil (Qty: 4) Procedure Transfer parts as necessary.

IGNITION COIL REPLACEMENT (LFM)

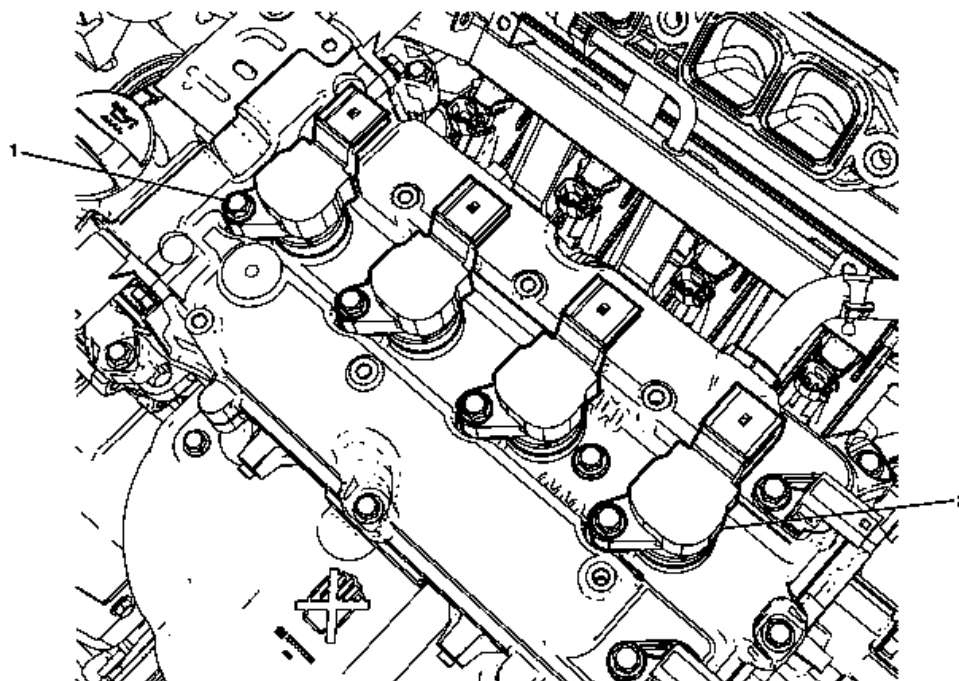


Fig. 67: Ignition Coil (LFM)

Courtesy of GENERAL MOTORS COMPANY

Ignition Coil Replacement (LFM)

Callout	Component Name
Preliminary Procedures	
1. Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Remove the ignition coil cover. Refer to <u>Ignition Coil Cover Replacement (LL0)</u> , <u>Ignition Coil Cover Replacement (LFM)</u> . 3. Disconnect the 4 ignition coil connectors.	
1	Ignition Coil Cover Bolt (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . Procedure Remove the ignition coil bolts (1). Tighten 10 (89 lb in)
2	Ignition Coil (Qty: 4) Procedure

Transfer parts as necessary.

SPARK PLUG INSPECTION

Spark Plug Usage

1. Ensure that the correct spark plug is installed. Refer to **Ignition System Specifications** .
2. Ensure that the spark plug has the correct heat range. An incorrect heat range causes the following conditions:
 - Spark plug fouling-colder plug
 - Pre-ignition causing spark plug and/or engine damage-hotter plug

Spark Plug Inspection

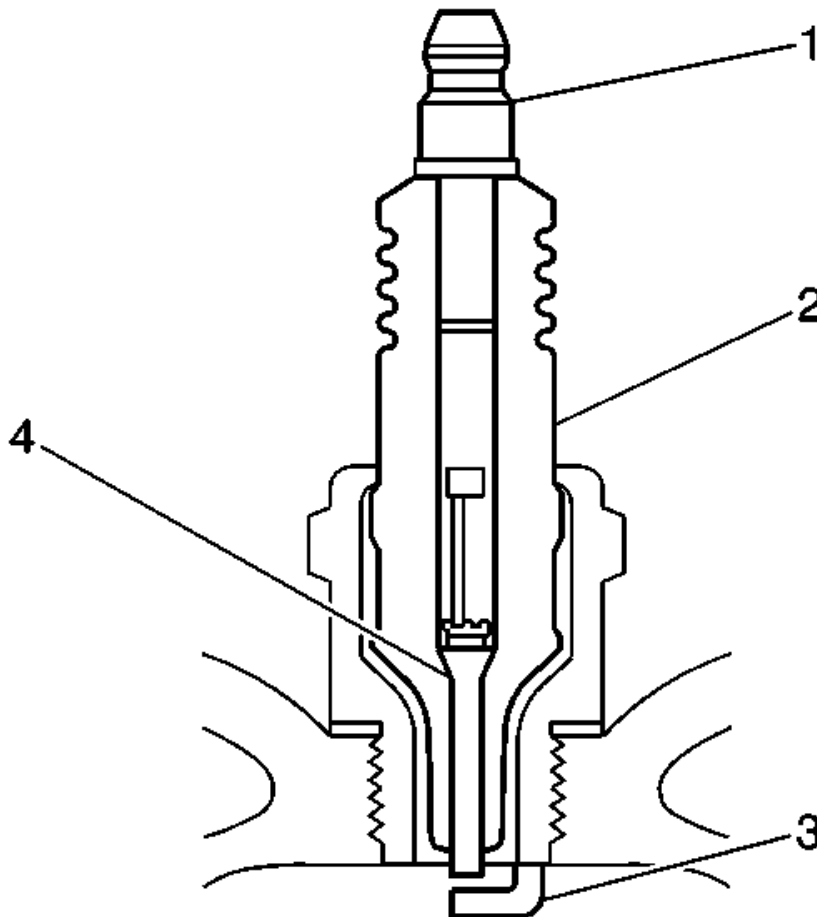


Fig. 68: Cross Sectional View Of Spark Plug
Courtesy of GENERAL MOTORS COMPANY

1. Inspect the terminal post (1) for damage.
 - Inspect for a bent or broken terminal post (1).
 - Test for a loose terminal post (1) by twisting and pulling the post. The terminal post (1) should not move.
2. Inspect the insulator (2) for flashover or carbon tracking, soot. This is caused by the electrical charge traveling across the insulator (2) between the terminal post (1) and ground. Inspect for the following conditions:
 - Inspect the spark plug boot for damage.
 - Inspect the spark plug recess area of the cylinder head for moisture, such as oil, coolant or water.
 - A spark plug boot that is saturated causes arcing to ground.

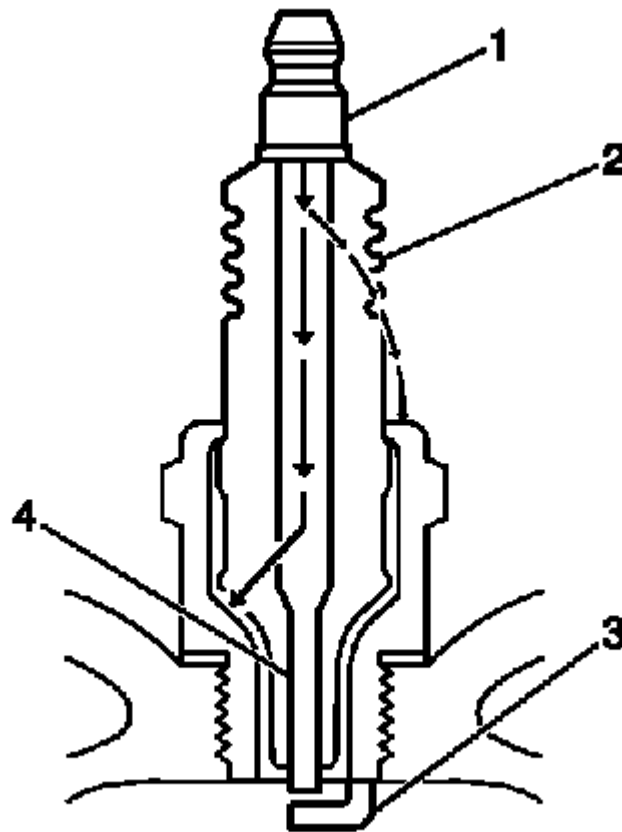


Fig. 69: Inspecting Spark Plug Insulator
Courtesy of GENERAL MOTORS COMPANY

3. Inspect the insulator (2) for cracks. All or part of the electrical charge may arc through the crack instead of the electrodes (3, 4).

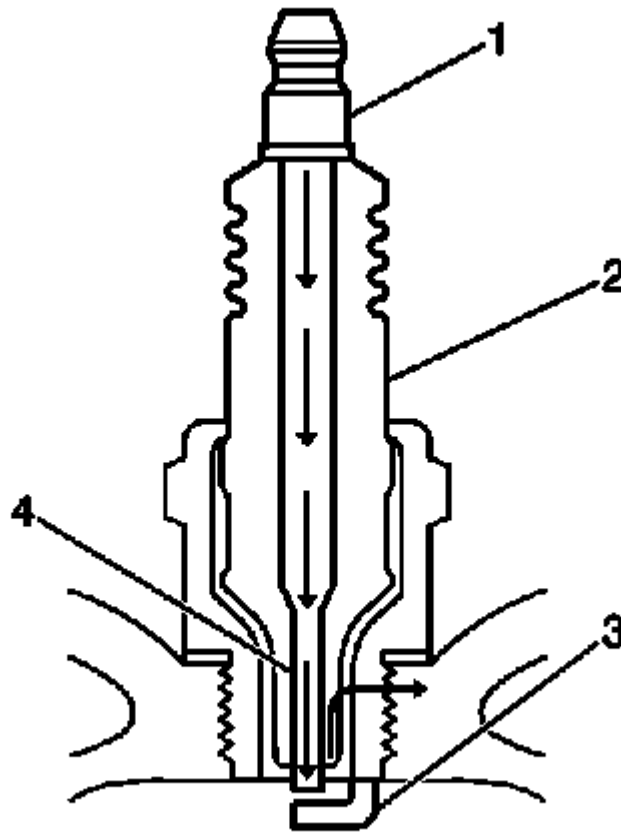


Fig. 70: Cutaway/Description View Of Spark Plug
Courtesy of GENERAL MOTORS COMPANY

4. Inspect for evidence of improper arcing.
 - Measure the gap between the center electrode (4) and the side electrode (3) terminals. Refer to an excessively wide electrode gap can prevent correct spark plug operation.
 - Inspect for the correct spark plug torque. Refer to insufficient torque can prevent correct spark plug operation. An over torqued spark plug, causes the insulator (2) to crack.
 - Inspect for signs of tracking that occurred near the insulator tip instead of the center electrode (4).
 - Inspect for a broken or worn side electrode (3).
 - Inspect for a broken, worn or loose center electrode (4) by shaking the spark plug.
5. A rattling sound indicates internal damage.
6. A loose center electrode (4) reduces the spark intensity.
 - Inspect for bridged electrodes (3, 4). Deposits on the electrodes (3, 4) reduce or eliminates the gap.
 - Inspect for worn or missing platinum pads on the electrodes (3, 4) If equipped.
 - Inspect for excessive fouling.
 - Inspect the spark plug recess area of the cylinder head for debris. Dirty or damaged threads can cause the spark plug not to seat correctly during installation.

Spark Plug Visual Inspection

1. Normal operation: brown to grayish-tan with small amounts of white powdery deposits are normal combustion by-products from fuels with additives.
2. Carbon fouled-dry, fluffy black carbon or soot caused by the following conditions:
 - Rich fuel mixtures
 - Leaking fuel injectors
 - Excessive fuel pressure
 - Restricted air filter element
 - Incorrect combustion
 - Reduced ignition system voltage output
 - Weak coils
 - Worn ignition wires
 - Incorrect spark plug gap
 - Excessive idling or slow speeds under light loads can keep spark plug temperatures so low that normal combustion deposits may not burn off.
 - Deposit fouling-oil, coolant or additives that include substances such as silicone, very white coating, reduces the spark intensity. Most powdery deposits will not effect spark intensity unless they form into a glazing over the electrode.

SPARK PLUG REPLACEMENT (LL0)

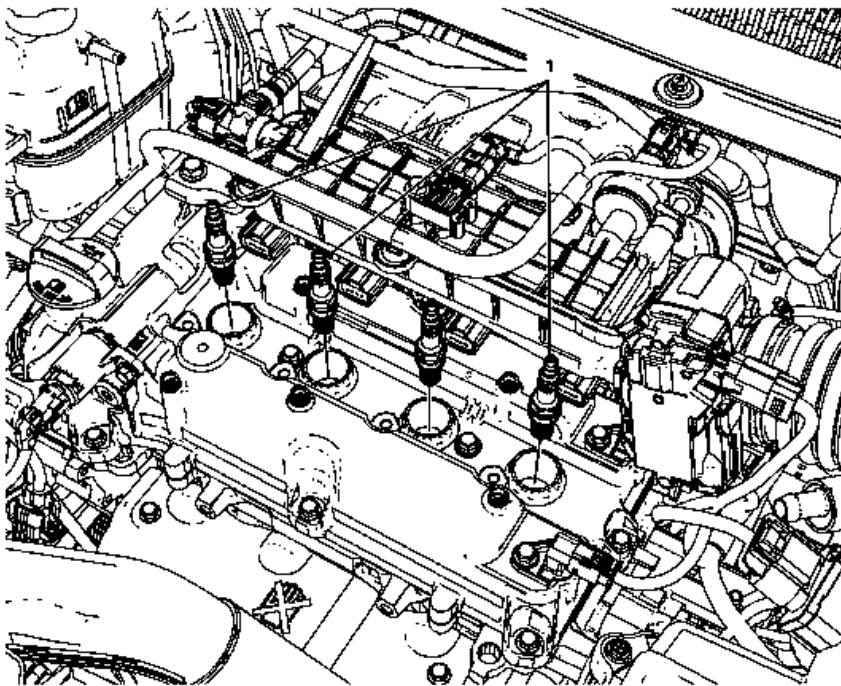


Fig. 71: Spark Plug

Courtesy of GENERAL MOTORS COMPANY

Spark Plug Replacement (LL0)

Callout	Component Name
Preliminary Procedure Remove the ignition coil. Refer to <u>Ignition Coil Replacement (LL0)</u> , <u>Ignition Coil Replacement (LFM)</u> .	
1	Spark Plug CAUTION: Refer to <u>Fastener Caution</u> . Procedure Remove the spark plug (1). Tighten 20 (15 lb ft)

SPARK PLUG REPLACEMENT (LFM)

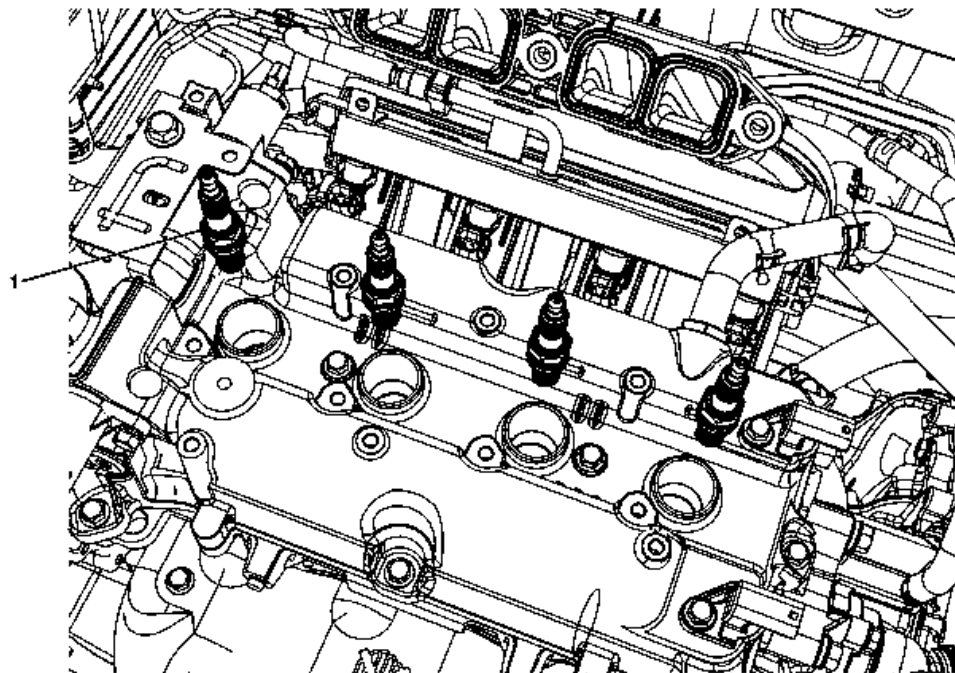


Fig. 72: Spark Plug (LFM)

Courtesy of GENERAL MOTORS COMPANY

Spark Plug Replacement (LFM)

Callout	Component Name
Preliminary Procedure Remove the ignition coil. Refer to <u>Ignition Coil Replacement (LL0)</u> , <u>Ignition Coil Replacement (LFM)</u> .	

Spark Plug

CAUTION:

Refer to Fastener Caution .

1

Procedure

Remove the spark plug (1).

Tighten

20 (15 lb ft)

CAMSHAFT POSITION ACTUATOR SOLENOID VALVE REPLACEMENT (LL0)

Removal Procedure

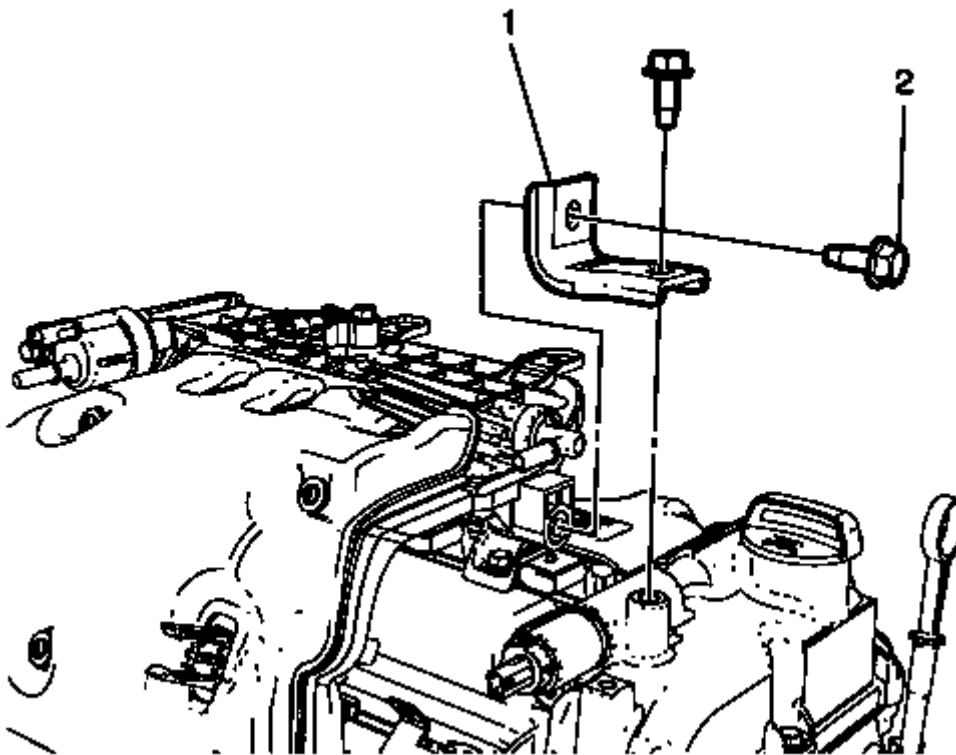


Fig. 73: Camshaft Position Actuator Solenoid Valve
Courtesy of GENERAL MOTORS COMPANY

1. Open the hood.
2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection .
3. Remove the 2 intake manifold upper bracket bolt (2) and intake manifold upper bracket (1).

4. Disconnect the camshaft position actuator solenoid valve electrical connector.

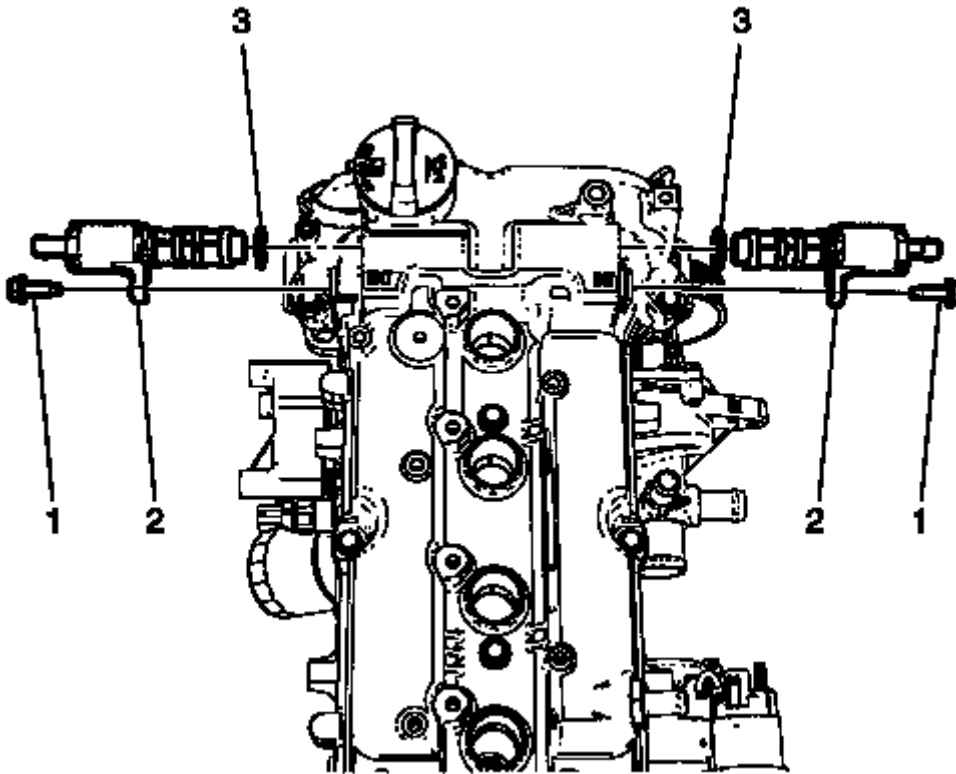


Fig. 74: Camshaft Position Actuator Solenoid Valve Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the camshaft position actuator solenoid valve bolts (1).
6. Remove the camshaft position actuator solenoid valves (2).
7. Remove the 2 camshaft position actuator solenoid valve seal (3).
8. Transfer parts as necessary.

Installation Procedure

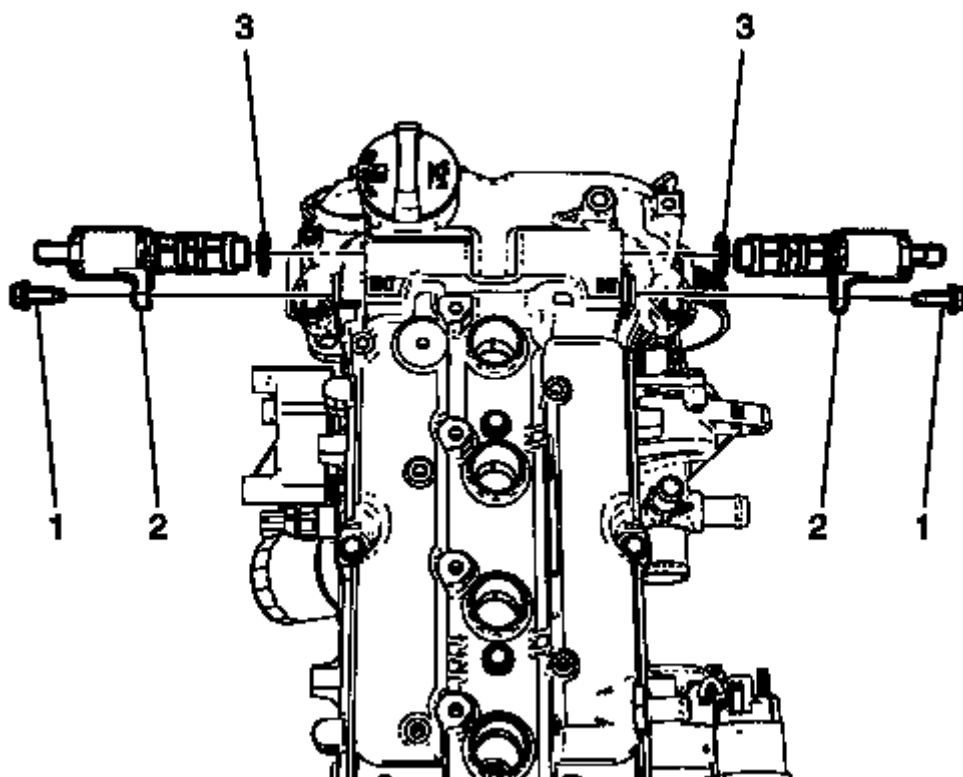


Fig. 75: Camshaft Position Actuator Solenoid Valve Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: Lubricate the NEW camshaft position actuator solenoid valve seals with NEW engine oil.

1. Install NEW 2 camshaft position actuator solenoid valve seal (3).
2. Install the camshaft position actuator solenoid valves (2).

CAUTION: Refer to Fastener Caution .

3. Install the camshaft position actuator solenoid valve bolts (1) and tighten to 10 (53 lb in).
4. Connect the camshaft position actuator solenoid valve electrical connector.

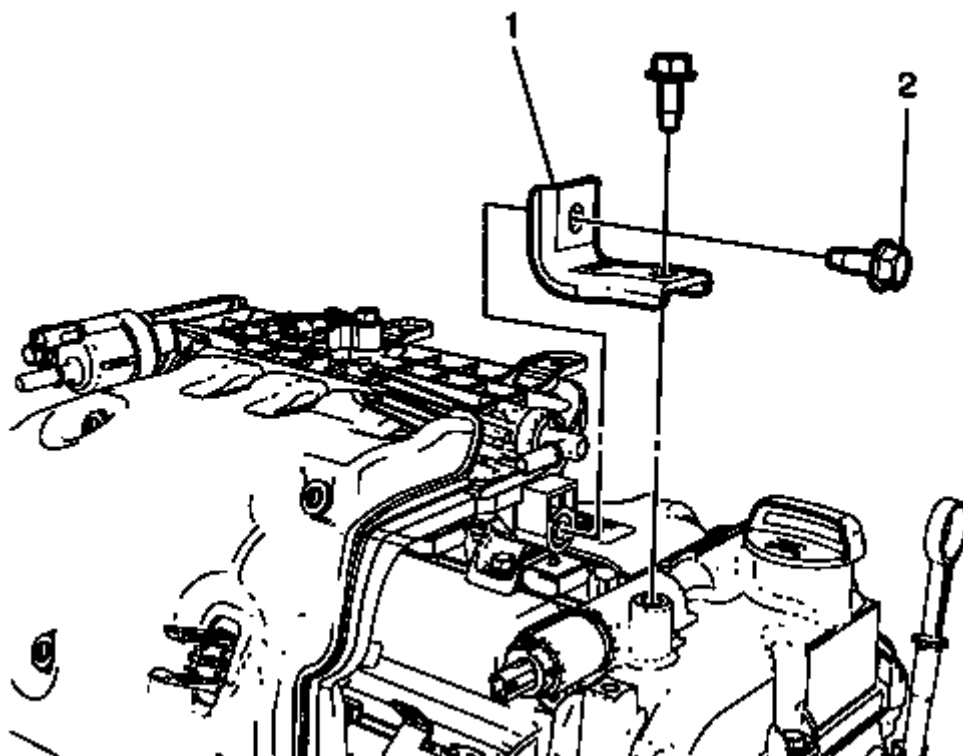


Fig. 76: Camshaft Position Actuator Solenoid Valve
Courtesy of GENERAL MOTORS COMPANY

5. Install the intake manifold upper bracket (1).
6. Install the 2 intake manifold upper bracket bolt (2) and tighten to 25 (18 lb ft).
7. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
8. Close the hood.

CAMSHAFT POSITION ACTUATOR SOLENOID VALVE REPLACEMENT (LFM)

Removal Procedure

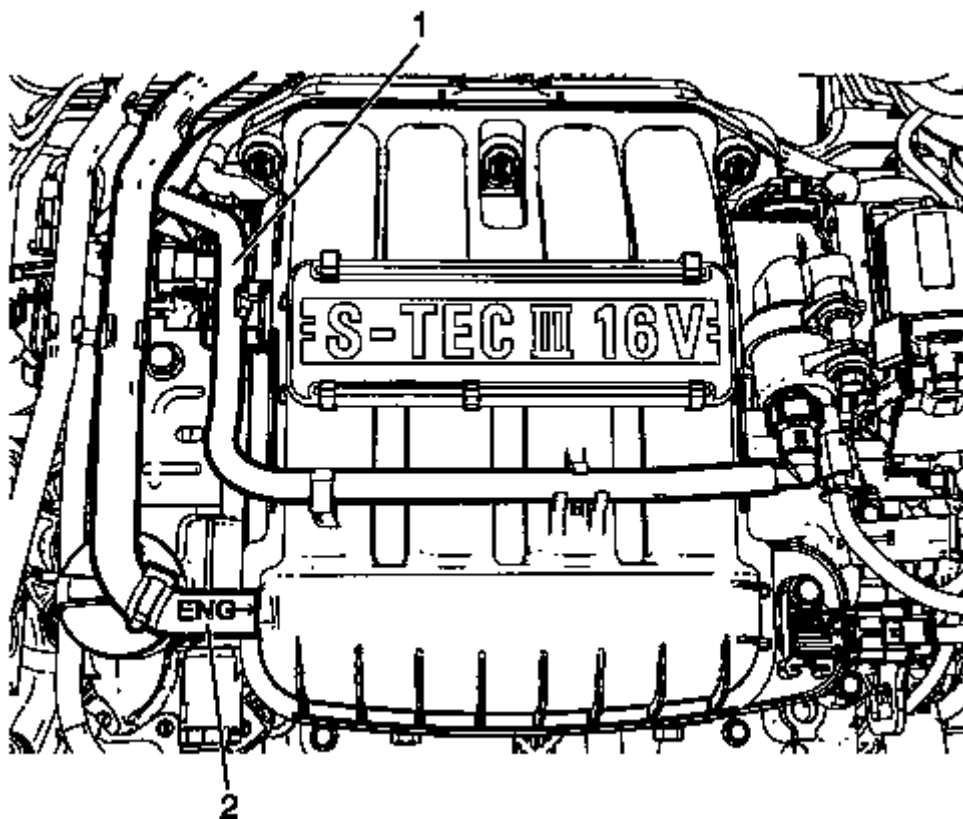


Fig. 77: Evaporative Emission Canister Purge Solenoid Valve Hose
Courtesy of GENERAL MOTORS COMPANY

1. Open the hood.
2. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
3. Remove and reposition the evaporative emission canister purge solenoid valve hose (1) from the upper intake manifold. Refer to **Evaporative Emission Canister Purge Solenoid Valve Replacement (LL0)**, **Evaporative Emission Canister Purge Solenoid Valve Replacement (LFM)**.
4. Remove and reposition the power brake booster vacuum hose (2) from the upper intake manifold. Refer to **Power Brake Booster Vacuum Hose Replacement** .
5. Disconnect the camshaft position actuator solenoid valve electrical connector.

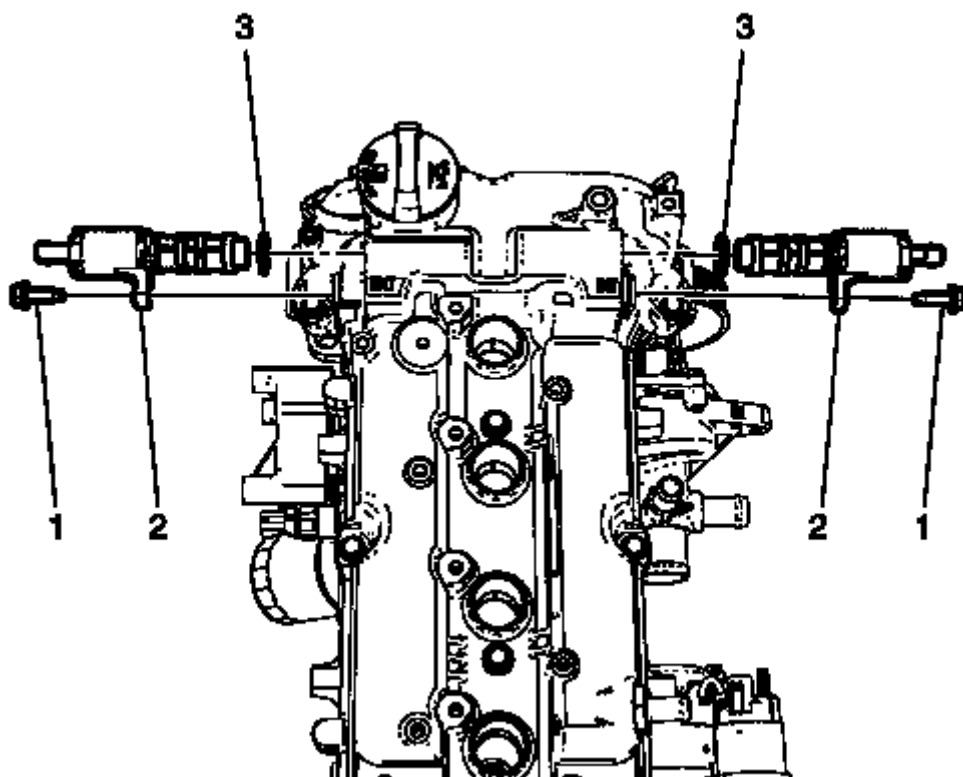


Fig. 78: Camshaft Position Actuator Solenoid Valve Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Remove the camshaft position actuator solenoid valve bolts (1).
7. Remove the camshaft position actuator solenoid valves (2).
8. Remove the 2 camshaft position actuator solenoid valve seal (3).
9. Transfer parts as necessary.

Installation Procedure

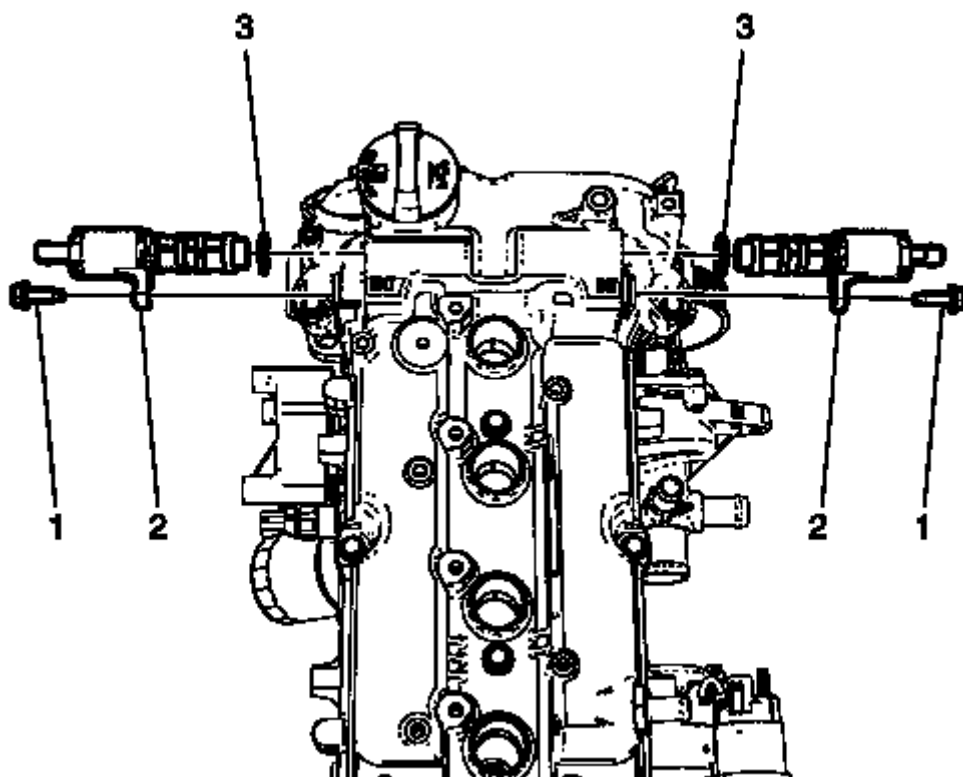


Fig. 79: Camshaft Position Actuator Solenoid Valve Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: Lubricate the NEW camshaft position actuator solenoid valve seals with NEW engine oil.

1. Install NEW 2 camshaft position actuator solenoid valve seal (3).
2. Install the camshaft position actuator solenoid valves (2).

CAUTION: Refer to Fastener Caution .

3. Install the camshaft position actuator solenoid valve bolts (1) and tighten to 10 (53 lb in).
4. Connect the camshaft position actuator solenoid valve electrical connector.

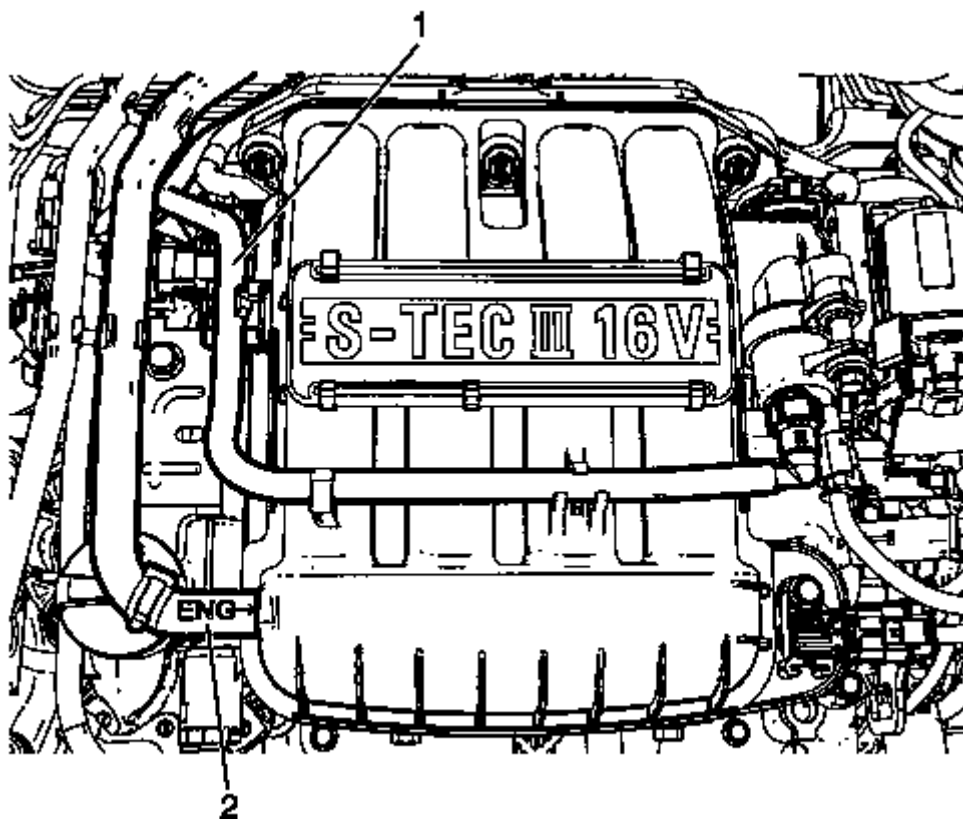


Fig. 80: Evaporative Emission Canister Purge Solenoid Valve Hose
Courtesy of GENERAL MOTORS COMPANY

5. Connect the power brake booster vacuum hose (2) from the upper intake manifold. Refer to **Power Brake Booster Vacuum Hose Replacement** .
6. Connect the evaporative emission canister purge solenoid valve hose (1) from the upper intake manifold. Refer to **Evaporative Emission Canister Purge Solenoid Valve Replacement (LL0)**, **Evaporative Emission Canister Purge Solenoid Valve Replacement (LFM)**.
7. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
8. Close the hood.

CRANKSHAFT POSITION SENSOR REPLACEMENT

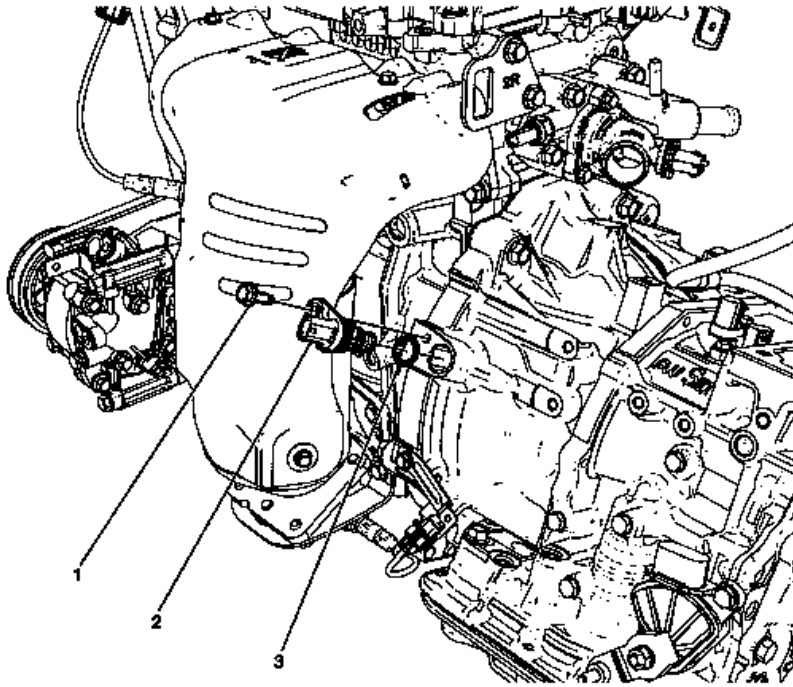


Fig. 81: Crankshaft Position Sensor
 Courtesy of GENERAL MOTORS COMPANY

Crankshaft Position Sensor Replacement

Callout	Component Name
Preliminary Procedures 1. Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Remove the air cleaner assembly. Refer to <u>Air Cleaner Assembly Replacement</u>. 3. Disconnect the crankshaft position sensor connector.	
1	Crankshaft Position Sensor Bolt CAUTION: Refer to <u>Fastener Caution</u> . Procedure Remove the crankshaft position sensor bolt. Tighten 10 (89 lb in)
2	Crankshaft Position Sensor
3	Crankshaft Position Sensor O-ring Seal

CRANKSHAFT POSITION SYSTEM VARIATION LEARN

NOTE: The Crankshaft Position Variation Learn procedure is also required when the following service procedures have been performed, regardless of whether DTC P0315 is set:

- An engine replacement
- An engine control module (ECM) replacement
- A crankshaft balancer replacement
- A crankshaft replacement
- A crankshaft position sensor replacement
- Any engine repairs which disturb the crankshaft to crankshaft position sensor relationship.

NOTE: The ECM monitors certain component signals to determine if all the conditions are met to continue with the Crankshaft Position Variation Learn procedure.

1. Ignition ON, observe the DTC information with a scan tool. Verify no other DTCs are set, except DTCs P0300-P0304 or P0315.
 - If DTCs are set, except DTCs P0300-P0304 or P0315, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** for further diagnosis.
2. Select the Crankshaft Position Variation Learn Procedure with a scan tool and follow the on screen instructions:
3. Verify DTC P0315 does not set.
 - **If DTC P0315 set or another DTC is present** refer to **Diagnostic Trouble Code (DTC) List - Vehicle** for the applicable DTC that set.
 - **If the DTC does not set**
4. All OK.

CAMSHAFT POSITION SENSOR REPLACEMENT (LFM)

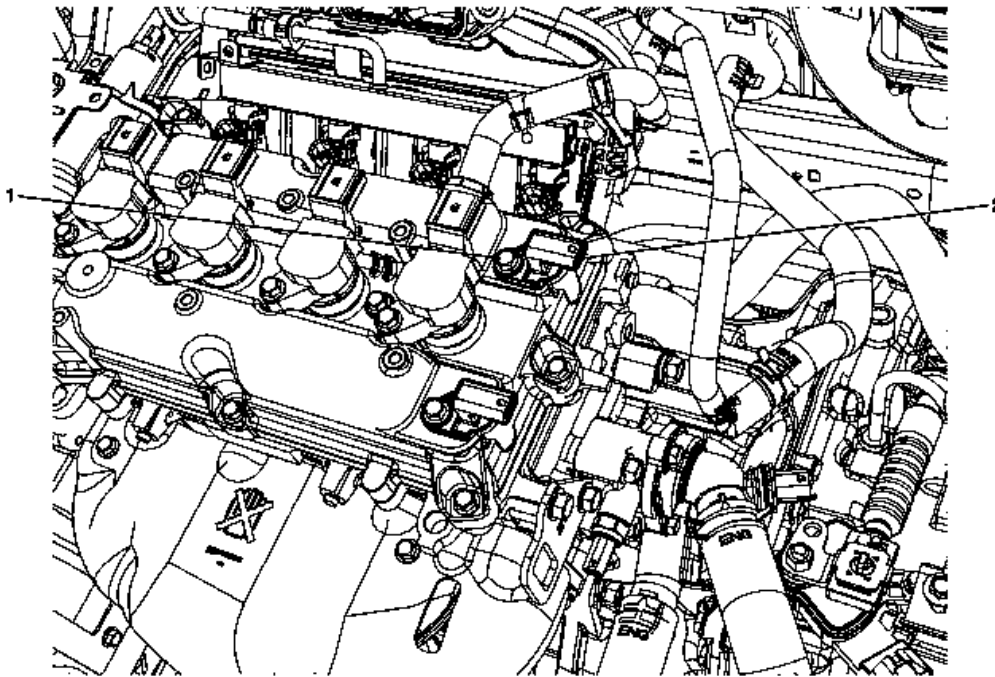


Fig. 82: Camshaft Position Sensor (LFM)
 Courtesy of GENERAL MOTORS COMPANY

Camshaft Position Sensor Replacement (LFM)

Callout	Component Name
Preliminary Procedures 1. Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Remove the ignition coil cover. Refer to <u>Ignition Coil Cover Replacement (LL0)</u> , <u>Ignition Coil Cover Replacement (LFM)</u> . 3. Disconnect the camshaft position sensor connectors.	
1	Camshaft Position Sensor Bolt (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Procedure Remove the camshaft position sensor bolts. Tighten 10 (89 lb in)
2	Camshaft Position Sensor (Qty: 2)

CAMSHAFT POSITION SENSOR REPLACEMENT (LL0)

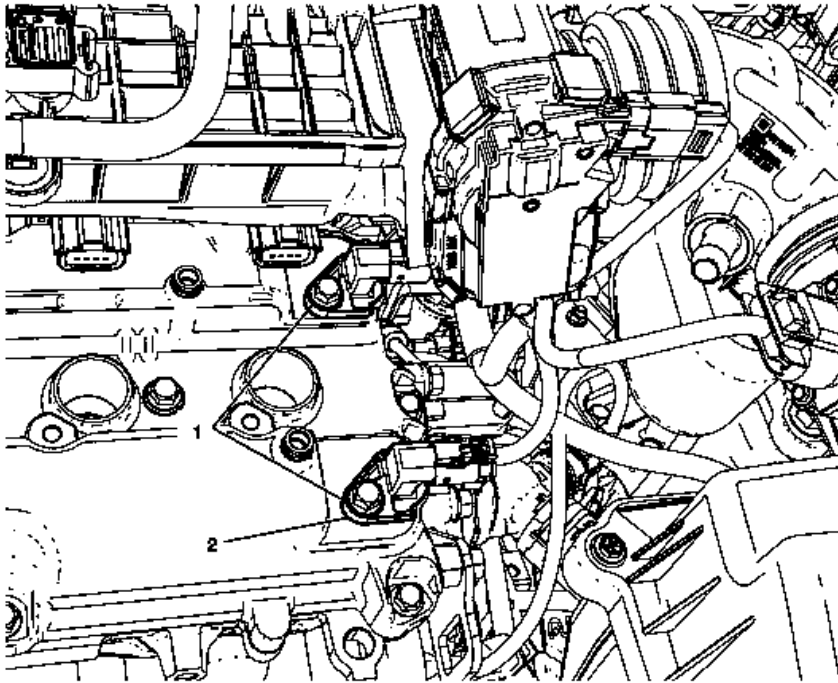


Fig. 83: Camshaft Position Sensor
 Courtesy of GENERAL MOTORS COMPANY

Camshaft Position Sensor Replacement (LL0)

Callout	Component Name
Preliminary Procedures 1. Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Remove the ignition coil cover. Refer to <u>Ignition Coil Cover Replacement (LL0)</u> , <u>Ignition Coil Cover Replacement (LFM)</u> . 3. Disconnect the camshaft position sensor connectors.	
1	Camshaft Position Sensor Bolt (Qty 2) CAUTION: Refer to <u>Fastener Caution</u> . Procedure Remove the camshaft position sensor bolts. Tighten 10 (89 lb in)
2	Camshaft Position Sensor (Qty 2)

AIR CLEANER ELEMENT REPLACEMENT

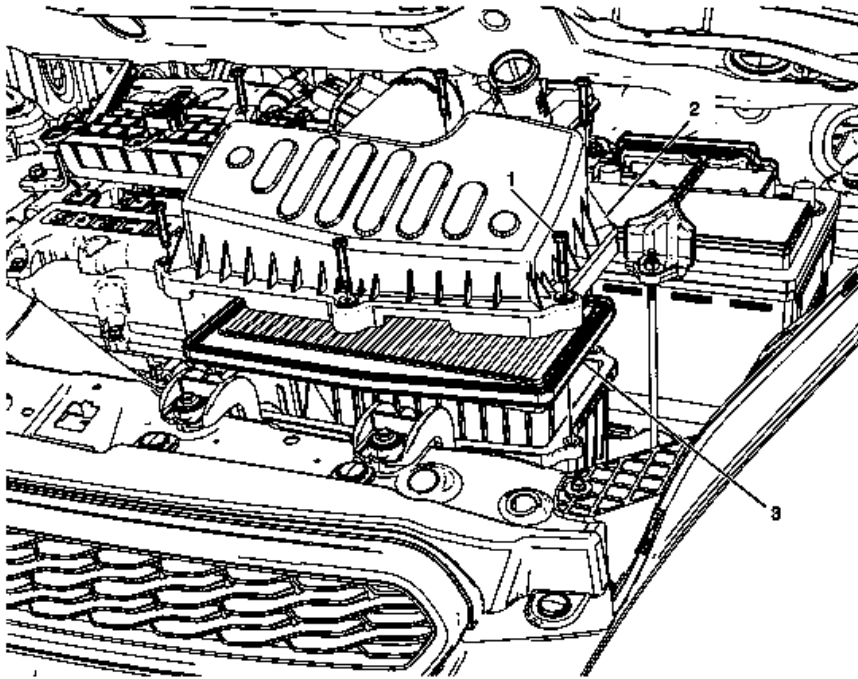


Fig. 84: Air Cleaner Element
Courtesy of GENERAL MOTORS COMPANY

Air Cleaner Element Replacement

Callout	Component Name
Preliminary Procedure Open the hood.	
1	Air Cleaner Housing Bolt (Qty 6) CAUTION: Refer to <u>Fastener Caution</u> . Procedure Remove the air cleaner housing bolts Tighten 2 (17 lb in)
2	Air Cleaner Upper Housing Procedure Release clip and remove air cleaner upper housing (2).
3	Air Cleaner Element Procedure Replace air cleaner element (3).

AIR CLEANER ASSEMBLY REPLACEMENT

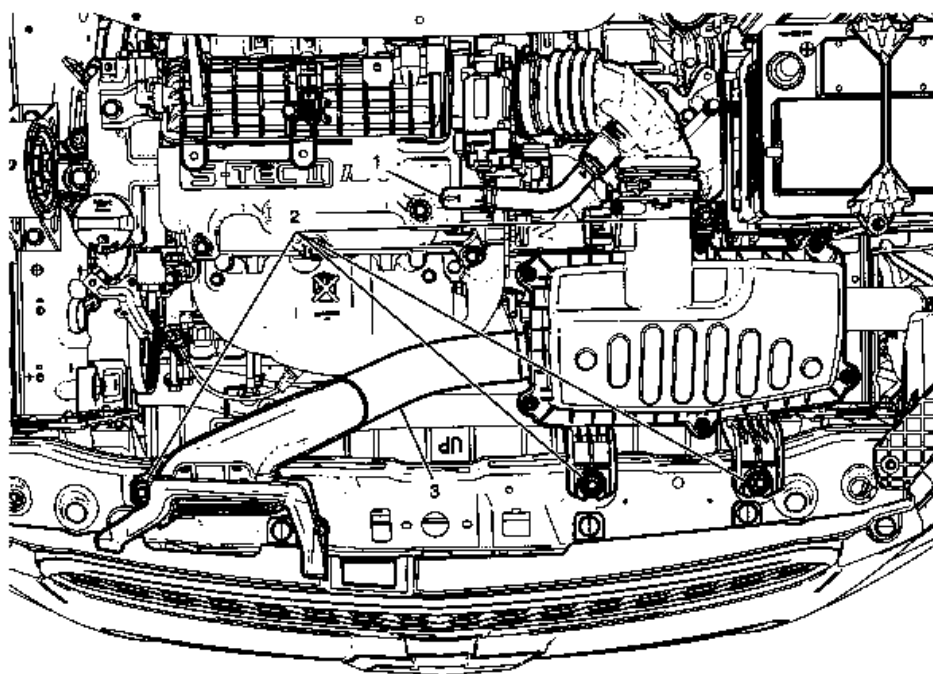


Fig. 85: Air Cleaner Assembly
 Courtesy of GENERAL MOTORS COMPANY

Air Cleaner Assembly Replacement

Callout	Component Name
Preliminary Procedures 1. Open the hood and disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Disconnect the air flow sensor connector.	
1	Breather Hose Procedure Disconnect the breather hose (1) and clamp from the air cleaner outlet duct.
2	Air Cleaner Assembly Retaining Bolt (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . Procedure Remove the air cleaner assembly retaining bolt (3). Tighten 6 (53 lb in)
3	Air Cleaner Assembly Procedure Disconnect the resonator duct from the air cleaner assembly.

AIR CLEANER RESONATOR REPLACEMENT

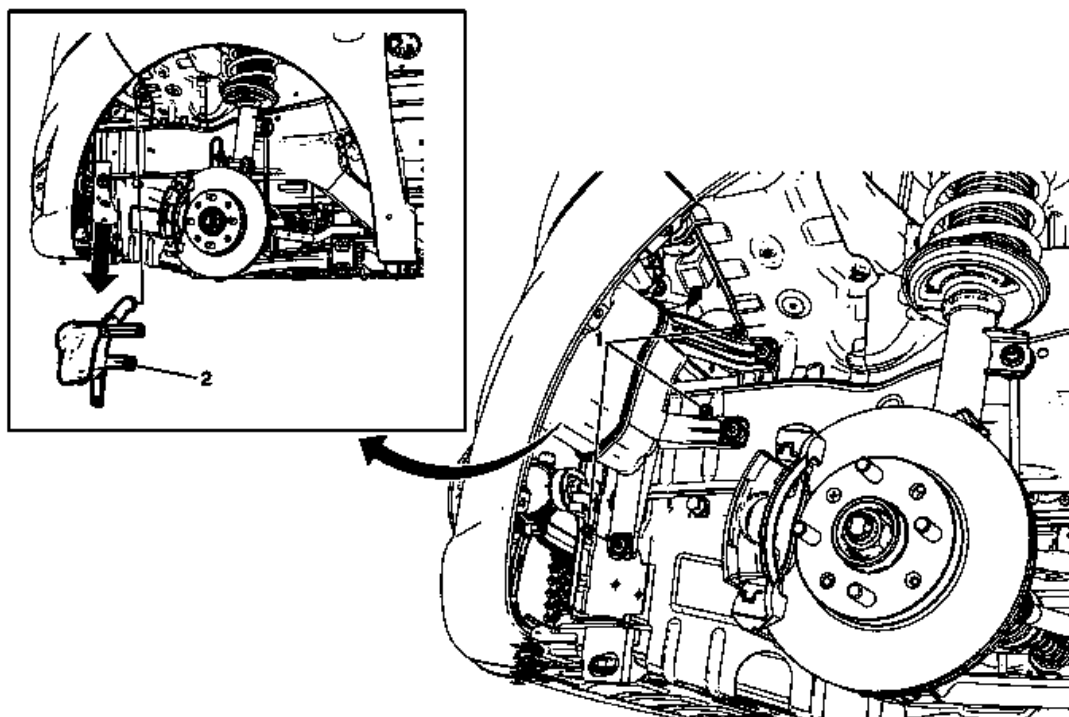


Fig. 86: Air Cleaner Resonator
Courtesy of GENERAL MOTORS COMPANY

Air Cleaner Resonator Replacement

Callout	Component Name
Preliminary Procedures	
1. Remove the front (LH) tire and wheel. Refer to <u>Tire and Wheel Removal and Installation</u> .	
2. Remove the front (LH) wheel house liner. Refer to <u>Front Wheelhouse Liner Replacement</u> .	
1	Air Cleaner Resonator Assembly Retaining Nut CAUTION: Refer to <u>Fastener Caution</u> . Procedure Remove the air cleaner resonator assembly retaining nut (1). Tighten 6 (53 lb in)
2	Air Cleaner Resonator Assembly

ACCELERATOR PEDAL POSITION SENSOR REPLACEMENT

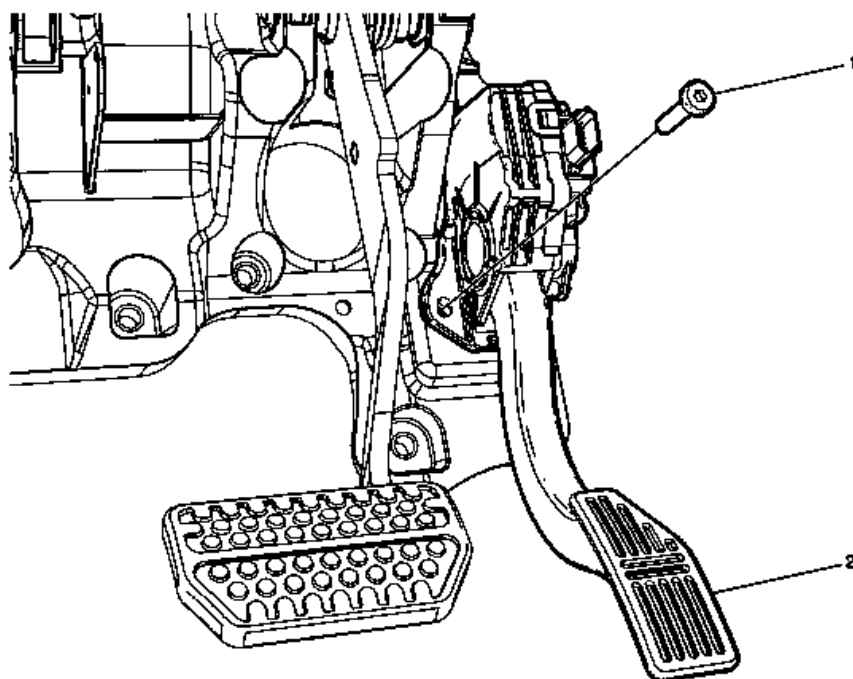


Fig. 87: Accelerator Pedal Position Sensor
 Courtesy of GENERAL MOTORS COMPANY

Accelerator Pedal Position Sensor Replacement

Callout	Component Name
Preliminary Procedure Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> .	
1	Accelerator Pedal Position Sensor Fastener CAUTION: Refer to <u>Fastener Caution</u> . Tighten 6 (53 lb in)
2	Accelerator Pedal Position Sensor Procedure Disconnect the electrical wiring harness connector from accelerator pedal position sensor.

ENGINE

Engine Heating and Cooling - Spark

SPECIFICATIONS

TEMPERATURE VERSUS RESISTANCE

Temperature Versus Resistance

°C	°F	Sensor Resistance
Temperature vs Resistance Values (Approximate)		
100	212	155
90	194	208
80	176	283
70	158	392
60	140	552
50	122	793
45	113	958
40	104	1165
35	95	1425
30	86	1755
25	77	2176
20	68	2717
15	59	3428
10	50	4356
5	41	5578
0	32	7198
-5	23	9362
-10	14	12278
-15	5	16229
-20	-4	21653
-30	-22	39631
-40	-40	75532

FASTENER TIGHTENING SPECIFICATIONS (LL0)

Fastener Tightening Specifications (LL0)

Application	Specification	
	Metric	English
Air Conditioning Compressor and Condenser Under Pipe Nut	11	96 lb in
Air Conditioning Compressor and Condenser Upper Pipe Nut	11	96 lb in

Block Heater Connecting Plug Holder Bolt	8	71 lb in
Engine Coolant Fan Bolt	3	27 lb in
Engine Coolant Thermostat Bolt	10	89 lb in
Engine Coolant Thermostat Housing Bolt	25	18 lb ft
Intake Manifold Rear Bracket Bolt - Down	58	42 lb ft
Intake Manifold Rear Bracket Bolt - Up	22	16 lb ft
Radiator Drain Cock	2	18 lb in
Radiator Overflow Hose Bracket Nut	9	80 lb in
Radiator Support Bracket Bolt	22	16 lb ft
Radiator Support Mounting Bolt	22	16 lb ft
Radiator Surge Tank Mounting Bolt	8	71 lb ft
Water Pump Bolt	25	18 lb ft

FASTENER TIGHTENING SPECIFICATIONS (LFM)

Fastener Tightening Specifications (LFM)

Application	Specification	
	Metric	English
Air Conditioning Compressor and Condenser Under Pipe Nut	11	96 lb in
Air Conditioning Compressor and Condenser Upper Pipe Nut	11	96 lb in
Engine Coolant Fan Bolt	3	27 lb in
Engine Coolant Thermostat Bolt	10	89 lb in
Engine Coolant Thermostat Housing Bolt	25	18 lb ft
Intake Manifold Rear Bracket Bolt - Down	58	42 lb ft
Intake Manifold Rear Bracket Bolt - Up	22	16 lb ft
Radiator Drain Cock	2	18 lb in
Radiator Overflow Hose Bracket Nut	9	80 lb in
Radiator Support Bracket Bolt	22	16 lb ft
Radiator Support Mounting Bolt	22	16 lb ft
Radiator Surge Tank Mounting Bolt	8	71 lb ft
Water Pump Bolt	25	18 lb ft

SCHEMATIC WIRING DIAGRAMS

ENGINE HEATING/COOLING WIRING SCHEMATICS

Engine Cooling Wiring Schematics

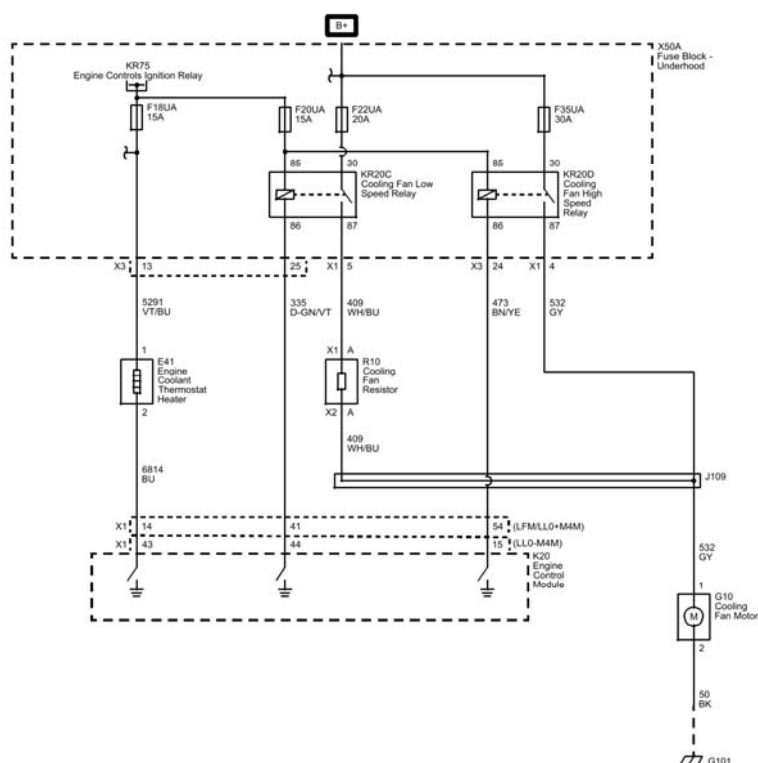


Fig. 1: Engine Cooling Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC P00B3 or P00B4</u>	DTC P00B3 Radiator Coolant Temperature (RCT) Sensor Circuit Low Voltage DTC P00B4 Radiator Coolant Temperature (RCT) Sensor Circuit High Voltage
<u>DTC P00B7</u>	DTC P00B7 Radiator Coolant Temperature (RCT) Insufficient Flow
<u>DTC P0480, P0481, P0691, P0692, P0693, or P0694</u>	DTC P0480 Cooling Fan Relay 1 Control Circuit DTC P0481 Cooling Fan Relay Control Circuit 2 DTC P0691 Cooling Fan Relay 1 Control Circuit Low Voltage DTC P0692 Cooling Fan Relay 1 Control Circuit High Voltage DTC P0693 Cooling Fan Relay 2 Control Circuit Low Voltage

	DTC P0694 Cooling Fan Relay 2 Control Circuit High Voltage
<u>DTC P0597-P0599</u>	DTC P0597 Engine Coolant Thermostat Heater Control Circuit DTC P0598 Engine Coolant Thermostat Heater Control Circuit Low Voltage DTC P0599 Engine Coolant Thermostat Heater Control Circuit High Voltage
<u>DTC P112F</u>	DTC P112F Radiator Coolant Temperature Sensor Not Plausible
<u>DTC P2181</u>	DTC P2181 Engine Cooling System Performance

DTC P00B3 OR P00B4: RADIATOR COOLANT TEMPERATURE (RCT) SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P00B3

Radiator Coolant Temperature (RCT) Sensor Circuit Low Voltage

DTC P00B4

Radiator Coolant Temperature (RCT) Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P00B3	P00B4	P00B4*	P00B6
Low Reference	-	P00B4	-	P00B6
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.				

Typical Scan Tool Data

Radiator Coolant Temperature Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine Running			
Parameter Normal Range: Varies with ambient temperature			
Signal	140°C (284°F)	-40°C (-40°F)	-40°C (-40°F)*

Low Reference	-	-40°C (-40°F)	-40°C (-40°F)*
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.			

Circuit/System Description

NOTE: The radiator coolant temperature sensor is referred to as B34B Engine Coolant Temperature Sensor 2 in schematics and other areas.

The radiator coolant temperature (RCT) sensor is a variable resistor that measures the temperature of the engine coolant in the radiator. This diagnostic checks for an open, short to ground or an intermittent circuit condition between the engine control module (ECM) and RCT sensor.

The following table illustrates the difference between temperature, resistance and voltage:

RCT	RCT Resistance	RCT Signal Voltage
Cold	High	High
Warm	Low	Low

Conditions for Running the DTC

P00B3

- The engine run time is greater than 10 s.
- The intake air temperature (IAT) is colder than 70°C (158°F).
- The DTC runs continuously when the above conditions are met.

P00B4

- The engine run time is greater than 60 s.
- The intake air temperature (IAT) is warmer than -7°C (19°F).
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

P00B3

The ECM detects that the RCT sensor is warmer than 149°C (300°F) for greater than 10 s.

P00B4

NOTE: The scan tool only displays to -40°C (-40°F).

The ECM detects that the RCT sensor is colder than -60°C (-76°F) for greater than 10 s.

Action Taken When the DTC Sets

- DTCs P00B3 and P00B4 are Type B DTCs.
- The cooling fans will be commanded ON by the ECM.
- The engine coolant temperature gauge is inoperative.

Conditions for Clearing the MIL/DTC

DTC P00B3 and P00B4 are Type B DTCs.

Diagnostic Aids

NOTE: **The engine coolant temperature (ECT) sensor is mounted on the engine and the radiator coolant temperature (RCT) sensor is mounted on the radiator.**

- As the thermostat opens, the RCT sensor temperature should rise steadily, then stabilize once the thermostat opens completely.
- Test the RCT sensor at various temperature levels in order to evaluate the possibility of a skewed sensor.
- If the vehicle has sat for greater than 8 hours, the ECT sensor and the RCT sensor values should display within 3°C (5°F).

Reference Information

Schematic Reference

Engine Controls Schematics (LL0-M4M) , Engine Controls Schematics (LFM/LL0+M4M)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Radiator Coolant Temperature Sensor parameter is between -39 to + 120°C (-38 to +248°F) and changes with engine run time.

- **If not between -39 to + 120°C (-38 to +248°F) or does not change**

Refer to Circuit/System Testing.

- **If between -39 to + 120°C (-38 to +248°F) and changes**

3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

5. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B34B Engine Coolant Temperature Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 ohms between the low reference circuit terminal 2 and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If less than 5 ohms**
3. Ignition ON.
4. Verify the scan tool Radiator Coolant Temperature Sensor parameter is colder than -39°C (-38°F).
 - **If warmer than -39°C (-38°F)**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If colder than -39°C (-38°F)**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the low reference circuit terminal 2.
6. Verify the scan tool Radiator Coolant Temperature Sensor parameter is at 149°C (300°F).
 - **If colder than 149°C (300°F)**

1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module, Ignition ON.
2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Ignition OFF.
4. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If warmer than 140°C (284°F)**
7. Test or replace the B34B Engine Coolant Temperature Sensor.

Component Testing

1. Ignition OFF, disconnect the harness connector at the B34B Engine Coolant Temperature Sensor.
2. Test the RCT Sensor by varying the sensor temperature while monitoring the sensor resistance. Compare the readings with the **Temperature Versus Resistance** table. The resistance values should be in range of the table values.
 - **If not within the specified range**
 - Replace the B34B Engine Coolant Temperature Sensor.
 - **If within the specified range**
3. Test for infinite resistance between each terminal and the sensor housing.
 - **If less than infinite resistance**

Replace the B34B Engine Coolant Temperature Sensor.

 - **If infinite resistance**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Engine Coolant Temperature Sensor Replacement (Radiator)** , **Engine Coolant Temperature Sensor Replacement (Thermostat)**
- **Engine Control Module Replacement** engine control module replacement, programming and setup

DTC P00B7: RADIATOR COOLANT TEMPERATURE (RCT) INSUFFICIENT FLOW

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.

- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P00B7

Radiator Coolant Temperature (RCT) Insufficient Flow

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P00B3	P00B4	P00B4*	P00B6
Low Reference	-	P00B4	-	P00B6
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.				

Typical Scan Tool Data

Radiator Coolant Temperature Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine Running in Closed Loop			
Parameter Normal Range: Varies with ambient temperature			
Radiator Coolant Temperature Sensor Signal	140°C (284°F)	-40°C (-40°F)	-40°C (-40°F)*
Low Reference	-	-40°C (-40°F)	-
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.			

Circuit Description

The engine control module (ECM) monitors the temperature of the engine radiator coolant. The ECM controls the thermostat with a pulse width modulated (PWM) signal. The ECM compares the radiator coolant temperature to the engine coolant temperature in order to determine if there sufficient coolant flow through the thermostat.

Conditions for Running the DTC

- DTCs P00B3, P00B4, P00B6, P0116, P0117 and P0118 are not set.
- The engine run time is greater than 5 m.

OR

- The engine coolant temperature is warmer than 105°C (221°F).
- The DTC runs continuously when the above conditions are met for greater than 5 s.

Conditions for Setting the DTC

NOTE: The scan tool display range is between -40 and + 150°C (-40 and +302°F).

The ECM detects the difference between the RCT sensor and the ECT sensor is greater than 45°C (113°F) when the ECT sensor is warmer than 117°C (242°F) for greater than 5 s.

Action Taken When the DTC Sets

DTC P00B7 is a Type B DTC.

Conditions for Clearing the MIL/DTC

DTC P00B7 is a Type B DTC.

Diagnostic Aids

- The thermostat has a mechanical fail-safe in case of an electrical condition with the thermostat heater. The mechanical thermostat will open at approximately 80°C (176°F). The mechanical thermostat will cycle from approximately 85°C (185°F) to approximately 102°C (215°F).
- A high resistance condition in the RCT sensor circuits may cause this DTC. This condition results in a greater voltage on the RCT sensor signal circuit, which is interpreted by the ECM as a colder RCT.

Reference Information

Schematic Reference

- **Engine Controls Schematics (LL0-M4M) , Engine Controls Schematics (LFM/LL0+M4M)**
- **Engine Heating/Cooling Schematics**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.

2. Verify that DTC P00B3, P00B4, P0480, P0481, P0597, P0598 or P0599 are not set.

- **If DTC P00B3, P00B4, P0480, P0481, P0597, P0598 or P0599 are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If DTC P00B3, P00B4, P0480, P0481, P0597, P0598 or P0599 are not set**

3. Verify the coolant in the radiator surge tank is at the correct level and there are no engine coolant leaks.

- **If the coolant in the radiator surge tank is not at the correct level or there are engine coolant leaks**

Refer to **Cooling System Draining and Filling** and **Loss of Coolant**.

- **If the coolant in the radiator surge tank is at the correct level and there are no engine coolant leaks**

4. Verify the engine cooling fan operates.

- **If the engine cooling fan does not operate**

Refer to **Cooling Fan Inoperative (LL0)**.

- **If the engine cooling fan operates**

NOTE: Depending on ambient temperature, it may take up to 4 min for the temperature to decrease less than the specified value.

5. Engine idling for 15 min with the A/C OFF.

6. Command the Engine Coolant Thermostat Heater to 100% with a scan tool. Increase the engine speed to 3 000 RPM. Observe the scan tool ECT sensor parameters. The temperature should decrease to less than 85°C (185°F).

- **If the temperature does not decrease to less than 85°C (185°F)**

Refer to Circuit/System Testing.

- **If the temperature does decrease to less than 85°C (185°F)**

7. All OK.

Circuit/System Testing

1. Vehicle OFF, inspect the cooling system for the conditions below. Refer to **Symptoms - Engine Cooling**.

- Weak coolant solution
- Obstructed radiator air flow or bent radiator fins
- Blocked cooling system passages
- Radiator hoses that are restricted, collapsed or deteriorated
- Damaged water pump

- Loss of cooling system pressure
- Leaking surge tank cap
- Leaking radiator hoses
- Cylinder head or an engine block that is cracked or plugged
- **If a condition exists**

Repair or replace the affected component as necessary.

- **If no conditions exist**

2. Replace the E41 Engine Coolant Thermostat Heater.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Engine Coolant Thermostat Replacement

DTC P0480, P0481, P0691, P0692, P0693 OR P0694: COOLING FAN RELAY

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0480

Cooling Fan Relay 1 Control Circuit

DTC P0481

Cooling Fan Relay Control Circuit 2

DTC P0691

Cooling Fan Relay 1 Control Circuit Low Voltage

DTC P0692

Cooling Fan Relay 1 Control Circuit High Voltage

DTC P0693

Cooling Fan Relay 2 Control Circuit Low Voltage

DTC P0694

Cooling Fan Relay 2 Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Relay Switch B+	1	1	-	-
Relay Coil Ignition	P0481 or P0691	P0480 or P0481	-	-
Cooling Fan Low Speed Relay Control	P0480 or P0691	P0480	P0480 or P0692	-
Cooling Fan High Speed Relay Control	P0481 or P0693	P0481 or 1	P0481 or P0694	-
Cooling Fan Relay Switch Output	1	1	2	-
Cooling Fan Ground	-	1	-	-
1. Cooling fan speed inoperative without a DTC. 2. Cooling fan always ON without a DTC.				

Circuit/System Description

The engine cooling fan system is composed of one cooling fan, 2 relays, the engine control module (ECM) and the associated wiring. The cooling fan assembly includes 1 resistor mounted in the cooling fan shroud. The cooling fan resistor may be a stand alone component or a part of the cooling fan motor and harness assembly. This combination of components enables the ECM to operate the cooling fan at 2 speeds using two fan control circuits. The ECM activates the applicable relay by grounding the control circuit with a solid state device called a driver. Each driver is equipped with a feedback circuit that is pulled-up to a voltage. The ECM can determine if the control circuit is open, shorted to ground or shorted to a voltage by monitoring the feedback voltage. The ECM will operate the cooling fan at either Low or High speed based on the cooling requirements.

Conditions for Running the DTC

LL0 - ECM with 2 Face Mounted Connectors.

- The ignition voltage is 11-32 volts.
- The engine speed is 400 RPM or greater.
- The ECM has commanded the output driver ON and OFF at least once during the ignition cycle.
- DTCs P0480 and P0481 run continuously when the conditions above are met.

LL0 and LFM - ECM with 3 Face Mounted Connectors.

- The ignition voltage is 11 volts or greater.

- The ECM has commanded the output driver ON and OFF at least once during the ignition cycle.
- DTCs P0480 P0481, P0691, P0692 P0693 and P0694 run continuously when the conditions above are met.

Conditions for Setting the DTC

The commanded state of the ECM driver and the actual state of the control circuit do not match for greater than 5 seconds.

Action Taken When the DTC Sets

- DTCs P0480 and P0481 are Type B DTCs - LL0.
- DTCs P0480 P0481, P0691, P0692 P0693 and P0694 are Type B DTCs - LFM and LL0.

Conditions for Clearing the MIL/DTC

- DTCs P0480 and P0481 are Type B DTCs - LL0.
- DTCs P0480 P0481, P0691, P0692 P0693 and P0694 are Type B DTCs - LFM and LL0.

Diagnostic Aids

- The ECM has the capability of providing command to the fan relays even when a scan tool output control is being used. Always refer to the fan control command parameters on the scan tool to know which fans are being commanded ON by the ECM.
- The scan tool cooling fan output control operates as follows:
 - Cooling Fan Relay 1 operates the fan at low speed
 - Cooling Fan Relay 2 operates the fan at a high speed
- When disconnecting or removing fuses and relays from a fuse block, always inspect the component electrical terminals for corrosion and the correct orientation in the fuse block. Test the mating electrical terminals for tightness.

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **Electrical Center Identification Views**

Description and Operation

Cooling Fan Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify an audible click is heard or felt from each cooling fan relay when commanding the cooling fan ON and OFF with a scan tool.
 - **If a click is not heard or felt at each of the relays**

Refer to Circuit/System Testing.

- **If a click is heard or felt at each of the relays**
3. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
 4. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**
5. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the KR20 cooling fan relays listed below:
 - KR20C Cooling Fan Low Speed Relay
 - KR20D Cooling Fan High Speed Relay

NOTE: **The following test must be performed on each of the relay coil ignition circuits.**

2. Ignition ON, verify that a test lamp illuminates between ground and the relay coil ignition circuit terminal listed below:
 - KR20C Cooling Fan Low Speed Relay terminal 85
 - KR20D Cooling Fan High Speed Relay terminal 85
 - **If the test lamp does not illuminate and the fuse is good**
 - 1. Ignition OFF and all vehicle systems OFF, it may take up to 2 minutes for all vehicle systems to power down.
 - 2. Test for less than 2 ohms in the ignition circuit of the appropriate KR20 Cooling Fan Relay, end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 - 1. Ignition OFF and all vehicle systems OFF, it may take up to 2 minutes for all vehicle systems to power down.
 - 2. Test for infinite resistance between the relay coil ignition circuits listed below and ground:
 - KR20C Cooling Fan Low Speed Relay terminal 85
 - KR20D Cooling Fan High Speed Relay terminal 85
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance, test all of the appropriate relays for a short and replace as necessary.
 - **If the test lamp illuminates**
3. Ignition OFF, remove the test lamp, ignition ON.

NOTE: The following tests must be performed on the two fan relay control circuits.

4. Connect a DMM, set on the diode setting, between a control circuit terminal listed below and ground:
 - KR20C Cooling Fan Low Speed Relay terminal 86
 - KR20D Cooling Fan High Speed relay terminal 86
5. Verify the DMM reading is greater than 2.5 V or displays O.L.
 - **If 2.5 V or less**
 - 1. Ignition OFF and all vehicle systems OFF, it may take up to 2 minutes for all vehicle systems to power down. Disconnect the X1 harness connector at the K20 Engine Control Module.
 - 2. Test for infinite resistance between the appropriate relay coil control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If greater than 2.5 V or displays O.L.**

NOTE: The following test must be performed on the two fan relay circuits.

6. Verify the DMM reading is less than 1 V when commanding the Cooling Fan Relays ON with a scan tool.

- **If 1 V or greater**

1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module, ignition ON.
2. Test for less than 1 V between the appropriate KR20 Cooling Fan Relay control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V.
3. Ignition OFF.
4. Test for less than 2 ohms in the appropriate KR20 Cooling Fan Relay control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.

- **If less than 1 V**

7. Test or replace the appropriate KR20 Cooling Fan Relay.

Component Testing

1. Ignition OFF.
2. Disconnect a cooling fan relay.
3. Test for 70-110 ohms between terminals 85/2 and 86/1.
 - **If less than 70 ohms or greater than 110 ohms**

Replace the cooling fan relay.

- **If between 70-110 ohms**

4. Test for infinite resistance between following terminals:
 - 30/3 and 86/1
 - 30/3 and 87/5
 - 30/3 and 85/2
 - 85/2 and 87/5
 - **If less than infinite resistance**

Replace the cooling fan relay.

- **If infinite resistance**

5. Install a 20 A fused jumper wire between relay terminal 85/2 and 12 V.
6. Install a jumper wire between relay terminal 86/1 and ground.
7. Test for less than 2 ohms between terminals 30/3 and 87/5.
 - **If 2 ohms or greater**

Replace the cooling fan relay.

- **If less than 2 ohms**

8. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Relay Replacement (Within an Electrical Center)** , **Relay Replacement (Attached to Wire Harness)**
- **Control Module References** for ECM replacement, programming and setup

DTC P0597-P0599: ENGINE COOLANT THERMOSTAT HEATER

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0597

Engine Coolant Thermostat Heater Control Circuit

DTC P0598

Engine Coolant Thermostat Heater Control Circuit Low Voltage

DTC P0599

Engine Coolant Thermostat Heater Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Voltage	P0031, P0037, P0102, P0135, P0141, P0443, P0458, P0597, P0598*	P0031, P0037, P0102, P0135, P0137, P0141, P0458, P0598	-	-
Thermostat Control Circuit	P0597, P0598	P0597	P0599, P0690	-
*Opens the fuse that supplies voltage to the engine coolant thermostat				

Circuit/System Description

The engine control module (ECM) controls the pulse width modulated (PWM) thermostat. The thermostat

controls coolant flow and regulates the engine operating temperature. Ignition voltage is supplied directly to the thermostat through a fuse. The ECM controls the thermostat by grounding the control circuit with a solid state device called a driver. The driver is equipped with a feedback circuit that is pulled-up to a voltage. The ECM can determine if the control circuit is open, shorted to ground or shorted to a voltage by monitoring the feedback voltage.

Conditions for Running the DTCs

- The ignition is ON or the engine is running.
- The DTCs run continuously once the above condition is met

Conditions for Setting the DTC

The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match for greater than 15 seconds.

Action Taken When the DTC Sets

- DTCs P0597, P0598 and P0599 are Type B DTCs.
- The engine control module commands the engine cooling fans ON.

Conditions for Clearing the DTC

DTCs P0597, P0598 and P0599 are Type B DTCs.

Diagnostic Aids

- A low engine coolant level could cause the thermostat heater to overheat and set a DTC.
- The thermostat has a mechanical fail-safe in case of an electrical condition with the thermostat heater. The mechanical thermostat will open at approximately 80°C (176°F). The mechanical thermostat will cycle from approximately 85°C (185°F) to approximately 102°C (215°F).

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**

- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the coolant in the radiator surge tank is at the correct level and there are no engine coolant leaks.
Loss of Coolant and **Cooling System Draining and Filling**

- **If the coolant level is not correct**

Repair as necessary.

- **If the coolant level is correct**

2. Ignition ON.
3. Verify the parameters listed below do not display Malfunction when commanding the Engine Coolant Thermostat Heater ON and OFF with a scan tool.
 - Engine Coolant Thermostat Heater Control Circuit Low Voltage Test Status
 - Engine Coolant Thermostat Heater Control Circuit Open Test Status
 - Engine Coolant Thermostat Heater Control Circuit High Voltage Test Status
 - **If Malfunction is displayed**
4. Operate the vehicle within the conditions for running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure records data.
5. Verify the DTC does not set.
 - **If any DTC sets**

Refer to Circuit/System Testing.

- **If Malfunction is not displayed**

Refer to Circuit/System Testing.

- **If the DTC does not set**

6. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the E41 Engine Coolant Thermostat Heater, Ignition ON.

2. Verify that a test lamp illuminates between the ignition circuit terminal 1 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF, remove the test lamp.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance, test all the components connected to fuse and replace as necessary.
 - **If the test lamp illuminates**
3. Connect a test lamp between the ignition circuit terminal 1 and the control circuit terminal 2, command the Engine Coolant Thermostat Heater to Increase to 100 % and Decrease to 0 % with a scan tool.
4. Verify that a test lamp turns On and OFF.
 - **If the test is always ON**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V.
 - 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module.
 - 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms replace the K20 Engine Control Module.
 - **If Malfunction is displayed**
5. Test or replace the E41 Engine Coolant Thermostat Heater.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Engine Coolant Thermostat Replacement** for E41 Engine Coolant Thermostat Heater replacement.
- **Control Module References** engine control module replacement, programming and setup.

DTC P112F: RADIATOR COOLANT TEMPERATURE SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P112F

Radiator Coolant Temperature Sensor Not Plausible

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P00B3	P00B4	P00B4*	P112F
Low Reference	-	P00B4	-	P112F
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.				

Typical Scan Tool Data

Radiator Coolant Temperature Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine Running			
Parameter Normal Range: Varies with ambient temperature			
Signal	140°C (284°F)	-40°C (-40°F)	-40°C (-40°F)*
Low Reference	-	-40°C (-40°F)	-40°C (-40°F)*
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.			

Circuit Description

NOTE: The radiator coolant temperature sensor is referred to as B34B Engine Coolant Temperature Sensor 2 in schematics and other areas.

The engine coolant radiator temperature sensor is a variable resistor that measures the temperature of the engine coolant in the radiator. The engine control module (ECM) supplies 5 volts to the engine coolant radiator temperature signal circuit and supplies a ground to the low reference circuit. The purpose of this diagnostic is to determine if the input from the RCT sensor is skewed warmer than normal. The internal clock of the ECM will record the amount of time the engine is OFF. If the required engine OFF time is met at start-up, the ECM will compare the temperature difference between the actual measured RCT and ECT sensors.

The following table illustrates the difference between temperature, resistance and voltage:

RCT	RCT Resistance	RCT Signal Voltage
Cold	High	High
Warm	Low	Low

Conditions for Running the DTC

- DTCs P00B3, P00B4, P0112, P0113, P0117, P0118, P0502, P0503, P111E or P2610 are not set.
- The vehicle has been OFF for greater than 8 hours before vehicle ON.
- The engine is running.
- The intake air temperature (IAT) is warmer than -7°C (19°F).
- The fuel level is greater than 10 percent.
- The DTC runs once per ignition cycle when the above conditions are met.

Conditions for Setting the DTC

The ECM determines the absolute difference of temperature between the RCT start up temperature and ECT start up temperature is greater than 20°C (68°F).

Action Taken When the DTC Sets

DTC P112F is a Type B DTC.

Conditions for Clearing the MIL/DTC

DTC P112F is a Type B DTC.

Diagnostic Aids

NOTE: The engine coolant temperature (ECT) sensor is mounted on the engine and the radiator coolant temperature (RCT) sensor is mounted on the radiator.

- As the thermostat opens, the radiator coolant temperature sensor signal should rise steadily, then stabilize once the thermostat opens completely.
- Inspect for the correct operation of the engine cooling system and verify the correct coolant level.

Reference Information

Schematic Reference

Engine Controls Schematics (LL0-M4M) , Engine Controls Schematics (LFM/LL0+M4M)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Radiator Coolant Temperature Sensor parameter is between -39 to + 120°C (-38 to +248°F) and changes with engine run time.
 - **If not between -39 to + 120°C (-38 to +248°F) or does not change**

Refer to Circuit/System Testing.

- **If between -39 to + 120°C (-38 to +248°F) and changes**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
 4. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**
5. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B34B Engine Coolant Temperature Sensor 2. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 ohms between the low reference terminal 2 and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, replace the K20 Engine Control Module.
 - **If less than 5 ohms**
- 3. Ignition ON.
- 4. Verify the scan tool Radiator Coolant Temperature Sensor parameter is colder than -39°C (-38°F).
 - **If warmer than -39°C (-38°F)**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If colder than -39°C (-38°F)**
- 5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the low reference circuit terminal 2.
- 6. Ignition ON, Verify the scan tool Radiator Coolant Temperature Sensor parameter is warmer than 140°C (284°F).
 - **If colder than the 140°C (284°F)**
 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module, Ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Ignition OFF.
 4. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If warmer than 140°C (284°F)**
- 7. Test or replace the B34B Engine Coolant Temperature Sensor 2.

Component Testing

1. Ignition OFF, disconnect the harness connector at the B34 Engine Coolant Temperature Sensor.
2. Test the ECT sensor by varying the sensor temperature while monitoring the sensor resistance. Compare the readings with the **Temperature Versus Resistance** table. The resistance values should be in range of the table values.
 - **If not within the specified range**
 - Replace the B34B Engine Coolant Temperature Sensor.
 - **If within the specified range**
3. Test for infinite resistance between each terminal and the sensor housing.
 - **If less than infinite resistance**

Replace the B34B Engine Coolant Temperature Sensor.

- If infinite resistance

4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Engine Coolant Temperature Sensor Replacement (Radiator)** , **Engine Coolant Temperature Sensor Replacement (Thermostat)** for radiator temperature sensor replacement.
- **Engine Control Module Replacement** for engine control module replacement, programming and setup.

DTC P2181: ENGINE COOLING SYSTEM PERFORMANCE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P2181

Engine Cooling System Performance

Circuit/System Description

The engine control module (ECM) monitors temperature difference between the engine coolant temperature (ECT) sensor and the radiator coolant temperature (RCT) sensor during a cold start-up. The purpose of this diagnostic is to analyze the engine coolant thermostat for being stuck open.

Conditions for Running the DTC

- DTCs P00B3, P00B4, P00B6, P0101, P0102, P0103, P0111, P0112, P0113, P0114, P0116, P0117 or P0118 are not set.
- The engine run time is between 70 s and 30 min.
- The engine coolant temperature (ECT) sensor at start-up is between -10°C to +59°C (14°F to 138°F).
- The intake air temperature (IAT) sensor is between -7°C to +60°C (-4°F to +140°F).
- The airflow into the engine is between 1 to 100 g/s.
- The DTC runs once per ignition cycle when the above conditions are met.

Conditions for Setting the DTC

The ECM detects the engine coolant thermostat is stuck open for at least 2.5 min.

Action Taken When the DTC Sets

DTC P2181 is a Type B DTC

Conditions for Clearing the DTC

DTC P2181 is a Type B DTC

Diagnostic Aids

- Insufficient vehicle interior heating is an indication of improper thermostat operation.
- The scan tool Desired ECT Sensor and the ECT Sensor parameters should be within 5°C (9°F) when the engine is at operating temperature.
- A resistance condition in the ECT sensor circuits may cause this DTC. This condition results in a greater voltage on the ECT sensor signal circuit, which is interpreted by the ECM as a colder ECT.

Reference Information

Schematic Reference

Engine Controls Schematics (LL0-M4M) , Engine Controls Schematics (LFM/LL0+M4M)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Cooling System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Engine running, observe the DTC information with a scan tool. DTC P00B3, P00B4, P00B6, P0117 or P0118 should not be set.
 - If a DTC is set, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** for further diagnosis.

2. Verify the coolant in the radiator surge tank is at the correct level and there are no engine coolant leaks. Refer to **Cooling System Draining and Filling** and **Loss of Coolant**.

NOTE: **Depending on ambient temperature, it may take up to 4 min for the temperature to increase greater than the specified value.**

3. Engine idling for 15 min with the A/C OFF. Verify the engine cooling fan is not ON at all times.
4. Command the Engine Coolant Thermostat Heater to 0 % with a scan tool. Increase the engine speed to 3,000 RPM. Observe the scan tool ECT sensor parameter. The temperature should increase to greater than 102°C (215°F).
 - If less than the specified value, replace the E41 engine coolant thermostat heater.
5. Operate the vehicle within the conditions for running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the freeze frame/failure records data.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

Engine Coolant Thermostat Replacement

SYMPTOMS - ENGINE COOLING

Important Preliminary Inspections Before Starting

Before using the Symptom diagnosis, perform the following:

- Perform **Diagnostic System Check - Vehicle** and verify all of the following items:
 - Engine control module (ECM) and malfunction indicator lamp (MIL) are operating correctly.
 - There are no diagnostic trouble codes (DTCs) stored.
 - Scan tool data is within a normal operating range.
- Verify the customer concern.
- Perform the Visual/Physical Inspection in this section. The visual/physical inspection is extremely important and can lead to correcting a condition without additional testing. It may also help reveal the cause of an intermittent condition.
- Locate the correct symptom. Perform the tests and inspections associated with the symptom.

Review the entire cooling system operation in order to familiarize yourself with the system functions. Refer to **Cooling Fan Description and Operation** and **Cooling System Description and Operation**.

Visual/Physical Inspection

CAUTION: Use the connector test adapter kit EL-35616-F for any test that requires probing the following items:

- **The control module harness connectors**
- **The electrical center fuse/relay cavities**
- **The component terminals**
- **The component harness connector**

Using this kit will prevent damage caused by the improper probing of connector terminals.

Several of the symptom procedures call for a careful visual and physical inspection. This can lead to correcting a condition without further tests and can save time. This inspection should include the following:

- Ensure that the control module grounds are clean, tight and correctly located.
- Inspect cooling system hoses and pipes for splits, kinks and improper connections. Inspect thoroughly for any type of leak or restriction.
- Inspect for a dirty or restricted radiator or HVAC condenser.
- Inspect for aftermarket devices which could affect the operation of the cooling system.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect the coolant recovery reservoir for proper coolant level.

Identifying Intermittent Conditions

Many intermittent conditions occur with harness or connector movement due to engine torque, rough pavement, vibration or physical movement of a component. Refer to the following for a list to help isolate an intermittent condition:

- Water intrusion in connectors, terminals or components
- Poor connector mating
- Terminal contact
- High circuit or component resistance-High resistance can include any resistance, regardless of the amount, which can interrupt the operation of the component.
- Harness' that are routed too tight or chaffed circuits
- High or low ambient temperatures
- High or low engine coolant temperatures
- High underhood temperatures
- Heat build up in components or circuits due to circuit resistance, poor terminal contact or high electrical load
- High or low system voltage
- High vehicle load conditions
- Rough road surface
- Electro-magnetic interference (EMI)/circuit interference from relays, solenoids or other electrical surge

- Incorrect installation of non-factory, aftermarket or after factory add on accessories

If an intermittent fault is detected, refer to **Testing for Intermittent Conditions and Poor Connections** for specific strategies in diagnosing intermittent conditions.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Cooling Fan Always On (LL0)**
- **Cooling Fan Inoperative (LL0)**
- **Engine Overheating**
- **Loss of Coolant**
- **Thermostat Diagnosis**
- **Engine Fails To Reach Normal Operating Temperature**

COOLING FAN ALWAYS ON (LL0)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provide an overview of each diagnostic category.

Circuit/System Description

The engine cooling fan system consists of a cooling fan assembly containing one electric cooling fan. The engine control module (ECM) uses two fan control circuits and a series of two relays to command the fans ON in either high speed or low speed, depending on cooling requirements. The ECM activates the applicable relay by grounding the control circuit with a solid state device called a driver. Each driver is equipped with a feedback circuit that is pulled-up to a voltage. The ECM can determine if the control circuit is open, shorted to ground or shorted to a voltage by monitoring the feedback voltage. In low speed, the fan is turned ON at a reduced speed. High speed has the fan turned ON at full speed.

Diagnostic Aids

- The scan tool cooling fan output control operates as follows:
 - Cooling Fan Relay 1 operates both fans at a low speed
 - Cooling Fan Relay 2 operates one fan at a high speed
- Certain resistance conditions with IAT or ECT sensors may cause unwarranted cooling fan activation. If the ECM is commanding the cooling fans ON for no apparent reason and without any component or system DTCs set, the IAT or ECT sensor may be skewed. If this condition is suspected, refer to the temperature versus resistance tables in the appropriate Engine Controls subsection.

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **Electrical Center Identification Views**

Description and Operation

Cooling Fan Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC P0480 or P0481 is not set.
 - **If any of the DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If none of the DTCs are set**
3. Verify the scan tool parameters listed below display OFF:
 - Cooling Fan Relay 1 Command
 - Cooling Fan Relays 2 Command
 - **If a scan tool parameter displays ON**

Refer to Diagnostic Aids and **Symptoms - Engine Cooling** for further diagnosis.

- **If both scan tool parameters display OFF**
4. Verify that the fan is not activated.
 - **If a fan is operating**

Refer to Circuit/System Testing.

- **If the fan is OFF**

5. All OK.

Circuit/System Testing

Cooling Fan Always ON

1. Ignition OFF, disconnect the KR20C Cooling Fan Low Speed Relay and KR20D Cooling Fan High Speed Relay one at a time, ignition ON.
2. Verify that the cooling fan is OFF.
 - **If the cooling fan is ON after both relays are removed**
 1. Ignition OFF, disconnect the harness connector at the G10 Cooling Fan Motor, ignition ON.
 2. Test for less than 1 V between the appropriate output control circuit terminal 87 and ground.
 - If 1 V or greater, repair the short to voltage in the circuit.
 - **If the cooling fan is OFF after both relays are removed**
3. Test or replace the appropriate cooling fan relay.

Component Testing

1. Ignition OFF.
2. Disconnect a cooling fan relay.
3. Test for 70-110 ohms between terminals 85/2 and 86/1.
 - **If less than 70 ohms or greater than 110 ohms**

Replace the cooling fan relay.

- **If between 70-110 ohms**

4. Test for infinite resistance between following terminals:
 - 30/3 and 86/1
 - 30/3 and 87/5
 - 30/3 and 85/2
 - 85/2 and 87/5

- **If less than infinite resistance**

Replace the cooling fan relay.

- **If infinite resistance**

5. Install a 20 A fused jumper wire between relay terminal 85/2 and 12 V.
6. Install a jumper wire between relay terminal 86/1 and ground.
7. Test for less than 2 ohms between terminals 30/3 and 87/5.

- If 2 ohms or greater

Replace the cooling fan relay.

- If less than 2 ohms

8. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Relay Replacement (Within an Electrical Center) , Relay Replacement (Attached to Wire Harness)

COOLING FAN INOPERATIVE (LL0)

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Circuit/System Description

The engine cooling fan system is composed of one cooling fan, 2 relays, the engine control module (ECM) and the associated wiring. The cooling fan assembly includes 1 resistor mounted in the cooling fan shroud. The cooling fan resistor may be a stand alone component or a part of the cooling fan motor and harness assembly. This combination of components enables the ECM to operate the cooling fan at 2 speeds using two fan control circuits. The ECM activates the applicable relay by grounding the control circuit with a solid state device called a driver. Each driver is equipped with a feedback circuit that is pulled-up to a voltage. The ECM can determine if the control circuit is open, shorted to ground or shorted to a voltage by monitoring the feedback voltage. The ECM will operate the cooling fan at either Low or High speed based on the cooling requirements.

Diagnostic Aids

- The scan tool cooling fan output control operates as follows:
 - Cooling Fan Relay 1 operates the fan at a low speed
 - Cooling Fan Relay 2 operates the fan at a high speed
- When disconnecting or removing fuses and relays from a fuse block, always inspect the component electrical terminals for corrosion and the correct orientation in the fuse block. Test the mating electrical terminals for tightness.

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **Electrical Center Identification Views**

Description and Operation

Cooling Fan Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC P0480, P0481, P0691, P0692, P0693 or P0694 is not set.
 - **If a DTC is set**

Refer to **DTC P0480, P0481, P0691, P0692, P0693 or P0694.**

- **If no DTC is set**
3. Verify that the cooling fan operates at low and high speed, when commanding the appropriate cooling fan relays ON and OFF with a scan tool.
 - **If the cooling fan does not operate at all speeds**

Refer to Circuit/System Testing.

- **If the cooling fan operates at all speeds**
4. All OK.

Circuit/System Testing

Inoperative in Both Speeds

1. Ignition OFF, disconnect the harness connector at the G10 Cooling Fan Motor.
2. Verify that the test lamp illuminates between B+ and ground circuit terminal 2 of the G10 Cooling Fan Motor.

- **If the test lamp does not illuminate**
 1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
- **If the test lamp illuminates**
- 3. Disconnect the KR20D Cooling Fan Relay, ignition ON:
- 4. Verify a test lamp illuminates between the KR20D Cooling Fan High Speed Relay terminal 30 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF, remove the test lamp.
 2. Test for infinite resistance between the KR20D Cooling Fan High Speed Relay terminal 87 and ground:
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance, test or replace the G10 Cooling Fan Motor, replace the fuse as necessary.
 - **If the test lamp illuminates**
- 5. Ignition OFF, install the KR20D Cooling Fan Relay, Ignition ON.
- 6. Command the cooling fan ON at high speed with a scan tool.
- 7. Verify a test lamp illuminates between the G10 Cooling Fan Motor terminals 1 and ground.
 - **If the test lamp does not illuminate**
 1. Ignition OFF, remove the test lamp.
 2. Disconnect the KR20D Cooling Fan High Speed Relay.
 3. Test for less than 2 ohms between KR20D High Speed Relay terminal 87 and the G10 Cooling Fan Motor terminal 1.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - **If the test lamp illuminates at each terminal**
- 8. Test or replace the G10 Cooling Fan Motor.

Inoperative in Low Speed

1. Disconnect the KR20C Cooling Fan Low Speed relay, ignition ON:
2. Verify a test lamp illuminates between ground and the KR20C Cooling Fan Low Speed Relay B+ circuit terminal 30.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 ohms in the relay B+ circuit, end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF, remove the test lamp and disconnect the R10 Cooling Fan Resistor.
 2. Test for infinite resistance between the relay circuit terminals listed below and ground:
 - KR20C Cooling Fan Low Speed Relay terminal 87.
 - KR20C Cooling Fan Low Speed Relay terminal 30.
 - If less than infinite resistance, repair the short to ground in the circuit. Replace the fuse as necessary.
 - **If the test lamp illuminates**
- 3. Ignition OFF, install the KR20C relay. Disconnect R10 Cooling Fan Resistor, Ignition ON.
- 4. Command the cooling fan ON at low speed with a scan tool.
- 5. Verify a test lamp illuminates between the R10 Cooling Fan Resistor terminal X1-A and ground.
 - **If the test lamp does not illuminate**
 1. Ignition OFF, remove the test lamp.
 2. Disconnect the KR20C Cooling Fan Low Speed Relay.
 3. Test for less than 2 ohms between KR20C Low Speed Relay terminal 87 and Cooling Fan Resistor terminal X1 A.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace KR20C Cooling Fan Low Speed Relay.
 - **If the test lamp illuminates**
- 6. Ignition OFF, reconnect the Cooling Fan Resistor and disconnect the harness connector at the G10 Cooling Fan Motor.
 1. Ignition ON, Command the cooling fan ON at low speed with a scan tool.
 2. Verify a test lamp illuminates between the G10 Cooling Fan Motor terminal 1 and ground.
 - **If the test lamp does not illuminate**
 3. Ignition OFF.
 4. Test for less than 2 ohms between the Cooling Fan Resistor terminal X2 A and G10 Cooling Fan terminal 1, end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - **If the test lamp illuminates**
- 7. Replace the R10 Cooling Fan Resistor.

Inoperative in High Speed

1. Disconnect the KR20D Cooling Fan High Speed Relay, ignition ON:
2. Verify a test lamp illuminates between the KR20D Cooling Fan High Speed Relay and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 ohms in the relay B+ circuit, end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
- **If the test lamp illuminates**
- 3. Ignition OFF, install the KR20D Cooling Fan High Speed Relay. Disconnect the harness connector at the G10 Cooling Fan Motor, ignition ON.
- 4. Command the cooling fan ON at high speed with a scan tool.
- 5. Verify a test lamp illuminates between the G10 Cooling Fan Motor terminal 1 and ground.
 - **If the test lamp does not illuminate**
 - 1. Ignition OFF, remove the test lamp.
 - 2. Disconnect the KR20D Cooling Fan High Speed Relay.
 - 3. Test for less than 2 ohms between KR20D High Speed Relay terminal 87 and G10 Cooling Fan Motor terminal 1.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the KR20D Cooling Fan High Speed Relay.

ENGINE OVERHEATING

Engine Overheating

Step	Action	Yes	No
DEFINITION: Either of the following conditions indicate a probable engine overheat condition. - The engine temperature gauge is in the red (overheat) zone and/or the engine temperature indicator is ON. - Hot engine coolant overflows from the coolant recovery reservoir and/or coolant pressure cap onto the ground while the engine is running.			
1	1. Inspect and fill the cooling system, as necessary. 2. Inspect the cooling system for leaks, as necessary. 3. Repair the cooling system leaks, as necessary. Has the inspection/repair been performed?	Go to Step 2	-
2	1. Start the engine and allow the engine to run at approximately 1 200 RPM. 2. Use the Scan Tool in order to verify the overheat condition. Does the Scan Tool verify the engine overheat condition?	Go to Step 3	Go to <u>Engine Heating/Cooling Schematics</u>
3	1. Verify that the cooling fans are operating correctly. 2. Repair the cooling fan system, as necessary.		

	Does the engine still overheat?	Go to Step 4	System OK
4	Perform the following inspections: • Inspect the radiator and the A/C condenser cooling fans for debris or any other obstruction • Inspect the drive belt system and the drive belt tensioner for correct operation in order to ensure that the water pump is rotating correctly. • Inspect for loose, damaged and/or missing air deflector(s). • Check for a pinched or kinked cooling system hose. • Repair the system if necessary.		
	Does the engine still overheat?	Go to Step 5	System OK
5	Inspect the thermostat for correct operation. Does the thermostat operating correctly?	Go to Step 7	Go to Step 6
6	Replace the thermostat. Does the engine still overheat?	Go to Step 7	System OK
7	NOTE: Excessive coolant freeze point protection MAY cause the coolant to boil at low temperatures. 1. Inspect for the correct coolant concentration (mixture). Correct the coolant concentration as necessary. 2. Remove the coolant pressure cap. 3. Start the engine and inspect for a constant flow of air bubbles in the engine coolant. Is there a constant flow of air bubbles in the engine coolant?		
		Go to Step 8	Go to Step 9
8	The probable cause of the engine overheat is combustion chamber gasses leaking into the cooling system. This condition is usually caused by the following: • A worn or damaged cylinder head gasket. • Worn or damaged cylinder head. • A worn and/or damaged engine block.		

	Verify this condition by inspecting the spark plug electrodes and porcelain surrounding the spark plug electrode for signs of coolant. Replace and/or repair the engine internal component(s), as necessary, in order to repair the engine internal coolant leak. Does the engine still overheat?	Go to Step 1	System OK
9	The engine overheat may be caused by a cooling system blockage. Flush the cooling system. Does the engine still overheat?	Go to Step 10	System OK
10	NOTE: It is unlikely that the water pump is the cause of the overheat condition. If NONE of the cooling system passages are restricted, replace the water pump. Does the engine still overheat?	Go to Step 1	System OK

LOSS OF COOLANT

Loss of Coolant

Step	Action	Yes	No
DEFINITION: Loss of coolant in the coolant system internally or externally.			
1	Inspect the coolant level. Is the coolant at the correct level?	Go to Step 6	Go to Step 4
2	Fill the cooling system to the correct level. Is the action complete?	Go to Step 5	-
3	If the engine is suspected to have a coolant leak into a cylinder, the coolant can hydraulically lock the engine. Does the engine crankshaft rotate?	Go to Step 6	Repair the condition in which the engine cannot be cranked. Go to <u>Engine Will Not Crank - Crankshaft Will Not Rotate</u>
4	Engine overheating can cause a loss of coolant. Is the engine overheating?	Go to <u>Engine Overheating</u>	Go to Step 7
5	Extended operation with a low coolant level can cause engine internal component failure. Is the engine knocking?	Repair the engine knock. Refer to <u>Lower Engine Noise, Regardless of Engine Speed</u>	Go to Step 8
6	1. Idle the engine at the normal operation temperature. 2. Inspect for heavy white smoke coming out of the exhaust system.		

	Is a heavy white smoke present from the exhaust pipe?	Go to Step 9	Go to Step 10
7	• Coolant in the exhaust system creates a distinctive, burning coolant odor in the exhaust. • Condensation in the exhaust system can cause an odorless white smoke during engine warm up. Does the white smoke have a burning coolant type odor?	Repair the engine internal coolant leak. Refer to <u>Coolant in Engine Oil</u>	Go to Step 10
8	With the engine idling, inspect the coolant recovery reservoir. Does the coolant recovery system discharge coolant while the engine is idling?	Repair the engine internal coolant leak. Refer to <u>Coolant in Engine Oil</u>	Go to Step 11
9	Visually inspect the hoses and hose retaining clamps at the following locations: • Coolant bypass • Coolant reservoir • Heater core • Coolant bypass valve • Radiator Are any of the hoses leaking?	Repair or replace the leaking component. Refer to the appropriate repair.	Go to Step 12
10	Visually inspect the following component: • Coolant pressure cap • Core plug • Cylinder head gasket • Engine block • Intake manifold • Radiator • Thermostat housing • Water pump Are any of the listed components leaking?	Repair or replace any leaky part.	Go to Step 13
11	1. Pressure test the cooling system. 2. With the cooling system pressurized, visually inspect the components listed in steps 11 and 12.		

	Is there any leakage?	Repair or replace the leaking component.	Go to Step 14
12	Pressure test the coolant pressure cap. Does the coolant pressure cap hold pressure?	Go to Step 13	Replace the coolant pressure cap.
13	Inspect for the following conditions: • A coolant smell inside of the vehicle. • Coolant in the HVAC module drain tube. • Coolant on the vehicle floor covering near the HVAC module. Is coolant present?	Replace the heater core.	Go to Step 15
14	Inspect the underside of the engine oil filler cap for a gray/white milky substance. Is there a milky substance on under the oil fill cap?	Repair the engine internal coolant leak. Refer to <u>Coolant in Engine Oil</u>	Replace the coolant pressure cap.
15	Inspect the engine oil level indicator for a gray/white milky substance. Is there a milky substance on the engine oil level indicator?	Repair the engine internal coolant leak. Refer to <u>Coolant in Engine Oil</u>	Replace the coolant pressure cap.

THERMOSTAT DIAGNOSIS

1. Remove the thermostat from the vehicle. Refer to **Engine Coolant Thermostat Replacement**.
2. Make sure the valve spring is tight when the thermostat is fully closed. If the spring is not tight, replace the thermostat.
3. Suspend the thermostat and a thermometer in a pan of 50/50 mixture of ethylene glycol and water. Do not let the thermostat or the thermometer rest on the bottom of the pan because the uneven concentration of heat on the bottom could result in inaccurate temperature measurements.
4. Heat the pan on a burner.
5. Use the thermometer to measure the temperature of the heated solution.
6. The thermostat should begin to open at 105°C (221°F) and it should be fully open at 120°C (248°F) and it should be fully close at 98° C (208.4° F). If it does not open or close at these temperature, replace the thermostat. Also, the thermostat rod's stroke from the initially open to the fully open should be 8 mm (0.32 in).

ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE

Engine Fails To Reach Normal Operating Temperature

Step	Action	Yes	No
	1. Ensure that the cooling system is full. 2. Allow the engine to cool. 3. Start the engine.		

1	4. Turn the air conditioning system off. 5. Inspect the engine cooling fan(s). Is the electric cooling fan on?	Go to Step 2	Go to Step 3
2	1. Diagnose and repair the cooling fan system. 2. Verify the customer complaint. Does the engine still fail to reach normal operating temperature?	Go to Step 3	System OK
3	Install the scan tool to the DLC. Compare the scan tool coolant temperature reading to the I/P cluster coolant temperature. Is the I/P cluster coolant temperature close to the reading on the scan tool?	Go to Step 5	Go to Step 4
4	1. Diagnose and repair the coolant temperature gauge system. 2. Verify the customer complaint. Does the engine still fail to reach normal operating temperature?	Go to Step 5	System OK
5	Inspect the thermostat for correct operation. Is the thermostat operating correctly?	System OK	Go to Step 6
6	1. Replace the thermostat. 2. Verify the customer complaint. Does the engine still fail to reach normal operating temperature?	Go to Step 1	System OK

COOLING SYSTEM LEAK TESTING

WARNING: Under pressure, the temperature of the solution in the radiator can be considerably higher, without boiling. Removing the radiator cap while the engine is hot (pressure is high), will cause the solution to boil instantaneously, with explosive force. The solution will spew out over the engine, fenders and the person removing the cap. Serious bodily injury may result. Flammable antifreeze, such as alcohol, is not recommended for use at any time. Flammable antifreeze could cause a serious fire.

WARNING: In order to help avoid being burned, do not remove the radiator cap while the engine and the radiator are hot. Scalding fluid and steam can be blown out under pressure if the cap is removed too soon.

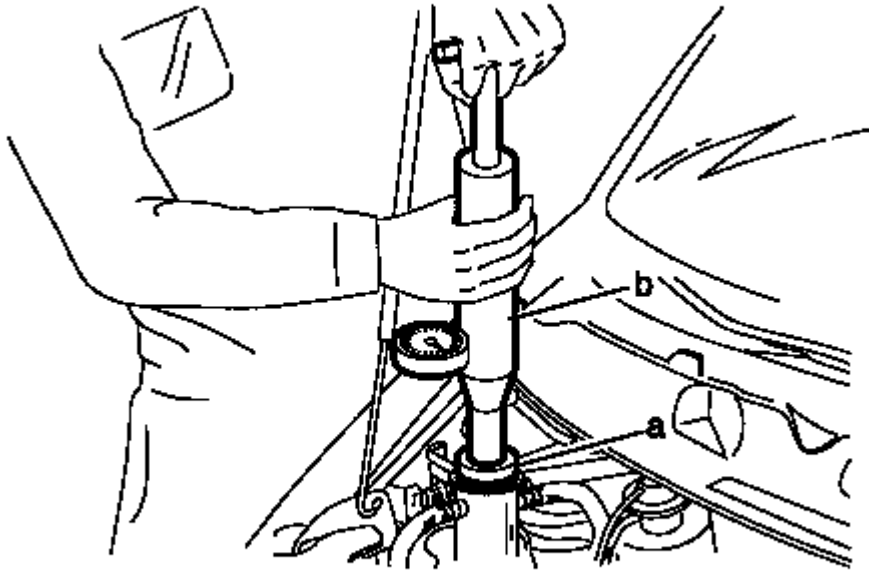


Fig. 2: Removing Surge Tank Cap

Courtesy of GENERAL MOTORS COMPANY

1. Remove the surge tank cap after the engine cools.
2. Check the coolant level.
3. Install a suitable cooling system pressure tester (b) to the surge tank filler neck using the adapter (a) and pressurize 110-120 kPa (16.0-17.4 psi).
4. Check the coolant leaks on the hoses and connections during 2 minutes.
5. If the leak is checked, replace the parts or repair the connections.

REPAIR INSTRUCTIONS

COOLING SYSTEM DRAINING AND FILLING

Draining Procedure

WARNING: To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.

1. Remove the surge tank cap.
2. Raise the vehicle by its full height. Refer to Lifting and Jacking the Vehicle .
3. Place a drain pan under the drain cock.

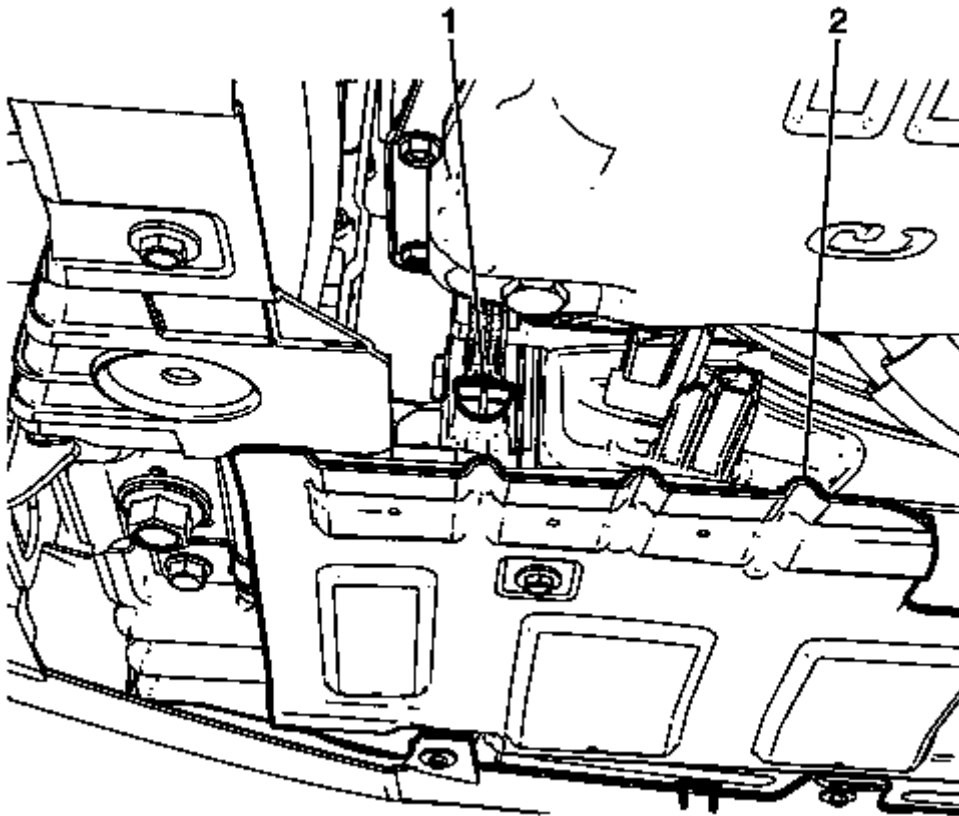


Fig. 3: Radiator Drain Cock
Courtesy of GENERAL MOTORS COMPANY

4. Remove the compartment splash shield (2). Refer to Front Compartment Splash Shield Replacement .
5. Loosen the radiator coolant drain cock (1) on the radiator.
6. Drain the cooling system.
7. Lower the vehicle.
8. Inspect the coolant.
9. Follow the appropriate procedure based on the condition of the coolant.
 - Normal in appearance-Follow the filling procedure.
 - Discolored-Follow the flush procedure. Refer to Coolant System Flushing.

Filling Procedure

CAUTION: The procedure below must be followed. Improper coolant level could result in a low or high coolant level condition, causing engine

damage.

1. Raise and support the vehicle.

CAUTION: Refer to Fastener Caution .

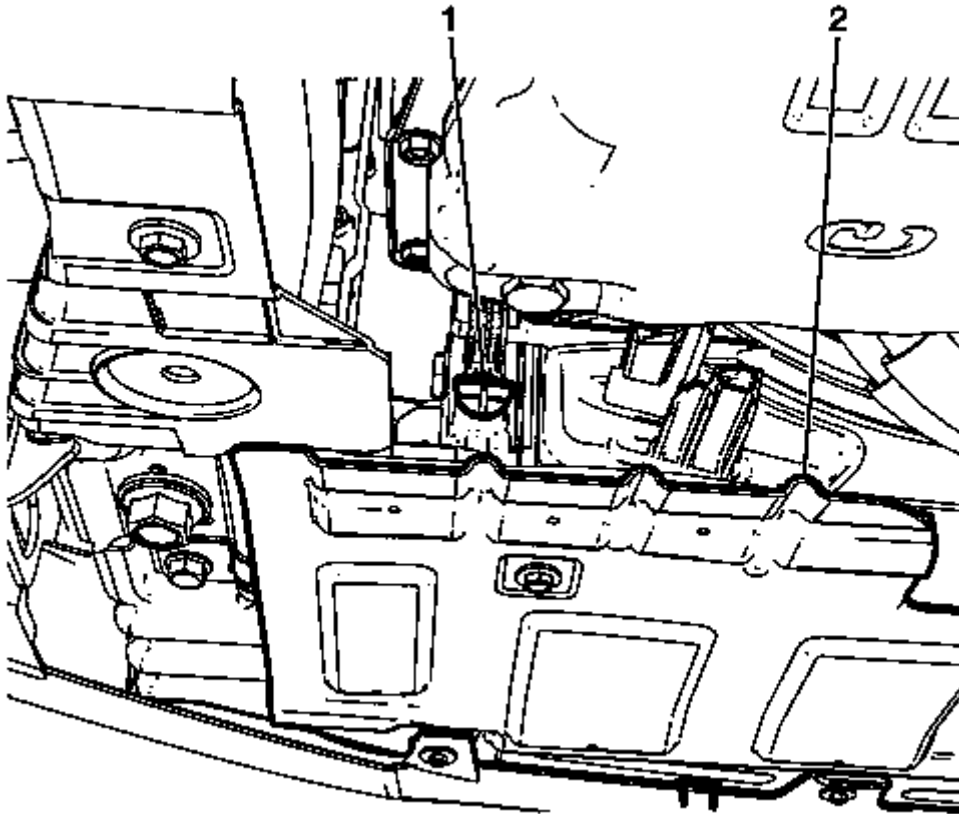


Fig. 4: Radiator Drain Cock

Courtesy of GENERAL MOTORS COMPANY

2. Tighten the radiator drain cock (1) to 2 (18 lb in).
3. Install the compartment splash shield (2). Refer to Front Compartment Splash Shield Replacement .
4. Lower the vehicle.

NOTE: Use a 50/50 mixture of DEX-COOL antifreeze and clean drinkable water.

5. Slowly fill the radiator with a 50/50 coolant mixture until the coolant level reaches the base of the radiator surge tank.
6. Allow 30 seconds for the coolant level to stabilize and continue to fill the coolant filler neck until the level stabilizes for at least 2 minutes.

7. Start the engine and allow the engine to idle in PARK or NEUTRAL with the parking brake engaged.
8. Slowly fill the coolant mixture until the level stabilizes at the base of the radiator surge tank.
9. Install the coolant pressure cap.
10. Raise the engine RPM to 2500 RPM for 30-40 seconds.
11. Shut the engine OFF.
12. Allow the engine to cool, remove coolant fill cap and repeat steps 3-9 until the coolant level has completely stabilized within the radiator surge tank.
13. Inspect and if necessary, fill the coolant reservoir bottle as necessary.
14. Rinse away any excess coolant from the engine and the engine compartment.
15. Inspect the cooling system for leaks.
16. Top off the radiator surge tank if necessary.

COOLANT SYSTEM FLUSHING

NOTE:

- Do not use a chemical flush.
- Store used coolant in the proper manner, such as in a used engine coolant holding tank.
- Do not pour used coolant down a drain. Ethylene glycol antifreeze is a very toxic chemical.
- Do not dispose of coolant into the sewer system or ground water. This is illegal and ecologically unsound.
- Various methods and equipment can be used to flush the cooling system. If special equipment is used, such as a back flusher, follow the manufactures instruction. However, always remove the thermostat before back flushing the system.

1. Apply the parking brake.
2. Drain the coolant. Refer to Cooling System Draining and Filling.
3. Fill the cooling system with clean drinkable water. Refer to Cooling System Draining and Filling.
4. Start the engine and run at 2, 000 RPM until the thermostat opens.
5. Turn OFF the engine.
6. Drain the coolant system. Refer to Cooling System Draining and Filling.
7. Repeat the above procedure until the water from the coolant system is colorless.
8. Drain the coolant system. Refer to Cooling System Draining and Filling.
9. Repeat the above procedure until the water from the coolant system is colorless. Refer to Cooling System Draining and Filling.

RADIATOR CLEANING

WARNING: NEVER spray water on a hot heat exchanger. The resulting steam could cause personal injury.

CAUTION: The heat exchanger fins are necessary for good heat transfer. Do not brush the fins. This may cause damage to the fins, reducing heat transfer.

NOTE: Blow compressed air through the engine side of the radiator to remove any foreign material, such as insects, leaves and dust.

- Warm water and mild soap may be needed in some conditions.
- Wash the A/C condenser fin.
- Wash the A/C condenser and radiator thoroughly.
- Wash the radiator cooling fin.
- Repair any damaged cooling fin.

RADIATOR SURGE TANK REPLACEMENT (LL0)

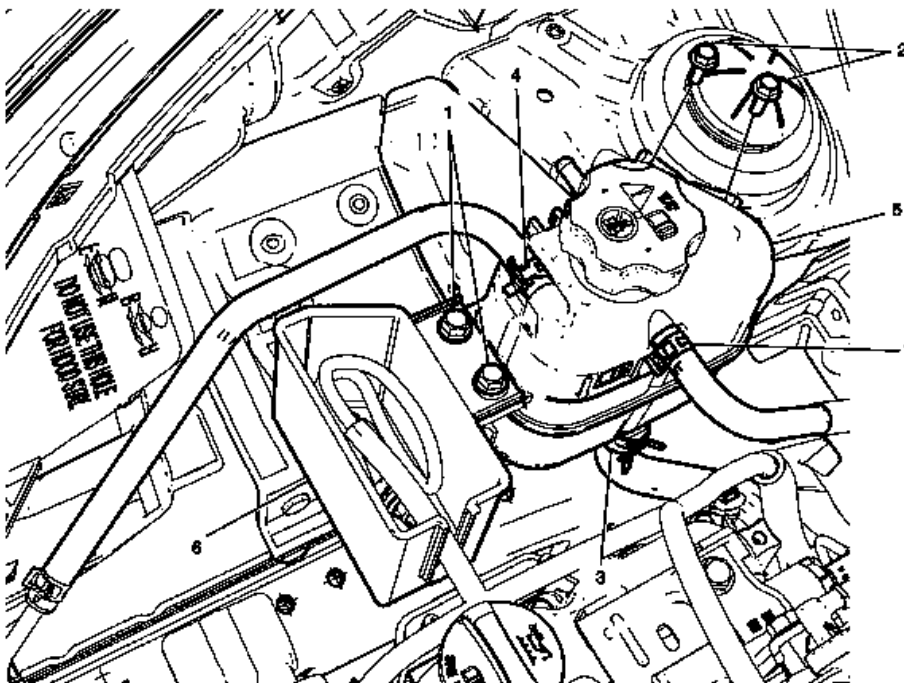


Fig. 5: Radiator Surge Tank
Courtesy of GENERAL MOTORS COMPANY

Radiator Surge Tank Replacement (LL0)

Callout	Component Name
Preliminary Procedure	
Drain the cooling system. Refer to <u>Cooling System Draining and Filling.</u>	
	Block Heater Connecting Plug Holder Bolt (Qty: 2)

1	CAUTION: Refer to <u>Fastener Caution</u> . Tighten 8 (71 lb in)
2	Radiator Surge Tank Mounting Bolt (Qty: 2) Tighten 8 (71 lb in)
3	Radiator Surge Tank Outlet Hose & Clamp
4	Radiator Surge Tank Inlet Hose & Clamp
5	Radiator Surge Tank
6	Block Heater Connecting Plug Holder
7	Coolant Hose & Clamp

RADIATOR SURGE TANK REPLACEMENT (LFM)

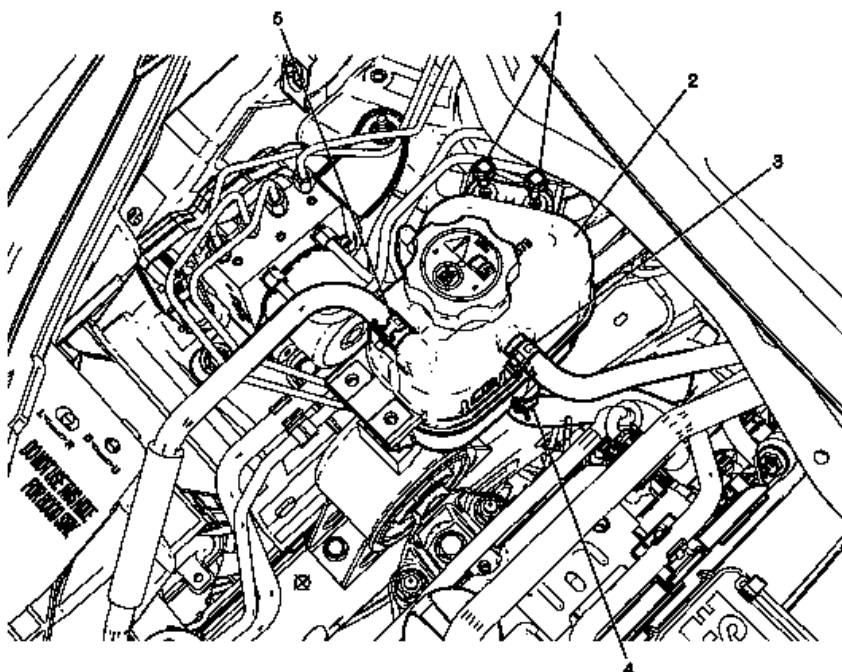


Fig. 6: Radiator Surge Tank Replacement (LFM)
Courtesy of GENERAL MOTORS COMPANY

Radiator Surge Tank Replacement (LFM)

Callout	Component Name
Preliminary Procedure Drain the cooling system. Refer to <u>Cooling System Draining and Filling</u> .	
	Radiator Surge Tank Mounting Bolt (Qty: 2)

1	CAUTION: Refer to <u>Fastener Caution</u> . Tighten 8 (71 lb in)
2	Radiator Surge Tank
3	Coolant Hose and Clamp
4	Radiator Surge Tank Outlet Hose and Clamp
5	Radiator Surge Tank Inlet Hose and Clamp

RADIATOR SURGE TANK OUTLET HOSE REPLACEMENT

Special Tools

J-38185 Hose Clamp Pliers

For equivalent regional tools, refer to **Special Tools**.

Removal Procedure

1. Drain the coolant. Refer to **Cooling System Draining and Filling**.

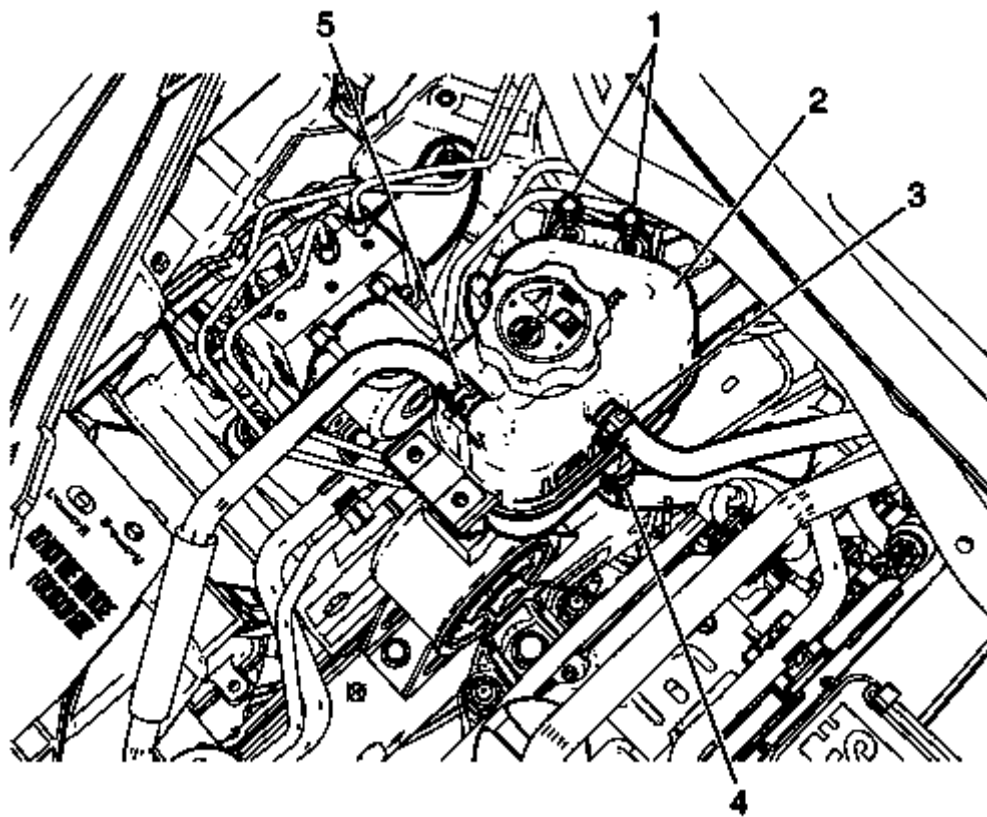


Fig. 7: Radiator Surge Tank Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

2. Loosen the radiator surge tank outlet hose clamp (4) and remove the radiator surge tank outlet hose from the radiator surge tank (2).
3. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** .

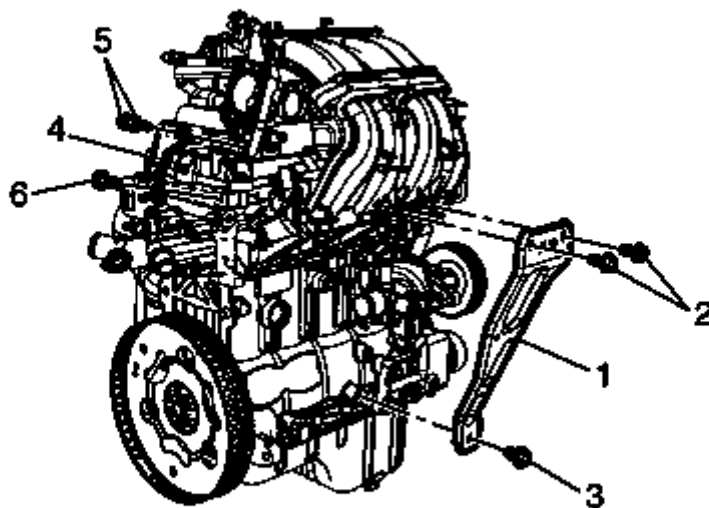


Fig. 8: Intake Manifold Rear Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove the intake manifold rear bracket bolts (2, 3).
5. Remove the intake manifold rear bracket (1).

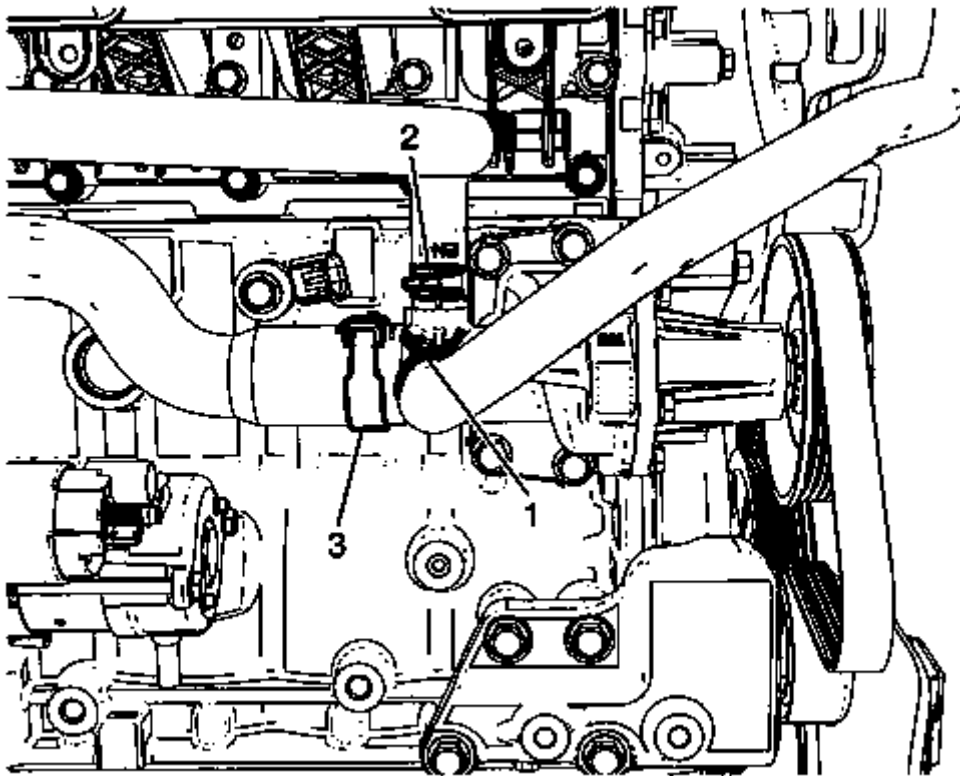


Fig. 9: Heater Outlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

6. Loosen the radiator surge tank outlet hose clamp (1) and remove the radiator surge tank outlet hose from the water pump.
7. Transfer parts as necessary.

Installation Procedure

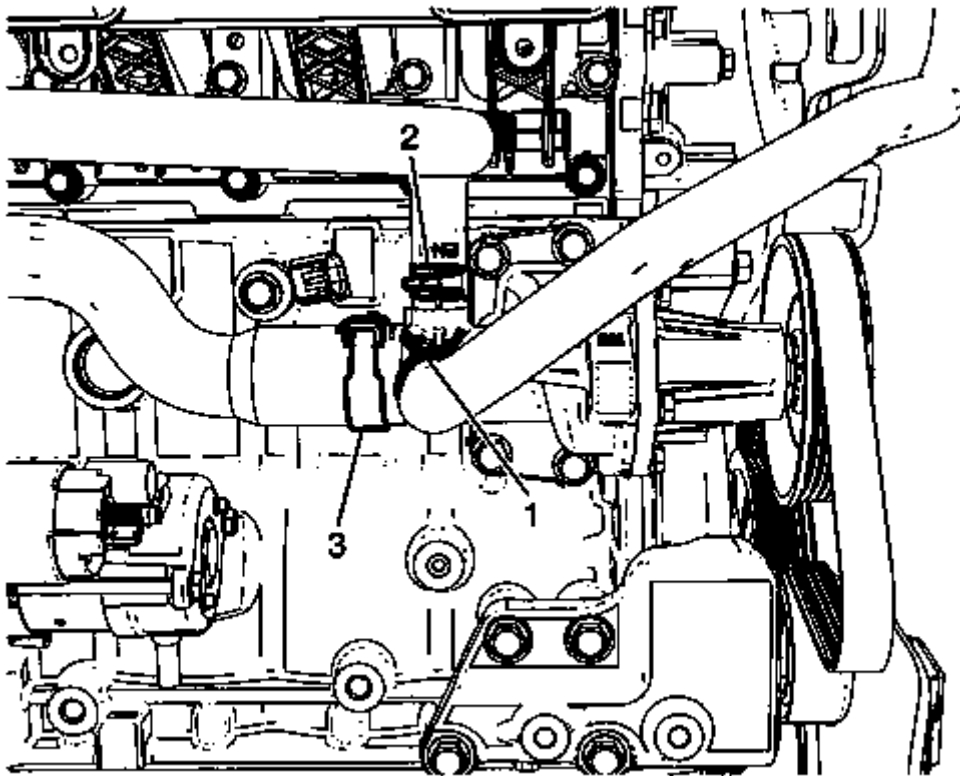


Fig. 10: Heater Outlet Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

1. Install the radiator surge tank outlet hose with the radiator surge tank outlet hose clamp (1) to the water pump.

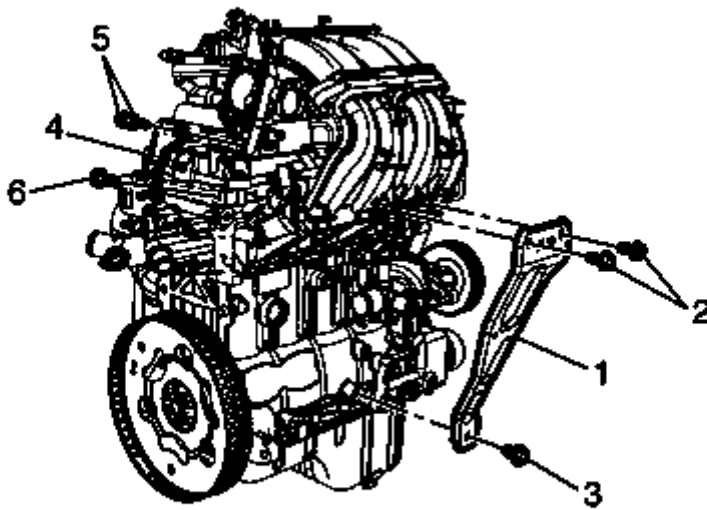


Fig. 11: Intake Manifold Rear Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Install the intake manifold rear bracket (1).

CAUTION: Refer to Fastener Caution .

3. Install the intake manifold rear bracket bolts - up (2) and tighten to 22 (16 lb ft).
4. Install the intake manifold rear bracket bolt- down (3) and tighten to 58 (42 lb ft).

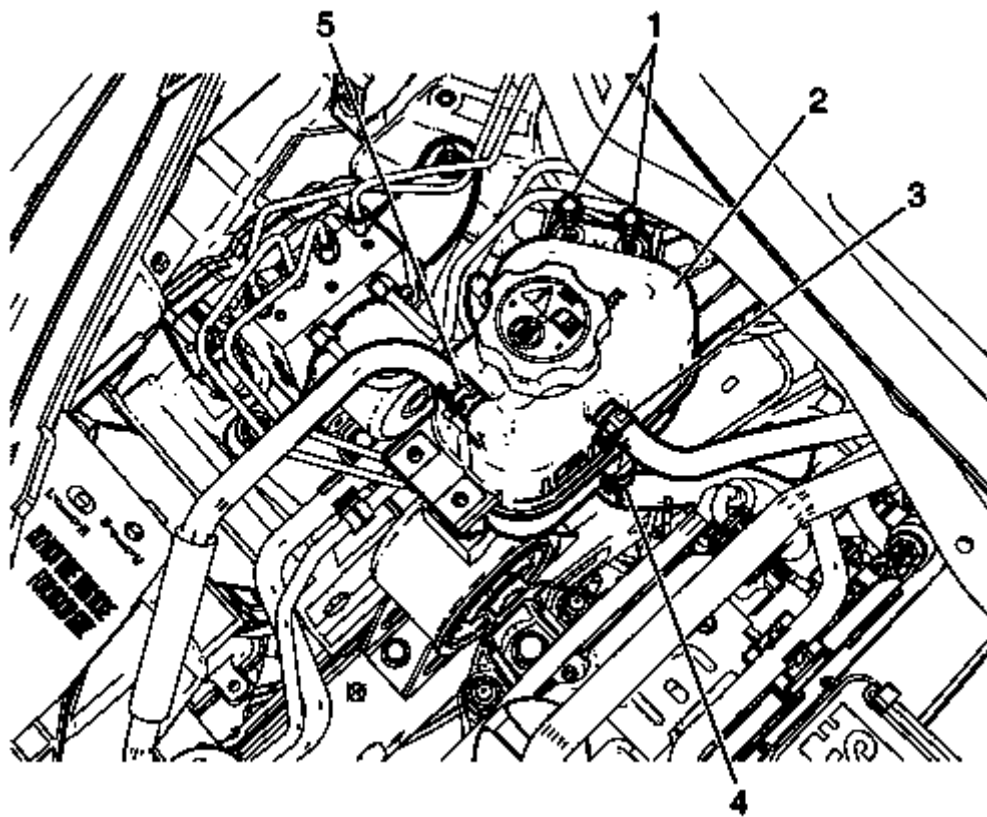


Fig. 12: Radiator Surge Tank Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

5. Lower the vehicle.
6. Install the radiator surge tank outlet hose with the radiator surge tank outlet hose clamp (4) to the radiator surge tank (2).
7. Fill the cooling system. Refer to **Cooling System Draining and Filling**.
8. Start the engine and check for coolant leaks.

RADIATOR INLET HOSE REPLACEMENT

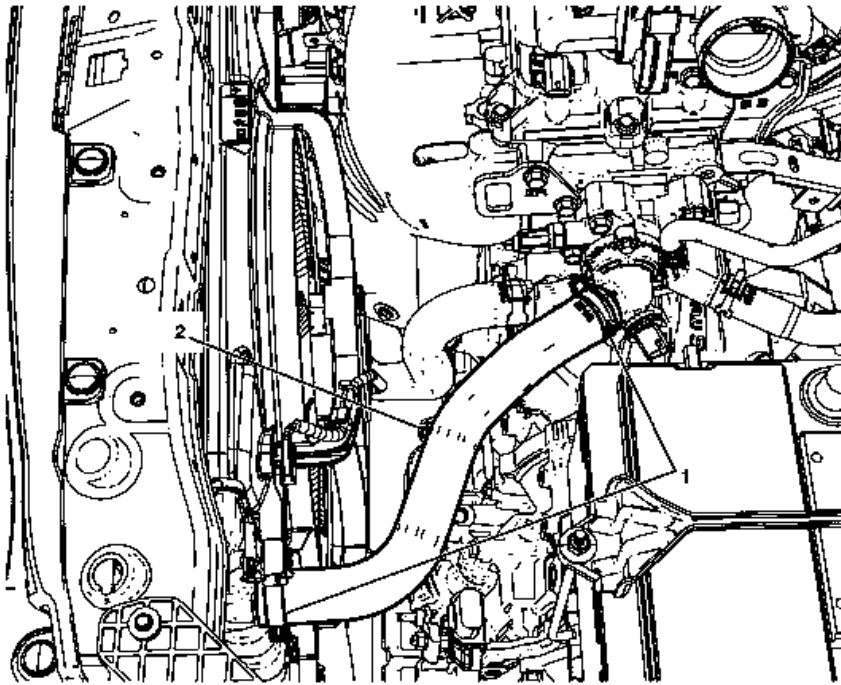


Fig. 13: Radiator Inlet Hose
 Courtesy of GENERAL MOTORS COMPANY

Radiator Inlet Hose Replacement

Callout	Component Name
Preliminary Procedures 1. Open the hood. 2. Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 3. Remove the air cleaner assembly. Refer to <u>Air Cleaner Assembly Replacement</u> . 4. Drain the cooling system. Refer to <u>Cooling System Draining and Filling</u>.	
1	Radiator Inlet Hose Clamp (Qty: 2) Procedure Loosen the radiator inlet hose clamp (1).
2	Radiator Inlet Hose

RADIATOR OUTLET HOSE REPLACEMENT

Removal Procedure

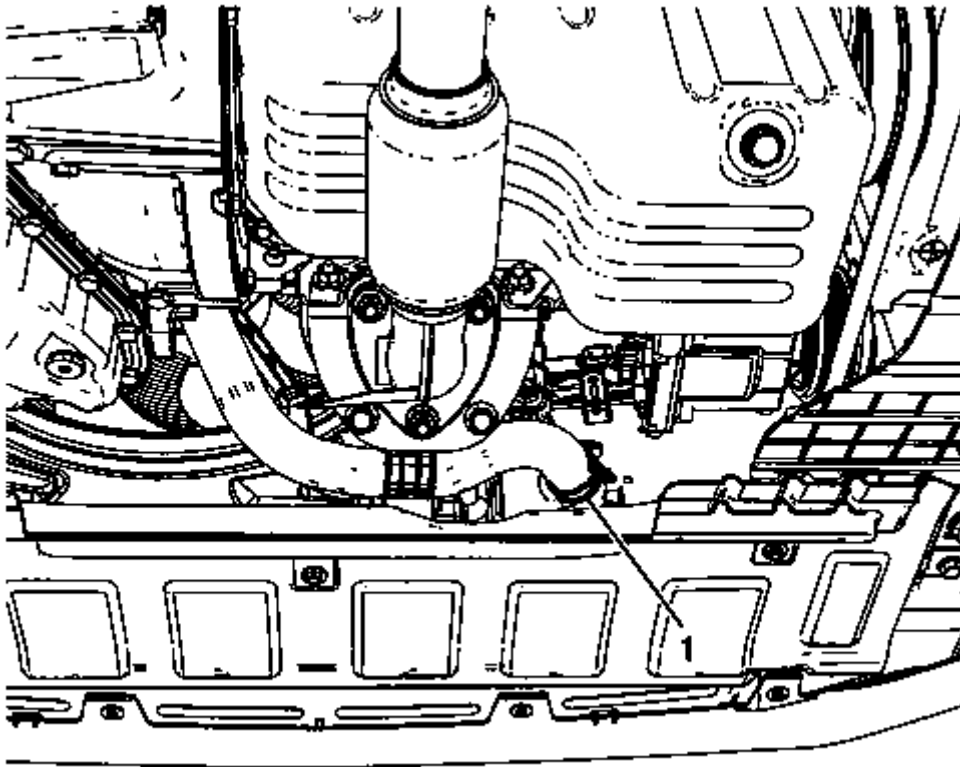


Fig. 14: Radiator Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

1. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Drain the cooling system. Refer to **Cooling System Draining and Filling**.
3. Loosen the radiator outlet hose clamp (1).
4. Remove the radiator outlet hose from the radiator.
5. Lower the vehicle. Refer to **Lifting and Jacking the Vehicle** .
6. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .

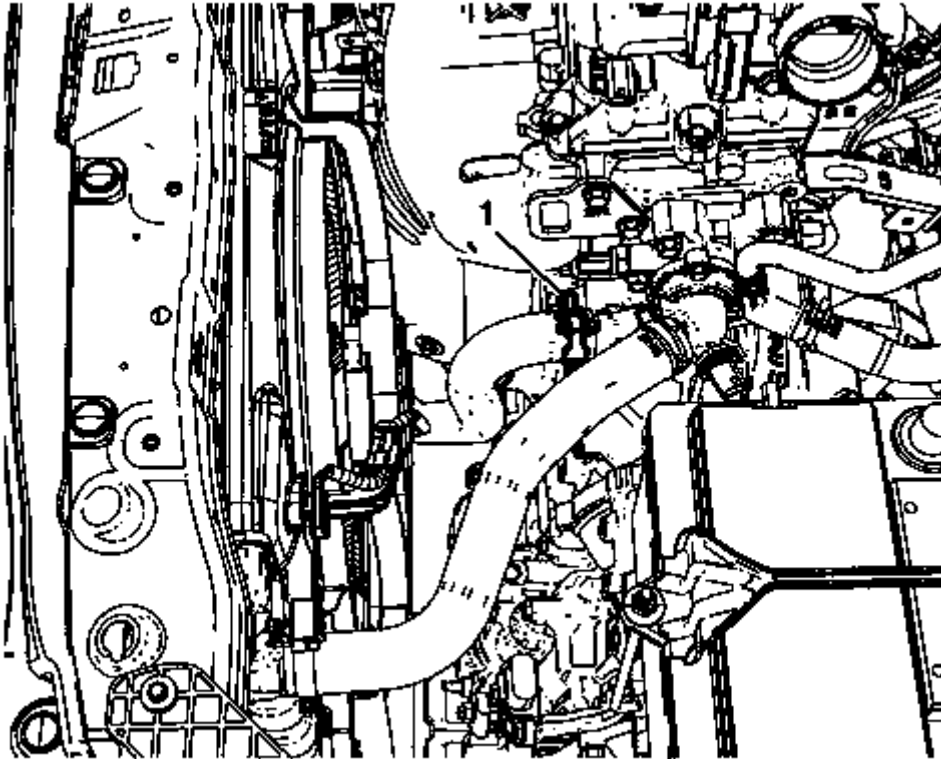


Fig. 15: Radiator Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

7. Loosen the radiator outlet hose clamp (1).
8. Remove the radiator outlet hose from the water pump outlet pipe.

Installation Procedure

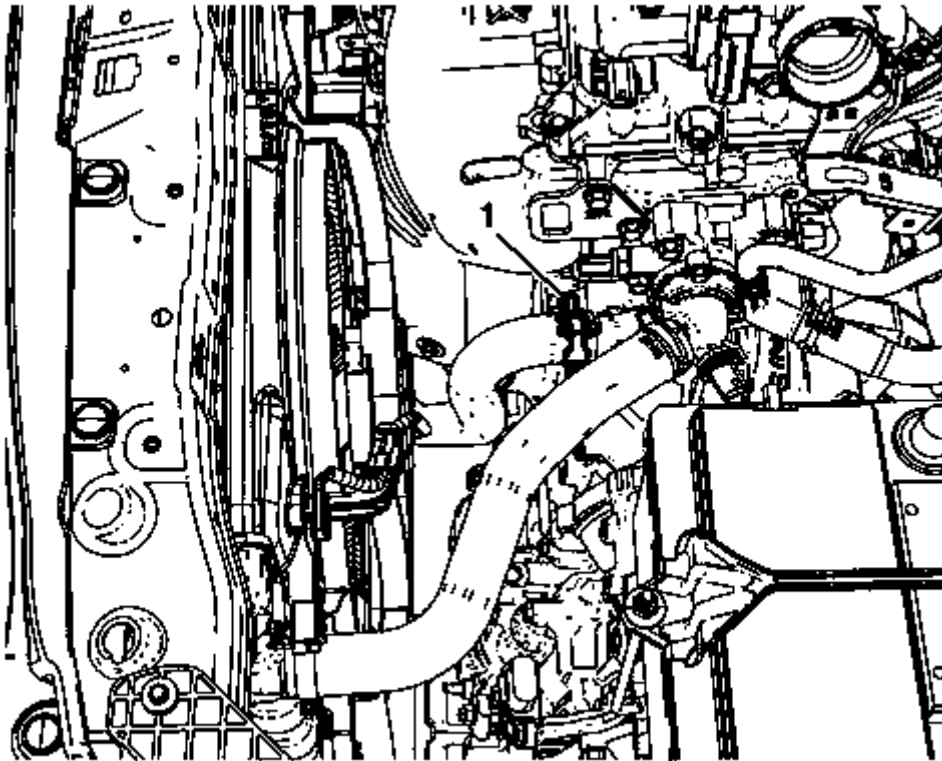


Fig. 16: Radiator Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

1. Install the radiator outlet hose to the water pump outlet pipe.
2. Install the radiator outlet hose clamp (1).
3. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
4. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** .

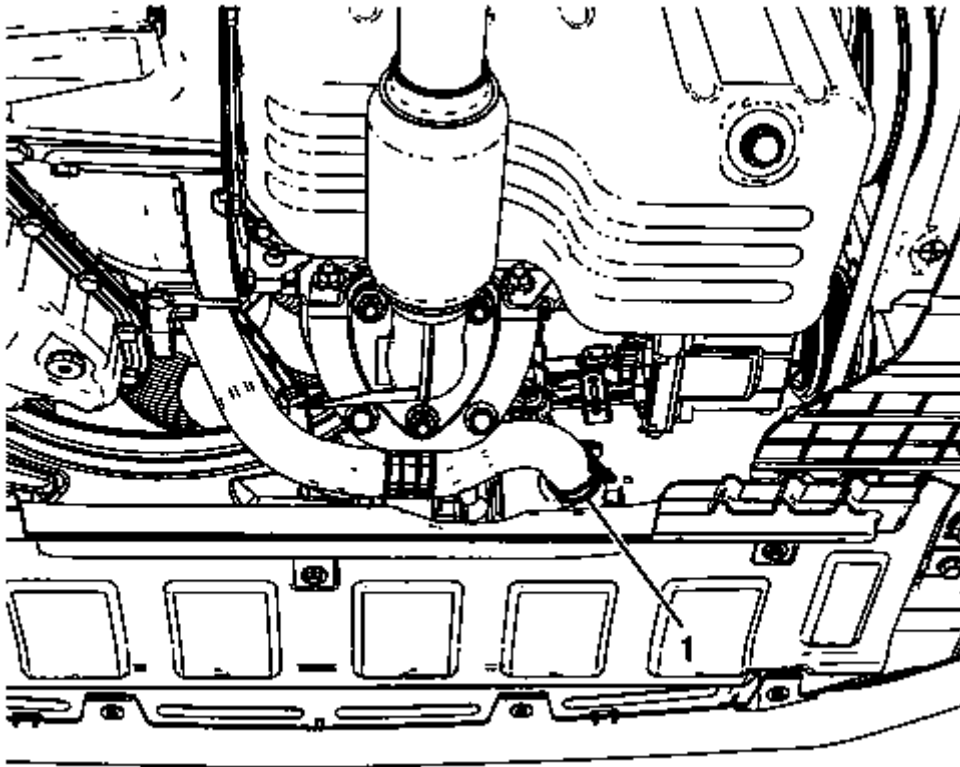


Fig. 17: Radiator Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

5. Install the radiator outlet hose to the radiator.
6. Install the radiator outlet hose clamp (1).
7. Lower the vehicle. Refer to Lifting and Jacking the Vehicle .
8. Fill the cooling system. Refer to Cooling System Draining and Filling.

RADIATOR MOUNTING STUD REPAIR

NOTE: In this vehicle, mounting pin repair system is only applied to lower side of the radiator, not upper.

NOTE: If the radiator is leaky, replace it. Refer to Radiator Replacement.

1. Pressure test the cooling system. Refer to Cooling System Leak Testing.

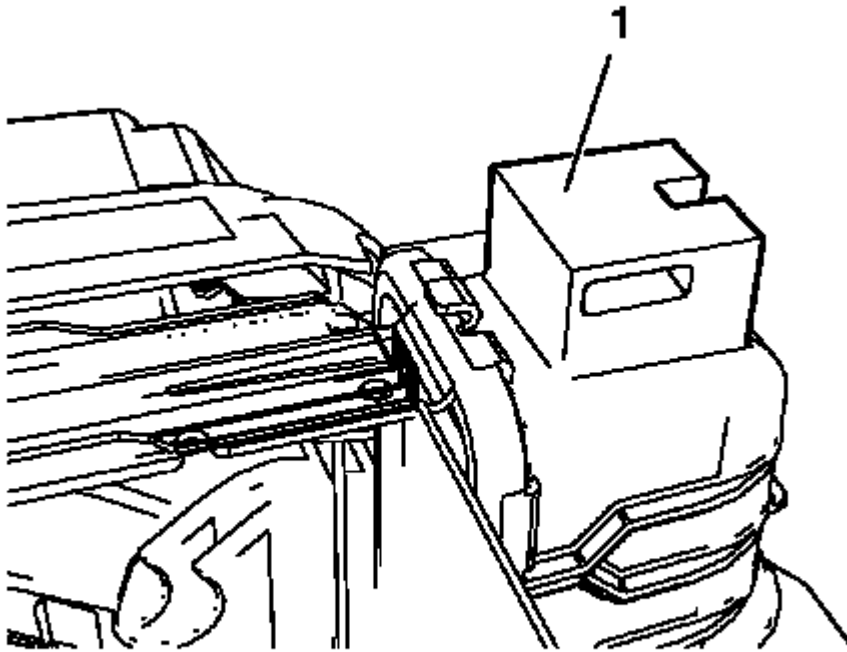


Fig. 18: Identifying Fracture Surface
Courtesy of GENERAL MOTORS COMPANY

2. Grind the fracture surface (1) with a proper tool.
3. Drill a persistent hole in center of the fracture surface, using a 6 mm (0.24 in) drill.

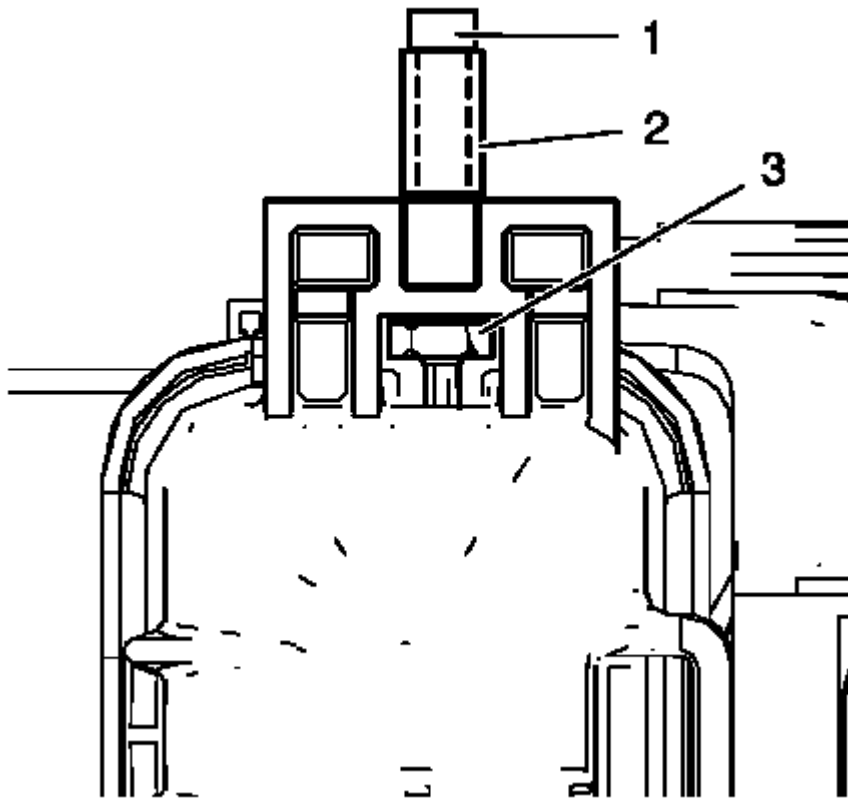


Fig. 19: Radiator Mounting Pin, Nut And Bolt
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

NOTE: Bolt should not be longer than 35 mm (1.38 in).

4. Install the new radiator mounting pin (2).

Install the nut (3).

RADIATOR OVERFLOW HOSE REPLACEMENT

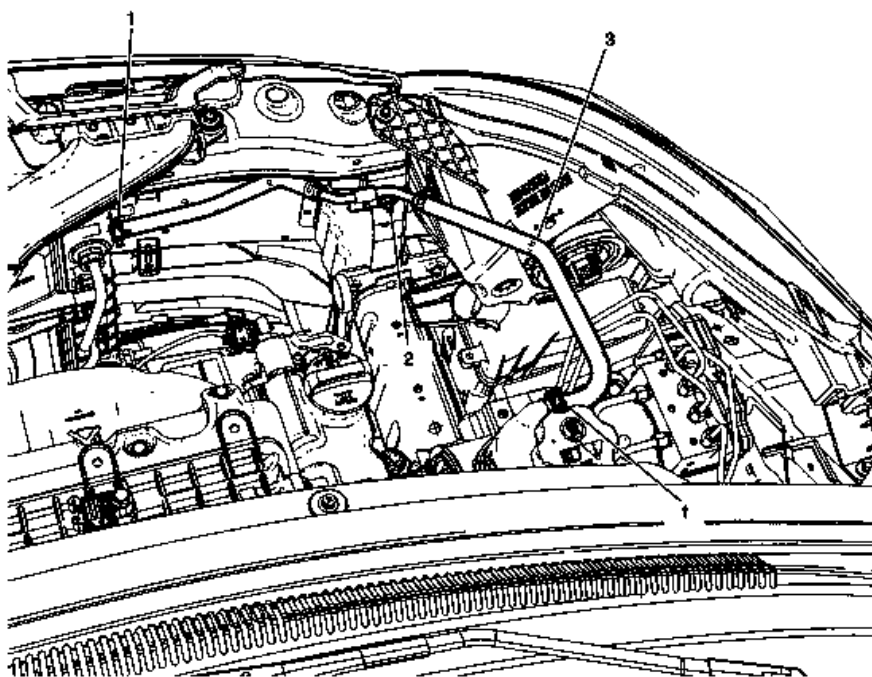


Fig. 20: Radiator Overflow Hose
 Courtesy of GENERAL MOTORS COMPANY

Radiator Overflow Hose Replacement

Callout	Component Name
Preliminary Procedure Drain the cooling system. Refer to Cooling System Draining and Filling .	
1	Radiator Overflow Hose Clamp (Qty: 2)
2	Radiator Overflow Hose Bracket Nut CAUTION: Refer to Fastener Caution . Procedure Remove the radiator overflow hose bracket nut. Tighten 9 (80 lb ft)
3	Radiator Overflow Hose

ENGINE COOLANT FAN REPLACEMENT

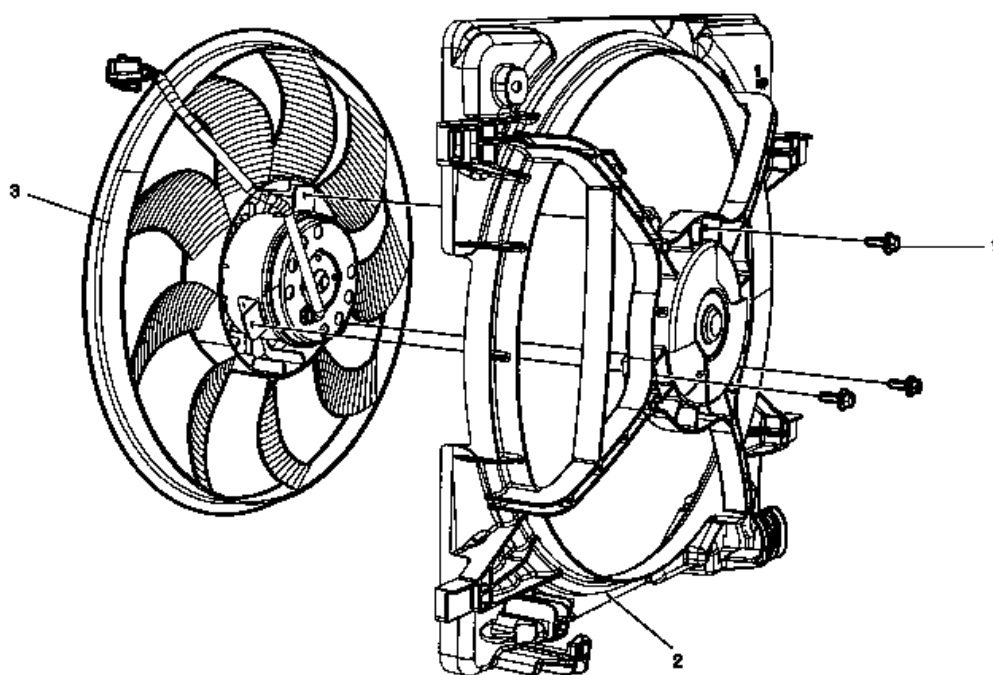


Fig. 21: Engine Coolant Fan
 Courtesy of GENERAL MOTORS COMPANY

Engine Coolant Fan Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the engine coolant fan shroud. Refer to <u>Engine Coolant Fan Shroud Replacement</u>. 2. Disconnect the wiring harness plug of the engine cooling fan.	
1	Engine Coolant Fan Bolt (Qty: 3) Procedure Remove the engine coolant fan bolts. Tighten 3 (27 lb in)
2	Engine Coolant Fan Shroud
3	Engine Coolant Fan

ENGINE COOLANT THERMOSTAT HOUSING REPLACEMENT

Removal Procedure

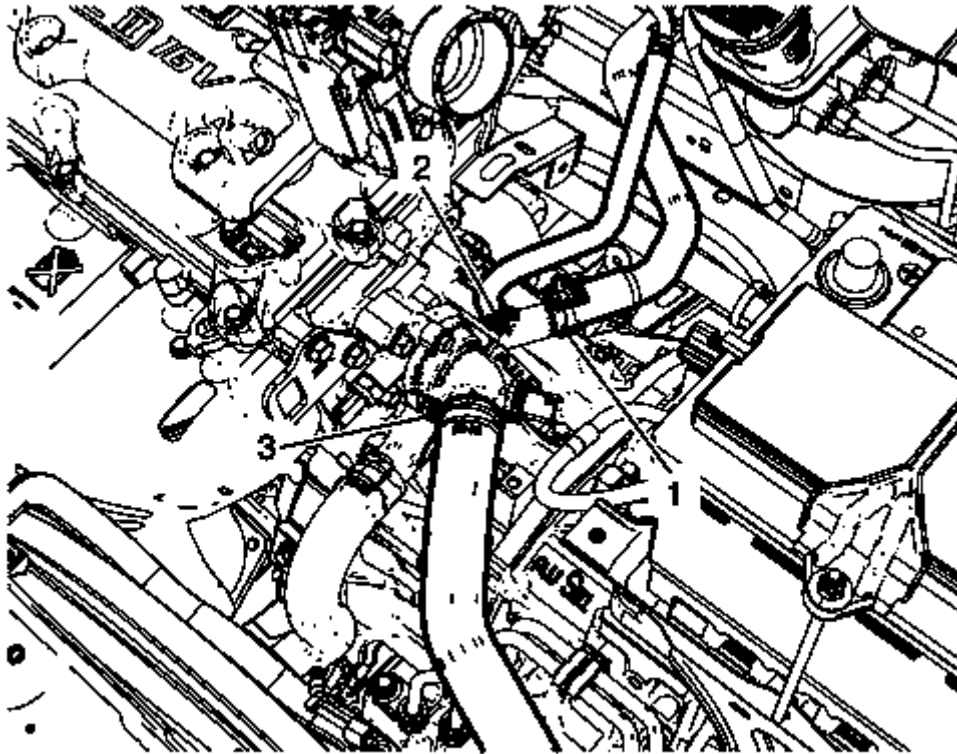


Fig. 22: Radiator Inlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

WARNING: In order to avoid personal injury, do not remove the cap or open the cooling system drains from a hot system. Allow the system to cool first.

1. Drain the system. Refer to **Cooling System Draining and Filling**.
2. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement**.
3. Disconnect the heater inlet hose and clamp (1).
4. Disconnect the coolant hose and clamp (2).
5. Disconnect the radiator inlet hose and clamp (3).

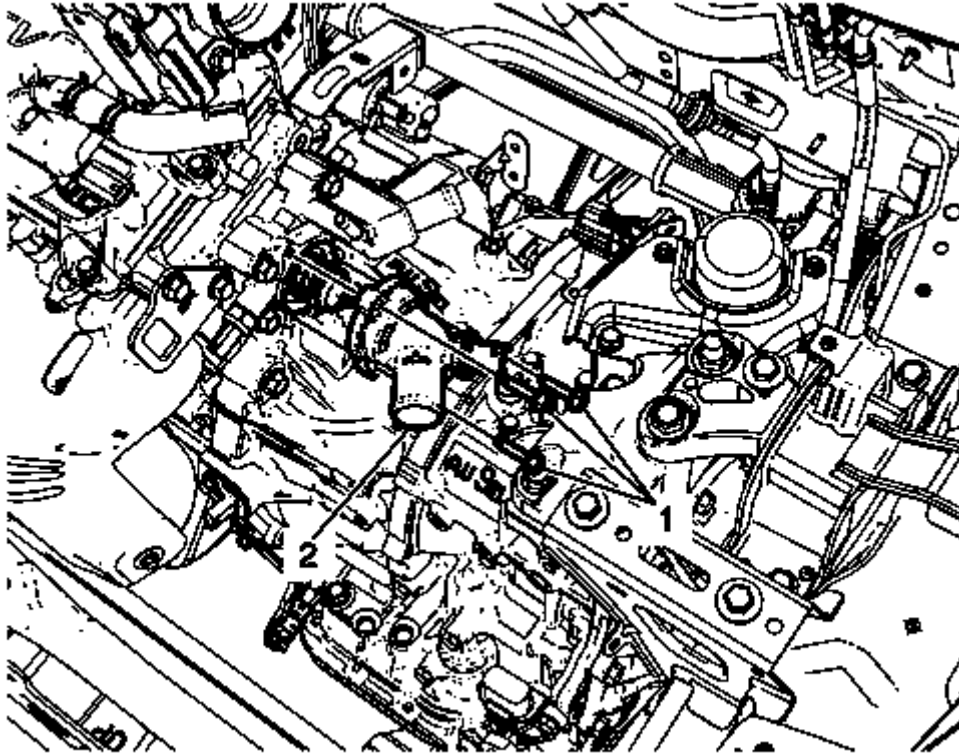


Fig. 23: Engine Coolant Thermostat

Courtesy of GENERAL MOTORS COMPANY

6. Remove the engine coolant thermostat (2). Refer to **Engine Coolant Thermostat Replacement**.

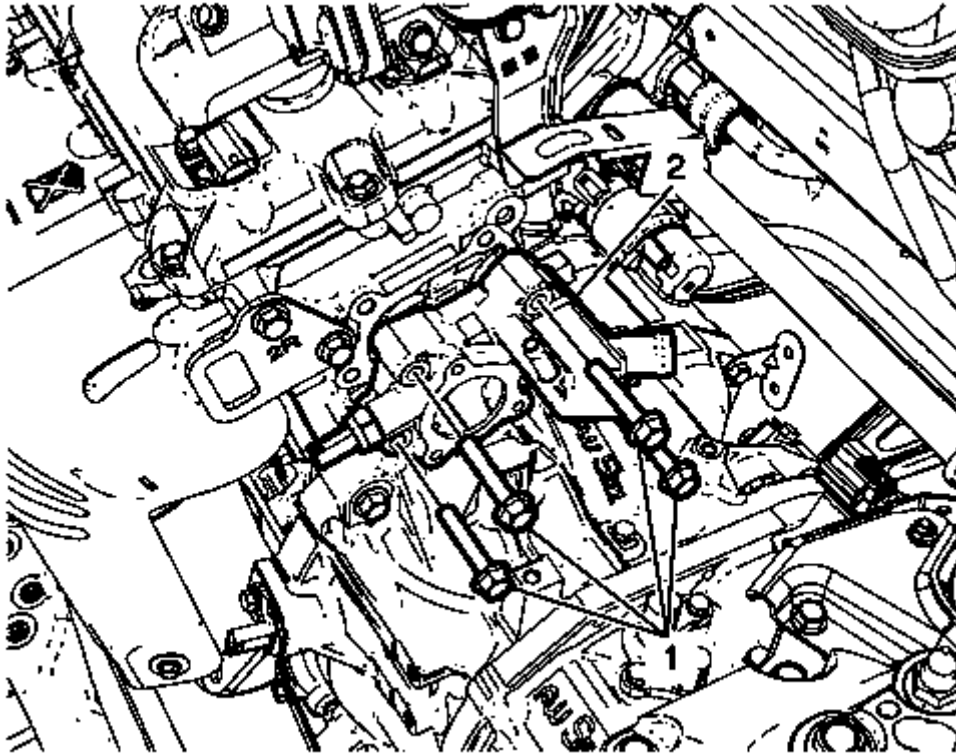


Fig. 24: Engine Coolant Thermostat Housing Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Remove the engine coolant thermostat housing bolts (1).
8. Remove the engine coolant thermostat housing (2).

Installation Procedure

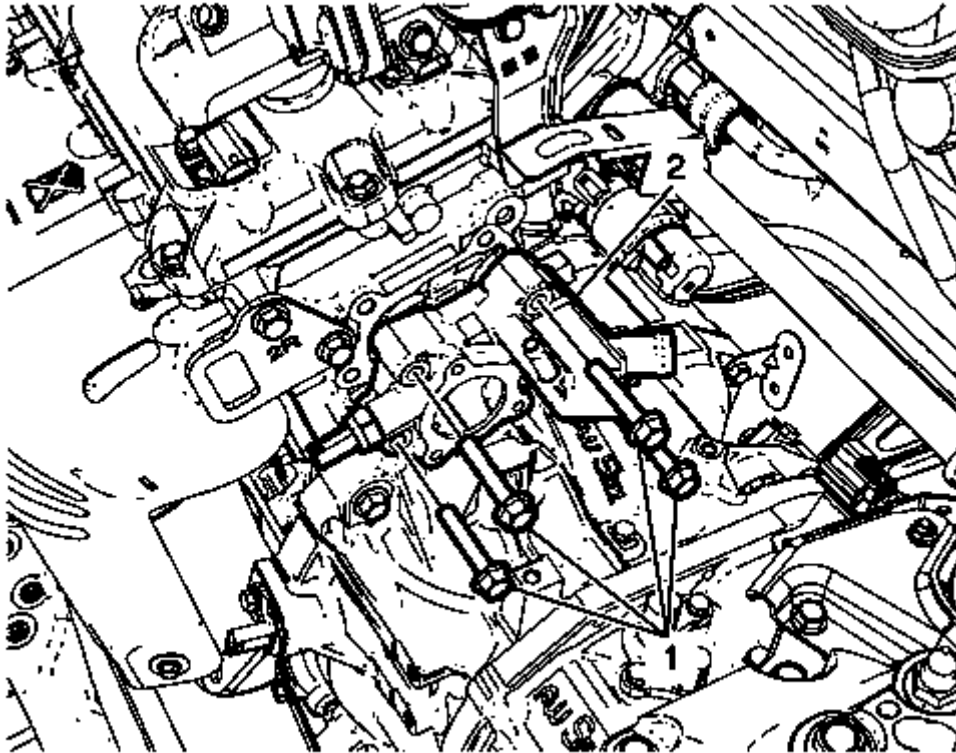


Fig. 25: Engine Coolant Thermostat Housing Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the coolant thermostat housing (2).

CAUTION: Refer to Fastener Caution .

2. Install the engine coolant thermostat housing bolts (1) and tighten to 25 (18 lb ft).

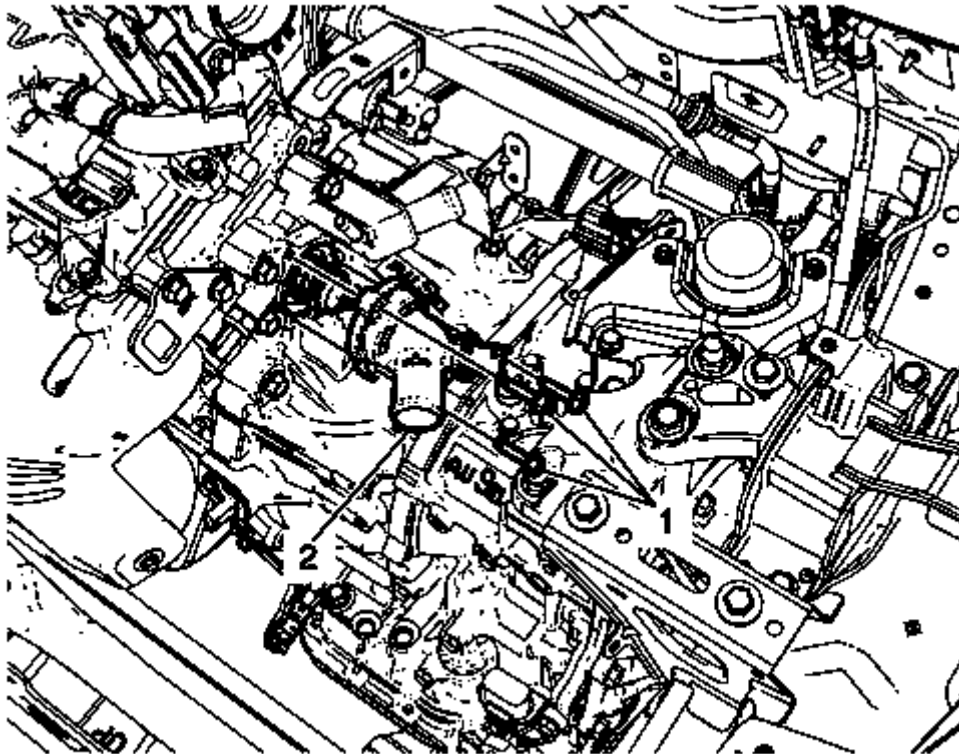


Fig. 26: Engine Coolant Thermostat
Courtesy of GENERAL MOTORS COMPANY

3. Install the engine coolant thermostat (2). Refer to **Engine Coolant Thermostat Replacement**.

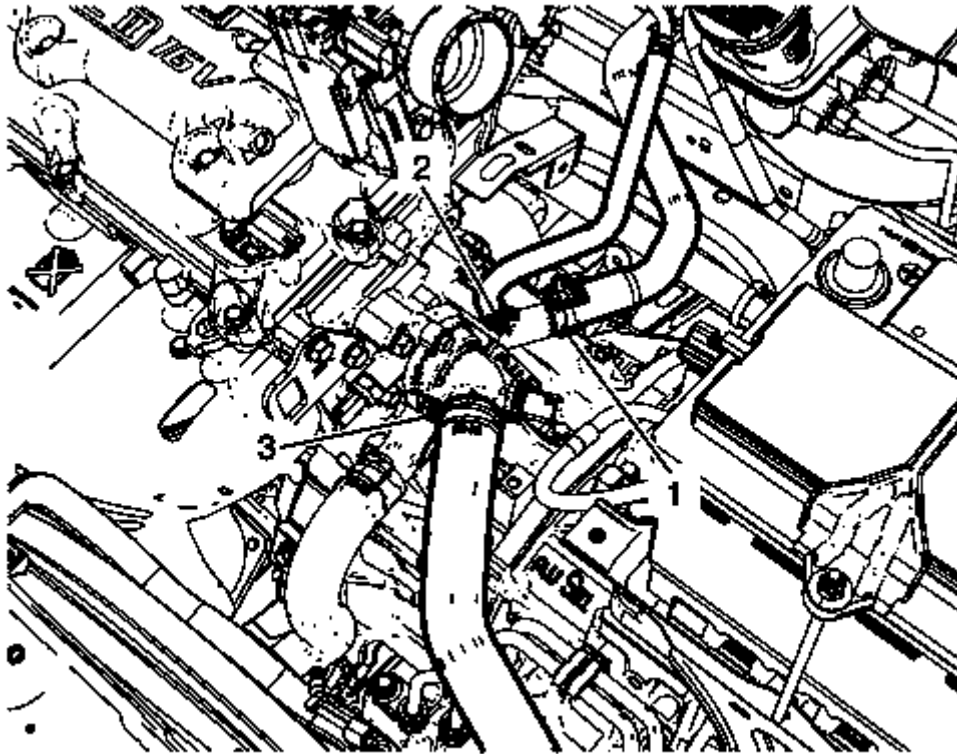


Fig. 27: Radiator Inlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

4. Connect the radiator inlet hose and clamp (3).
5. Connect the coolant hose and clamp (2).
6. Connect the heater inlet hose and clamp (1).
7. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
8. Fill the cooling system. Refer to **Cooling System Draining and Filling**.
9. Start the engine and check for coolant leaks.

ENGINE COOLANT THERMOSTAT REPLACEMENT

Removal Procedure

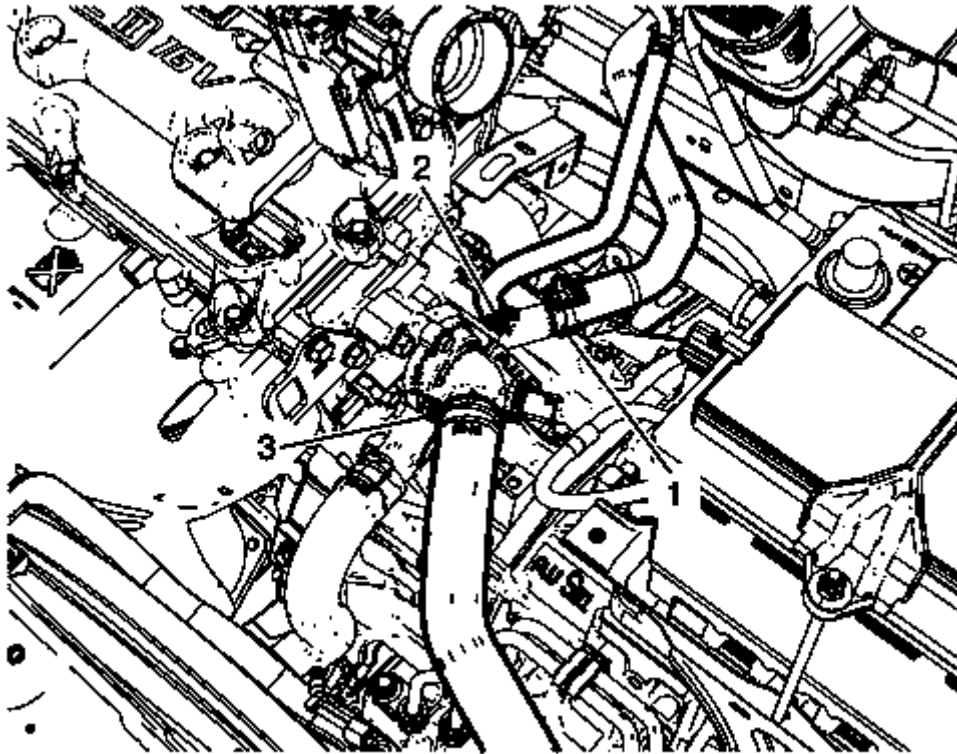


Fig. 28: Radiator Inlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

1. Open the hood.
2. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
3. Drain the cooling system. Refer to **Cooling System Draining and Filling**.
4. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
5. Disconnect the radiator inlet hose and clamp (3).
6. Disconnect the electrical connector from the engine coolant thermostat heater connector.

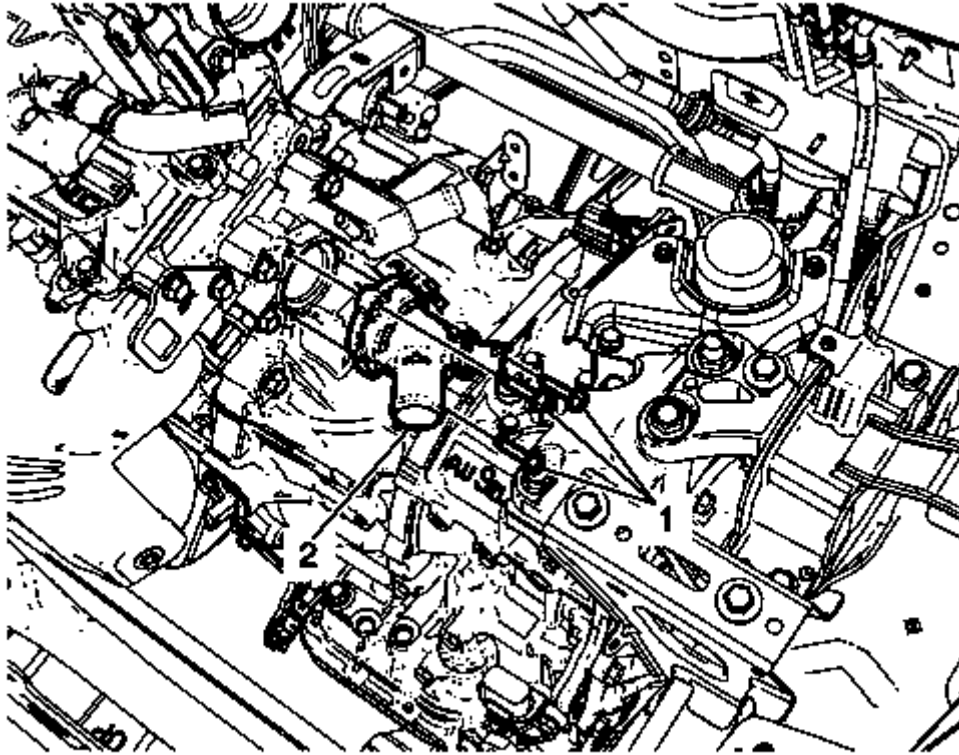


Fig. 29: Engine Coolant Thermostat Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Remove the engine coolant thermostat bolts (1).
8. Remove the engine coolant thermostat assembly (2).

Installation Procedure

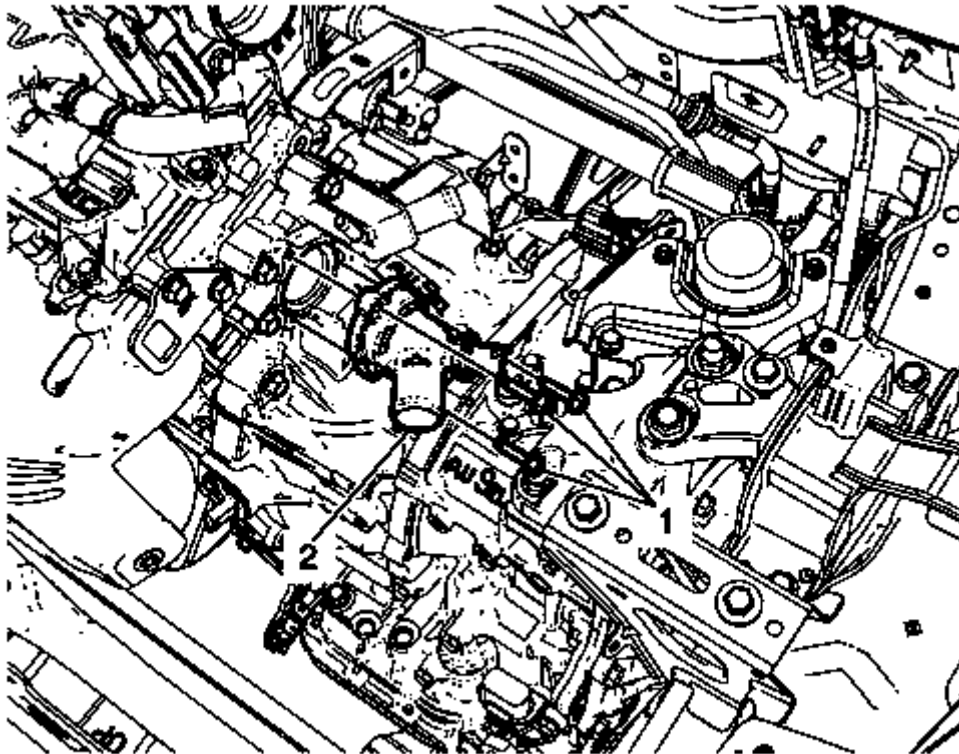


Fig. 30: Engine Coolant Thermostat Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the engine coolant thermostat assembly (2).

CAUTION: Refer to Fastener Caution .

2. Install the 3 engine coolant thermostat bolts (1) and tighten to 10 (89 lb in).

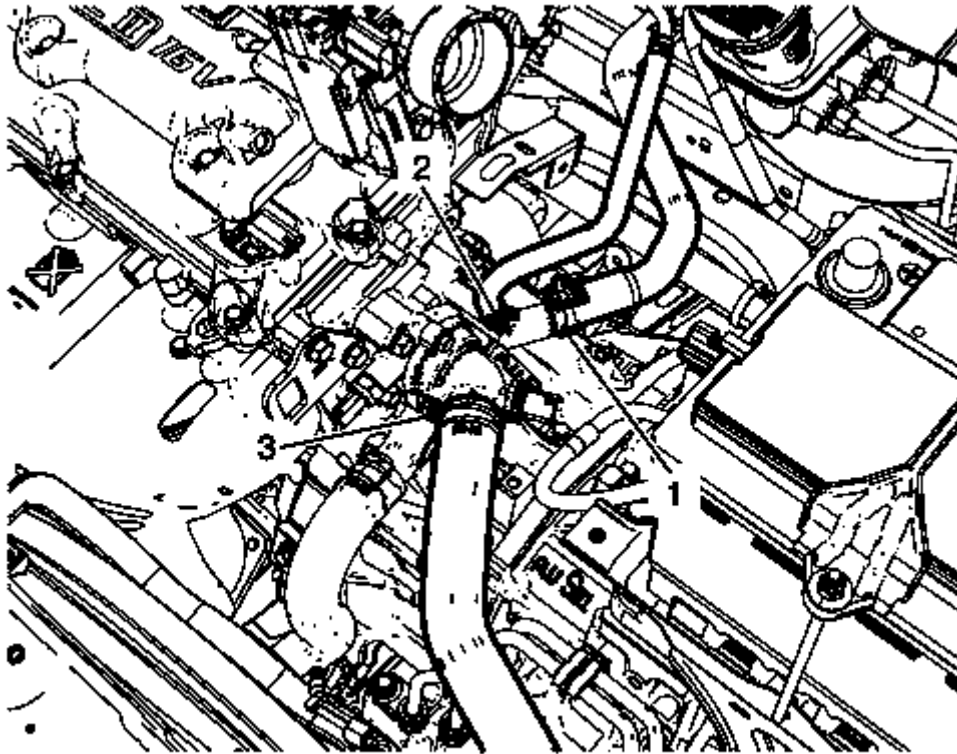


Fig. 31: Radiator Inlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

3. Connect the electrical connector to the engine coolant thermostat heater connector.
4. Connect the radiator inlet hose and clamp (3).
5. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
6. Fill the cooling system. Refer to **Cooling System Draining and Filling**.
7. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
8. Start the engine and check for coolant leaks.
9. Close the hood.

WATER PUMP REPLACEMENT

Removal Procedure

1. Drain the coolant. Refer to **Cooling System Draining and Filling**.
2. Remove the water pump and generator belt. Refer to **Water Pump and Generator Belt Replacement** .
3. Remove the generator. Refer to **Generator Replacement** .

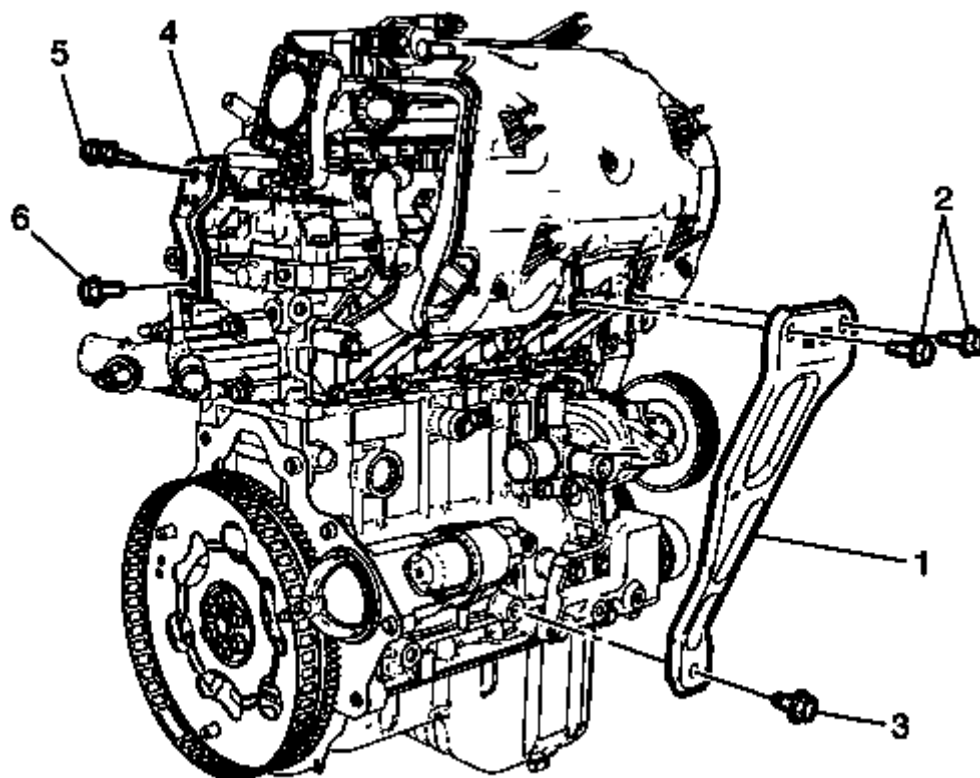


Fig. 32: Intake Manifold Support Bracket And Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove the intake manifold rear bracket bolts (2, 3).
5. Remove the intake manifold rear bracket (1).

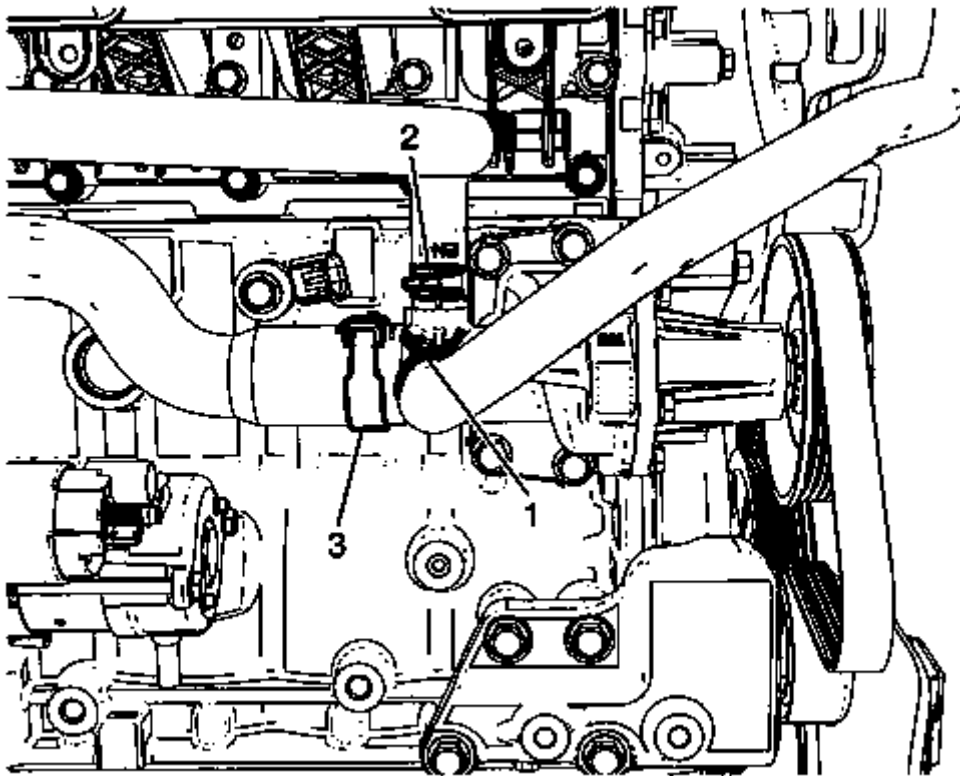


Fig. 33: Heater Outlet Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

6. Disconnect the radiator surge tank outlet hose and clamp (1).
7. Disconnect the heater outlet hose and clamp (2).
8. Disconnect the water pipe hose and clamp (3).

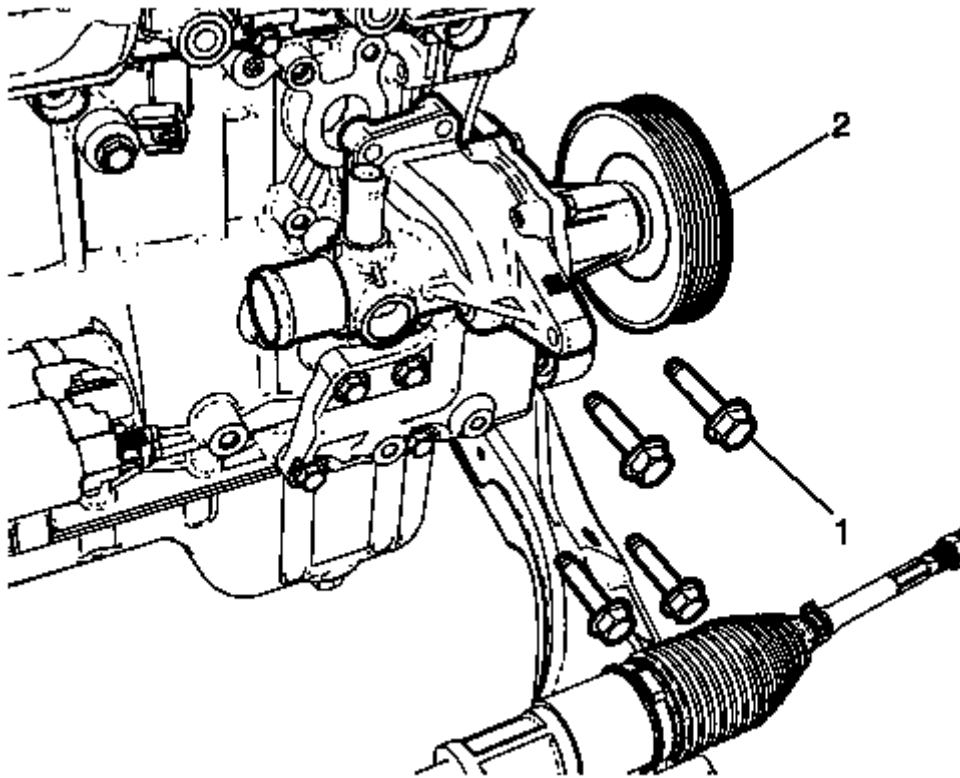


Fig. 34: Water Pump Bolts

Courtesy of GENERAL MOTORS COMPANY

9. Remove the 4 water pump bolts (1).
10. Remove the water pump assembly (2) from the engine block.
11. Remove the water pump oil seal ring.

Installation Procedure

1. Clean the water pump threads.
2. Insert a NEW water pump seal ring.

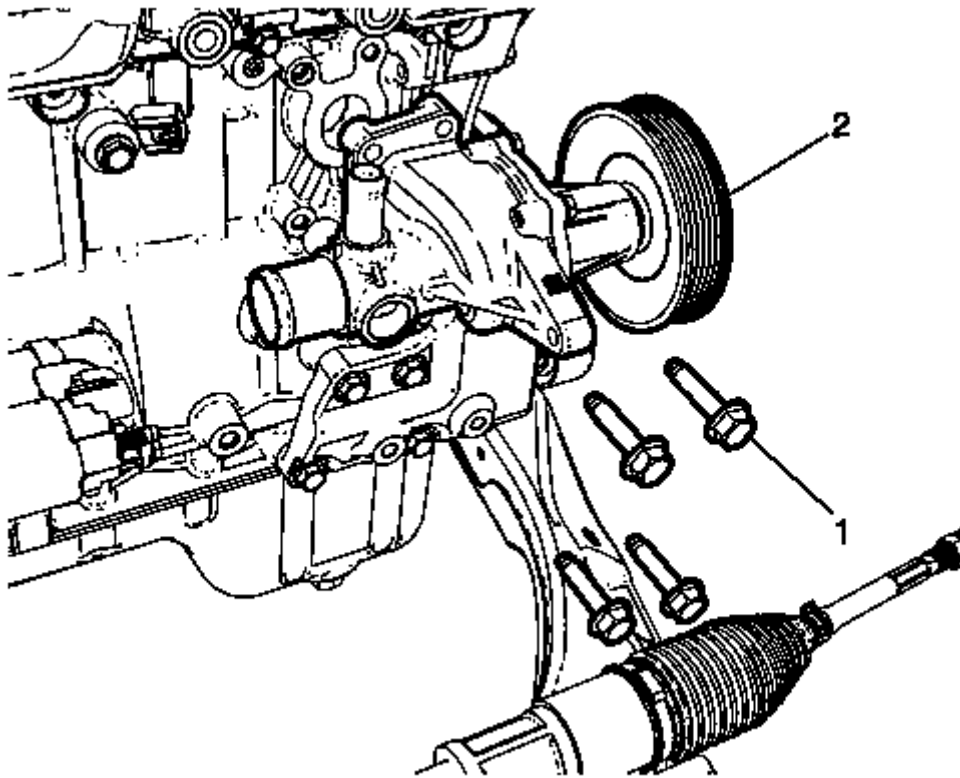


Fig. 35: Water Pump Bolts

Courtesy of GENERAL MOTORS COMPANY

3. Install the water pump assembly (2) to engine block.

CAUTION: Refer to Fastener Caution .

4. Install the 4 water pump bolts (1) and tighten to 10 (89 lb in).

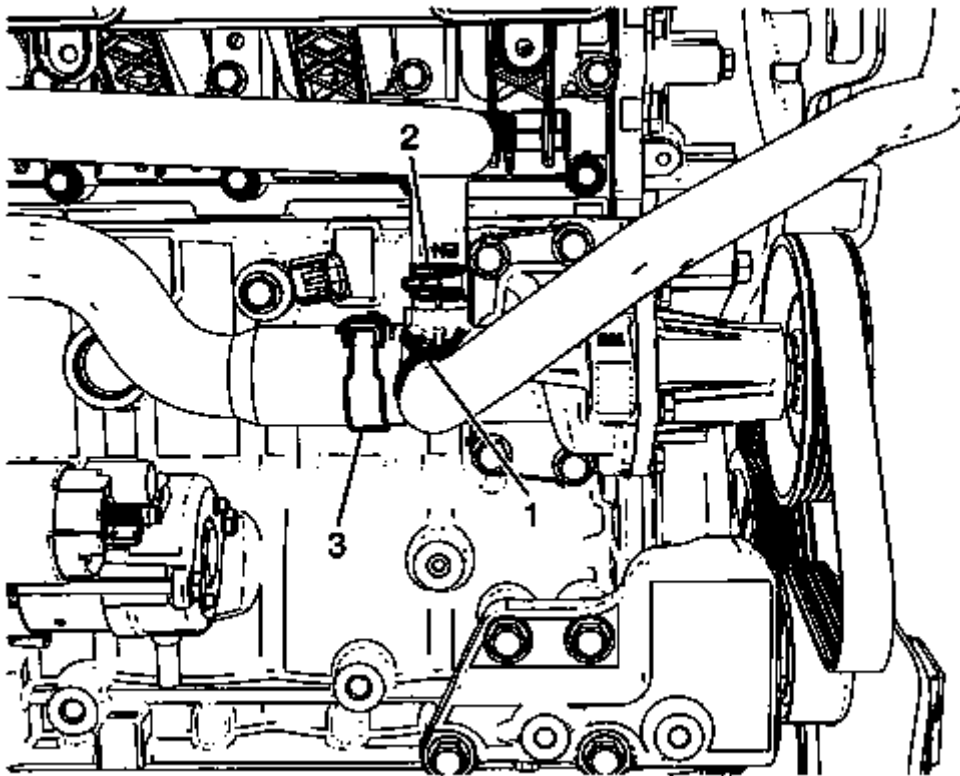


Fig. 36: Heater Outlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

5. Connect the water pipe hose and clamp (3).
6. Connect the heater outlet hose and clamp (2).
7. Connect the radiator surge tank outlet hose and clamp (1).

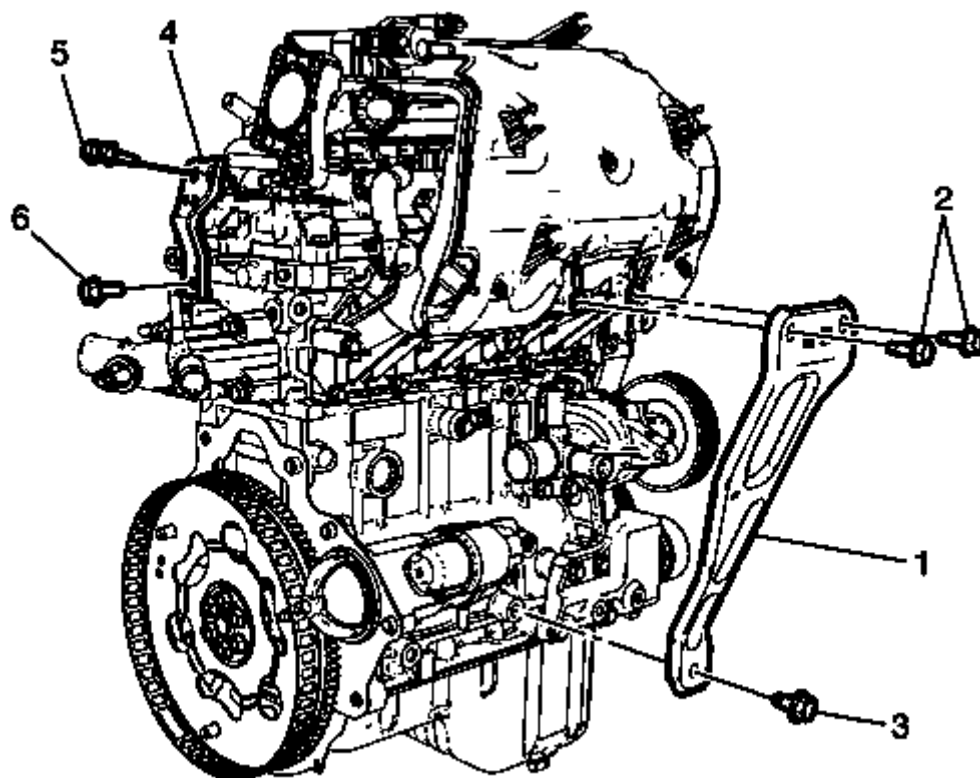


Fig. 37: Intake Manifold Support Bracket And Bolts
Courtesy of GENERAL MOTORS COMPANY

8. Install the intake manifold rear bracket (1).
9. Install the intake manifold rear bracket bolts (2) and tighten to 25 (18 lb ft).
10. Install the intake manifold rear bracket bolt (3) and tighten to 46 (34 lb ft).
11. Install the generator. Refer to **Generator Replacement** .
12. Install the water pump and generator belt. Refer to **Water Pump and Generator Belt Replacement** .
13. Fill the engine cooling system. Refer to **Cooling System Draining and Filling**.
14. Start the engine and check for coolant leaks.

ENGINE COOLANT FAN SHROUD REPLACEMENT

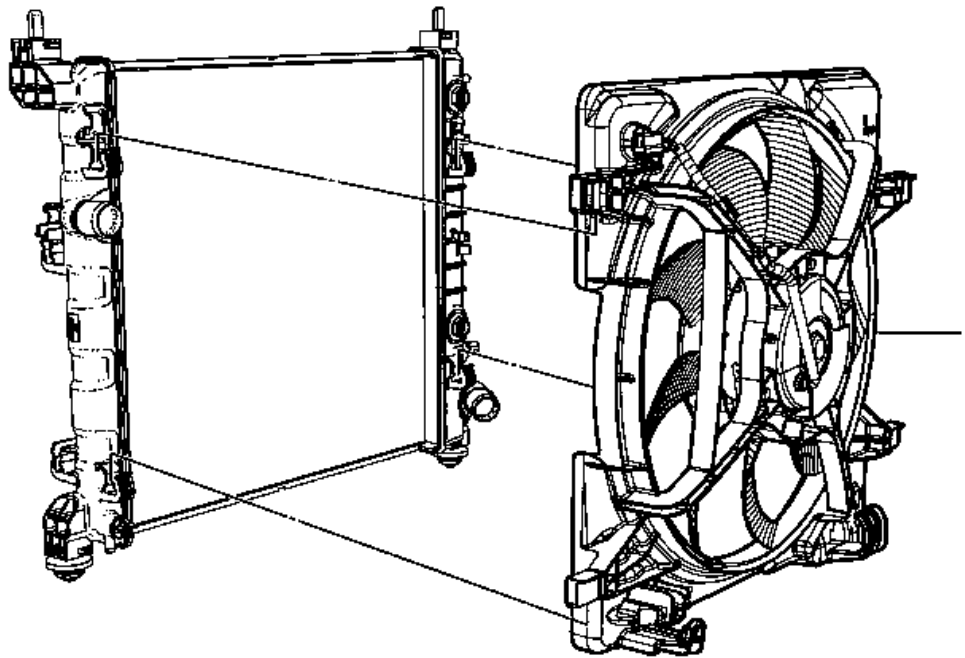


Fig. 38: Engine Coolant Fan Shroud
Courtesy of GENERAL MOTORS COMPANY

Engine Coolant Fan Shroud Replacement

Callout	Component Name
Preliminary Procedures	
1. Unclip transmission cooler lines from shroud if equipped. 2. Unclip radiator outlet hose from fan shroud. 3. Disconnect any electrical connectors from the fan shroud.	
1	Engine Coolant Fan Shroud TIP: Unclip engine coolant fan shroud from radiator.

RADIATOR REPLACEMENT

Removal Procedure

1. Drain the cooling system. Refer to Cooling System Draining and Filling.
2. Recover the refrigerant. Refer to Refrigerant Recovery and Recharging.
3. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
4. Remove the air cleaner assembly. Refer to Air Cleaner Assembly Replacement.
5. Disconnect the radiator inlet hose from the radiator. Refer to Radiator Inlet Hose Replacement.
6. Disconnect the radiator overflow hose from the radiator. Refer to Radiator Overflow Hose Replacement.

7. Disconnect the radiator outlet hose from the radiator. Refer to **Radiator Outlet Hose Replacement**.
8. Remove the transaxle oil cooler hoses from the oil cooler fittings on the radiator. Refer to **Transmission Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection** .
9. Remove the front bumper fascia. Refer to **Front Bumper Fascia Replacement** .

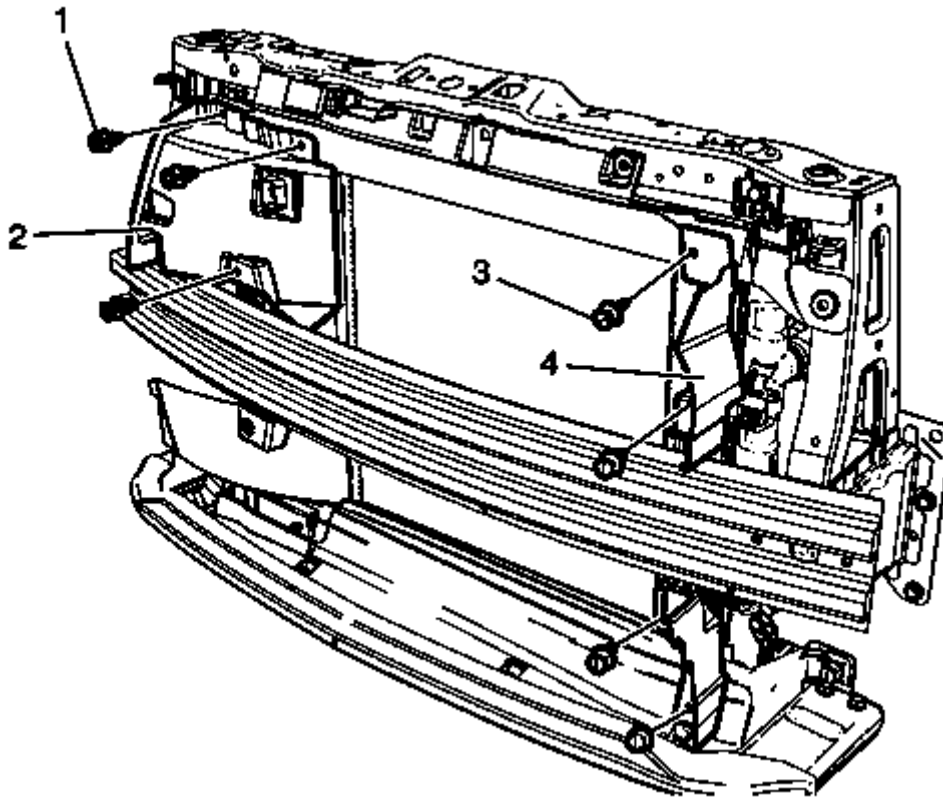


Fig. 39: Front Side Air Baffle Retainers
Courtesy of GENERAL MOTORS COMPANY

10. Remove the 3 right side opening cover retainer (1) and right side opening cover (2).
11. Remove the 4 left side opening cover retainer (3) and left side opening cover (4).

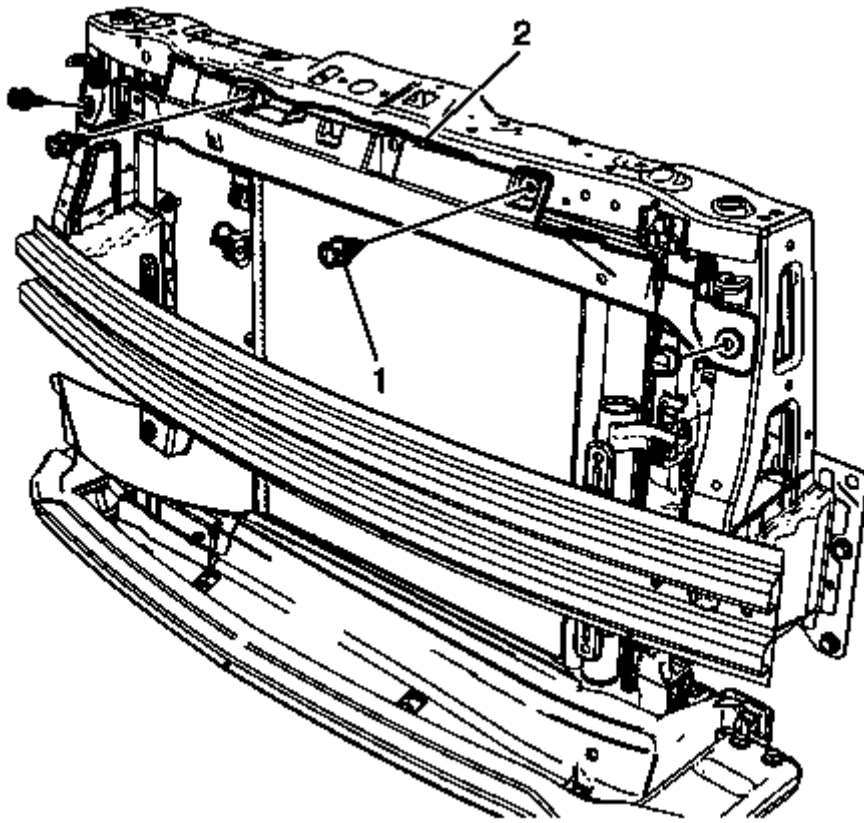


Fig. 40: Upper Air Guard Retainers
Courtesy of GENERAL MOTORS COMPANY

12. Remove the 4 upper opening cover retainer (1) and upper opening cover (2).

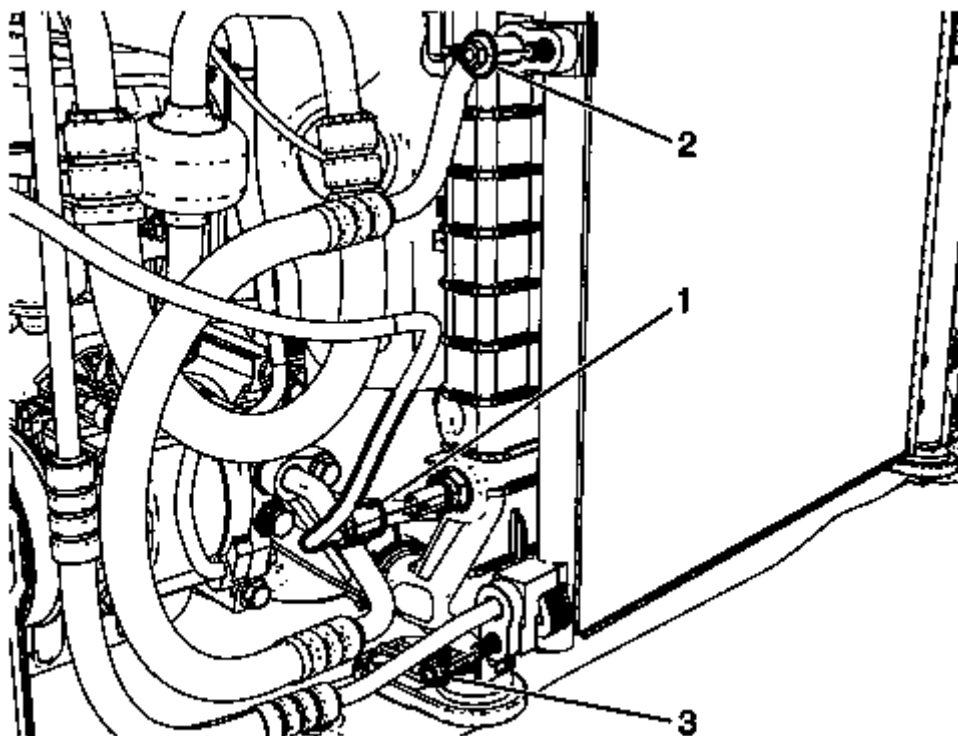


Fig. 41: Engine Coolant Temperature Sensor
Courtesy of GENERAL MOTORS COMPANY

13. Disconnect the engine coolant temperature sensor (1).
14. Remove the air conditioning compressor and condenser upper pipe nut (2).
15. Remove the air conditioning compressor and condenser under pipe nut (3).
16. Remove the air conditioning compressor and condenser pipe from the air conditioning condenser.

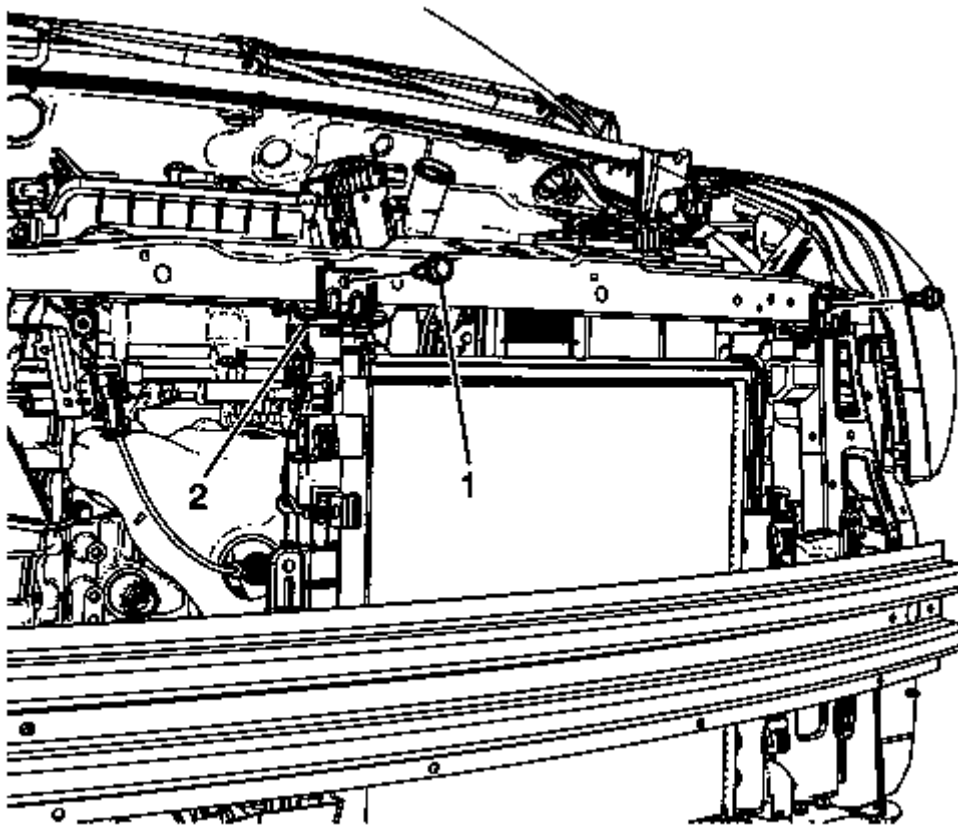


Fig. 42: Radiator Support Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

17. Remove the 2 radiator support bracket bolts (1).
18. Remove the 2 radiator support brackets (2).
19. Disconnect electrical connectors from the fan shroud.
20. Remove the radiator and air conditioning condenser and engine coolant fan shroud from the vehicle.

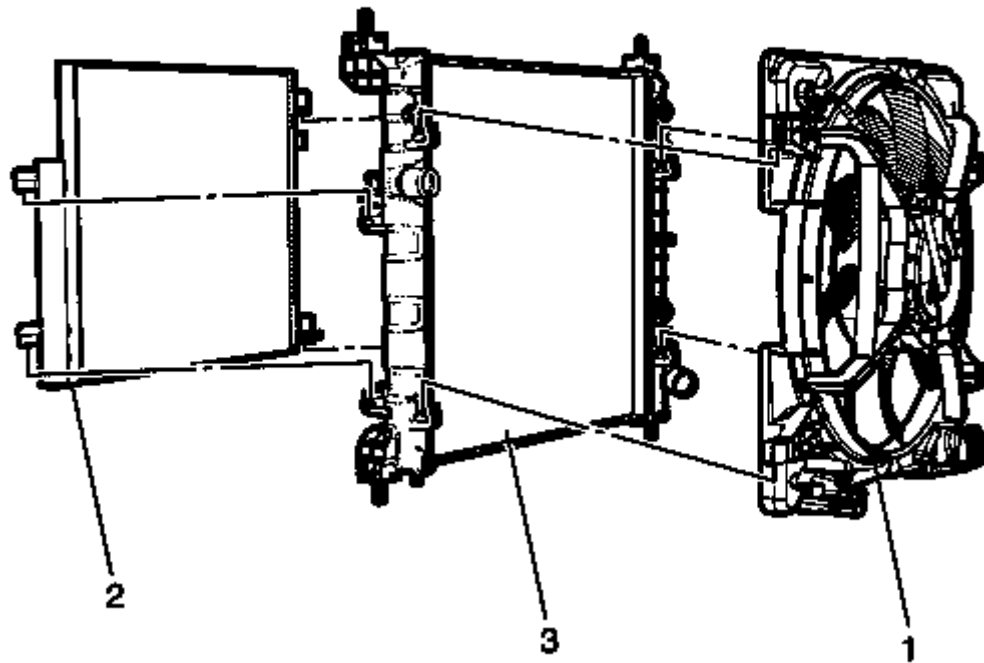


Fig. 43: Engine Coolant Fan Shroud
Courtesy of GENERAL MOTORS COMPANY

21. Unclip engine coolant fan shroud (1) from the radiator (3).
22. Unclip conditioning condenser (2) from the radiator (3).
23. Transfer parts as needed.

Installation Procedure

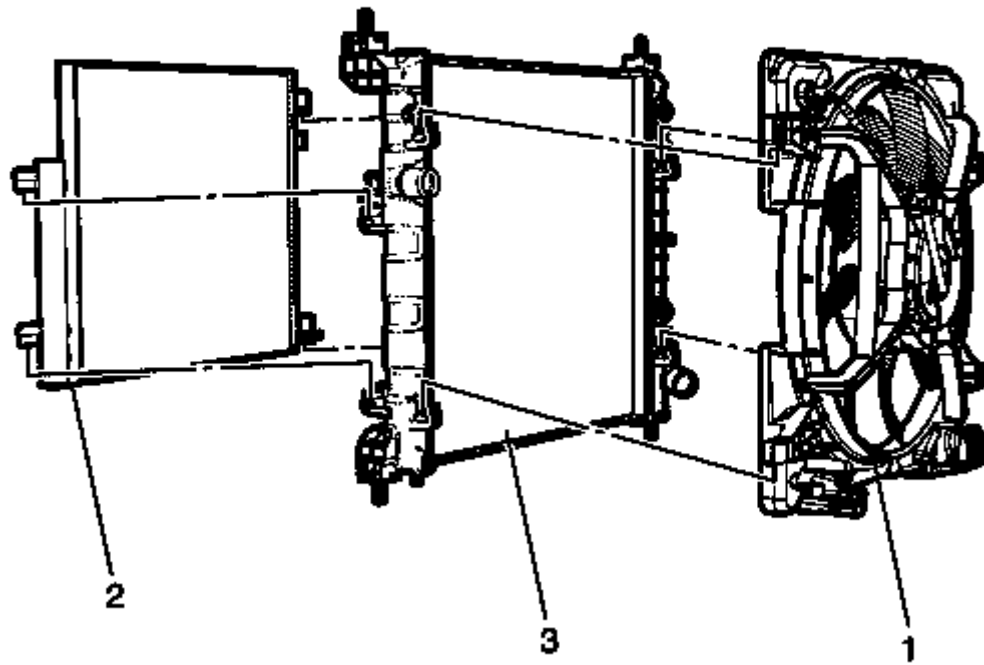


Fig. 44: Engine Coolant Fan Shroud
Courtesy of GENERAL MOTORS COMPANY

1. Clip the engine coolant fan shroud (1) to the radiator (3).
2. Clip the air conditioning condenser (2) to the radiator (3).
3. Install the radiator and air conditioning condenser and engine coolant fan shroud to the vehicle.

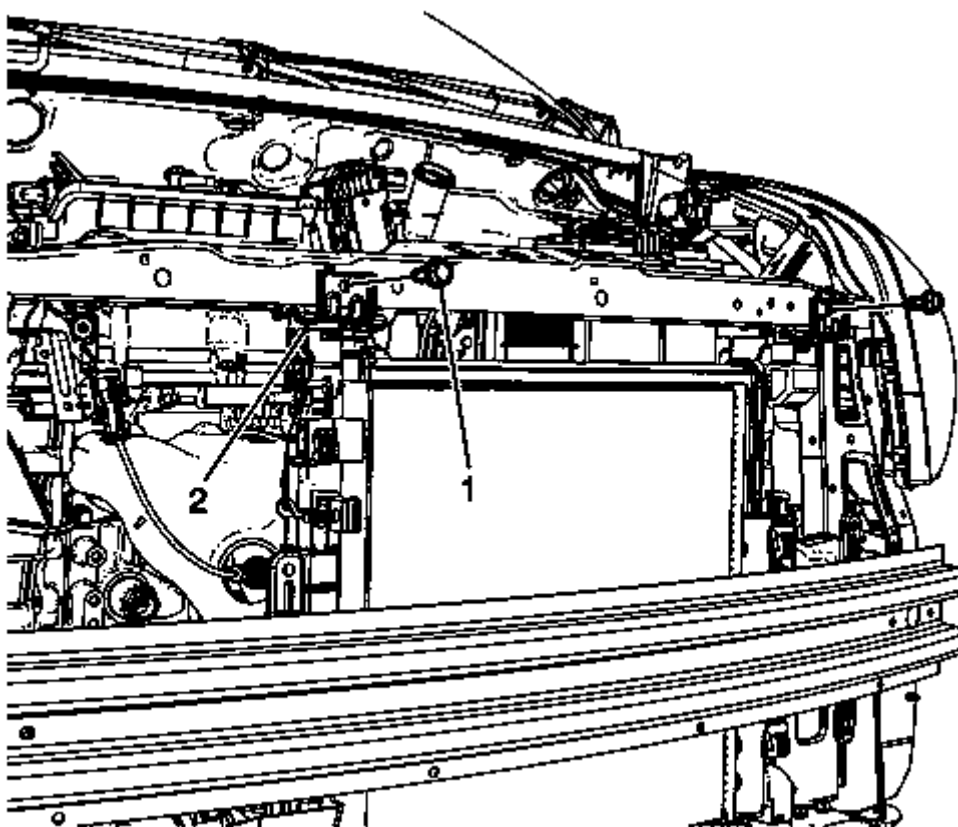


Fig. 45: Radiator Support Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Install the 2 radiator support bracket (2).

CAUTION: Refer to Fastener Caution .

5. Install the 2 radiator support bracket bolt (1) and tighten to 22 (16 lb in).
6. Connect electrical connectors from the fan shroud.

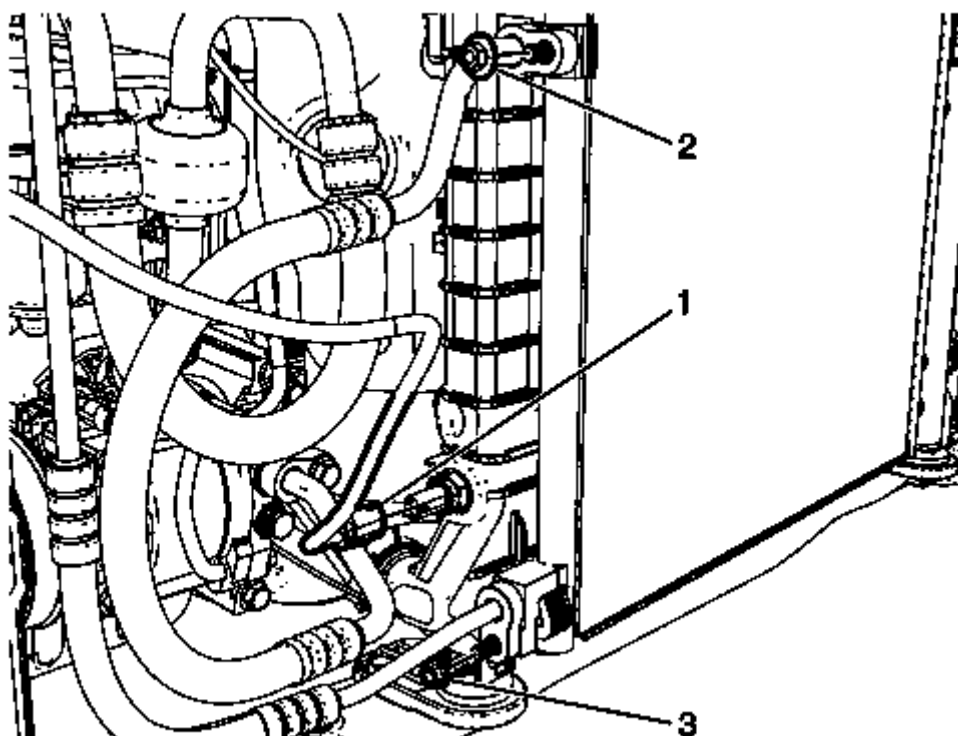


Fig. 46: Engine Coolant Temperature Sensor
Courtesy of GENERAL MOTORS COMPANY

7. Install the air conditioning compressor and condenser pipe to the air conditioning condenser.

CAUTION: Refer to Fastener Caution .

8. Install the air conditioning compressor and condenser upper pipe nut (2) and tighten to 11 (96 lb in).
9. Install the air conditioning compressor and condenser under pipe nut (3) and tighten to 11 (96 lb in).
10. Connect the engine coolant temperature sensor (1).

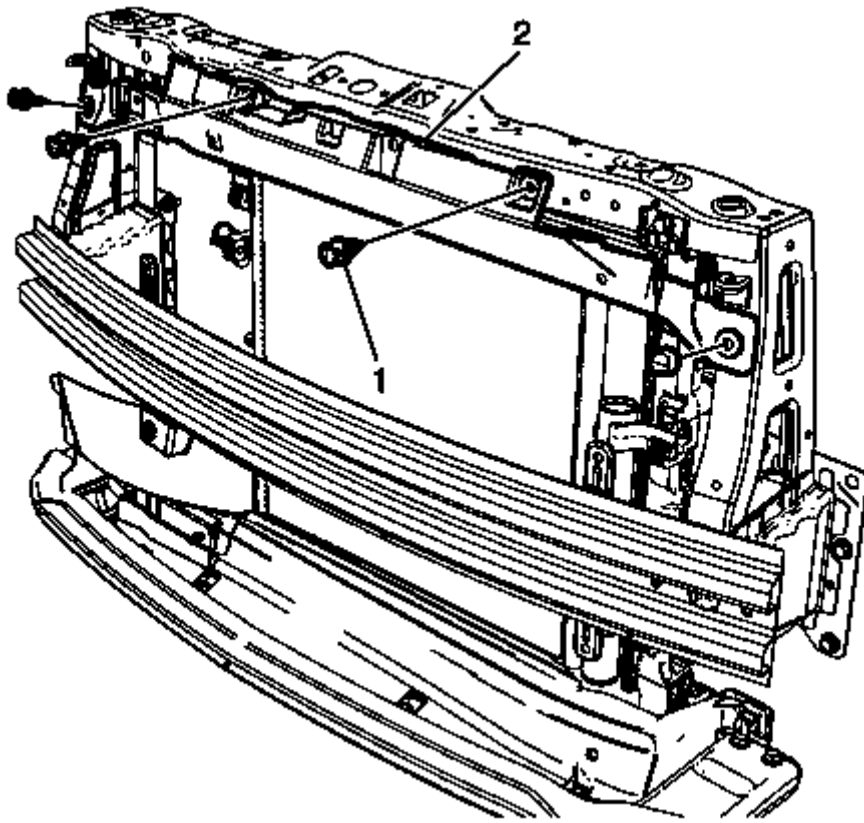


Fig. 47: Upper Air Guard Retainers
Courtesy of GENERAL MOTORS COMPANY

11. Install the upper opening cover (2) and 4 upper opening cover retainer (1).

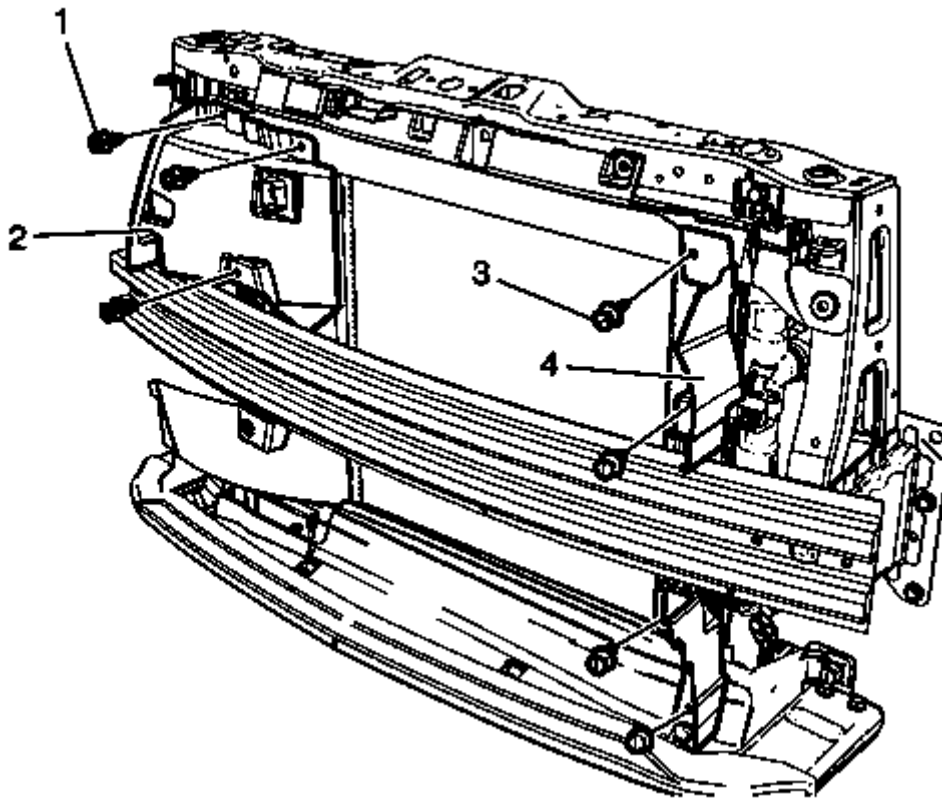


Fig. 48: Front Side Air Baffle Retainers
Courtesy of GENERAL MOTORS COMPANY

12. Install the left side opening cover (4) and 4 left side opening cover retainer (3).
13. Install the right side opening cover (2) and 3 right side opening cover retainer (1).
14. Install the front bumper fascia. Refer to **Front Bumper Fascia Replacement** .
15. Install the transaxle oil cooler hoses to the oil cooler fittings on the radiator. Refer to **Transmission Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection** .
16. Connect the radiator outlet hose to the radiator. Refer to **Radiator Outlet Hose Replacement**.
17. Connect the radiator inlet hose to the radiator. Refer to **Radiator Inlet Hose Replacement**.
18. Connect the radiator overflow hose from the radiator. Refer to **Radiator Overflow Hose Replacement**.
19. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
20. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
21. Fill the cooling system. Refer to **Cooling System Draining and Filling**.
22. Charge the refrigerant system. Refer to **Refrigerant Recovery and Recharging** .
23. Start the engine and check for coolant leaks.

RADIATOR SUPPORT BRACKET REPLACEMENT

Removal Procedure

1. Remove the front bumper fascia. Refer to Front Bumper Fascia Replacement .

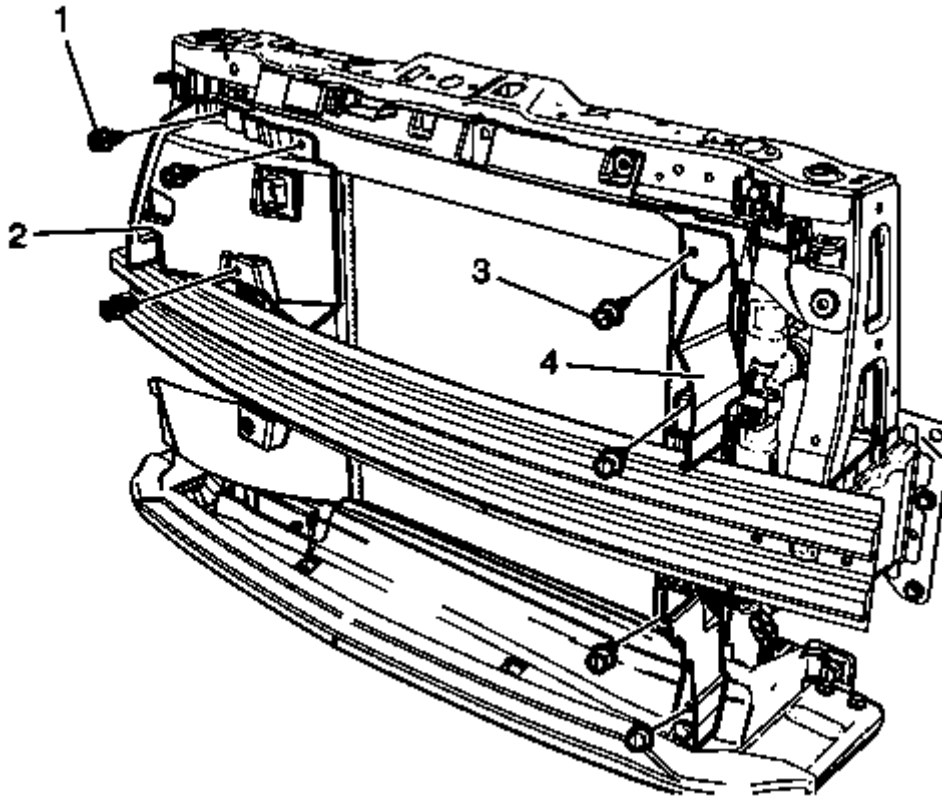


Fig. 49: Front Side Air Baffle Retainers
Courtesy of GENERAL MOTORS COMPANY

2. Remove the 3 right side opening cover retainer (1) and right side opening cover (2).
3. Remove the 4 left side opening cover retainer (3) and left side opening cover (4).

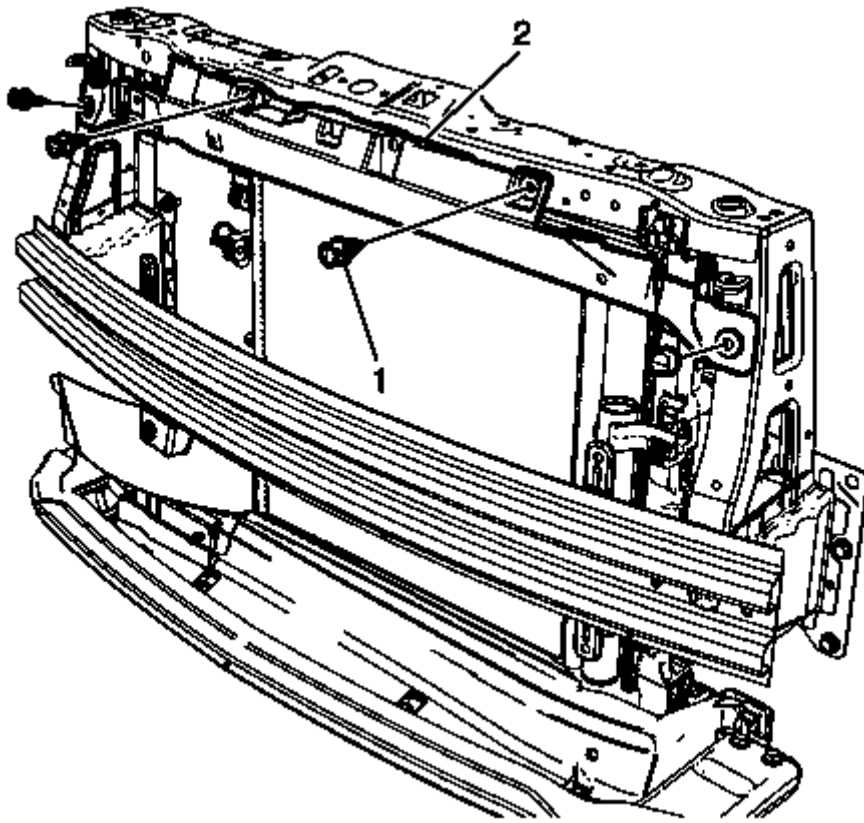


Fig. 50: Upper Air Guard Retainers
Courtesy of GENERAL MOTORS COMPANY

4. Remove the 4 upper opening cover retainer (1) and upper opening cover (2).

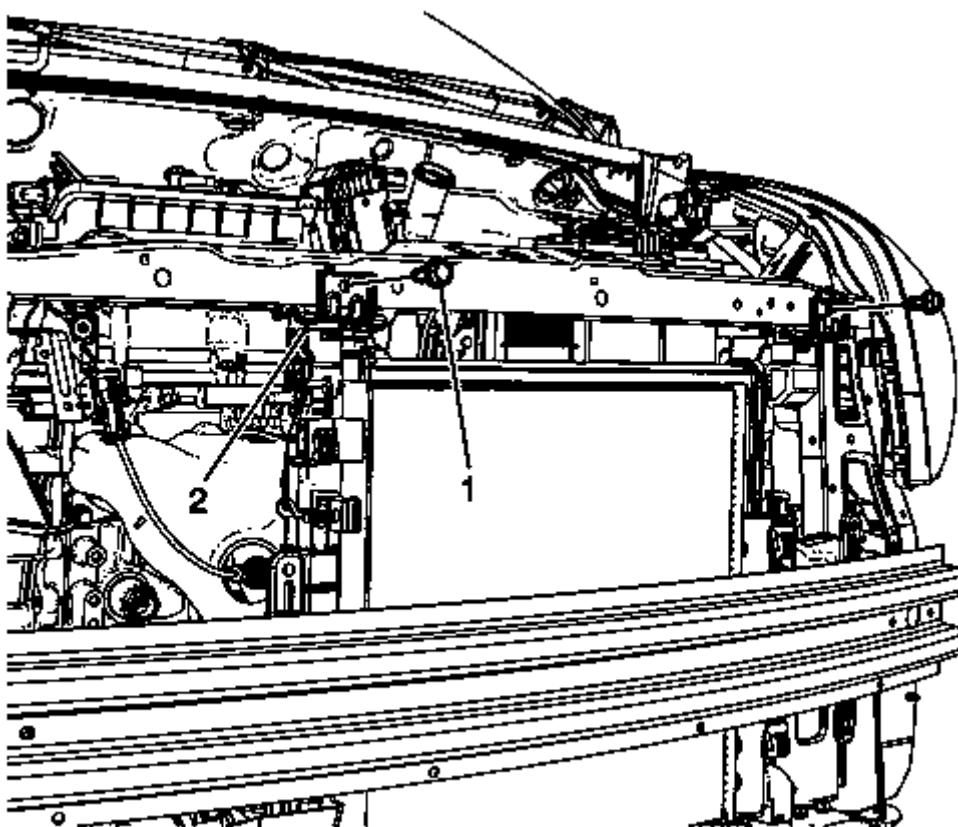


Fig. 51: Radiator Support Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the 2 radiator support bracket bolt (1).
6. Remove the 2 radiator support bracket (2).

Installation Procedure

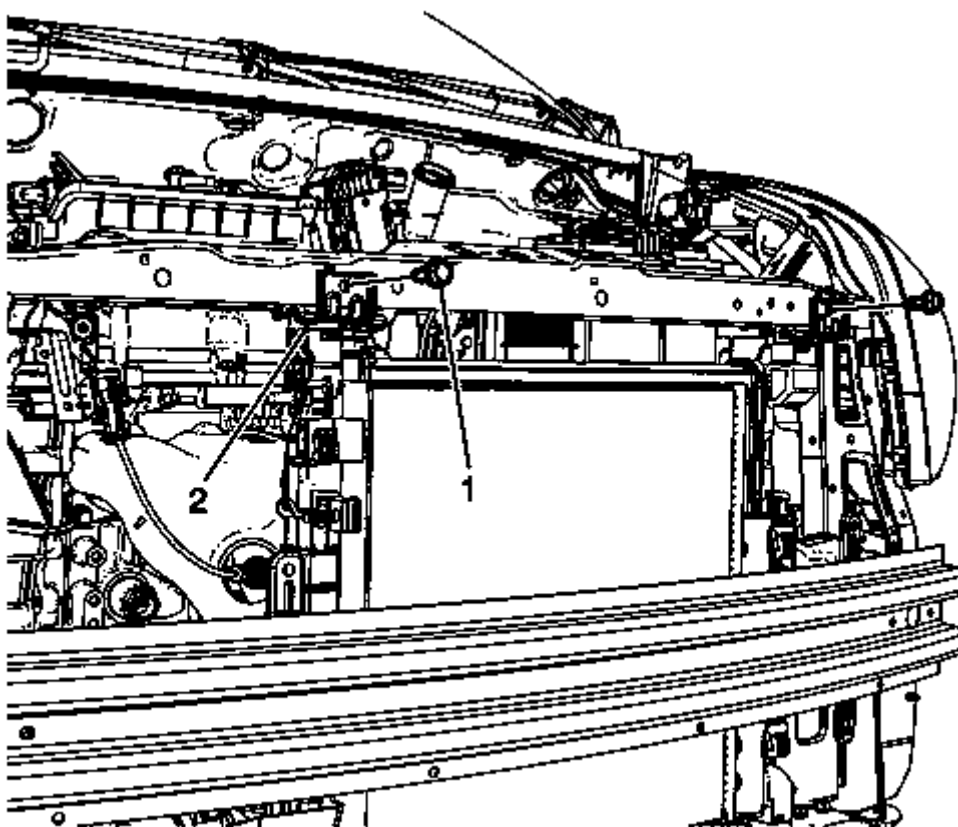


Fig. 52: Radiator Support Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the 2 radiator support bracket (2).

CAUTION: Refer to Fastener Caution .

2. Install the 2 radiator support bracket bolts (1) and tighten to 22 (16 lb in).

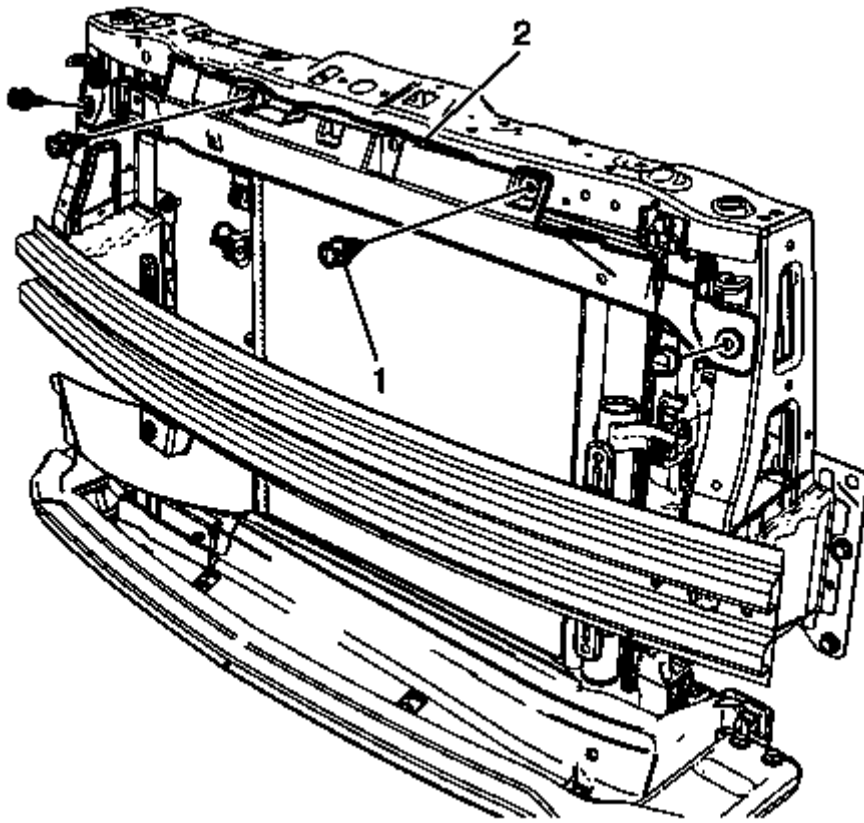


Fig. 53: Upper Air Guard Retainers
Courtesy of GENERAL MOTORS COMPANY

3. Install the upper opening cover (2) and 4 upper opening cover retainers (1).

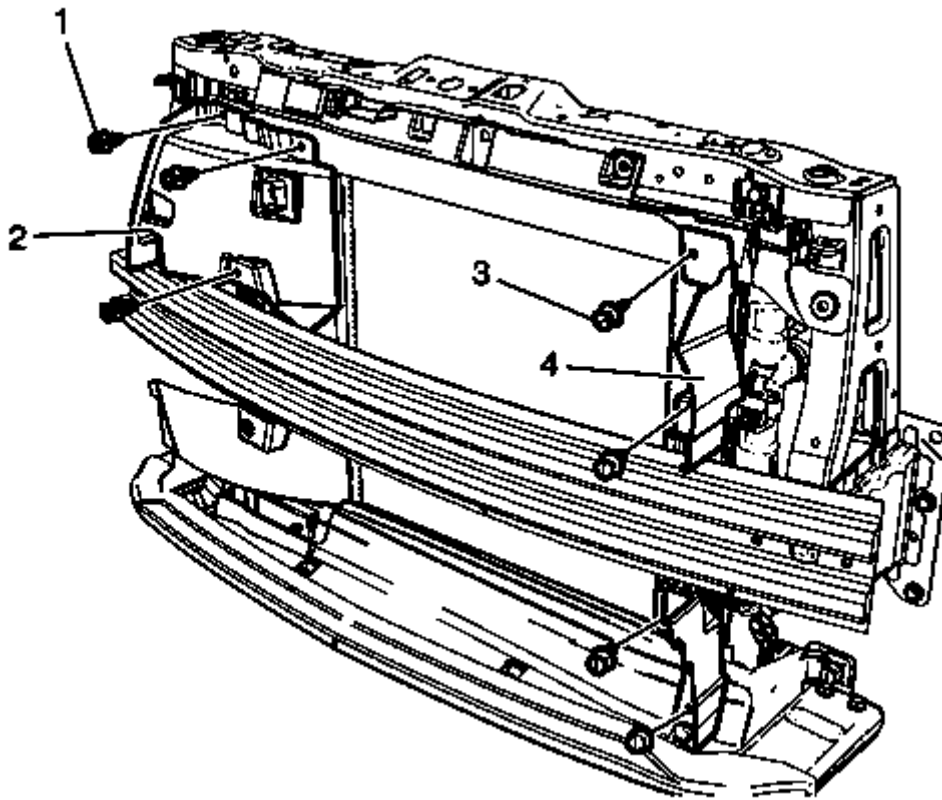


Fig. 54: Front Side Air Baffle Retainers
Courtesy of GENERAL MOTORS COMPANY

4. Install the left side opening cover (4) and 4 left side opening cover retainers (3).
5. Install the right side opening cover (2) and 3 right side opening cover retainers (1).
6. Install the front bumper fascia. Refer to **Front Bumper Fascia Replacement** .

RADIATOR SUPPORT REPLACEMENT

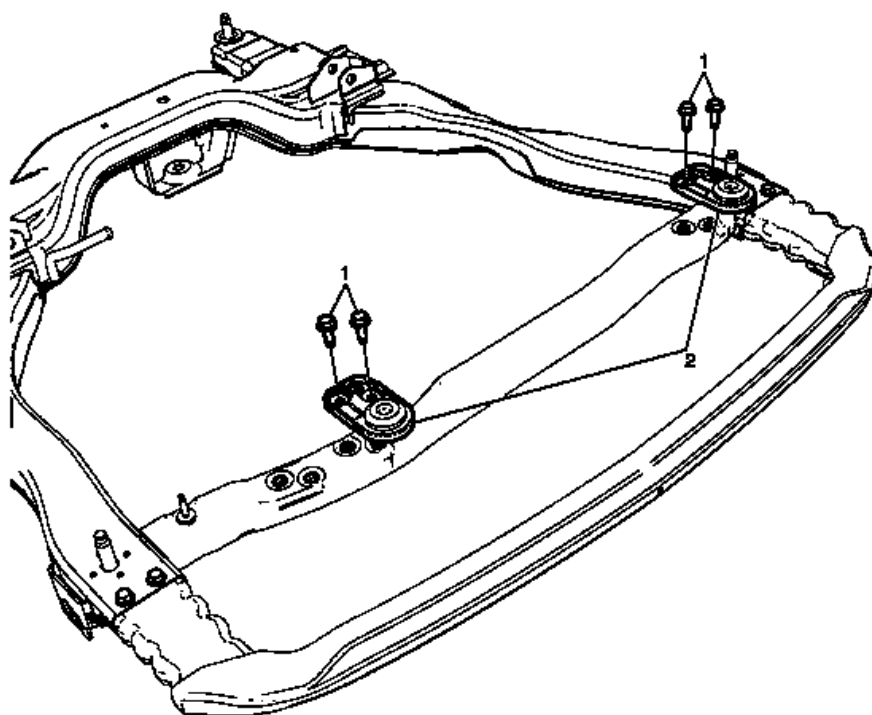


Fig. 55: Radiator Support

Courtesy of GENERAL MOTORS COMPANY

Radiator Support Replacement

Callout	Component Name
Preliminary Procedure Disconnect the condenser from the radiator. Refer to <u>Radiator Replacement</u> .	
1	Radiator Support Mounting Bolt (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 22 (16 lb ft)
2	Radiator Support Procedure Rotate the radiator support and disconnect it from the radiator.

DESCRIPTION AND OPERATION

COOLING FAN DESCRIPTION AND OPERATION

System Overview

The engine cooling fan system is composed of one cooling fan, 2 relays, the engine control module (ECM) and the associated wiring. The cooling fan assembly includes 1 resistor mounted in the cooling fan shroud. The cooling fan resistor may be a stand alone component or a part of the cooling fan motor and harness assembly. This combination of components enables the ECM to operate the cooling fan at 2 speeds using two fan control circuits. The ECM will operate the cooling fan at either Low or High speed based on the cooling requirements.

Low Speed Operation

The ECM applies ground at the FAN 1 control circuit for the coil side of the low speed cooling fan relay. The energized low speed relay switch closes to supply B+ through the cooling fan resistor, to the engine cooling fan motor. The result is cooling fan operation at a reduced speed.

High Speed Operation

The ECM applies ground at the FAN 2 control circuit for the coil side of the cooling fan high speed relay. The energized high speed relay switch closes to supply B+ directly to the engine cooling fan motor, by-passing the cooling fan resistor. The result is cooling fan operation at full speed.

COOLING SYSTEM DESCRIPTION AND OPERATION

Cooling System

The cooling system maintains the engine operating temperature at the efficient level under any speed and operating condition. When the engine is cold, the cooling system cools the engine slowly or not at all. The slow cooling of the engine allows the engine to warm up quickly. The cooling system includes a radiator and recovery subsystem, cooling fans, a thermostat and housing, an oil cooler, a water pump and a water pump drive belt. The accessory belt drives the water pump. All components must function properly in order for the cooling system to operate. Before the coolant reaches operating temperature of the thermostat, the coolant circulates through water jackets in the engine block, the cylinder head, the heater core and the oil cooler. The coolant pump draws the coolant from the bypass pipe which the pipe receives returning flow from the engine and the heater core. When the coolant reaches the operating temperature of the thermostat, the thermostat opens. The coolant then goes to the radiator where it cools. This system directs some coolant through the hoses or pipes to the heater core and oil cooler. This provides for heating, defrosting and engine oil cooling. The surge tank is connected to the radiator to recover the coolant displaced by expansion from the high temperatures. The surge tank maintains the correct coolant level. The cooling system for this vehicle has no radiator cap or filler neck. The coolant is added to the cooling system through the surge tank.

Water Pump

The belt-driven centrifugal water pump consists of an impeller, a drive shaft and a belt pulley. The water pump is mounted on the front of the transverse-mounted engine and is driven by the accessory belt.

The impeller is supported by a completely sealed bearing. The water pump is serviced as an assembly and cannot be disassembled.

Thermostat

A wax pellet-type thermostat controls the flow of the engine coolant through the engine cooling system. The

thermostat is mounted in the thermostat housing to the rear of the cylinder head. The thermostat stops the flow of the engine coolant from the engine to the radiator to provide faster warm-up and to regulate the coolant temperature. The thermostat remains closed while the engine coolant is cold, preventing circulation of the engine coolant through the radiator.

As the engine warms, the thermostat opens. This allows the engine coolant to flow through the radiator where the heat is dissipated through the radiator. This opening and closing of the thermostat permits enough engine coolant to enter the radiator to keep the engine within proper engine temperature operating limits.

The wax pellet in the thermostat is hermetically sealed in a metal case. The wax element of the thermostat expands when it is heated and contracts when it is cooled.

As the vehicle is driven and the engine warms, the engine coolant temperature increases. When the engine coolant reaches a specified temperature, the wax pellet element in the thermostat expands and exerts pressure against the metal case, forcing the valve open. This allows the engine coolant to flow through the engine cooling system and cool the engine. As the wax pellet cools, the contraction allows a spring to close the valve. To provide fuel economy and low emission benefit during part load driving condition, the electric controlled thermostat enables changing the thermostat opening temperature. Basically, the thermostat begins to open at 105° C (221° F) and is fully open at 120° C (248° F) when the electric energy not assisted.

If a certain driving environment encountered that requiring better cooling performance, the ECM orders to put electric energy to the thermostat. The energized electric heater in the wax pellet gives thermal energy to the wax for assisting the wax expansion. Then the thermostat valve opens earlier than the specified coolant temperature. For this vehicle, the programmed temperature set value by the ECM is 105° C (221° F) for cold and part load driving mode and 90° C (194° F) for hot and full load driving mode.

Radiator

The radiator is a heat exchanger. It consists of a core and 2 tanks. The aluminum core is a tube and fin cross-flow design that extends from the inlet tank to the outlet tank. Fins are placed around the outside of the tubes to improve heat transfer to the atmosphere.

The inlet and outlet tanks are a molded, high temperature, nylon reinforced plastic material. A high temperature rubber gasket seals the tank flange edge to the aluminum core. The tanks are clamped to the core with clinch tabs. The tabs are part of the aluminum header at each end of the core.

The radiator removes heat from the coolant passing through it. The fins on the core transfer heat from the coolant passing through the tubes. As air passes between the fins, it absorbs heat and cools the coolant.

Surge Tank

The surge tank is a plastic tank with a threaded pressure cap. The tank is mounted at a point higher than all other coolant passages. The surge tank provides an air space in the cooling system that allows the coolant to expand and contract. The surge tank provides a coolant fill point and a central air bleed location. During vehicle use, the coolant heats and expands. The increased coolant volume flows into the surge tank. As the coolant circulates, any air is allowed to bubble out. Coolant without air bubbles absorbs heat much better than coolant with bubbles.

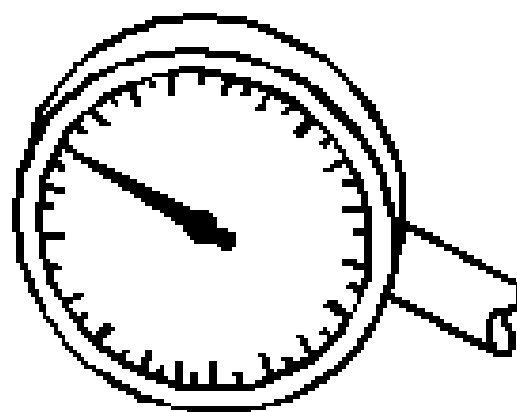
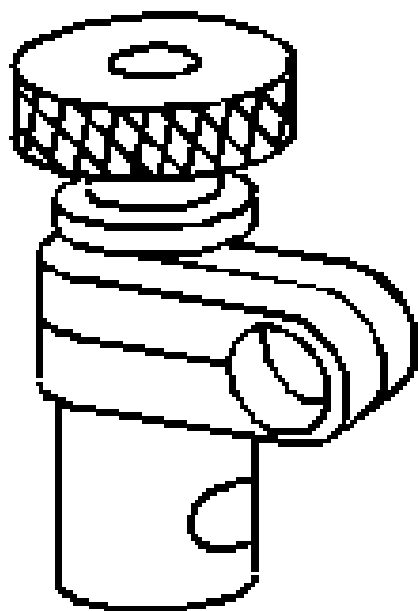
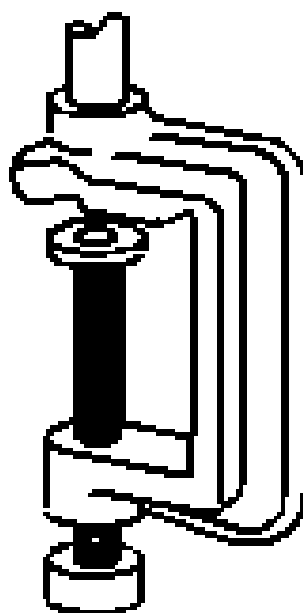
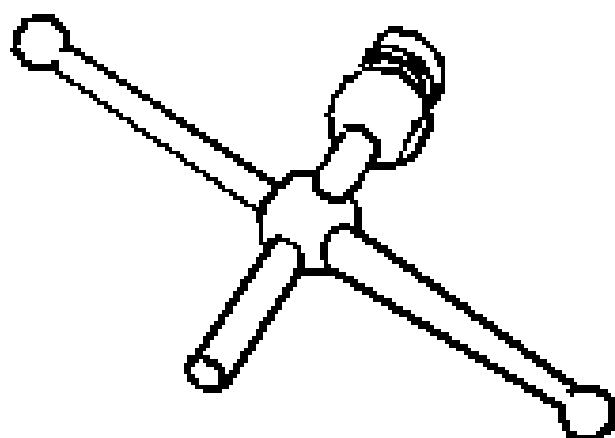
THERMOSTAT HEATER CONTROL SYSTEM DESCRIPTION

A conventional thermostat valve is moved only by the coolant temperature. The temperature range at which the thermostat begins to open is fixed and cannot be adjusted. An electric thermostat valve is moved by the coolant temperature and the built-in heater that is controlled electrically by the ECM. The ECM controls the heater by providing a pulse width modulated (PWM) ground to the thermostat heater control circuit. In this system, a desired ECT can be achieved causing the vehicle better fuel consumption and reduced emissions in city driving or slow cruising.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number / Description
	BO-38185 J-38185 Hose Clamp Pliers



ENGINE

Engine Exhaust - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS (LL0)

Fastener Tightening Specifications (LL0)

Application	Specification	
	Metric	English
Exhaust Front Muffler to Exhaust Muffler Nut	46	34 lb ft
Exhaust Front Pipe to Exhaust Manifold Nut	46	34 lb ft
Exhaust Front Pipe to Exhaust Muffler Nut	46	34 lb ft
Exhaust Manifold Bolt	20	15 lb ft
Exhaust Manifold Bracket Bolt	46	34 lb ft
Exhaust Manifold Heat Shield Retaining Bolt	10	89 lb in
Exhaust Pipe - Rear Muffler Nut	46	34 lb ft
Exhaust Rear Muffler Heat Shield Retaining Nut	1.2	10 lb in
Fuel Tank Heat Shield Retaining Screw	6	53 lb in
Fuel Tank Strap Retaining Bolt	20	15 lb ft

FASTENER TIGHTENING SPECIFICATIONS (LFM)

Fastener Tightening Specifications (LFM)

Application	Specification	
	Metric	English
Exhaust Manifold Pipe Nut	46	34 lb ft
Exhaust Manifold Bolt	20	15 lb ft
Exhaust Manifold Bracket Bolt	46	34 lb ft
Exhaust Manifold Heat Shield Retaining Bolt	10	89 lb in
Exhaust Pipe - Rear Muffler Nut	46	34 lb ft
Exhaust Rear Muffler Heat Shield Retaining Nut	1.2	10 lb in
Fuel Tank Heat Shield Retaining Screw	6	53 lb in
Fuel Tank Strap Retaining Bolt	20	15 lb ft

DIAGNOSTIC INFORMATION AND PROCEDURES

SYMPTOMS - ENGINE EXHAUST

Diagnostic Starting Point - Engine Exhaust

Begin the system diagnosis by reviewing the exhaust system description and operation. Reviewing the

information will help you determine the correct symptom diagnostic procedure when a malfunction exists.

It will also help you determine if the condition described by the customer is normal operation. To identify the correct procedure for diagnosing the system, refer to **Exhaust System Description**.

Visual/Physical Inspection

- Inspect for aftermarket or non-OEM devices. These could affect the operation and performance of the exhaust system.
- Verify the exact operating conditions under which the concern exists. Note factors such as engine RPM, engine temperature, engine load, and frequency of concern.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause any symptom.

Intermittent Conditions

Test the vehicle under the same conditions that the customer reported in order to verify the system is operating as designed.

Symptom List

For the following symptoms, refer to **Restricted Exhaust**.

- Loss of power
- Poor fuel economy
- Poor acceleration

For the following symptoms, refer to **Exhaust Leakage**.

- Exhaust hissing
- Exhaust popping

For the following symptoms, refer to **Exhaust Noise**.

- Exhaust rattle
- Loud exhaust
- Exhaust buzz, groan or hum

RESTRICTED EXHAUST

Test Description

The numbers below refer to the step numbers on the diagnostic table.

The exhaust system has very low back pressure under normal conditions. If the exhaust system is restricted, a significant increase in the exhaust pressure is noticed on the **J-35314-A** exhaust back pressure gauge.

Removing the heated oxygen sensor may set a DTC. When finishing this diagnostic table all codes must be cleared.

4

This step will isolate the catalytic converter from the remainder of the exhaust system.

Restricted Exhaust

Step	Action	Value(s)	Yes	No
Special Tools				
J-35314-A Exhaust Back Pressure Gauge				
1	Did you verify the customers complaint?	-	Go to Step 2	-
2	Did you review the exhaust symptoms diagnostic information and perform the necessary inspections?	-	Go to Step 3	Go to Symptoms - Engine Exhaust.
3	1. Remove the heated oxygen sensor 1. Refer to <u>Heated Oxygen Sensor Replacement - Sensor 1</u> . 2. Install the EN-35314-A exhaust back pressure gauge in place of the heated oxygen sensor 1. 3. Start the engine. 4. Increase and monitor the engine speed at 2, 000 RPM. 5. Observe the exhaust system back pressure reading on the gauge. 6. Check the value.	-	Go to Step 4	Go to Step 4
4	1. Turn the engine off and place the ignition in the lock position. 2. Remove the EN-35314-A exhaust back pressure gauge. 3. Install the heated oxygen sensor 1. Refer to <u>Heated Oxygen Sensor Replacement - Sensor 1</u> . 4. Remove the heated oxygen sensor 2. Refer to <u>Heated Oxygen Sensor Replacement - Sensor 2</u> . 5. Install the EN-35314-A exhaust back pressure gauge in place of the heated oxygen sensor 2.	-		

	6. Start the engine. 7. Increase and monitor the engine speed at 2,000 RPM. 8. Observe the exhaust system back pressure reading on the gauge. Compare the reading with the above value. The values are same?		Go to Step 5	Go to Step 6
5	Inspect the exhaust system for the following conditions: • Damage in the exhaust pipe • Debris in the exhaust pipe • Muffler or resonator internal failure • Two-layer exhaust pipe separation Did you find and correct the condition?	-	Go to Step 7	-
6	Replace the exhaust manifold. Refer to <u>Exhaust Manifold Replacement</u> . Did you find and correct the condition?	-	Go to Step 7	-
7	1. Remove the EN-35314-A exhaust back pressure gauge. 2. Install the heated oxygen sensor 2. Refer to <u>Heated Oxygen Sensor Replacement - Sensor 2</u> . 3. Clear any DTCs. 4. Road test the vehicle in order to verify the repair. Did you correct the condition?	-	System OK	Go to Step 2

EXHAUST LEAKAGE

Exhaust Leakage

Condition	Action
DEFINITION: An exhaust leak may show stains at the area of the leak. The leak may be felt by holding a hand close to the suspected areas or using a smoke pencil. The leak may make a popping or hissing noise. Refer to <u>Symptoms - Engine Exhaust</u> prior to beginning this table.	
Misaligned or incorrectly installed exhaust system components	• Align and tighten the exhaust system components to the required specifications. • Make sure the exhaust hangers are in the proper locations and not loose.

Exhaust leaks at the following connections: • Exhaust manifold to pipe • Flange	Tighten the affected components to the required specifications.
Seals or gaskets leaking • Exhaust manifold to cylinder head • Exhaust pipes to exhaust manifold • Catalytic converter connection	Replace the leaking seal or gasket.
Irregularities at the mating surfaces on the flange connections	Repair as required or replace the affected component.
Exhaust manifold cracked or broken	Replace the exhaust manifold. Refer to <u>Exhaust Manifold Replacement</u> .
Exhaust system component connection welds leaking	Replace the leaking component.
Muffler or resonator, if equipped, damaged or leaking at the seams	Replace the affected muffler. Refer to <u>Exhaust Muffler Replacement</u> .

EXHAUST NOISE

Exhaust Noise

Condition	Action
DEFINITION: An audible or physical noise due to a faulty component or damaged components causing a loose or misaligned exhaust system resulting in a rattle or vibration noise. Refer to <u>Symptoms - Engine Exhaust</u> .	
Popping or hissing noise	Exhaust leak. Refer to <u>Exhaust Leakage</u> .
Loud exhaust	1. Compare to a known good vehicle. 2. Inspect for a damaged or failed muffler. 3. Replace the faulty muffler. Refer to <u>Exhaust Muffler Replacement</u>.
External rattle or vibration noise	1. Inspect for a bent or loose hanger, loose heat shield, or loose clamp. 2. Inspect for an exhaust pipe causing interference. 3. Repair or replace the affected component.
Internal rattle	1. Test the components by tapping with a rubber mallet to confirm a rattle. 2. Replace the faulty catalytic converter, or muffler. Refer to one of the following procedures: • <u>Exhaust Manifold Replacement</u> • <u>Exhaust Muffler Replacement</u>

REPAIR INSTRUCTIONS

EXHAUST MANIFOLD REPLACEMENT

Removal Procedure

1. Remove the exhaust manifold heat shield. Refer to Exhaust Manifold Heat Shield Replacement.
2. Raise the vehicle by its full height. Refer to Lifting and Jacking the Vehicle.

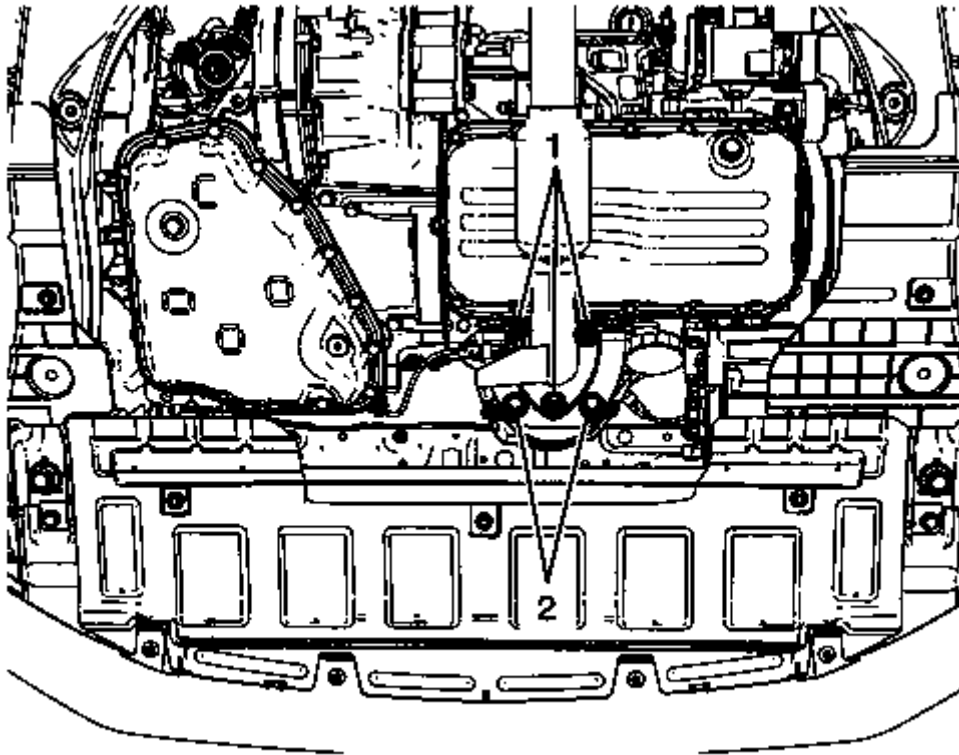


Fig. 1: Exhaust Manifold Pipe Nut
Courtesy of GENERAL MOTORS COMPANY

3. Remove the exhaust manifold pipe nut (1).
4. Remove the exhaust manifold bracket bolts (2).
5. Remove the exhaust manifold pipe gasket.

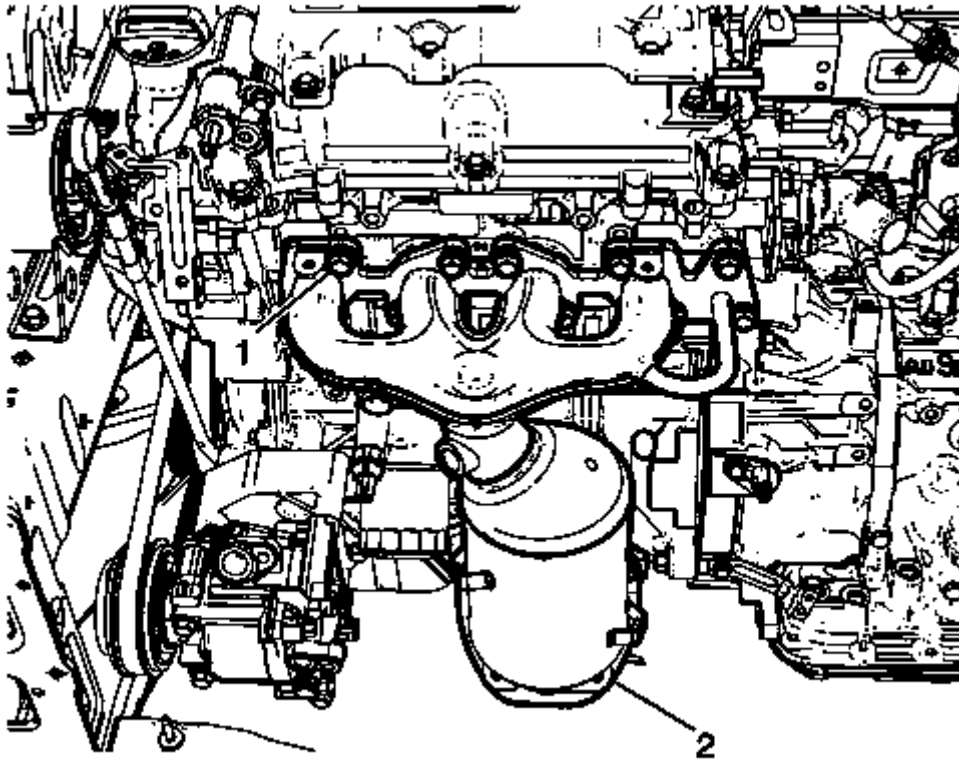


Fig. 2: Exhaust Manifold Bolt

Courtesy of GENERAL MOTORS COMPANY

6. Remove the 10 exhaust manifold bolt (1).
7. Remove the exhaust manifold (2) and gasket.
8. Transfer parts as necessary.

Installation Procedure

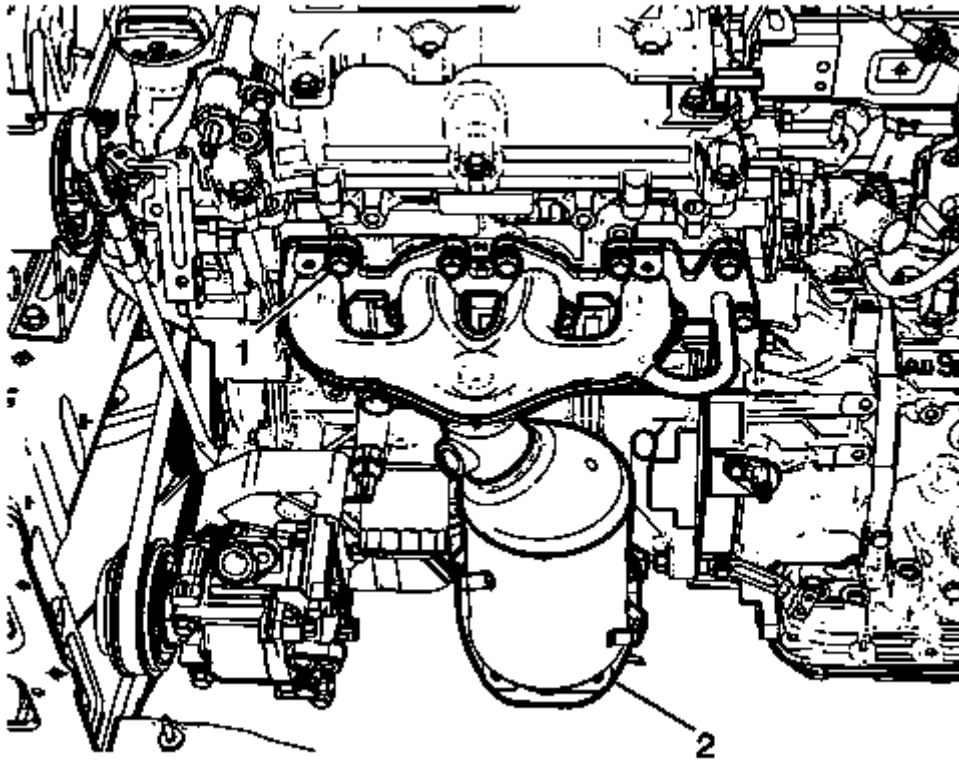


Fig. 3: Exhaust Manifold Bolt

Courtesy of GENERAL MOTORS COMPANY

1. Install the exhaust manifold (2) and gasket.

CAUTION: Refer to Fastener Caution .

2. Install the 10 exhaust manifold bolt (1) and tighten to 20 (15 lb ft).
3. Raise the vehicle by its full height. Refer to Lifting and Jacking the Vehicle .

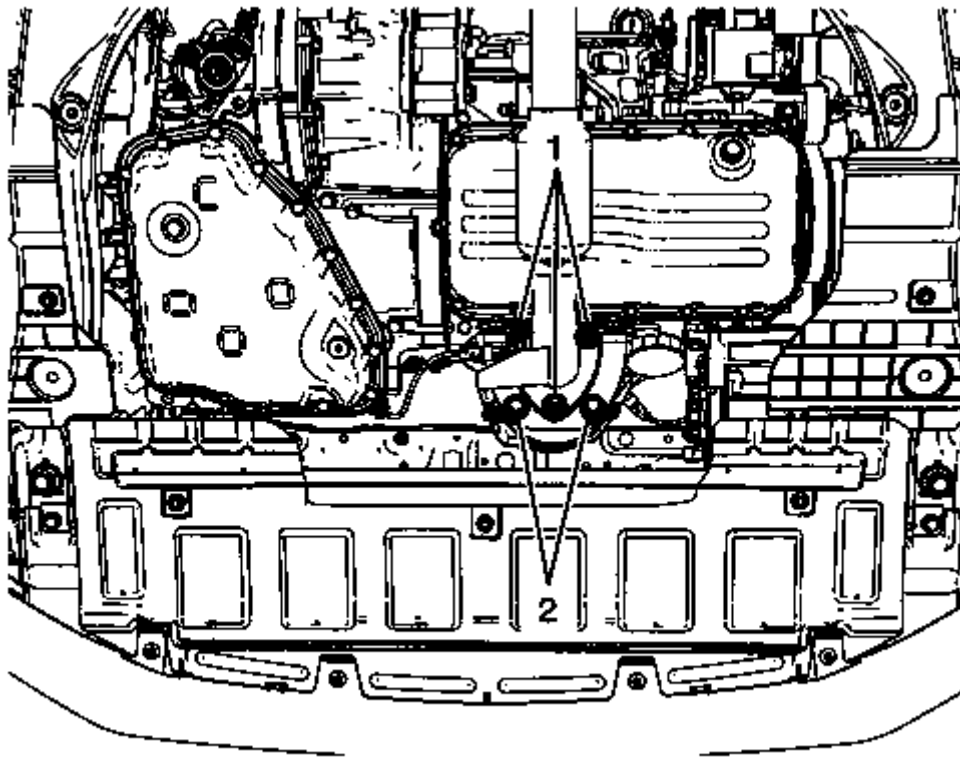


Fig. 4: Exhaust Manifold Pipe Nut
Courtesy of GENERAL MOTORS COMPANY

4. Install the exhaust manifold pipe gasket.
5. Install the exhaust manifold pipe nut (1) and tighten to 46 (34 lb ft).
6. Install the exhaust manifold bracket bolts (2) and tighten to 46 (34 lb ft).
7. Install the exhaust manifold heat shield. Refer to **Exhaust Manifold Heat Shield Replacement**.

EXHAUST PIPE REPLACEMENT (LFM)

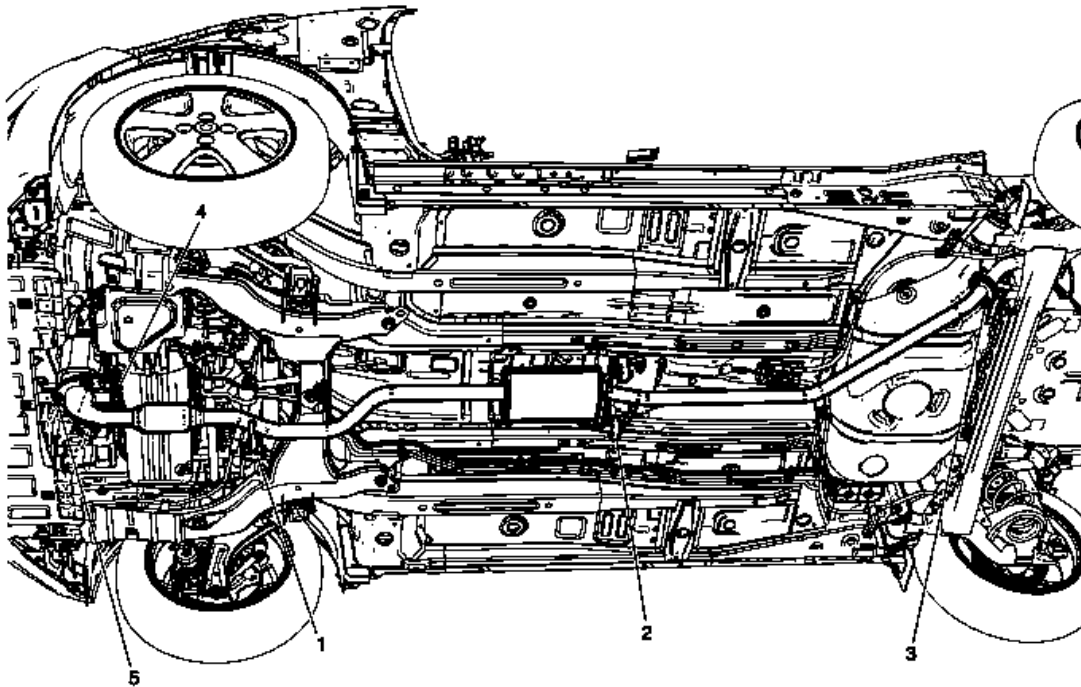


Fig. 5: Exhaust Pipe (LFM)

Courtesy of GENERAL MOTORS COMPANY

Exhaust Pipe Replacement (LFM)

Callout	Component Name
Preliminary Procedures	
1. Raise the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> .	
2. Remove the heated oxygen sensor 2. Refer to <u>Heated Oxygen Sensor Replacement - Sensor 2</u> .	
1	Exhaust Pipe Hanger (Qty: 1)
2	Exhaust Pipe Front Muffler Hanger (Qty: 2)
3	Exhaust Pipe - Rear Muffler Nut (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 46 (34 lb ft)
4	Catalytic Converter - Exhaust Pipe Nut (Qty: 3)
5	Catalytic Converter - Exhaust Pipe Nut (Qty: 3)

EXHAUST FRONT PIPE REPLACEMENT (LL0)

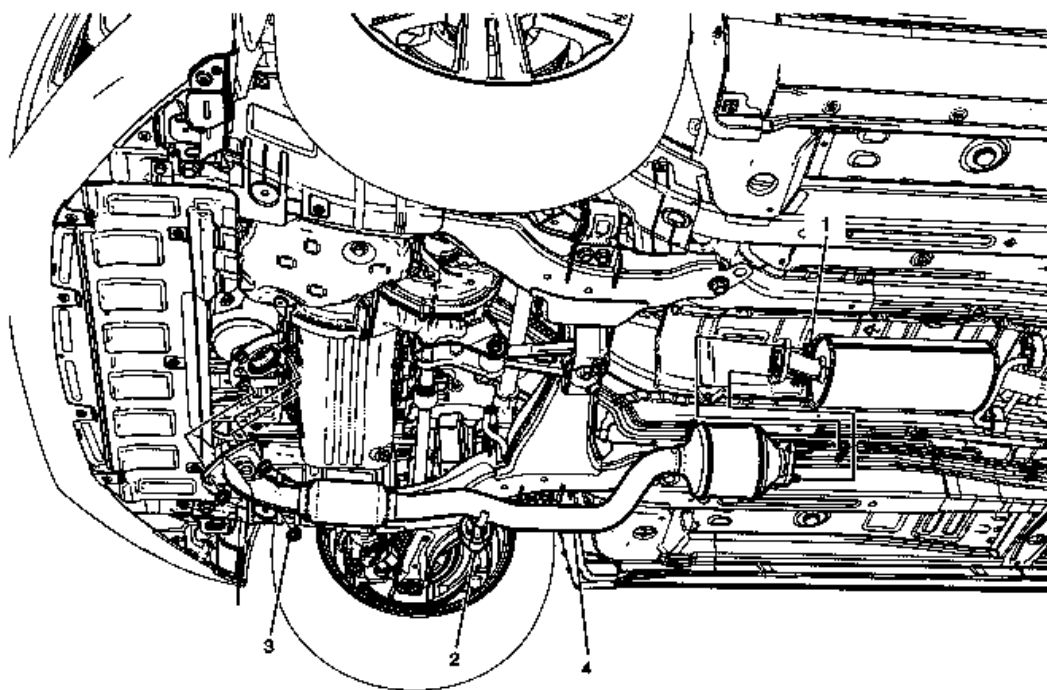


Fig. 6: Exhaust Front Pipe
 Courtesy of GENERAL MOTORS COMPANY

Exhaust Front Pipe Replacement (LL0)

Callout	Component Name
Preliminary Procedures	
1. Raise the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Remove the heated oxygen sensor 2. Refer to <u>Heated Oxygen Sensor Replacement - Sensor 2</u> .	
1	Exhaust Front Pipe to Exhaust Muffler Nut (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 46 (34 lb ft)
2	Exhaust Front Pipe Hanger (Qty: 1)
3	Exhaust Front Pipe to Exhaust Manifold Nut (Qty: 3) Tighten 46 (34 lb ft)
4	Exhaust Front Pipe

EXHAUST MUFFLER REPLACEMENT - FRONT (LL0)

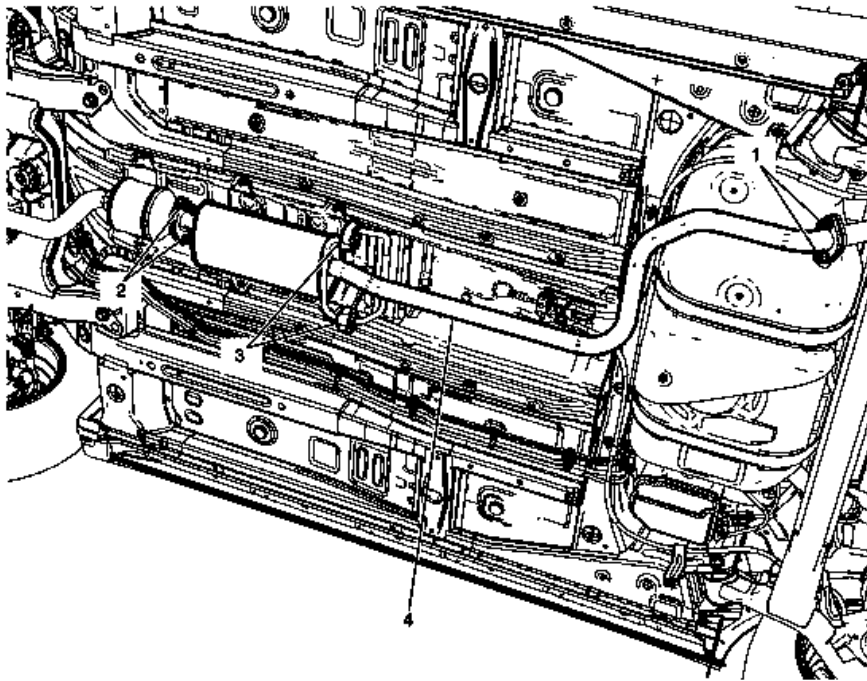


Fig. 7: Exhaust Muffler - Front
 Courtesy of GENERAL MOTORS COMPANY

Exhaust Muffler Replacement - Front (LL0)

Callout	Component Name
Preliminary Procedure Raise the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> .	
1	Exhaust Front Muffler to Exhaust Muffler Nut (Qty: 2) CAUTION: Refer to <u>Component Fastener Tightening Caution</u> . Tighten 46 (34 lb ft)
2	Exhaust Front Pipe to Exhaust Muffler Nut (Qty: 2) CAUTION: Refer to <u>Component Fastener Tightening Caution</u> . Tighten 46 (34 lb ft)
3	Exhaust Muffler Hanger (Qty: 2)
4	Exhaust Muffler (Front)

EXHAUST MUFFLER REPLACEMENT

Removal Procedure

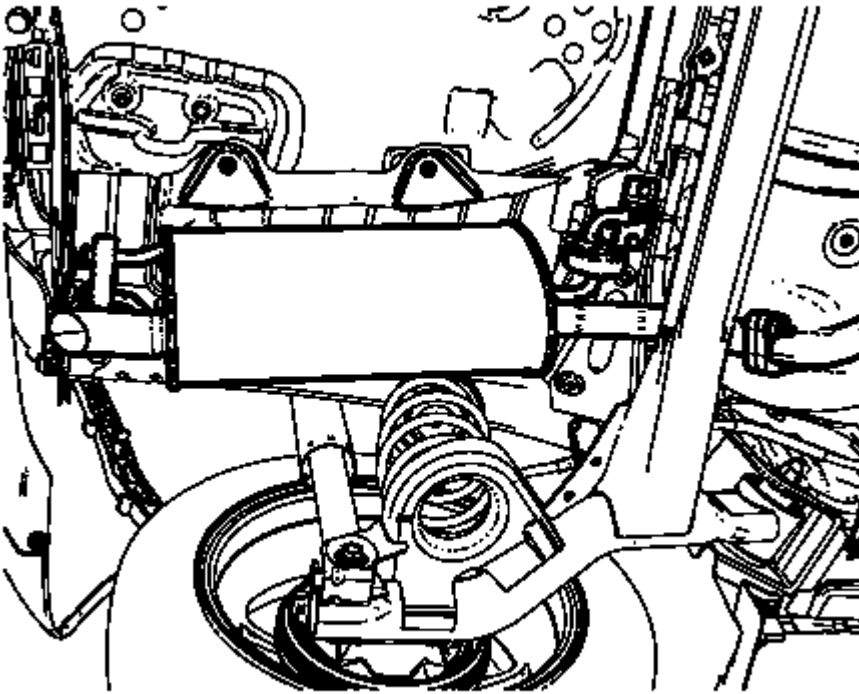


Fig. 8: Exhaust Rear Muffler Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Remove the exhaust pipe - rear muffler nut.
2. Disconnect the exhaust rear muffler assembly from the rubber hanger and remove it.

Installation Procedure

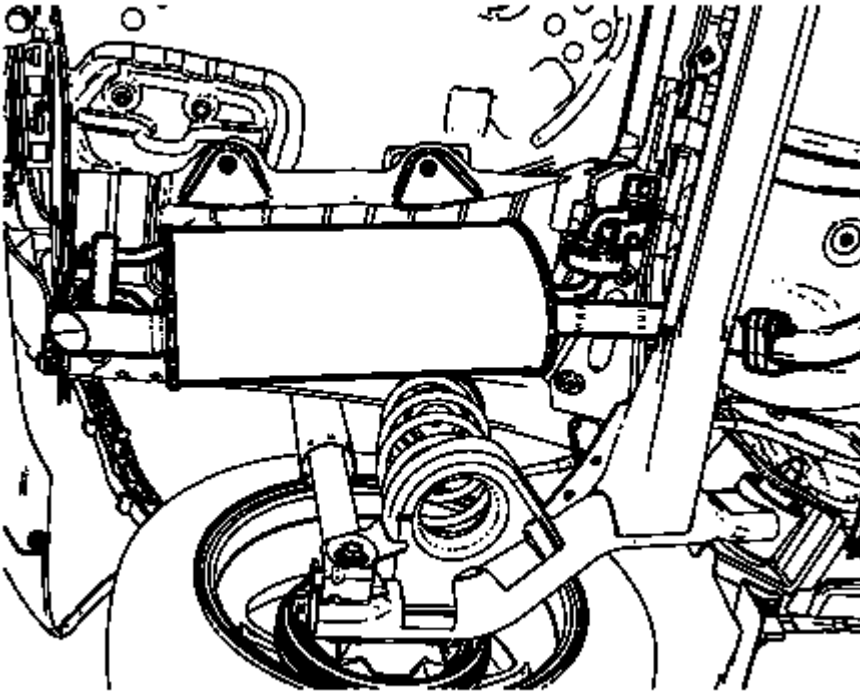


Fig. 9: Exhaust Rear Muffler Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Connect the exhaust rear muffler assembly to the rubber hanger and install.

CAUTION: Refer to Fastener Caution .

2. Install the exhaust pipe - rear muffler nut and tighten to 46 (34 lb ft).

FUEL TANK HEAT SHIELD REPLACEMENT (LL0)

Removal Procedure

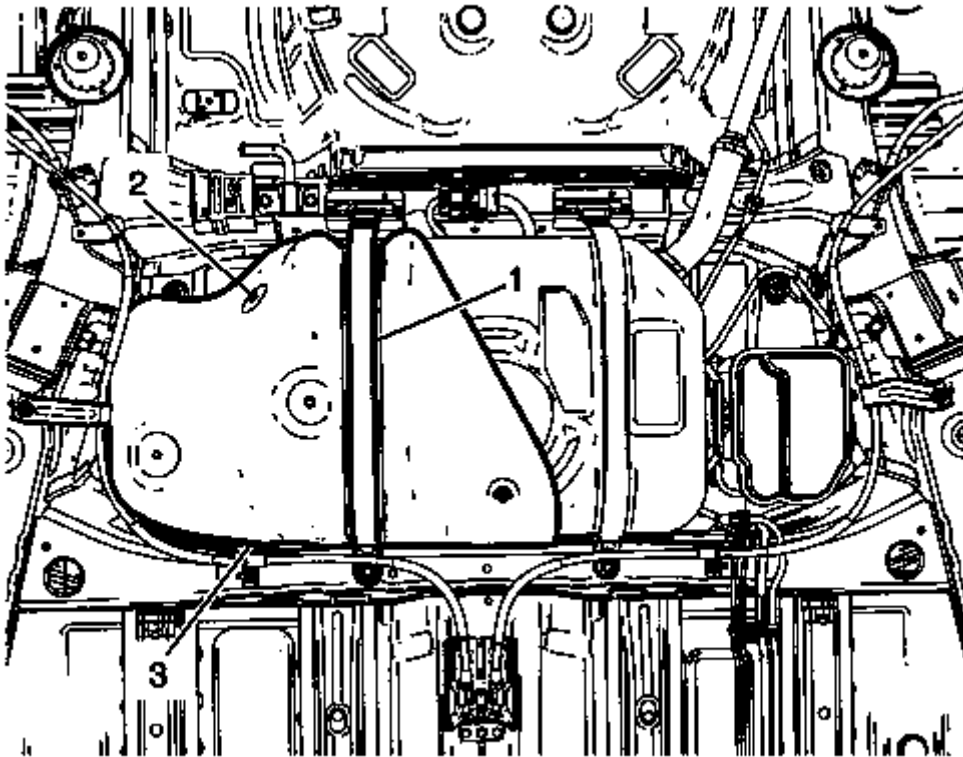


Fig. 10: Front Exhaust Muffler Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Remove the front exhaust muffler assembly. Refer to **Exhaust Muffler Replacement - Front (LL0)**.
2. Remove the fuel tank strap retaining bolt and band (1) left side only.
3. Remove the 3 fuel tank heat shield retaining screw bolt (2).
4. Remove the fuel tank heat shield (3).

Installation Procedure

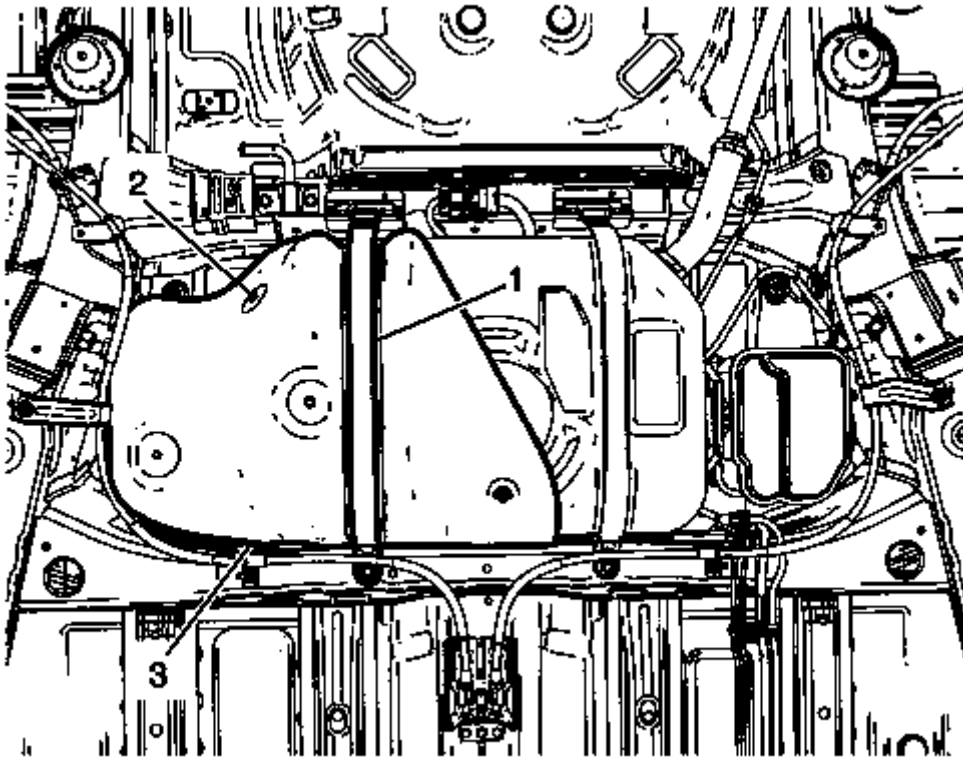


Fig. 11: Front Exhaust Muffler Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Install the fuel tank heat shield (3).

CAUTION: Refer to Fastener Caution .

2. Install the 3 fuel tank heat shield retaining screw bolt (2) and tighten to 6 (53 lb in).
3. Install the fuel tank strap (1) retaining bolt and tighten to 20 (15 lb ft).
4. Install the front exhaust muffler assembly. Refer to **Exhaust Muffler Replacement - Front (LL0)**.

FUEL TANK HEAT SHIELD REPLACEMENT (LFM)

Removal Procedure

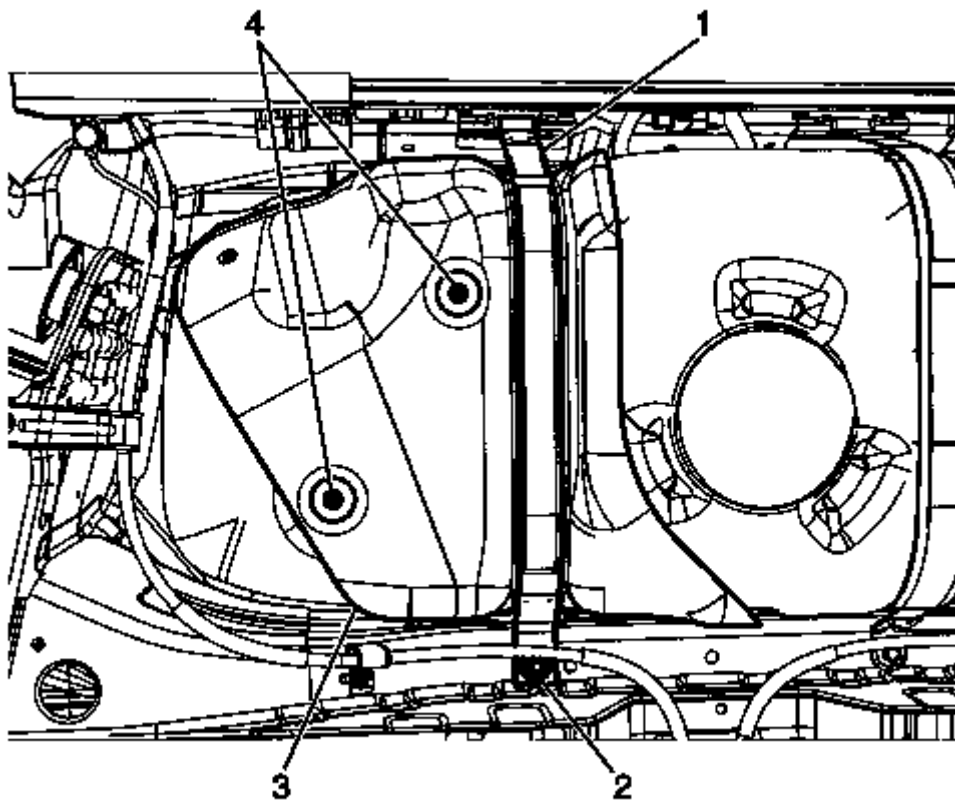


Fig. 12: Fuel Tank Strap Retaining Bolt And Band
Courtesy of GENERAL MOTORS COMPANY

1. Remove the exhaust pipe - rear muffler nut. Refer to **Exhaust Pipe Replacement (LFM)**.
2. Remove the fuel tank strap retaining bolt (2) and band (1) left side only.
3. Remove the 2 fuel tank heat shield retaining screw bolts (4).
4. Remove the fuel tank heat shield (3).

Installation Procedure

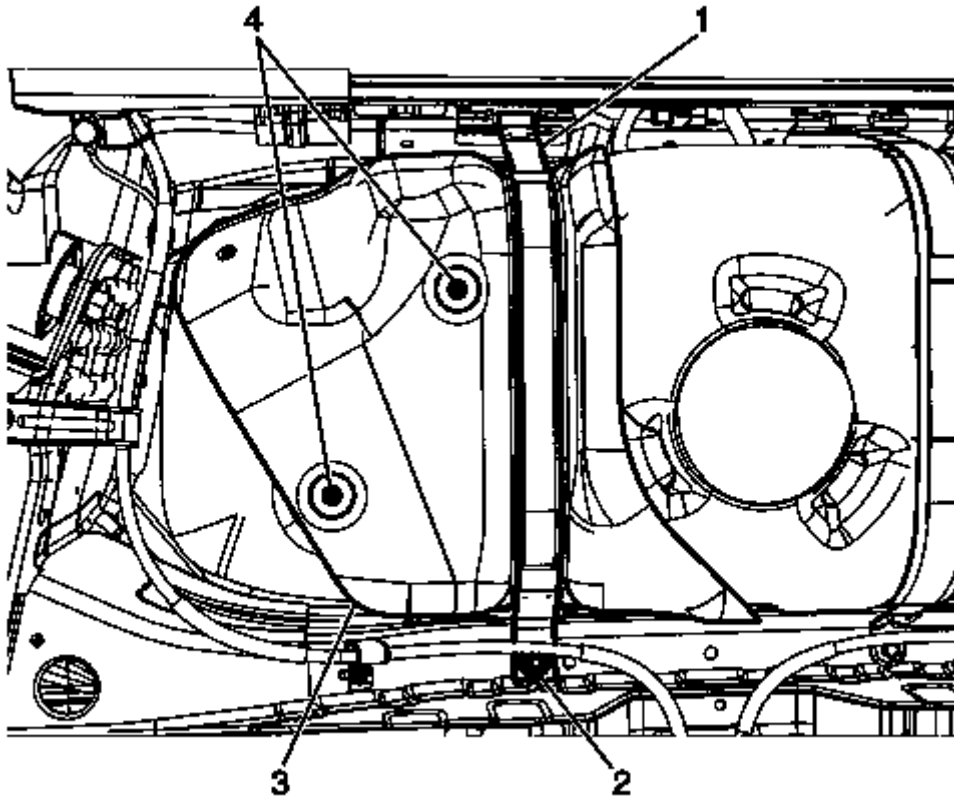


Fig. 13: Fuel Tank Strap Retaining Bolt And Band
Courtesy of GENERAL MOTORS COMPANY

1. Install the fuel tank heat shield (3).

CAUTION: Refer to Fastener Caution .

2. Install the 2 fuel tank heat shield retaining screw bolts (4) and tighten to 6 (53 lb in).
3. Install the fuel tank strap band (1) and tighten the fuel tank strap retaining bolt (2) to 20 (15 lb ft).
4. Install the exhaust pipe - rear muffler nut. Refer to **Exhaust Pipe Replacement (LFM)**.

EXHAUST MANIFOLD HEAT SHIELD REPLACEMENT

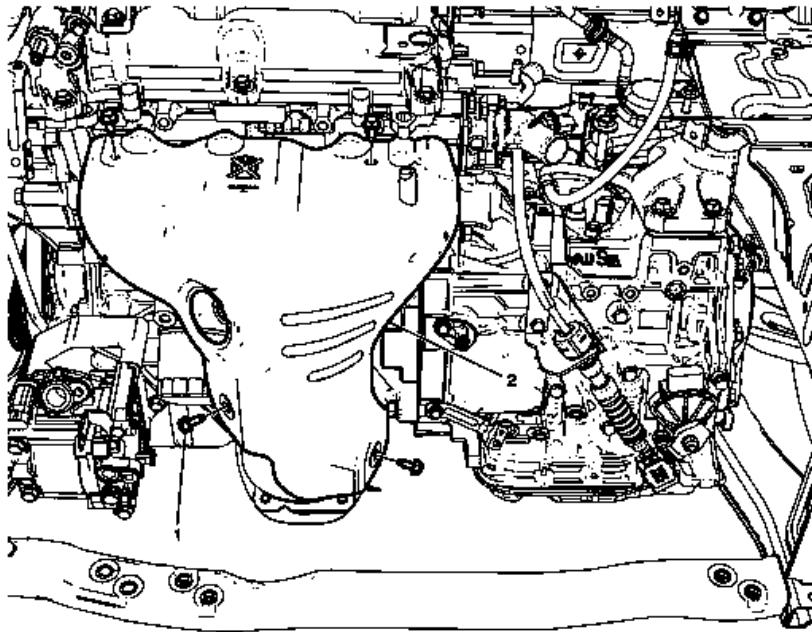


Fig. 14: Exhaust Manifold Heat Shield
 Courtesy of GENERAL MOTORS COMPANY

Exhaust Manifold Heat Shield Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the air cleaner assembly. Refer to Air Cleaner Assembly Replacement . 2. Remove the front headed oxygen sensor. Refer to Heated Oxygen Sensor Replacement - Sensor 1 .	
1	Exhaust Manifold Heat Shield Retaining Bolt (Qty: 4) CAUTION: Refer to Fastener Caution . Tighten 10 (89 lb in)
2	Exhaust Manifold Heat Shield

EXHAUST REAR MUFFLER HEAT SHIELD REPLACEMENT

Removal Procedure

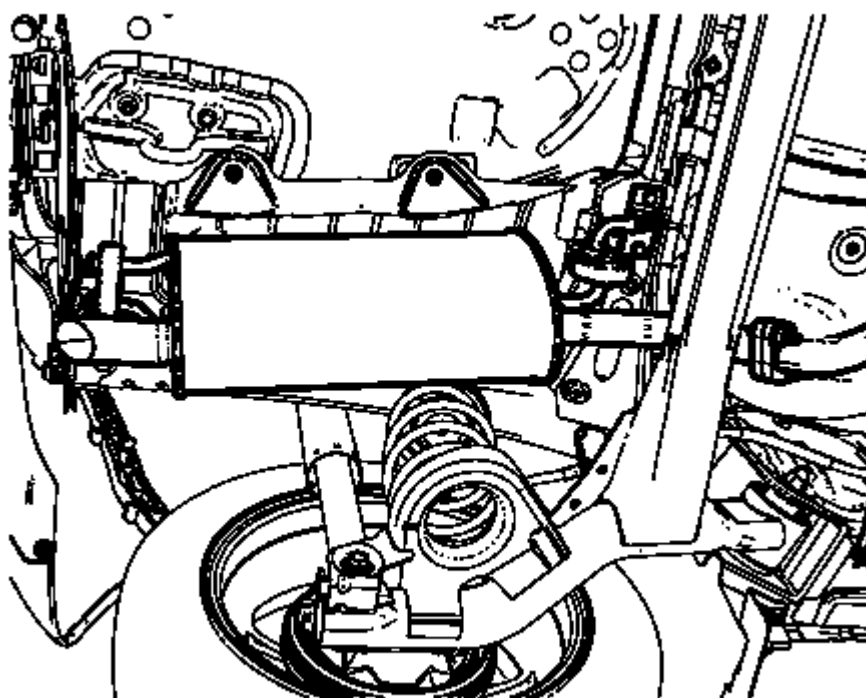


Fig. 15: Exhaust Rear Muffler Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Remove the exhaust rear muffler. Refer to **Exhaust Muffler Replacement**.

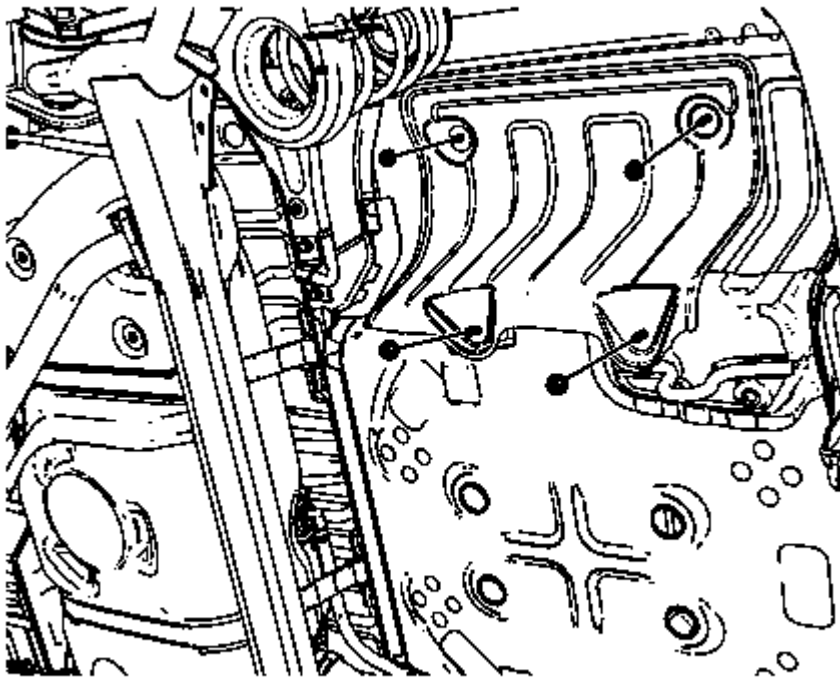


Fig. 16: Exhaust Rear Muffler Heat Shield Retaining Nuts
Courtesy of GENERAL MOTORS COMPANY

2. Remove the 4 exhaust rear muffler heat shield retaining nuts.

Installation Procedure

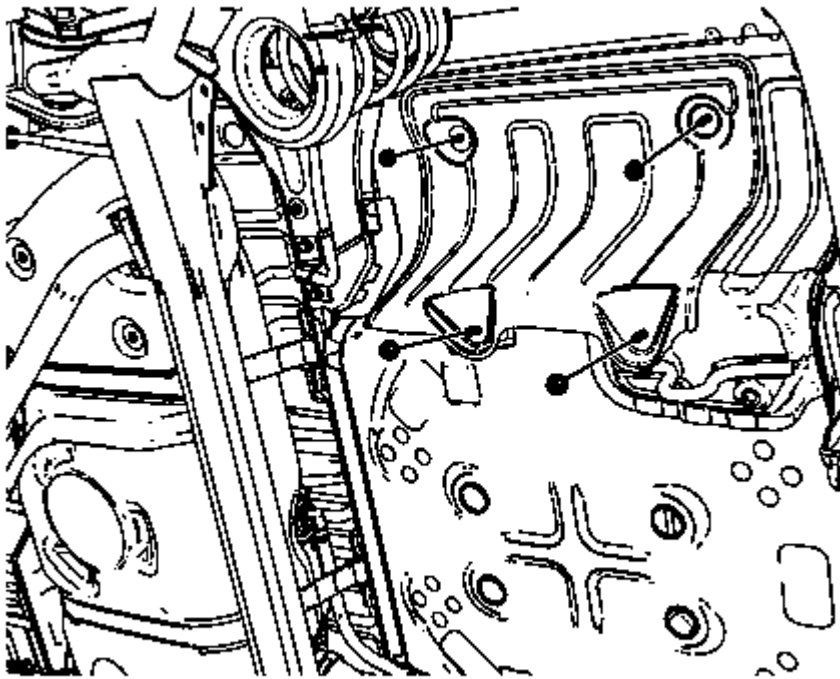


Fig. 17: Exhaust Rear Muffler Heat Shield Retaining Nuts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

1. Install the 4 exhaust rear muffler heat shield retaining nuts and tighten to 1.2 (11 lb in).

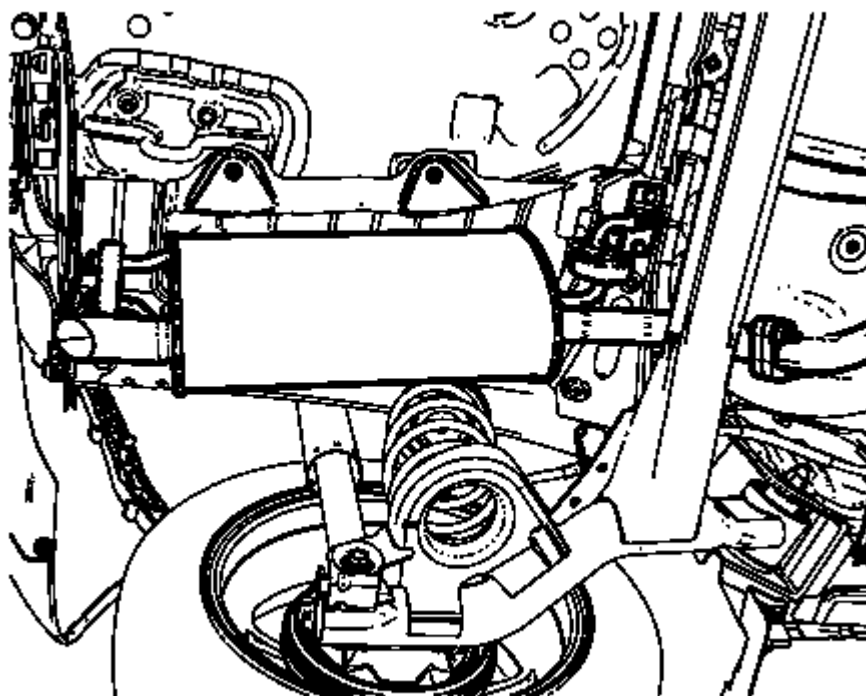


Fig. 18: Exhaust Rear Muffler Assembly
Courtesy of GENERAL MOTORS COMPANY

2. Install the exhaust rear muffler. Refer to Exhaust Muffler Replacement.

DESCRIPTION AND OPERATION

EXHAUST SYSTEM DESCRIPTION

Catalytic Converter

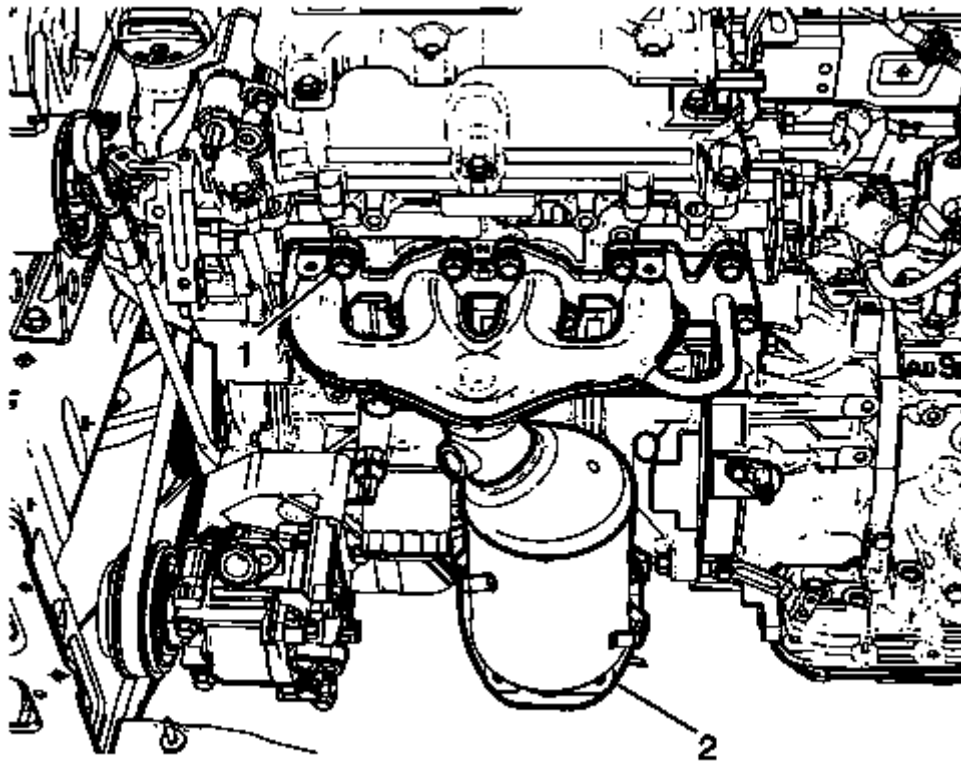


Fig. 19: Exhaust Manifold Bolt

Courtesy of GENERAL MOTORS COMPANY

The catalytic converter is an emission control device added to the engine exhaust system in order to reduce hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NO_x) pollutants from the exhaust gas. The catalytic converter is comprised of a ceramic monolith substrate, supported in insulation and housed within a sheet metal shell. The substrate may be washcoated with 3 noble metals, Platinum (Pt), Palladium (Pd) and Rhodium (Rh).

Exhaust Rear Muffler

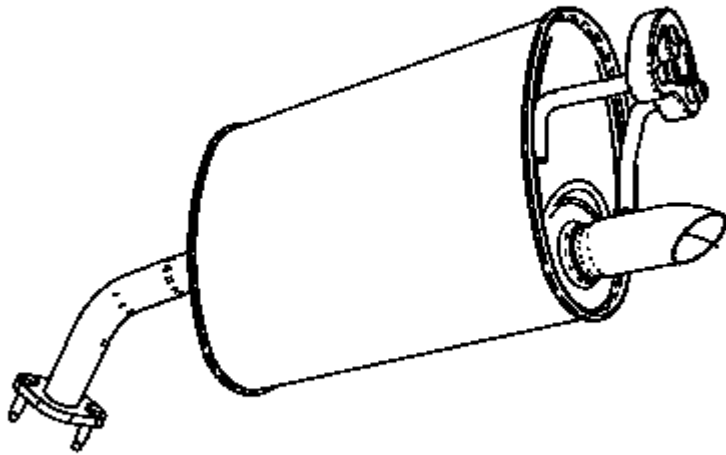


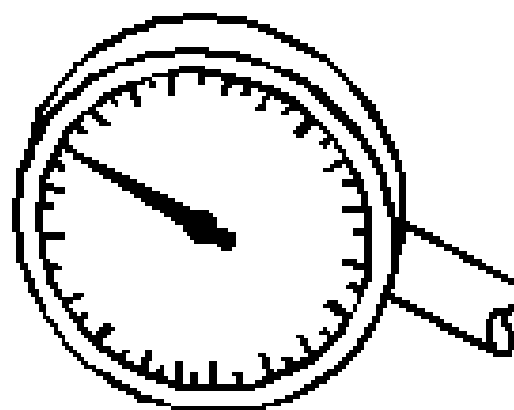
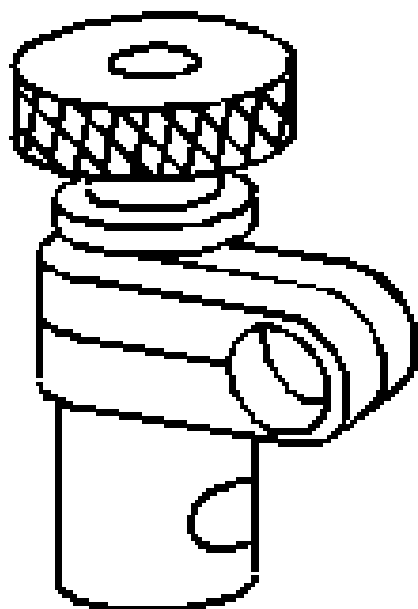
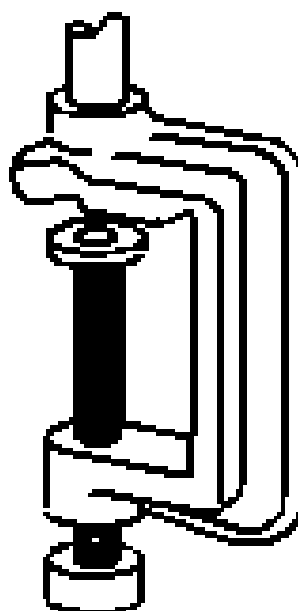
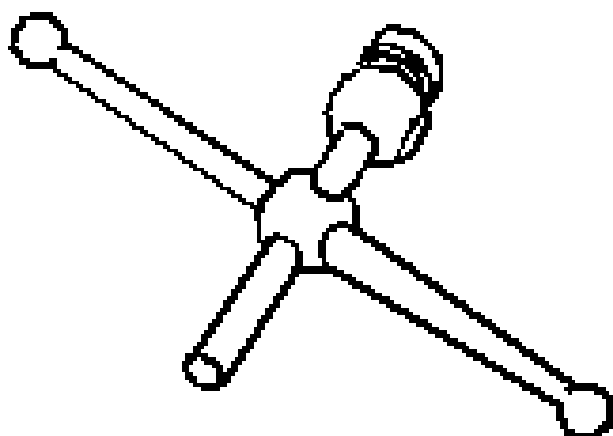
Fig. 20: Exhaust Rear Muffler
Courtesy of GENERAL MOTORS COMPANY

The rear muffler is to reduce broad band engine exhaust noise. It is comprised of a series of perforated tubes and baffles to break up the sound waves and reflect them. It is made of stainless steel to protect the front muffler from corrosion.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description



EN-35314
A
J 35314 A
Exhaust
Back
Pressure
Gauge

ENGINE

Engine Mechanical - 1.0L, 1.19L or 1.2L - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS (LL0)

Fastener Tightening Specifications (LL0)

Application	Specification	
	Metric	English
A/C Compressor Suction Pipe Bolt	22	16 lb ft
A/C Condenser Discharger Pipe Bolt	10	89 lb in
Air Conditioning Compressor Bracket Bolt	22	16 lb ft
Automatic Transmission Flex Plate Bolt	20 + 25°	15 lb ft + 25°
Block Heater Connecting Plug Holder Bolt	8	71 lb in
Camshaft Bearing Cap Bolt	10	89 lb in
Camshaft Cover Bolt	10	89 lb in
Camshaft Cover Front Bracket Bolt	10	89 lb in
Camshaft Position Actuator Solenoid Valve Bolt	10	89 lb in
Connecting Rod Bearing Cap Bolt	20 + 90°	15 lb ft + 90°
Coolant Surge Tank Retaining Bolt	8	71 lb in
Cradle Bolt	135	100 lb ft
Crankshaft Balancer Bolt	95 + 55°	70 lb ft + 55°
Crankshaft Bearing Cap Bolt	30 + 30°	22 lb ft + 30°
Crankshaft Rear Oil Seal Housing Bolt	10	89 lb in
Cylinder Head Bolt	22 + 82°	16 lb in + 82°
Electronic Brake Control Module (EBCM) and Brake Pressure Modular Valve (BPMV) Bracket Bolt	22	16 lb ft
Electronic Brake Control Module (EBCM) and Brake Pressure Modular Valve (BPMV) Bracket Nut	22	16 lb ft
Engine Block Heater	60	44 lb ft
Engine Block Oil Gallery Plug	12.5	9 lb ft
Engine Coolant Outlet Adapter Housing Bolt	25	18 lb ft
Engine Coolant Thermostat Bolt	10	89 lb in
Engine Front Cover Bolt (M6)	10	89 lb in
Engine Front Cover Bolt (M8)	22	16 lb ft
Engine Injection and Ignition Bracket Bolt	10	89 lb in
Engine Lift Front Bracket Bolt	25	18 lb ft
Engine Lift Rear Bracket Bolt	25	18 lb ft
Engine Mount - Body Retaining Bolt	50	37 lb ft
Engine Mount - Engine Retaining Bolt	66	49 lb ft

Engine Mount - Engine Retaining Nut	66	49 lb ft
Exhaust Camshaft Bearing Cap Bolt	10	89 lb in
Exhaust Camshaft Sprocket Bolt	32 + 50°	24 lb ft + 50°
Exhaust Manifold Bolt	20	15 lb ft
Exhaust Manifold Heat Shield Bolt	9	80 lb in
Flywheel Bolt	20 + 25°	15 lb ft + 25°
Front Brake Caliper Bolt	95	70 lb ft
Front Upper Stabilizer Shaft Link Nut	43	32 lb ft
Generator Bracket Retaining Bolt	22	16 lb ft
Generator Bracket Tensioner Nut	50	37 lb ft
Ground Wiring Harness Bolt	10	89 lb in
Ignition Coil Bolt	10	89 lb in
Ignition Coil Cover Bolt	10	89 lb in
Intake Camshaft Bearing Cap Bolt	10	89 lb in
Intake Camshaft Sprocket Bolt	32 + 50°	24 lb ft + 50°
Intake Manifold Bolt	10	89 lb in
Intake Manifold Rear Bracket Bolt (down)	58	42 lb ft
Intake Manifold Rear Bracket Bolt (up)	22	16 lb ft
Intake Manifold Upper Bracket (Left) Bolt (M8)	25	18 lb ft
Knock Sensor Bolt	25	18 lb ft
Lower Intake Manifold Bolt	10	89 lb in
Lower Intermediate Steering Shaft Bolt	27	20 lb ft
Lower Transmission Housing Bolt	61	45 lb ft
Lower Transmission Housing Nut	61	45 lb ft
Oil Filter	16	12 lb ft
Oil Level Indicator Tube Bolt	10	89 lb in
Oil Pan Bolt	10	89 lb in
Oil Pan Drain Plug	25	18 lb ft
Oil Pan Nut	10	89 lb in
Oil Pressure Switch	35	26 lb ft
Oil Pump Hosing Retaining Bolt	10	89 lb in
Positive Cable Retaining Nut	10	89 lb in
Radiator Surge Tank Mounting Bolt	8	71 lb in
Spark Plug	20	15 lb ft
Throttle Body Bolt	10	89 lb in
Timing Chain Guide Retaining Bolt	10	89 lb in
Timing Chain Shoe Retaining Bolt	10	89 lb in
Timing Chain Tensioner Retaining Bolt	10	89 lb in
Torque Converter Bolt	60	44 lb ft
Torque Converter Cover Plate Bolt	9	80 lb in
Transmission Housing Bolt	61	45 lb ft

	60	44 lb ft
Transmission Mount - Transmission Retaining Bolt (M12)	95	70 lb ft
Transmission Mount - Transmission Retaining Nut	95	70 lb ft
Upper Intake Manifold Side Bracket Bolt (M6)	10	89 lb in
Upper Intake Manifold Side Bracket Bolt (M8)	25	18 lb ft
Water Pump Bolt	25	18 lb ft
Wiring Harness Plug Retaining Bolt	6	53 lb in

FASTENER TIGHTENING SPECIFICATIONS (LFM)

Fastener Tightening Specifications (LFM)

Application	Specification	
	Metric	English
A/C Compressor Suction Pipe Bolt	22	16 lb ft
A/C Condenser Discharger Pipe Bolt	10	89 lb in
Air Conditioning Compressor Bracket Bolt	22	16 lb ft
Automatic Transmission Flex Plate Bolt	20 + 25°	15 lb ft + 25°
Camshaft Bearing Cap Bolt	10	89 lb in
Camshaft Cover Bolt	10	89 lb in
Camshaft Cover Front Bracket Bolt	10	89 lb in
Camshaft Position Actuator Solenoid Valve Bolt	10	89 lb in
Connecting Rod Bearing Cap Bolt	20 + 90°	15 lb ft + 90°
Coolant Surge Tank Retaining Bolt	8	71 lb in
Cradle Bolt	135	100 lb ft
Crankshaft Balancer Bolt	95 + 55°	70 lb ft + 55°
Crankshaft Bearing Cap Bolt	30 + 30°	22 lb ft + 30°
Crankshaft Rear Oil Seal Housing Bolt	10	89 lb in
Cylinder Head Bolt	22 + 82°	16 lb in + 82°
Electronic Brake Control Module (EBCM) and Brake Pressure Modular Valve (BPMV) Bracket Bolt	22	16 lb ft
Electronic Brake Control Module (EBCM) and Brake Pressure Modular Valve (BPMV) Bracket Nut	22	16 lb ft
Engine Block Oil Gallery Plug	12.5	9 lb ft
Engine Coolant Outlet Adapter Housing Bolt	25	18 lb ft
Engine Coolant Thermostat Bolt	10	89 lb in
Engine Injection and Ignition Bracket Bolt	10	89 lb in
Engine Front Cover Bolt (M6)	10	89 lb in
Engine Front Cover Bolt (M8)	22	16 lb ft
Engine Lift Front Bracket Bolt	25	18 lb ft
Engine Lift Rear Bracket Bolt	25	18 lb ft
Engine Mount - Body Retaining Bolt	50	37 lb ft
Engine Mount - Engine Retaining Bolt	66	49 lb ft

Engine Mount - Engine Retaining Nut	66	49 lb ft
Exhaust Camshaft Bearing Cap Bolt	10	89 lb in
Exhaust Camshaft Sprocket Bolt	32 + 50°	24 lb ft + 50°
Exhaust Manifold Bolt	20	15 lb ft
Exhaust Manifold Heat Shield Bolt	9	80 lb in
Front Brake Caliper Bolt	95	70 lb ft
Front Upper Stabilizer Shaft Link Nut	43	32 lb ft
Generator Bracket Retaining Bolt	22	16 lb ft
Generator Bracket Tensioner Nut	55	41 lb ft
Ground Wiring Harness Bolt	10	89 lb in
Ignition Coil Bolt	10	89 lb in
Ignition Coil Cover Bolt	10	89 lb in
Intake Camshaft Bearing Cap Bolt	10	89 lb in
Intake Camshaft Sprocket Bolt	32 + 50°	24 lb ft + 50°
Intake Manifold Rear Bracket Bolt (Down)	58	42 lb ft
Intake Manifold Rear Bracket Bolt (Up)	22	16 lb ft
Knock Sensor Bolt	25	18 lb ft
Lower Intake Manifold Bolt	10	89 lb in
Lower Intermediate Steering Shaft Bolt	27	20 lb ft
Lower Transmission Housing Bolt	61	45 lb ft
Lower Transmission Housing Nut	61	45 lb ft
Oil Filter	16	12 lb ft
Oil Level Indicator Tube Bolt	10	89 lb in
Oil Pan Bolt	10	89 lb in
Oil Pan Drain Plug	25	18 lb ft
Oil Pan Nut	10	89 lb ft
Oil Pressure Switch	35	26 lb ft
Oil Pump Hosing Retaining Bolt	10	89 lb in
Positive Cable Retaining Nut	10	89 lb in
Radiator Surge Tank Mounting Bolt	8	71 lb in
Spark Plug	20	15 lb ft
Throttle Body Bolt	10	89 lb in
Timing Chain Guide Retaining Bolt	10	89 lb in
Timing Chain Shoe Retaining Bolt	10	89 lb in
Timing Chain Tensioner Retaining Bolt	10	89 lb in
Torque Converter Bolt	60	44 lb ft
Torque Converter Cover Plate Bolt	9	80 lb in
Transmission Housing Bolt	61	45 lb ft
Transmission Mount - Body Retaining Bolt	60	44 lb ft
Transmission Mount - Transmission Retaining Bolt (M12)	95	70 lb ft
Transmission Mount - Transmission Retaining Nut	95	70 lb ft

	10	89 lb in
Upper Intake Manifold Front Bracket Bolt (M8)	25	18 lb ft
Upper Intake Manifold Side Bracket Bolt (M6)	10	89 lb in
Upper Intake Manifold Side Bracket Bolt (M8)	25	18 lb ft
Water Pump Bolt	25	18 lb ft
Wiring Harness Plug Retaining Bolt	6	53 lb in

ENGINE MECHANICAL SPECIFICATIONS (LL0)

1.2L (LL0)

Application	Specification	
	Metric	English
General Data		
• Engine Type	4 Cylinder (In-Line)	
• Displacement	1249 cm ³	
• Bore - Stroke	70.5-80 mm	2.7756- 3.1496 in
• Compression Ratio	10.5	
• Firing Order	1-3-4-2	
• Engine Idle Speed	670 RPM (A/C OFF) 800 RPM (A/C ON)	
Cylinder Bore		
• Diameter	70.5 mm	2.7756 in
• Out of Round (Maximum)	0.0005 mm	0.0000197 in
Piston		
• Diameter	70.455-70.469 mm	2.7738-2.7743 in
• Clearance to Bore	0.023-0.053 mm	0.00091-0.00209 in
Piston Rings		
Piston Ring End Gap		
• Top Ring	0.15-0.30 mm	0.0059-0.0118 in
• 2nd Ring	0.30-0.45 mm	0.0118-0.0177 in
• Oil Ring	0.20-0.70 mm	0.0078-0.0276 in
Groove Clearance		
• Top Ring	0.03-0.07 mm	0.0118-0.00276 in
• 2nd Ring	0.03-0.07 mm	0.0118-0.00276 in
• Oil Ring	0.04-0.12 mm	0.00157-0.00472 in
Piston Pin		
• Diameter	17.996-18.000 mm	0.7085-0.7087 in
	0.006 -0.014 mm	0.00024-0.00055 in

• Pin Clearance to Piston Bore		
Camshaft		
• End Play	0.08-0.26 mm	0.00314-0.01024 in
Journal OD		
• No. 1	31.934-31.95 mm	1.2572-1.2579 in
• No. 2	22.939-22.96 mm	0.9031-0.9039 in
• No. 3	22.939-22.96 mm	0.9031-0.9039 in
• No. 4	22.939-22.96 mm	0.9031-0.9039 in
• No. 5	22.939-22.96 mm	0.9031-0.9039 in
Journal ID		
• No. 1	32-32.021 mm	1.2598-1.2607 in
• No. 2	23-23.021 mm	0.9055-0.9063 in
• No. 3	23-23.021 mm	0.9055-0.9063 in
• No. 4	23-23.021 mm	0.9055-0.9063 in
• No. 5	23-23.021 mm	0.9055-0.9063 in
Crankshaft		
Main Journal		
• Diameter (All)	48.979-48.995 mm	1.9283-1.9289 in
• Main Bearing Clearance (All)	0.018-0.058 mm	0.00071-0.00228 in
• Crankshaft End Play	0.08-0.29 mm	0.00314-0.01142 in
Connecting Rod Journal		
• Diameter (All)	37.979-37.995 mm	1.4952-1.4959 in
• Rod Bearing Clearance (All)	0.02-0.06 mm	0.00079-0.00236 in
• End Play	0.1-0.25 mm	0.00393-0.00984 in
Valve System		
Seat Inner Diameter		
• Intake	23.862 mm	0.9394 in
• Exhaust	21.079 mm	0.8299 in
• Valve Guide Inside Diameter (All)	5.0-5.012 mm	0.1969-0.1973 in
Valve Stem Diameter		
• Intake	4.972 ± 0.007 mm	0.1957 ± 0.00028 in
• Exhaust	4.963-0.007 mm	0.1954-0.00028 in
Valve Length		
• Intake	87.16 ± 0.225 mm	3.4315-0.00886 in
• Exhaust	88.18 ± 0.225 mm	3.4717 ± 0.00886 in

Valve Spring		
• Free Length	46.52 mm	1.8315 in
• Valve Closed	260 ± 13 N (1919.6 lbs) @ 32 mm (1.25 in)	

ENGINE MECHANICAL SPECIFICATIONS (LFM)

1.0L (LFM)

Application	Specification	
	Metric	English
General Data		
• Engine Type	4 Cylinder (In-Line)	
• Displacement	995 cm ³	
• Bore - Stroke	68.5-67.5 mm	2.6969-2.6575 in
• Compression Ratio	10.5	
• Firing Order	1-3-4-2	
• Engine Idle Speed	670 RPM (A/C OFF) 800 RPM (A/C ON)	
Cylinder Bore		
• Diameter	68.51 mm	2.6972 in
• Out of Round (Maximum)	0.0005 mm	0.0000197 in
Piston		
• Diameter	68.465-68.479 mm	2.6955-2.6960 in
• Clearance to Bore	0.023-0.053 mm	0.00091-0.00209 in
Piston Rings		
Piston Ring End Gap		
• Top Ring	0.15-0.30 mm	0.0059-0.0118 in
• 2nd Ring	0.30-0.45 mm	0.0118-0.0177 in
• Oil Ring	0.20-0.50 mm	0.0078-0.0197 in
Groove Clearance		
• Top Ring	0.03-0.07 mm	0.0118-0.00276 in
• 2nd Ring	0.03-0.07 mm	0.0118-0.00276 in
• Oil Ring	0.04-0.12 mm	0.00157-0.00472 in
Piston Pin		
• Diameter	17.996-18.000 mm	0.7085-0.7087 in
• Pin Clearance to Piston Bore	0.006 -0.014 mm	0.00024-0.00055 in
Camshaft		
• End Play	0.08-0.26 mm	0.00314-0.01024 in

Journal OD		
• No. 1	31.934-31.95 mm	1.2572-1.2579 in
• No. 2	22.939-22.96 mm	0.9031-0.9039 in
• No. 3	22.939-22.96 mm	0.9031-0.9039 in
• No. 4	22.939-22.96 mm	0.9031-0.9039 in
• No. 5	22.939-22.96 mm	0.9031-0.9039 in
Journal ID		
• No. 1	32-32.021 mm	1.2598-1.2607 in
• No. 2	23-23.021 mm	0.9055-0.9063 in
• No. 3	23-23.021 mm	0.9055-0.9063 in
• No. 4	23-23.021 mm	0.9055-0.9063 in
• No. 5	23-23.021 mm	0.9055-0.9063 in
Crankshaft		
Main Journal		
• Diameter (All)	48.979-48.995 mm	1.9283-1.9289 in
• Main Bearing Clearance (All)	0.018-0.058 mm	0.00071-0.00228 in
• Crankshaft End Play	0.08-0.29 mm	0.00314-0.01142 in
Connecting Rod Journal		
• Diameter (All)	37.979-37.995 mm	1.4952-1.4959 in
• Rod Bearing Clearance (All)	0.02-0.06 mm	0.00079-0.00236 in
• End Play	0.1-0.25 mm	0.00393-0.00984 in
Valve System		
Seat Inner Diameter		
• Intake	22-22.2 mm	0.8661-0.8740 in
• Exhaust	18.5-18.7 mm	0.7283-0.7362 in
• Valve Guide Inside Diameter (All)	5.0-5.012 mm	0.1969-0.1973 in
Valve Stem Diameter		
• Intake	4.972 ± 0.007 mm	0.1957 ± 0.00028 in
• Exhaust	4.963 ± 0.007 mm	0.1954 ± 0.00028 in
Valve Length		
• Intake	99.17 ± 0.225 mm	3.9043 ± 0.00886 in
• Exhaust	100.01 ± 0.225 mm	3.9374 ± 0.00886 in
Valve Spring		
• Free Length	4.33 mm	1.7453 in
• Valve Closed	118 ± 4.72 N @ 34	26.5264 ± 1.0611 lbs

	mm	@ 1.3386 in
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ADHESIVES, FLUIDS, LUBRICANTS AND SEALERS

Adhesives, Fluids, Lubricants and Sealers

Application	Type of Material	GM Part Number
Bolt Connections	Screw Locking Compound	Refer to Electronic Parts Catalog
Engine Block Oil Gallery Plug	Sealant	Refer to Electronic Parts Catalog
Engine Oil	Dexos 1, 5W-20 Extreme cold area -29°C (20°F) below: 0W-30	Refer to Electronic Parts Catalog
First Camshaft Bearing Cap	Surface Sealant	Refer to Electronic Parts Catalog
Oil Pan	RTV Sealant	Refer to Electronic Parts Catalog
Oxygen Sensor	Assembly Paste	Refer to Electronic Parts Catalog
Seal Rings	Silicon Grease	Refer to Electronic Parts Catalog

COMPONENT LOCATOR

DISASSEMBLED VIEWS

Cylinder Block

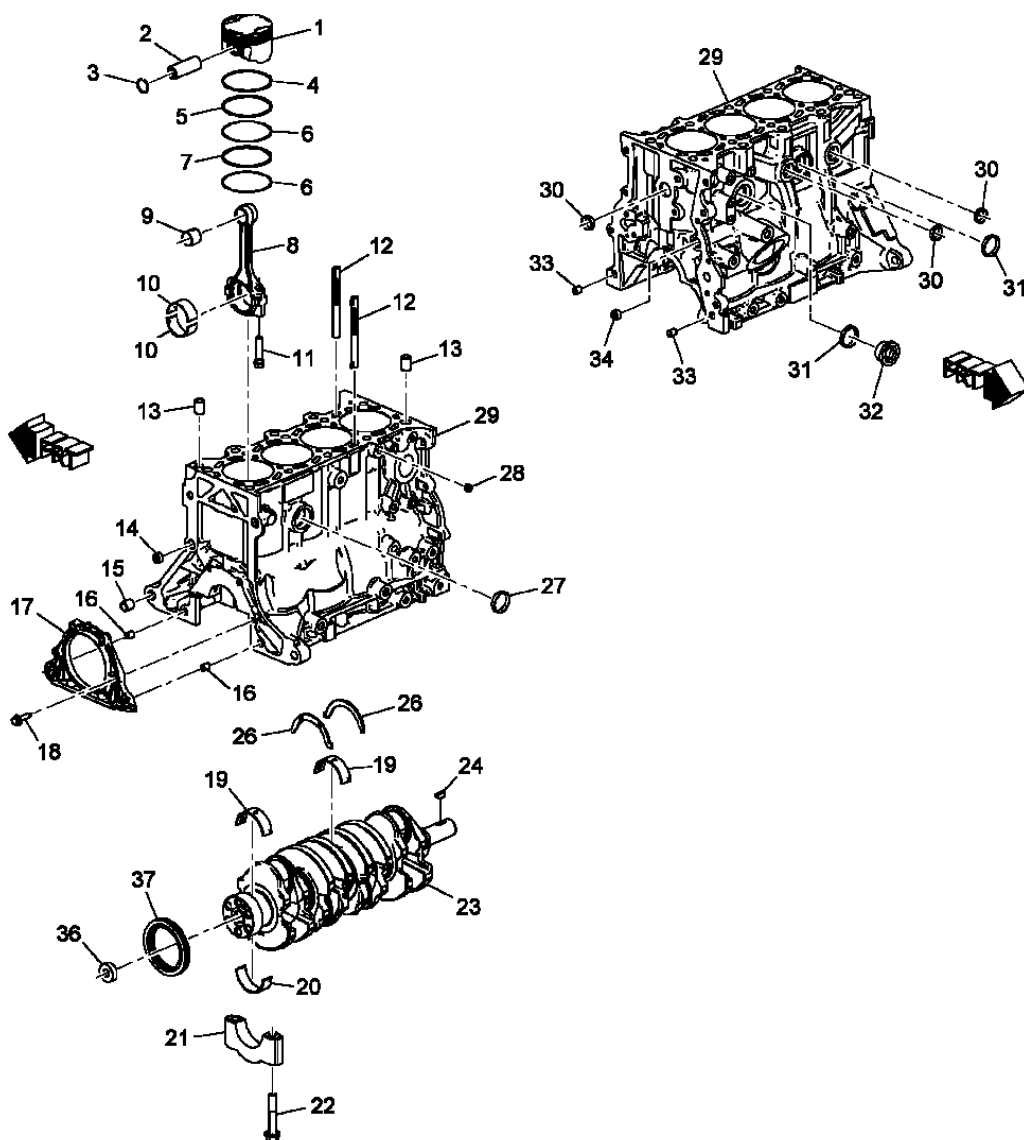


Fig. 1: Cylinder Block Components
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Piston Assembly
2	Piston Pin
3	Piston Pin Retainer
4	Piston Ring - Upper
5	Piston Ring - Lower
6	Piston Oil Ring Rail

7	Piston Oil Ring
8	Connecting Rod
9	Pin Guide
10	Connecting Rod Bearing
11	Connecting Rod Cap Bolt
12	Engine Cooling Guide
13	Dowel Pin
14	Plug
15	Dowel Pin
16	Dowel Pin
17	Crankshaft Rear Oil Seal Cover
18	Crankshaft Rear Oil Seal Cover Bolt
19	Crankshaft Upper Bearing
20	Crankshaft Lower Bearing
21	Crankshaft Bearing Cap Cover
22	Crankshaft Bearing Cap Cover Bolt
23	Crankshaft
24	Key
26	Bearing
27	Plug Cup
28	Plug
29	Cylinder Block
30	Plug Cup
31	Plug Cup
32	Plug
33	Dowel Pin
34	Plug
36	Plug
37	Crankshaft Rear Oil Seal

Cylinder Head

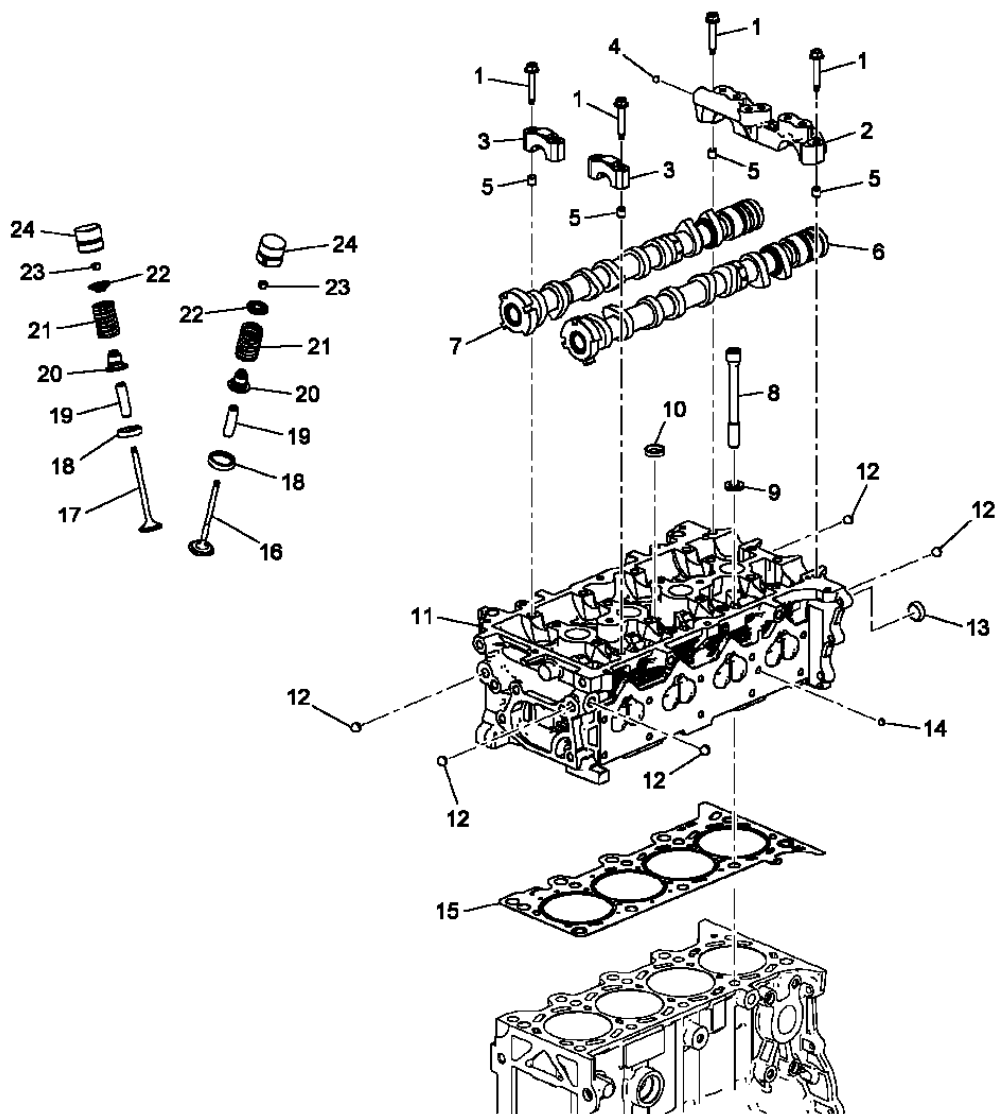


Fig. 2: Cylinder Head Components
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Camshaft Cap Bolt
2	Camshaft Front Bearing Cap
3	Camshaft Cap
4	Plug
5	Plug
6	Camshaft (Intake)

7	Camshaft (Exhaust)
8	Cylinder Head Bolt
9	Cylinder Head Bolt Washer
10	Plug
11	Cylinder Head
12	Plug
13	Plug
14	Plug
15	Cylinder Head Gasket
16	Valve (Intake)
17	Valve (Exhaust)
18	Valve Seat
19	Valve Guide
20	Valve Stem Oil Seal
21	Valve Spring
22	Valve Spring Retainer
23	Valve Key
24	Valve Tappet

Oil Pan

7	Oil Level Indicator Tube Bracket
8	Oil Level Indicator Tube Bracket Bolt
9	Oil Level Indicator
10	Oil Level Indicator Oil Seal
11	Engine Oil Pan Nut
13	Oil Pan Drain Plug
14	Oil Pan Drain Plug Seal Ring
15	Oil Strainer
16	Oil Strainer Bolt
17	Oil Strainer Seal Ring
18	Bolt Stud
19	Oil Pressure Switch

Timing System

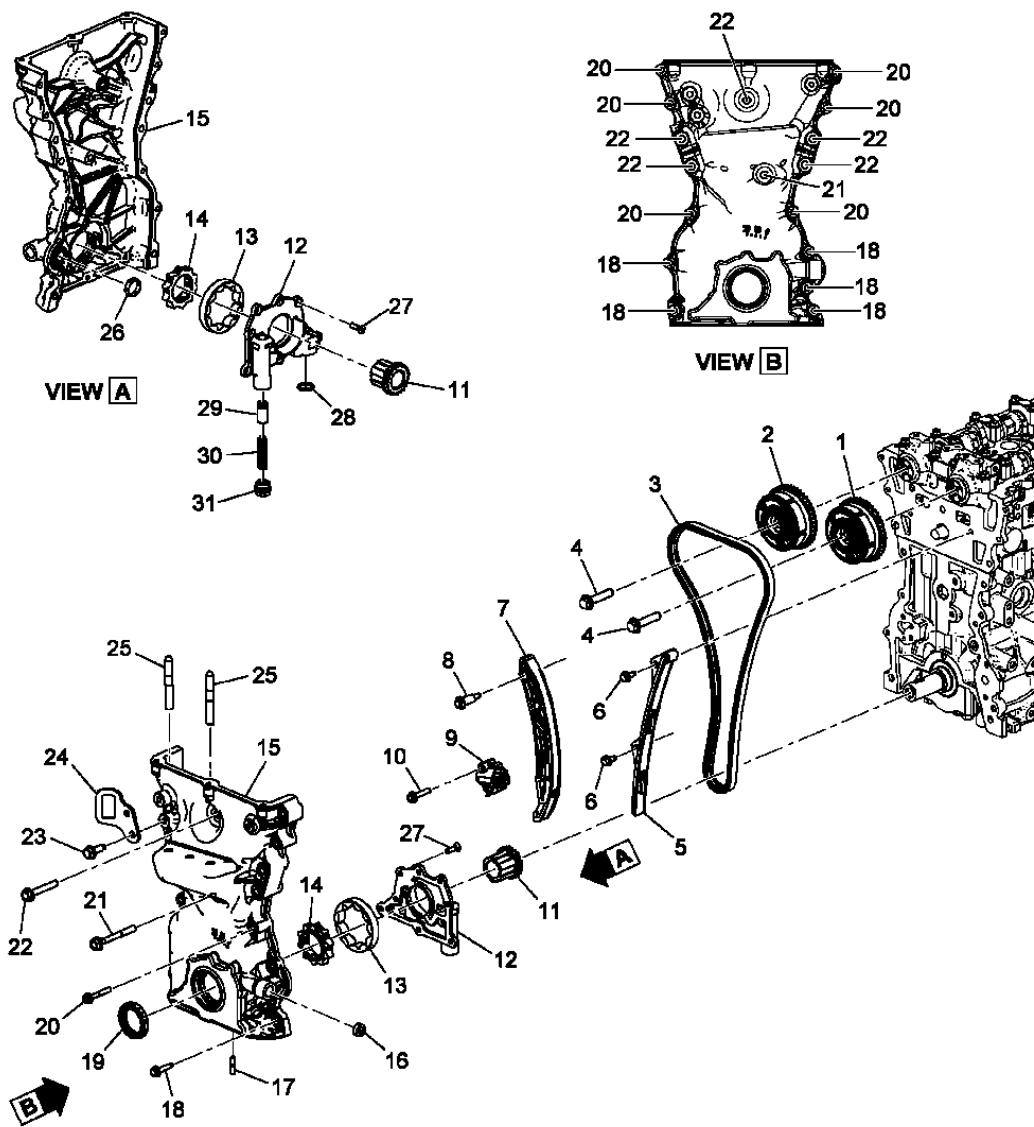


Fig. 4: Timing System Components
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Camshaft Sprocket (Exhaust)
2	Camshaft Sprocket (Intake)
3	Timing Chain
4	Camshaft Sprocket Retaining Bolt
5	Timing Chain Guide
6	Timing Chain Guide Bolt

7	Timing Chain Shoe
8	Timing Chain Shoe Bolt
9	Timing Chain Tensioner
10	Timing Chain Tensioner Bolt
11	Crankshaft Sprocket
12	Oil Pump Housing
13	Oil Pump Drive Gear
14	Oil Pump Drive Gear
15	Engine Front Cover
16	Plug
17	Stud Bolt
18	Engine Front Cover Bolt
19	Crankshaft Front Oil Seal
20	Engine Front Cover Bolt
21	Engine Front Cover Bolt
22	Engine Front Cover Bolt
23	Bracket Bolt
24	Bracket
25	Stud Bolt
26	Oil Seal
27	Oil Pump Housing Retaining Bolt
28	Oil Seal
29	Oil Relief Valve
30	Oil Relief Valve Spring
31	Oil Relief Valve Plug

DIAGNOSTIC INFORMATION AND PROCEDURES

SYMPTOMS - ENGINE MECHANICAL

Strategy Based Diagnostics

Perform the **Diagnostic System Check - Vehicle** .

All diagnosis on a vehicle should follow a logical process. Strategy based diagnostics is a uniform approach for repairing all systems. The diagnostic flow may always be used in order to resolve a system condition. The diagnostic flow is the place to start when repairs are necessary.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the engine.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

- Inspect for the correct oil level, proper oil viscosity and correct filter application.
- Verify the exact operating conditions under which the concern exists. Note factors such as engine RPM, ambient temperature, engine temperature, amount of engine warm-up time and other specifics.
- Compare the engine sounds, if applicable, to a known good engine and make sure you are not trying to correct a normal condition.

Intermittent

Test the vehicle under the same conditions that the customer reported in order to verify the system is operating properly.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Base Engine Misfire without Internal Engine Noises**
- **Base Engine Misfire with Abnormal Internal Lower Engine Noises**
- **Base Engine Misfire with Abnormal Valve Train Noise**
- **Base Engine Misfire with Coolant Consumption**
- **Base Engine Misfire with Excessive Oil Consumption**
- **Engine Noise on Start-Up, but Only Lasting a Few Seconds**
- **Upper Engine Noise, Regardless of Engine Speed**
- **Lower Engine Noise, Regardless of Engine Speed**
- **Engine Noise Under Load**
- **Engine Will Not Crank - Crankshaft Will Not Rotate**
- **Coolant in Engine Oil**
- **Engine Compression Test**
- **Oil Pressure Diagnosis and Testing**
- **Oil Leak Diagnosis**
- **Drive Belt Chirping, Squeal and Whine Diagnosis**
- **Drive Belt Rumbling and Vibration Diagnosis**
- **Drive Belt Falls Off and Excessive Wear Diagnosis**

OIL PRESSURE DIAGNOSIS AND TESTING

Special Tools

- **EN-21867-850** Adapter Oil Pressure Check
- **EN-50207** Oil Pressure Switch Remover/Installer
- **KM-498-B** Oil Pressure Gauge

For equivalent regional tools, refer to **Special Tools**.

Removal Procedure

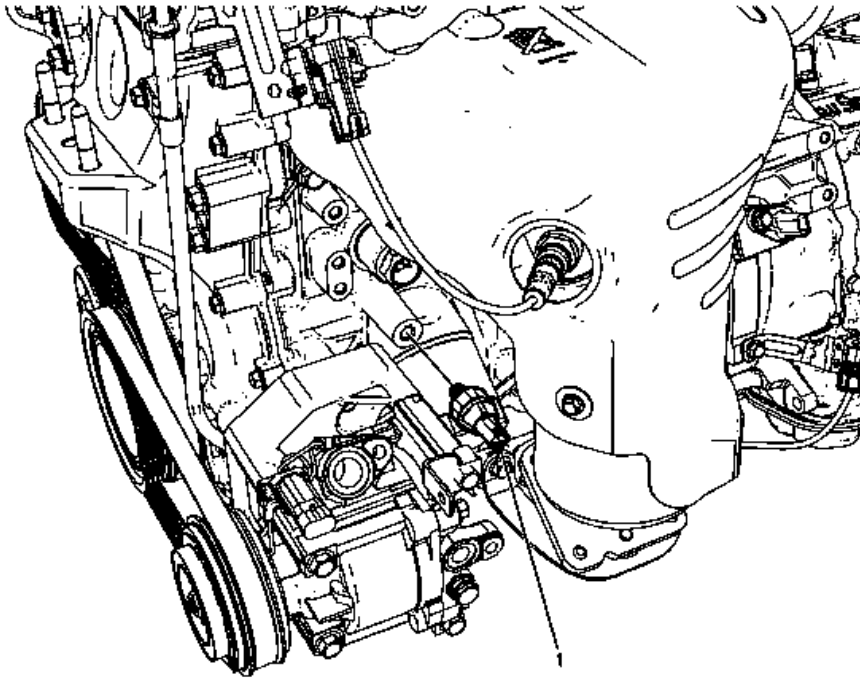


Fig. 5: Oil Pressure Switch

Courtesy of GENERAL MOTORS COMPANY

1. Remove the oil pressure switch (1) using the **EN-50207** oil pressure switch remover/installer.
2. Clean the thread.

Measurement Procedure

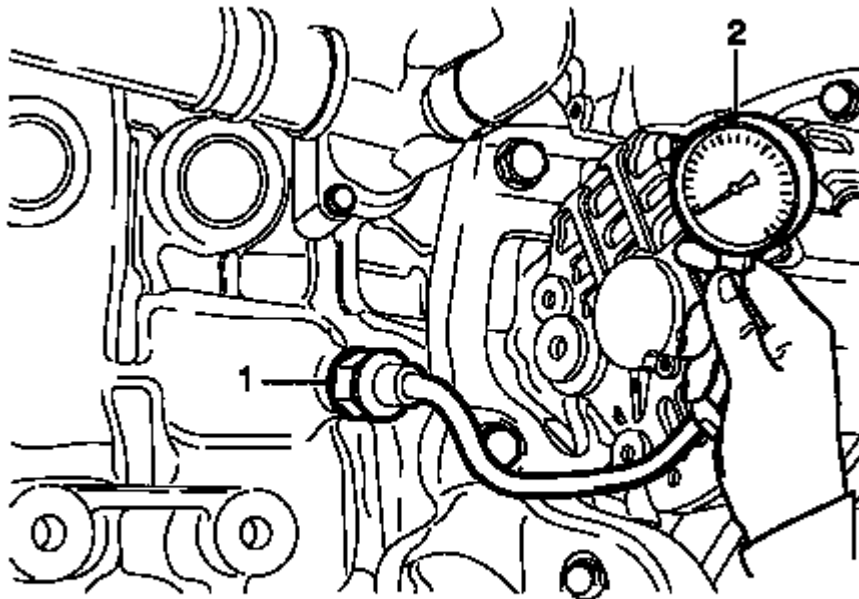


Fig. 6: Installing EN-21867-850 adapter Oil Pressure Check
Courtesy of GENERAL MOTORS COMPANY

1. Install the **EN-21867-850** adapter oil pressure check (1) to the **KM-498-B** oil pressure gauge (2).
2. Install the **EN-21867-01** adapter oil pressure check (1) with **EN 498-B** oil pressure gauge (2) to the oil pressure switch hole.
3. Start the engine.
4. Check oil pressure.

At idling speed, the oil pressure must be at least 110 kPa (15.95 psi) and the oil temperature must be less than or equal to 120°C (170°F).

5. Switch off the engine.
6. Remove the **EN-21867-01** adapter oil pressure check (1) with **EN 498-B** oil pressure gauge (2) from the oil pressure switch hole.

Installation Procedure

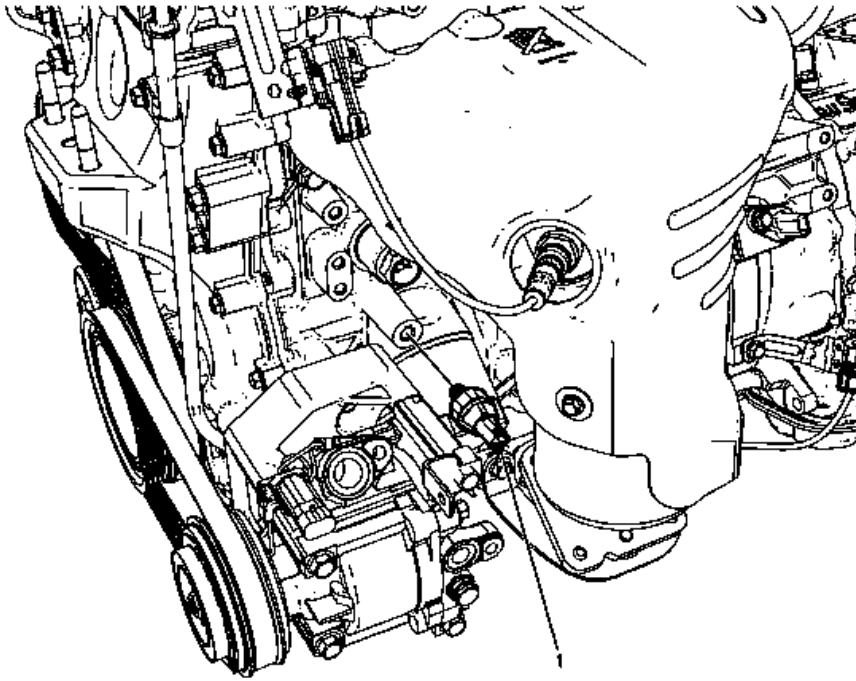


Fig. 7: Oil Pressure Switch
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

1. Install the oil pressure switch and tighten to 18 (13 lb ft).
2. Check the engine oil level.

ENGINE COMPRESSION TEST

Removal Procedure

1. Remove the ignition coil cover. Refer to Ignition Coil Cover Replacement (LL0), Ignition Coil Cover Replacement (LFM).
2. Remove the spark plugs. Refer to Spark Plug Replacement (LL0) , Spark Plug Replacement (LFM) .
3. Remove the relay holder cover.
4. Remove the fuel pump relay.

Measurement Procedure

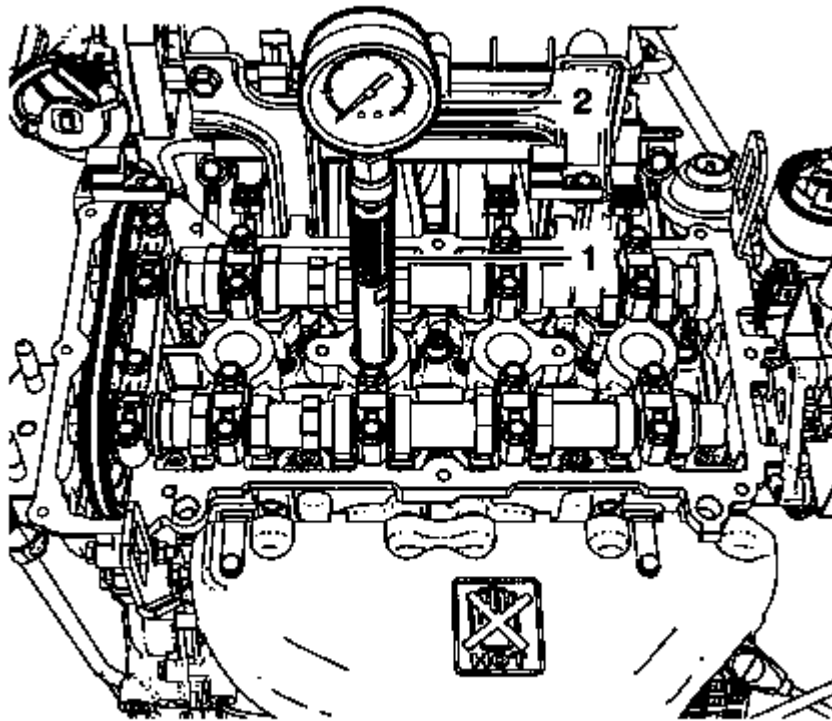


Fig. 8: Engine Compression Test Tool
Courtesy of GENERAL MOTORS COMPANY

1. Install the suitable engine compression test tool to the spark plug hole.
2. Start the engine (approximately 4 seconds).
3. Compare the compression values.

NOTE: **Engine revs at least 300/min.**

4. Maximum pressure differential is 100 kPa (14.5 psi).
5. Check compression for all cylinders.

Installation Procedure

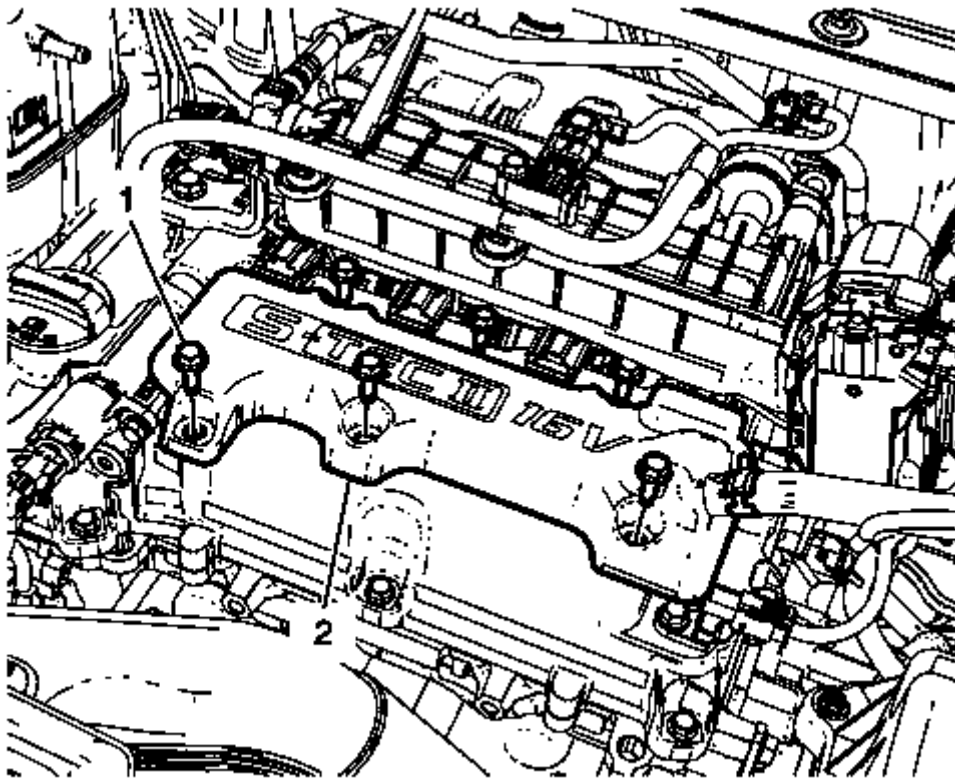


Fig. 9: Engine Compression Test Tool
Courtesy of GENERAL MOTORS COMPANY

1. Remove the suitable engine compression test tool to the spark plug hole.
2. Install the fuel pump relay.
3. Install the relay carrier cover.
4. Install the spark plugs and tighten the spark plug to 20 (14.7 lb ft).
5. Install the ignition coil cover (2). Refer to **Ignition Coil Cover Replacement (LL0)**, **Ignition Coil Cover Replacement (LFM)**.

CAUTION: Refer to Fastener Caution .

6. Tighten the bolts (1) to 10 (89 lb in).

DRIVE BELT CHIRPING, SQUEAL AND WHINE DIAGNOSIS

Diagnostic Aids

- A chirping or squeal noise may be intermittent due to moisture on the drive belts or the pulleys. It may be necessary to spray a small amount of water on the drive belts in order to duplicate the customers concern.

If spraying water on the drive belt duplicates the symptom, cleaning the belt pulleys may be the probable solution.

- If the noise is intermittent, verify the accessory drive components by varying their loads making sure they are operated to their maximum capacity. An overcharged A/C system, power steering system with a pinched hose or wrong fluid or a generator failing are suggested items to inspect.
- A chirping, squeal or whine noise may be caused by a loose or improper installation of a body or suspension component. Other items of the vehicle may also cause the noise.
- The drive belts will not cause a whine noise.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2

The noise may not be engine related. This step is to verify that the engine is making the noise. If the engine is not making the noise do not proceed further with this table.

3

The noise may be an internal engine noise. Removing the drive belts one at a time and operating the engine for a brief period will verify the noise is related to the drive belt. When removing the drive belt the water pump may not be operating and the engine may overheat. Also DTCs may set when the engine is operating with the drive belts removed.

4

Inspect all drive belt pulleys for pilling. Pilling is the small balls or pills or it can be strings in the drive belt grooves from the accumulation of rubber dust.

6

Misalignment of the pulleys may be caused from improper mounting of the accessory drive component, incorrect installation of the accessory drive component pulley or the pulley bent inward or outward from a previous repair. Test for a misaligned pulley using a straight edge in the pulley grooves across two or three pulleys. If a misaligned pulley is found refer to that accessory drive component for the proper installation procedure for that pulley.

10

Inspecting of the fasteners can eliminate the possibility that a wrong bolt, nut, spacer or washer was installed.

12

Inspecting the pulleys for being bent should include inspecting for a dent or other damage to the pulleys that would prevent the drive belt from not seating properly in all of the pulley grooves or on the smooth

surface of a pulley when the back side of the belt is used to drive the pulley.

14

This test is to verify that the drive belt tensioner operates properly. If the drive belt tensioner is not operating properly, proper belt tension may not be achieved to keep the drive belt from slipping which could cause a squeal noise.

15

This test is to verify that the drive belt is not too long, which would prevent the drive belt tensioner from working properly. Also if an incorrect length drive belt was installed, it may not be routed properly and may be turning an accessory drive component in the wrong direction.

16

Misalignment of the pulleys may be caused from improper mounting of the accessory drive component, incorrect installation of the accessory drive component pulley or the pulley bent inward or outward from a previous repair. Test for a misaligned pulley using a straight edge in the pulley grooves across two or three pulleys. If a misaligned pulley is found refer to that accessory drive component for the proper installation procedure for that pulley.

17

This test is to verify that the pulleys are the correct diameter or width. Using a known good vehicle compare the pulley sizes.

19

Replacing the drive belt when it is not damaged or there is not excessive pilling will only be a temporary repair.

Drive Belt Chirping, Squeal and Whine Diagnosis

Step	Action	Yes	No
CAUTION: Refer to <u>Belt Dressing Caution</u> .			
DEFINITION: The following items are indications of chirping: • A high pitched noise that is heard once per revolution of the drive belt or a pulley. • Chirping may occur on cold damp start-ups and will subside once the vehicle reaches normal operating temp.			
DEFINITION: The following items are indications of drive belt squeal: • A loud screeching noise that is caused by a slipping drive belt. This is unusual for a drive belt with			

multiple ribs.

- The noise occurs when a heavy load is applied to the drive belt, such as an air conditioning compressor engagement snapping the throttle or slipping on a seized pulley or a faulty accessory drive component.

DEFINITION: The following items are indications of drive belt whine:

- A high pitched continuous noise.
- The noise may be caused by an accessory drive component failed bearing.

1	Did you review the drive belt symptom operation and perform the necessary inspections?	Go to Step 2	Go to <u>Symptoms - Engine Mechanical</u>
2	Verify that there is a chirping, squeal or whine noise. Does the engine make the chirping squeal or whine noise?	Go to Step 3	Go to Diagnostic Aids
3	1. Remove the drive belt. If the engine has multiple drive belts, remove the belts one at a time and perform the test below each time a belt is removed. 2. Operate the engine for no longer than 30-40 seconds. 3. Repeat this test if necessary by removing the remaining belt(s). Does the chirping, squeal or whine noise still exist?	Go to <u>Symptoms - Engine Mechanical</u>	Go to Step 4
4	If diagnosing a chirping noise, inspect for severe pilling exceeding 1/3 of the belt groove depth. If diagnosing a squeal or whine noise, proceed to step 13. Do the belt grooves have pilling?	Go to Step 5	Go to Step 6
5	Clean the drive belt pulleys with a suitable wire brush. Did you complete the repair?	Go to Step 20	Go to Step 6
6	Inspect for misalignment of the pulleys. Are any of the pulleys misaligned?	Go to Step 7	Go to Step 8
7	Replace or repair any misaligned pulleys. Did you complete the repair?	Go to Step 20	Go to Step 8
8	Inspect for bent or cracked brackets. Did you find any bent or cracked brackets?	Go to Step 9	Go to Step 10
9	Replace any bent or cracked brackets. Did you complete the repair?	Go to Step 20	Go to Step 10
10	Inspect for improper, loose or missing fasteners. Did you find the condition?	Go to Step 11	Go to Step 12

	CAUTION: Refer to <u>Fastener Caution</u>		
11	1. Tighten any loose fasteners. Refer to <u>Fastener Tightening Specifications (LL0)</u> , <u>Fastener Tightening Specifications (LFM)</u> . 2. Replace any improper or missing fasteners.		
	Did you complete the repair?	Go to Step 20	Go to Step 12
12	Inspect for a bent pulley. Did you find the condition?	Go to Step 18	Go to Step 19
13	- Inspect for an accessory drive component seized bearing or a faulty accessory drive component. - If diagnosing a whine noise and the condition still exist, proceed to Diagnostic Aids.		
	Did you find and correct the condition?	Go to Step 20	Go to Step 14
14	Test the drive belt tensioner for proper operation. Did you find and correct the condition?	Go to Step 20	Go to Step 15
15	Inspect for the correct drive belt length. Did you find and correct the condition?	Go to Step 20	Go to Step 16
16	Inspect for misalignment of a pulley. Did you find and correct the condition?	Go to Step 20	Go to Step 17
17	Inspect for the correct pulley size. Did you find and correct the condition?	Go to Step 20	Go to Diagnostic Aids
18	Replace the bent pulley. Did you complete the repair?	Go to Step 20	Go to Step 19
19	Replace the drive belt. Refer to <u>Water Pump and Generator Belt Replacement</u> . Did you complete the repair?	Go to Step 20	Go to Diagnostic Aids
20	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

DRIVE BELT RUMBLING AND VIBRATION DIAGNOSIS

Diagnostic Aids

The accessory drive components can have an affect on engine vibration. Vibration from the engine operating may cause a body component or another part of the vehicle to make rumbling noise. Vibration can be caused by, but not limited to the A/C system over charged, the power steering system restricted or the incorrect fluid or an extra load on the generator. To help identify an intermittent or an improper condition, vary the loads on the accessory drive components.

The drive belt may have a rumbling condition that can not be seen or felt. Sometimes replacing the drive belt

may be the only repair for the symptom.

If replacing the drive belt, completing the diagnostic table and the noise is only heard when the drive belts are installed, there might be an accessory drive component with a failure. Varying the load on the different accessory drive components may aid in identifying which component is causing the rumbling noise.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2

This test is to verify that the symptom is present during diagnosing. Other vehicle components may cause a similar symptom.

3

This test is to verify that one of the drive belts is causing the rumbling noise or vibration. Rumbling noise may be confused with an internal engine noise due to the similarity in the description. Remove only one drive belt at a time if the vehicle has multiple drive belts. When removing the drive belts the water pump may not be operating and the engine may overheat. Also DTCs may set when the engine is operating with the drive belts removed.

4

Inspecting the drive belts is to ensure that they are not causing the noise. Small cracks across the ribs of the drive belt will not cause the noise. Belt separation is identified by the plies of the belt separating and may be seen at the edge of the belt or felt as a lump in the belt.

5

Small amounts of pilling is normal condition and acceptable. When the pilling is severe the drive belt does not have a smooth surface for proper operation.

9

Inspecting of the fasteners can eliminate the possibility that the wrong bolt, nut, spacer or washer was installed.

11

This step should only be performed if the water pump is driven by the drive belt. Inspect the water pump shaft for being bent. Also inspect the water pump bearings for smooth operation and excessive play. Compare the water pump with a known good water pump.

12

Accessory drive component brackets that are bent, cracked or loose may put extra strain on that accessory component causing it to vibrate.

Drive Belt Rumbling and Vibration Diagnosis

Step	Action	Yes	No
CAUTION: Refer to <u>Belt Dressing Caution</u> .			
DEFINITION: The following items are indications of drive belt rumbling: • A low pitch tapping, knocking or thumping noise heard at or just above idle. • Heard once per revolution of the drive belt or a pulley. • Rumbling may be caused from: ○ Pilling, the accumulation of rubber dust that forms small balls (pills) or strings in the drive belt pulley groove ○ The separation of the drive belt ○ A damaged drive belt ○ A worn drive belt idler pulley			
DEFINITION: The following items are indications of drive belt vibration: • The vibration is engine-speed related. • The vibration may be sensitive to accessory load.			
1	Did you review the Drive Belt Symptom operation and perform the necessary inspections?	Go to Step 2	Go to <u>Symptoms - Engine Mechanical</u>
2	Verify that there is a rumbling noise or that the vibration is engine related. Does the engine make the rumbling noise or vibration?	Go to Step 3	Go to Diagnostic Aids
3	1. Remove the drive belt. If the engine has multiple drive belts, remove the belts one at a time and perform the test below each time a belt is removed. 2. Operate the engine for no longer than 30-40 seconds. 3. Repeat this test if necessary by removing the remaining belt(s). Does the rumbling or vibration still exist?	Go to <u>Symptoms - Engine Mechanical</u>	Go to Step 4
4	Inspect the drive belts for wear, damage, separation, sections of missing ribs and debris build-up. Did you find any of these conditions?	Go to Step 7	Go to Step 5

5	Inspect for severe pilling of more than 1/3 of the drive belt pulley grooves. Did you find severe pilling?	Go to Step 6	Go to Step 7
6	1. Clean the drive belt pulleys using a suitable wire brush. 2. Reinstall a drive belt. Refer to <u>Water Pump and Generator Belt Replacement</u> . Did you correct the condition?	Go to Step 8	Go to Step 7
7	Install a drive belt. Refer to <u>Water Pump and Generator Belt Replacement</u> . Did you complete the replacement?	Go to Step 8	Go to Step 9
8	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 9
9	Inspect for improper, loose or missing fasteners. Did you find any of these conditions?	Go to Step 10	Go to Step 11
10	CAUTION: Refer to <u>Fastener Caution</u> . 1. Tighten any loose fasteners. Refer to <u>Fastener Tightening Specifications (LL0)</u> , <u>Fastener Tightening Specifications (LFM)</u> . 2. Replace improper or missing fasteners. Did you complete the repair?	Go to Step 13	Go to Step 11
11	Inspect for a bent water pump shaft. Refer to <u>Water Pump Replacement</u> . Did you find and correct the condition?	Go to Step 13	Go to Step 12
12	Inspect for bent or cracked brackets. Did you find and correct the condition?	Go to Step 13	Go to Diagnostic Aids
13	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

DRIVE BELT FALLS OFF AND EXCESSIVE WEAR DIAGNOSIS

Diagnostic Aids

If the drive belt repeatedly falls off the drive belt pulleys, this is because of pulley misalignment.

An extra load that is quickly applied on released by an accessory drive component may cause the drive belt to fall off the pulleys. Verify the accessory drive components operate properly.

If the drive belt is the incorrect length, the drive belt tensioner may not keep the proper tension on the drive belt.

Excessive wear on a drive belt is usually caused by an incorrect installation or the wrong drive belt for the

application.

Minor misalignment of the drive belt pulleys will not cause excessive wear, but will probably cause the drive belt to make a noise or to fall off.

Excessive misalignment of the drive belt pulleys will cause excessive wear but may also make the drive belt fall off.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2

This inspection is to verify the condition of the drive belt. Damage may have occurred to the drive belt when the drive belt fell off. The drive belt may have been damaged, which caused the drive belt to fall off. Inspect the belt for cuts, tears, sections of ribs missing or damaged belt plies.

4

Misalignment of the pulleys may be caused from improper mounting of the accessory drive component, incorrect installation of the accessory drive component pulley or the pulley bent inward or outward from a previous repair. Test for a misaligned pulley using a straight edge in the pulley grooves across two or three pulleys. If a misaligned pulley is found refer to that accessory drive component for the proper installation procedure of that pulley.

5

Inspecting the pulleys for being bent should include inspecting for a dent or other damage to the pulleys that would prevent the drive belt from not seating properly in all of the pulley grooves or on the smooth surface of a pulley when the back side of the belt is used to drive the pulley.

6

Accessory drive component brackets that are bent or cracked will let the drive belt fall off.

7

Inspecting of the fasteners can eliminate the possibility that a wrong bolt, nut, spacer or washer was installed. Missing, loose or the wrong fasteners may cause pulley misalignment from the bracket moving under load. Over tightening of the fasteners may cause misalignment of the accessory component bracket.

13

The inspection is to verify the drive belt is correctly installed on all of the drive belt pulleys. Wear on the drive belt may be caused by mis-positioning the drive belt by one groove on a pulley.

14

The installation of a drive belt that is too wide or too narrow will cause wear on the drive belt. The drive belt ribs should match all of the grooves on all of the pulleys.

15

This inspection is to verify the drive belt is not contacting any parts of the engine or body while the engine is operating. There should be sufficient clearance when the drive belt accessory drive components load varies. The drive belt should not come in contact with an engine or a body component when snapping the throttle.

Drive Belt Falls Off and Excessive Wear Diagnosis

Step	Action	Yes	No
CAUTION: Refer to <u>Belt Dressing Caution</u> .			
DEFINITION: The drive belt falls off the pulleys or may not ride correctly on the pulleys. DEFINITION: Wear at the outside ribs of the drive belt due to an incorrectly installed drive belt.			
1	Did you review the drive belt symptom operation and perform the necessary inspections?	Go to Step 2	Go to <u>Symptoms - Engine Mechanical</u>
2	• If diagnosing excessive wear, proceed to step 13. • If diagnosing a drive belt that falls off, inspect for a damaged drive belt. Did you find the condition?	Go to Step 3	Go to Step 4
3	Replace the drive belt. Refer to <u>Water Pump and Generator Belt Replacement</u> . Does the drive belt continue to fall off?	Go to Step 4	System OK
4	Inspect for misalignment of the pulleys. Did you find and repair the condition?	Go to Step 12	Go to Step 5
5	Inspect for a bent or dented pulley. Did you find and repair the condition?	Go to Step 12	Go to Step 6
6	Inspect for a bent or a cracked bracket. Did you find and repair the condition?	Go to Step 12	Go to Step 7
7	Inspect for improper, loose or missing fasteners. Did you find loose or missing fasteners?	Go to Step 8	Go to Step 9
8	CAUTION: Refer to <u>Fastener Caution</u> . 1. Tighten any loose fasteners. Refer to <u>Fastener Tightening Specifications (LL0)</u> , <u>Fastener Tightening Specifications (LFM)</u> .		

	2. Replace improper or missing fasteners.		
	Does the drive belt continue to fall off?	Go to Step 9	System OK
9	Test the drive belt tensioner for operating correctly. Does the drive belt tensioner operate correctly?	Go to Step 11	Go to Step 10
10	Replace the drive belt tensioner. Refer to <u>Generator Bracket Replacement</u> . Does the drive belt continue to fall off?	Go to Step 11	System OK
11	Inspect for failed drive belt idler and drive belt tensioner pulley bearings. Did you find and repair the condition?	Go to Step 12	Go to Diagnostic Aids
12	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 2
13	Replace the drive belt. Refer to <u>Water Pump and Generator Belt Replacement</u> . Did you find this condition?	Go to Step 16	Go to Step 14
14	Inspect for the proper drive belt. Did you find this condition?	Go to Step 16	Go to Step 15
15	Inspect for the drive belt rubbing against a bracket, hose or wiring harness. Did you find and repair the condition?	Go to Step 17	Go to Diagnostic Aids
16	Replace the drive belt. Refer to <u>Water Pump and Generator Belt Replacement</u> . Did you complete the replacement?	Go to Step 17	-
17	Operate the system in order to verify the repair. Did you correct the condition?	System OK	-

OIL LEAK DIAGNOSIS

Oil Leak Diagnosis

Step	Action	Yes	No
DEFINITION: You can repair most fluid leaks by first, visually locating the leak, repairing or replacing the component or by resealing the gasket surface. Once the leak is identified, determine the cause of the leak. Repair the leak and the cause of the leak.			
1	1. Operate the vehicle until it reaches normal operating temperature. Refer to <u>Engine Mechanical Specifications (LL0)</u> , <u>Engine Mechanical Specifications (LFM)</u> . 2. Park the vehicle on a level surface over a large sheet of paper or other clean surface. 3. Wait 15 minutes. 4. Inspect for drippings.		
	Are drippings present?	Go to Step 2	System OK

2	Can you identify the type of fluid and the approximate location of the leak?	Go to Step 10	Go to Step 3
3	1. Visually inspect the suspected area. Use a small mirror to assist in looking at hard to see areas. 2. Inspect for leaks at the following locations: • Sealing surfaces • Fittings • Cracked or damaged components Can you identify the type of fluid and the approximate location of the leak?	Go to Step 10	Go to Step 4
4	1. Completely clean the entire engine and surrounding components. 2. Operate the vehicle for several miles at normal operating temperature and at varying speeds. 3. Park the vehicle on a level surface over a large sheet of paper or other clean surface. 4. Wait 15 minutes. 5. Identify the type of fluid and the approximate location of the leak. Can you identify the type of fluid and the approximate location of the leak?	Go to Step 10	Go to Step 5
5	1. Visually inspect the suspected area. Use a small mirror to assist in looking at hard to see areas. 2. Inspect for leaks at the following locations: • Sealing surfaces • Fittings • Cracked or damaged components Can you identify the type of fluid and the approximate location of the leak?	Go to Step 10	Go to Step 6
6	1. Completely clean the entire engine and surrounding components. 2. Apply an aerosol-type powder, for example, baby powder or foot powder, to the suspected area. 3. Operate the vehicle for several miles at normal operating temperature and at varying speeds. 4. Identify the type of fluid and the approximate location of the leak from the discolorations in the powder surface.		

	Can you identify the type of fluid and the approximate location of the leak?	Go to Step 10	Go to Step 7
7	1. Visually inspect the suspected area. Use a small mirror to assist in looking at hard to see areas. 2. Inspect for leaks at the following locations: • Sealing surfaces • Fittings • Cracked or damaged components Can you identify the type of fluid and the approximate location of the leak?	Go to Step 10	Go to Step 8
8	Identify the type of fluid and the approximate location of the leak. Can you identify the type of fluid and the approximate location of the leak?	Go to Step 10	Go to Step 9
9	1. Visually inspect the suspected area. Use a small mirror to assist in looking at hard to see areas. 2. Inspect for leaks at the following locations: • Sealing surfaces • Fittings • Cracked or damaged components Can you identify the type of fluid and the approximate location of the leak?	Go to Step 10	System OK
10	1. Inspect the engine for mechanical damage. 2. Special interest should be shown to the following areas: • Higher than recommended fluid levels • Higher than recommended fluid pressures • Plugged or malfunctioning fluid filters or pressure bypass valves • Plugged or malfunctioning engine ventilation system • Improperly tightened or damaged fasteners • Cracked or porous components • Improper sealants or gaskets, where required • Improper sealant or gasket installation • Damaged or worn gaskets or seals • Damaged or worn sealing surfaces 3. Inspect the engine for customer modifications.		

	Is there mechanical damage or customer modifications to the engine?	Go to Step 11	System OK
11	Repair or replace all damaged or modified components. Did you complete the repair?	Go to Step 1	-

OIL CONSUMPTION DIAGNOSIS

Oil Consumption Diagnosis

Checks	Causes
The causes of excessive oil consumption may include the following conditions:	
Preliminary	• External oil leaks. • Incorrect oil level or improper reading of the oil level indicator. With the vehicle on a level surface, run the engine for a few minutes, allow adequate drain down time (2-3 minutes) and check for the correct engine oil level. • Improper oil viscosity. Refer to the vehicle owners manual and use the recommended SAE grade and viscosity for the prevailing temperatures. • Continuous high speed driving and/or severe usage. • Crankcase ventilation system restrictions or malfunctioning components. • Worn valve guides and/or valve stems. • Worn, missing or improperly installed valve stem oil seals. • Piston rings broken, worn, not seated properly. Allow adequate time for the rings to seat. Replace worn piston rings as necessary. • Piston and rings improperly installed or miss-fitted to the cylinder bore.

COOLANT IN ENGINE OIL

Coolant in Engine Oil

Cause	Correction
DEFINITION: Foamy or discolored oil or an engine oil overfill condition may indicate coolant entering the engine crankcase. Low coolant levels, an inoperative cooling fan or a faulty thermostat may lead to an overtemperature condition which may cause engine component damage. Contaminated engine oil and oil filter should be changed.	

1. Inspect the oil for excessive foaming or an overfill condition. Oil diluted by coolant may not properly lubricate the crankshaft bearings and may lead to component damage. Refer to lower engine noise, regardless of engine speed **Lower Engine Noise, Regardless of Engine Speed**.
2. Inspect by performing a cylinder leak-down test. During this test, excessive air bubbles within the cooling system may indicate a faulty gasket or damaged component.
3. Inspect by performing a cylinder compression test. Two cylinders side-by-side on the engine block with low compression may indicate a failed cylinder head gasket. Refer to **Engine Compression Test**.

Faulty cylinder head gasket	Replace the head gasket and components as required. Refer to <u>Engine Component Description</u> .
Warped cylinder head	Replace the cylinder head and gasket. Refer to <u>Engine Component Description</u> .
Cracked cylinder head	Replace the cylinder head and gasket.
Cracked cylinder liner	Replace the components as required.
Cylinder head or block porosity	Replace the components as required.

ENGINE NOISE UNDER LOAD

Engine Noise Under Load

Cause	Correction
Low oil pressure	1. Perform an oil pressure test. Refer to <u>Oil Pressure Diagnosis and Testing</u>. 2. Repair or replace as required.
Detonation or spark knock	Verify the correct operation of the ignition. Refer to <u>Symptoms - Engine Controls</u> .
Loose torque converter bolts	1. Inspect the torque converter bolts and flywheel. 2. Repair as required.
Cracked flywheel - automatic transmission	1. Inspect the flywheel bolts and flywheel. 2. Repair as required.
Excessive connecting rod bearing clearance	Inspect the following components and repair as required: 1. The connecting rod bearings 2. The connecting rods 3. The crankshaft
Excessive crankshaft bearing clearance	Inspect the following components and repair as required: 1. The crankshaft bearings 2. The crankshaft journals 3. The cylinder block crankshaft bearing bore

ENGINE NOISE ON START-UP, BUT ONLY LASTING A FEW SECONDS

Engine Noise on Start-Up, but Only Lasting a Few Seconds

Cause	Correction
Incorrect oil filter without anti-drainback feature	Install the correct oil filter.
Incorrect oil viscosity	1. Drain the oil. 2. Install the correct viscosity oil.
High valve lash adjuster leak down rate	Replace the lash adjusters as required.
Worn crankshaft thrust bearing	1. Inspect the thrust bearing and crankshaft. 2. Repair or replace as required.
Damaged or faulty oil filter by-pass valve	1. Inspect the oil filter by-pass valve for proper operation. 2. Repair or replace as required.
Malfunctioning camshaft position actuators - improper oil viscosity or contamination. The result is camshaft actuator locking pin does not lock	1. Verify correct engine oil viscosity by changing the engine oil and filter. Reevaluate the concern. 2. Isolate the noise to a specific camshaft position actuator. 3. Replace the camshaft actuator, oil and filter.

BASE ENGINE MISFIRE WITHOUT INTERNAL ENGINE NOISES

Base Engine Misfire without Internal Engine Noises

Cause	Correction
• Abnormalities, severe cracking, bumps or missing areas in the accessory drive belt • Abnormalities in the accessory drive system and/or components may cause engine revolutions per minute (RPM) variations and lead to a misfire diagnostic trouble code (DTC). A misfire code may be present without an actual misfire condition.	Replace the drive belt.
• Worn, damaged or mis-aligned accessory drive components or excessive pulley runout may lead to a misfire DTC. • A misfire code may be present without an actual misfire condition.	Inspect the components and repair or replace as required.
• A loose or improperly installed engine flywheel or crankshaft balancer • A misfire code may be present without an actual misfire condition.	Repair or replace the flywheel and/or balancer as required.
	Repair or replace as required.

• Restricted exhaust system • A severe restriction in the exhaust flow can cause significant loss of engine performance and may set a DTC. Possible causes of restrictions include collapsed or dented pipes or plugged mufflers and/or catalytic converters.	
Improperly installed or damaged vacuum hoses	Repair or replace as required.
Improper sealing between the intake manifold and cylinder heads or throttle body	Replace the intake manifold, gaskets, cylinder heads, and/or throttle body as required.
• Improperly installed or damaged manifold absolute pressure (MAP) sensor • The sealing grommet of the MAP sensor should not be torn or damaged.	Repair or replace the MAP sensor as required.
Damage to the MAP sensor housing	Replace the intake manifold.
• Worn or loose rocker arms • The rocker arm bearing end caps and/or needle bearings should be intact and in the proper position.	Replace the valve rocker arms as required.
• Stuck valves • Carbon buildup on the valve stem can cause the valve not to close properly.	Repair or replace as required.
Excessively worn or mis-aligned timing chain	Replace the timing chain and sprockets as required.
Worn camshaft lobes	Replace the camshaft and valve lifters.
• Excessive oil pressure • A lubrication system with excessive oil pressure may lead to excessive valve lifter pump up and loss of compression.	1. Perform an oil pressure test. Refer to <u>Oil Pressure Diagnosis and Testing</u>. 2. Repair or replace the oil pump as required.
• Faulty cylinder head gaskets and/or cracking or other damage to the cylinder heads and engine block cooling system passages • Coolant consumption may or may not cause the engine to overheat.	1. Inspect for spark plugs saturated by coolant. 2. Inspect the cylinder heads, engine block, and/or head gaskets. 3. Repair or replace as required.
• Worn piston rings • Oil consumption may or may not cause the engine to misfire.	1. Inspect the spark plugs for oil deposits. 2. Inspect the cylinders for a loss of compression. Refer to <u>Engine Compression Test</u>. 3. Perform cylinder leak down and compression testing to identify the cause. 4. Repair or replace as required.
1. A damaged crankshaft reluctor wheel. 2. A damaged crankshaft reluctor wheel can	Replace the sensor and/or crankshaft as required.

result in different symptoms depending on the severity and location of the damage.

- Systems with electronic communications, DIS or coil per cylinder and severe reluctor ring damage may exhibit periodic loss of crankshaft position, stop delivering a signal and then re-sync the crankshaft position.
- Systems with electronic communication, DIS or coil per cylinder and slight reluctor ring damage may exhibit no loss of crankshaft position and no misfire may occur. However, a DTC P0300 may be set.
- Systems with mechanical communications, high voltage switch and severe reluctor ring damage may cause additional pulses and effect fuel and spark delivery to the point of generating a DTC P0300 or P0336.

BASE ENGINE MISFIRE WITH ABNORMAL INTERNAL LOWER ENGINE NOISES

Base Engine Misfire with Abnormal Internal Lower Engine Noises

Cause	Correction
• Abnormalities, severe cracking, bumps or missing areas in the accessory drive belt. • Abnormalities in the accessory drive system and/or components may cause engine revolutions per minute (RPM) variations, noises similar to a faulty lower engine and also lead to a misfire condition. A misfire code may be present without an actual misfire condition.	Replace the drive belt.
• Worn, damaged or mis-aligned accessory drive components or excessive pulley runout. • A misfire code may be present without an actual misfire condition.	Inspect the components, repair or replace as required.
• Loose or improperly installed engine flywheel or crankshaft balancer. • A misfire code may be present without an actual misfire condition.	Repair or replace the flywheel and/or balancer as required.
• Worn piston rings. • Oil consumption may or may not cause the engine to misfire.	1. Inspect the spark plugs for oil deposits. 2. Inspect the cylinders for a loss of compression. Refer to <u>Engine Compression Test</u>.

	3. Perform cylinder leak down and compression testing to determine the cause. 4. Repair or replace as required.
• Worn crankshaft thrust bearings. • Severely worn thrust surfaces on the crankshaft and/or thrust bearing may permit fore and aft movement of the crankshaft and create a diagnostic trouble code (DTC) without an actual misfire condition.	Replace the crankshaft and bearings as required.

BASE ENGINE MISFIRE WITH ABNORMAL VALVE TRAIN NOISE

Base Engine Misfire with Abnormal Valve Train Noise

Cause	Correction
• Worn or loose rocker arms. • The rocker arm bearing end caps and/or needle bearings should intact within the rocker arm assembly.	Replace the valve rocker arms as required.
• Stuck valves • Carbon buildup on the valve stem can cause the valve to not close properly.	Repair or replace as required.
Excessively worn or mis-aligned timing chain	Replace the timing chain and sprockets as required.
Worn camshaft lobes	Replace the camshaft and valve lash adjusters.
Sticking lifters	Replace as required.

BASE ENGINE MISFIRE WITH COOLANT CONSUMPTION

Base Engine Misfire with Coolant Consumption

Cause	Correction
• Faulty cylinder head gasket and/or cracking or other damage to the cylinder head and engine block cooling system passages. • Coolant consumption may or may not cause the engine to overheat.	1. Inspect for spark plugs saturated by coolant. 2. Perform a cylinder leak down test. 3. Inspect the cylinder head and engine block for damage to the coolant passages and/or a faulty head gasket. 4. Repair or replace as required.

BASE ENGINE MISFIRE WITH EXCESSIVE OIL CONSUMPTION

Base Engine Misfire with Excessive Oil Consumption

Cause	Correction
Worn valves, valve guides, and/or valve stem oil seals	1. Inspect the spark plugs for oil deposits.

	2. Repair or replace as required.
- Worn piston rings - Oil consumption may or may not cause the engine to misfire.	1. Inspect the spark plugs for oil deposits. 2. Inspect the cylinders for a loss of compression. Refer to <u>Engine Compression Test</u> . 3. Perform cylinder leak down and compression testing to determine the cause. 4. Repair or replace as required.

UPPER ENGINE NOISE, REGARDLESS OF ENGINE SPEED

Upper Engine Noise, Regardless of Engine Speed

Cause	Correction
Low oil pressure	1. Perform an oil pressure test. Refer to <u>Oil Pressure Diagnosis and Testing</u> . 2. Repair or replace as required.
Loose and/or worn valve rocker arm attachments	1. Inspect the valve rocker arm stud, nut or bolt. 2. Repair or replace as required.
Worn valve rocker arm	Replace the valve rocker arm.
Improper lubrication to the valve rocker arms	Inspect the following components and repair or replace as required: - The valve rocker arm - The valve lifter - The oil filter bypass valve - The oil pump and pump screen - The engine block oil galleries
Broken valve spring	Replace the valve spring.
Worn or dirty valve lifters	Replace the valve lifters.
Stretched or broken timing belt and/or damaged sprocket teeth	Replace the timing belt and sprockets.
Worn, damaged or faulty timing belt tensioners	Replace tensioners
Worn engine camshaft lobes	1. Inspect the engine camshaft lobes. 2. Replace the camshaft and valve lifters as required.
Worn valve guides or valve stems	Inspect the following components and repair as required: - The valves - The valve guides
	Inspect the following components and repair as

• Stuck valves • Carbon on the valve stem or valve seat may cause the valve to stay open.	required: 1. The valves 2. The valve guides
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LOWER ENGINE NOISE, REGARDLESS OF ENGINE SPEED

Lower Engine Noise, Regardless of Engine Speed

Cause	Correction
Low oil pressure	1. Perform an oil pressure test. Refer to <u>Oil Pressure Diagnosis and Testing</u>. 2. Repair or replace damaged components as required.
Worn accessory drive components- abnormalities, such as severe cracking, bumps or missing areas in the accessory drive belt and/or misalignment of system components	1. Inspect the accessory drive system. 2. Repair or replace as required.
Loose or damaged crankshaft balancer	1. Inspect the crankshaft balancer. 2. Repair or replace as required.
Detonation or spark knock	Verify the correct operation of the ignition system. Refer to <u>Symptoms - Engine Controls</u> .
Loose torque converter bolts	1. Inspect the torque converter bolts and flywheel. 2. Repair or replace as required.
Loose or damaged flywheel	Repair or replace the flywheel.
• Damaged oil pan, contacting the oil pump screen • An oil pan that has been damaged, may improperly position the oil pump screen, preventing proper oil flow to the oil pump.	1. Inspect the oil pan. 2. Inspect the oil pump screen. 3. Repair or replace as required.
Oil pump screen loose, damaged or restricted	1. Inspect the oil pump screen. 2. Repair or replace as required.
Excessive piston-to-cylinder bore clearance	1. Inspect the piston and cylinder bore. 2. Repair as required.
Excessive piston pin-to-bore clearance	1. Inspect the piston, piston pin and the connecting rod. 2. Repair or replace as required.
Excessive connecting rod bearing clearance	Inspect the following components and repair as required: 1. The connecting rod bearings

	2. The connecting rods 3. The crankshaft 4. The crankshaft journals
Excessive crankshaft bearing clearance	Inspect the following components and repair as required: 1. The crankshaft bearings 2. The crankshaft journals
• Incorrect piston, piston pin and connecting rod installation • Pistons must be installed with the mark or dimple, on the top of the piston, facing the front of the engine. Piston pins must be centered in the connecting rod pin bore.	1. Verify the pistons, piston pins and connecting rods are installed correctly. 2. Repair as required.

ENGINE WILL NOT CRANK - CRANKSHAFT WILL NOT ROTATE

Engine Will Not Crank - Crankshaft Will Not Rotate

Cause	Correction
Seized accessory drive system component	1. Remove accessory drive belts. 2. Rotate crankshaft by hand at the balancer or flywheel location.
Hydraulically locked cylinder 1. Coolant/antifreeze in cylinder 2. Oil in cylinder 3. Fuel in cylinder	1. Remove spark plugs and check for fluid. 2. Inspect for broken head gasket. 3. Inspect for cracked engine block or cylinder head. 4. Inspect for a sticking fuel injector. 5. Inspect for cracked cylinder wall.
Seized automatic transmission torque converter	1. Remove the torque converter bolts. 2. Rotate crankshaft by hand at the balancer or flywheel location.
Seized manual transmission	1. Disengage the clutch. 2. Rotate crankshaft by hand at the balancer or flywheel location.
Broken timing chain and/or gears	1. Inspect timing chain and gears. 2. Repair as required.
Seized balance shaft	1. Inspect balance shaft. 2. Repair as required.
Material in cylinder	1. Inspect cylinder for damaged components

1. Broken valve 2. Piston material 3. Foreign material 4. Cracked cylinder wall	and/or foreign materials. 2. Inspect for fallen cylinder wall. 3. Repair or replace as required.
Seized crankshaft or connecting rod bearings	1. Inspect crankshaft and connecting rod bearings. 2. Inspect for fallen cylinder wall. 3. Repair as required.
Bent or broken connecting rod	1. Inspect connecting rods. 2. Repair as required.
Broken crankshaft	1. Inspect crankshaft. 2. Repair as required.

CRANKCASE VENTILATION SYSTEM INSPECTION/DIAGNOSIS

Results of Incorrect Operation

A plugged positive crankcase ventilation (PCV) orifice or hose may cause the following conditions:

- Rough idle
- Stalling or slow idle speed
- Oil leaks
- Oil in the throttle body
- Sludge in the engine

Functional Check

With these systems, any blow-by in excess of the system capacity, from a badly worn engine, sustained heavy load, etc., is exhausted into the throttle body and is drawn into the engine.

Proper operation of the crankcase ventilation system depends upon a sealed engine. If oil slugging or dilution is noted and the crankcase ventilation system is functioning properly, check the engine for a possible cause. Correct any problems.

If an engine is idling rough, inspect for a clogged PCV orifice, a dirty vent filter, air cleaner element or plugged hose. Replace as required. Use the following procedure:

1. Remove the PCV hose from the cylinder head cover.
2. Operate the engine at idle.
3. Place your thumb over the end of the hose in order to check for a vacuum. If there is no vacuum at the hose, inspect for the following items:
 - Plugged hoses

- The manifold port
4. Turn OFF the engine.
 5. Inspect the PCV orifice in the cylinder head cover for debris or blockage.

REPAIR INSTRUCTIONS - ON VEHICLE

WATER PUMP AND GENERATOR BELT REPLACEMENT

Removal Procedure

1. Support and raise the vehicle. Refer to Lifting and Jacking the Vehicle .

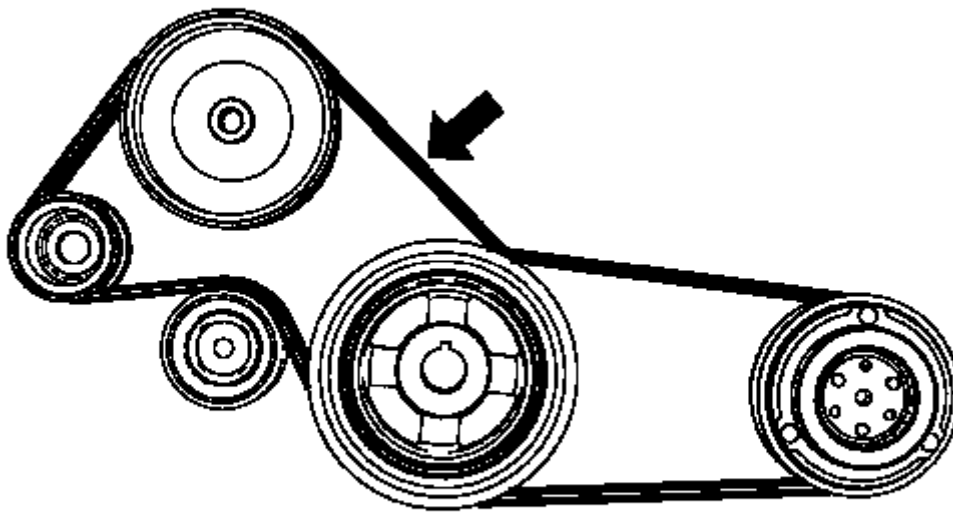


Fig. 10: Drive Belt Routing

Courtesy of GENERAL MOTORS COMPANY

2. Note the routing of the water pump and generator belt.

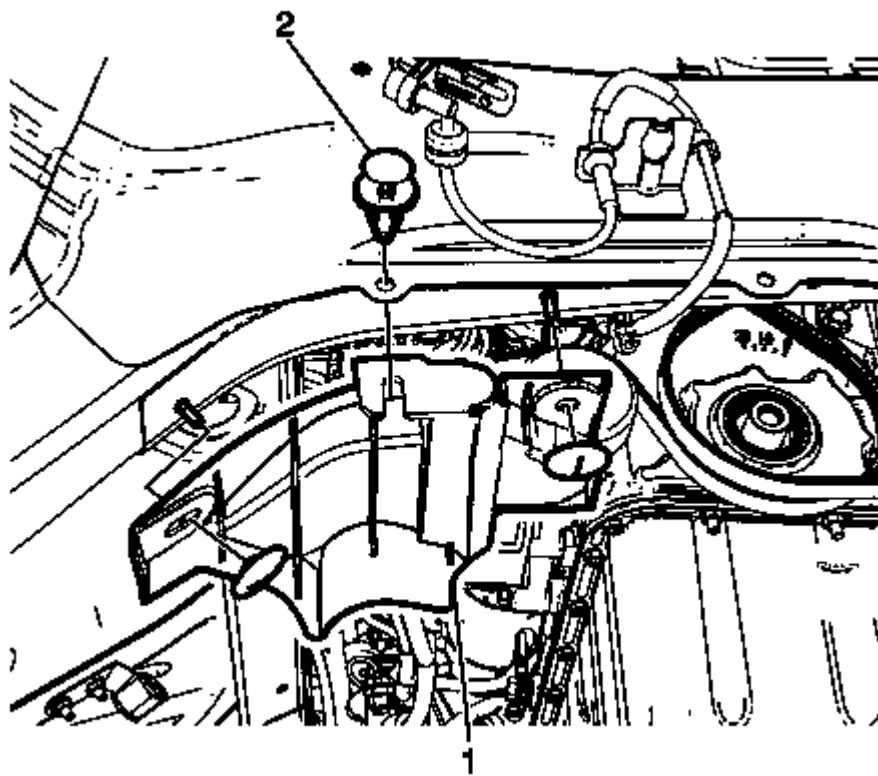


Fig. 11: Retainers And Water Deflector
Courtesy of GENERAL MOTORS COMPANY

3. Remove the retainers (2) and the water deflector (1).

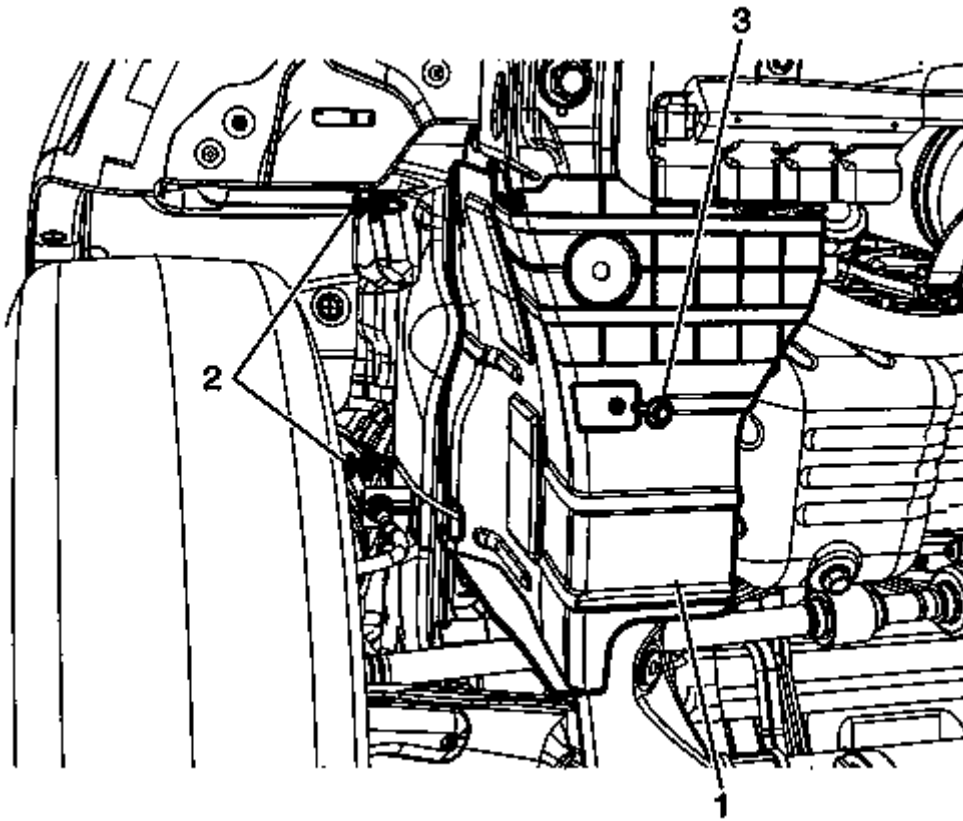


Fig. 12: Front Compartment Splash Shield Retainers And Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Remove the front compartment splash shield retainers (2) and bolt (3).
5. Remove the front compartment splash shield (1).
6. Remove the air conditioning compressor belt. Refer to **Air Conditioning Compressor Belt Replacement**.

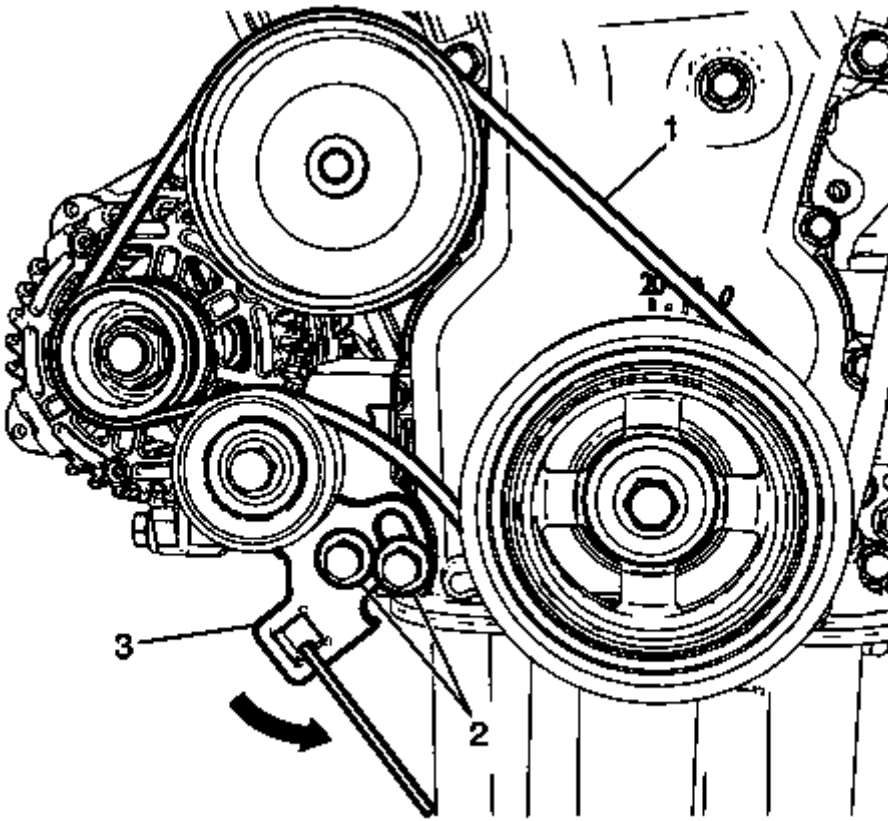


Fig. 13: Generator Bracket With Tensioner Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Loosen the generator bracket with tensioner bolts (2).
8. Rotate the generator bracket arm (3) counterclockwise by using an extensional tool or suitable tool.
9. Remove the water pump and generator belt (1).

Installation Procedure

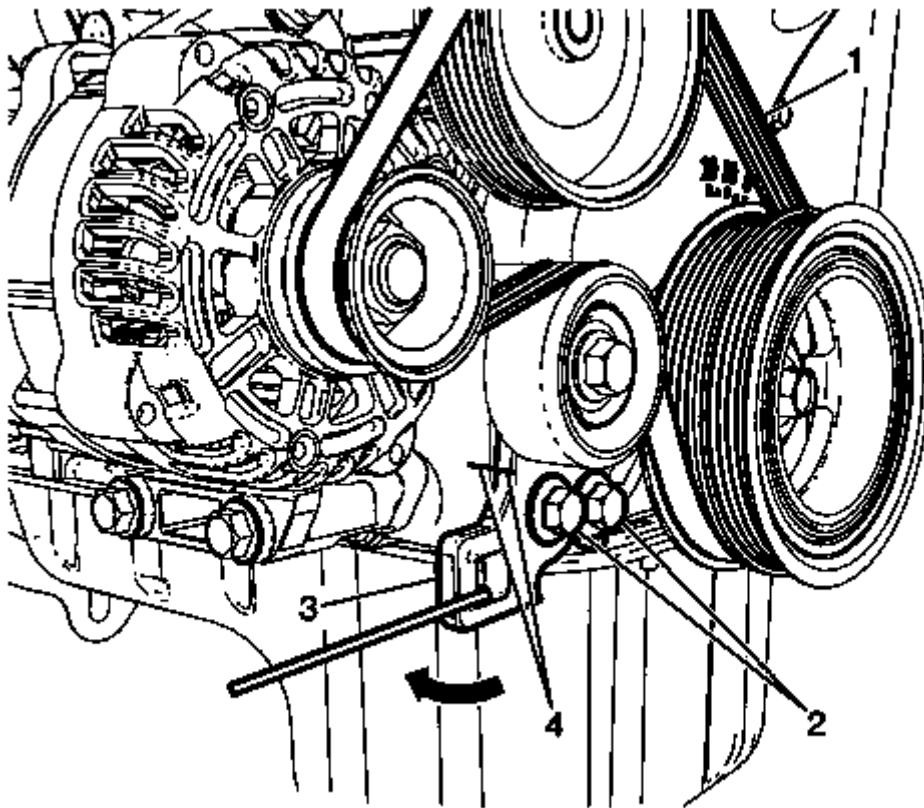


Fig. 14: Water Pump And Generator Belt
Courtesy of GENERAL MOTORS COMPANY

NOTE: Make sure the water pump and generator belt is correctly aligned and seated into the grooves of the generator pulley, crankshaft balancer and water pump pulley.

1. Install the water pump and generator belt (1).
2. Rotate the generator bracket arm (3) clockwise by using an extensional tool or suitable tool.
3. Keep turning the bracket arm until the indicator lines (4) are located at collinear position.

CAUTION: Refer to Fastener Caution .

4. Tighten the generator bracket with tensioner bolts (2) to 55 (41 lb ft).
5. Install the air conditioning compressor belt. Refer to Air Conditioning Compressor Belt Replacement.
6. Rotate engine one full revolution.

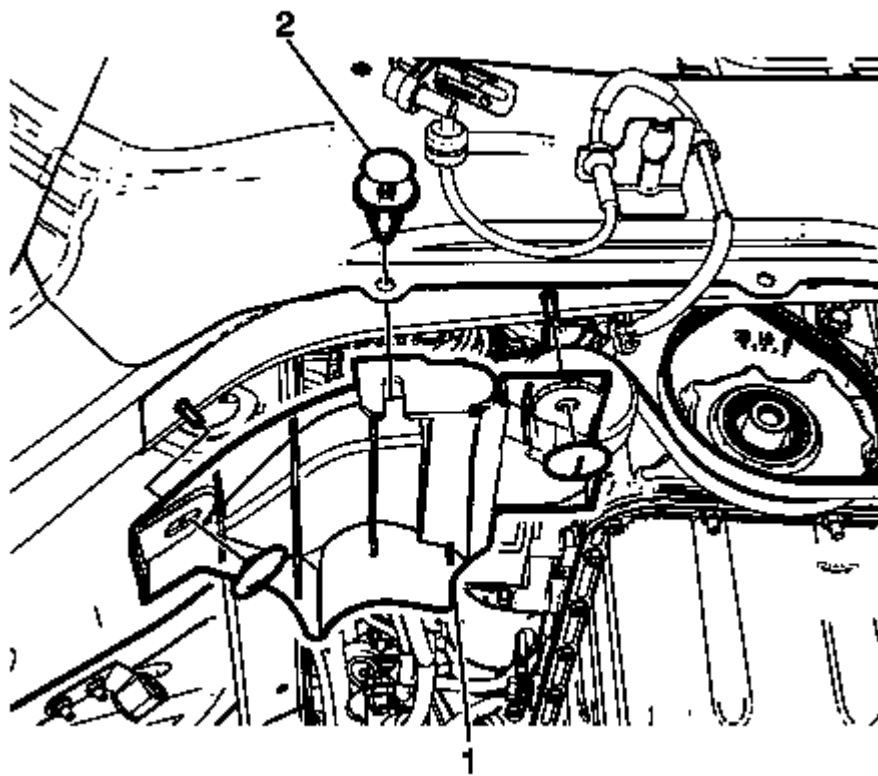


Fig. 15: Retainers And Water Deflector
Courtesy of GENERAL MOTORS COMPANY

7. Install the retainers (2) and the water deflector (1).

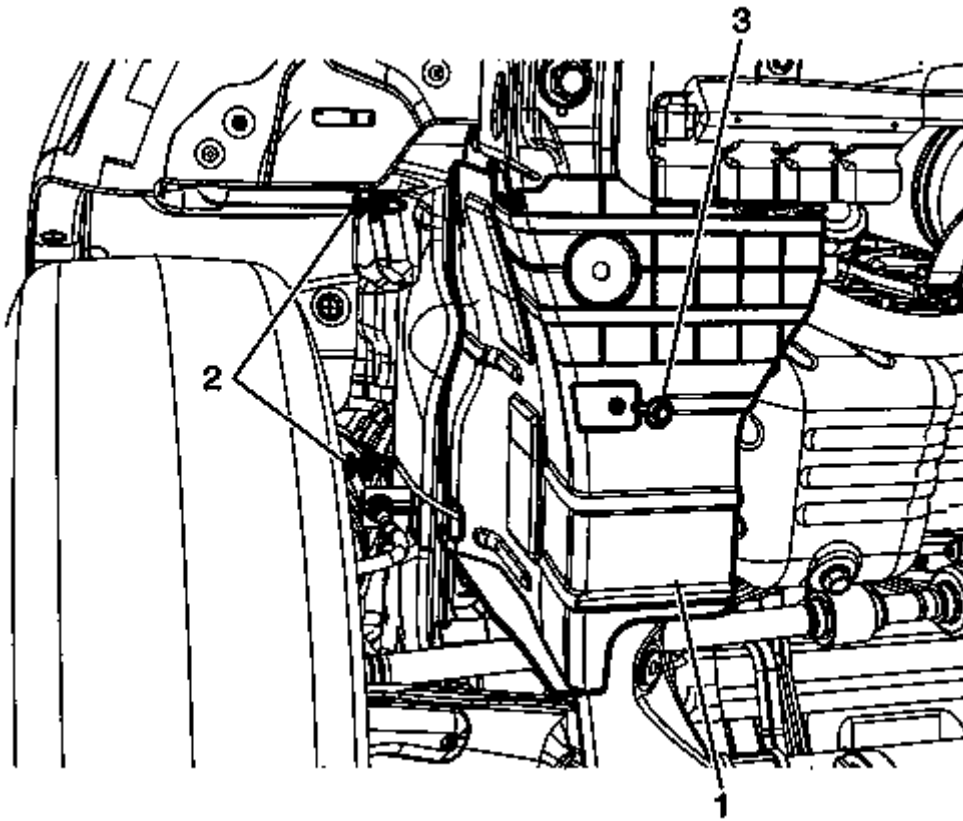


Fig. 16: Front Compartment Splash Shield Retainers And Bolt
Courtesy of GENERAL MOTORS COMPANY

8. Install the front compartment splash shield (1).
9. Install the front compartment splash shield retainers (2) and bolt (3).
10. Tighten the bolt (3) to 9 (80 lb in).
11. Lower the vehicle.

WATER PUMP AND GENERATOR BELT TENSION INSPECTION

Special Tools

GE-50576 Acoustic Belt Tension Tester

For equivalent regional tools, refer to **Special Tools**.

1. Support and raise the vehicle. Refer to **Lifting and Jacking the Vehicle** .

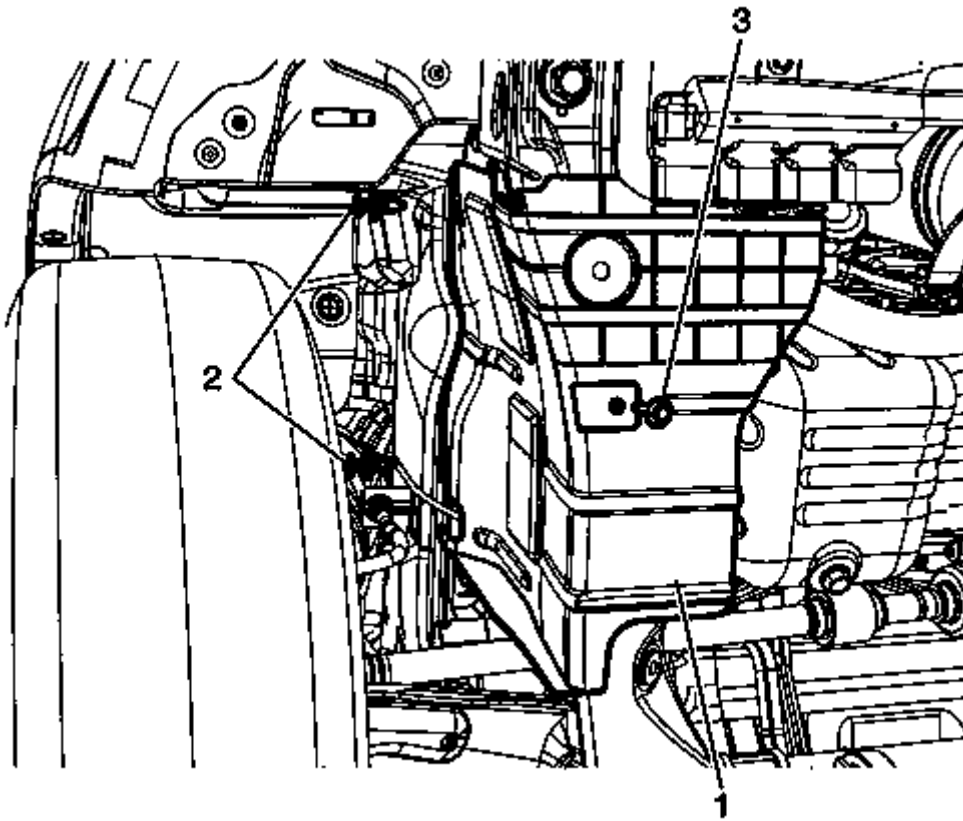


Fig. 17: Front Compartment Splash Shield Retainers And Bolt
Courtesy of GENERAL MOTORS COMPANY

2. Remove the front compartment splash shield retainers (2) and bolt (3).
3. Remove the front compartment splash shield (1).

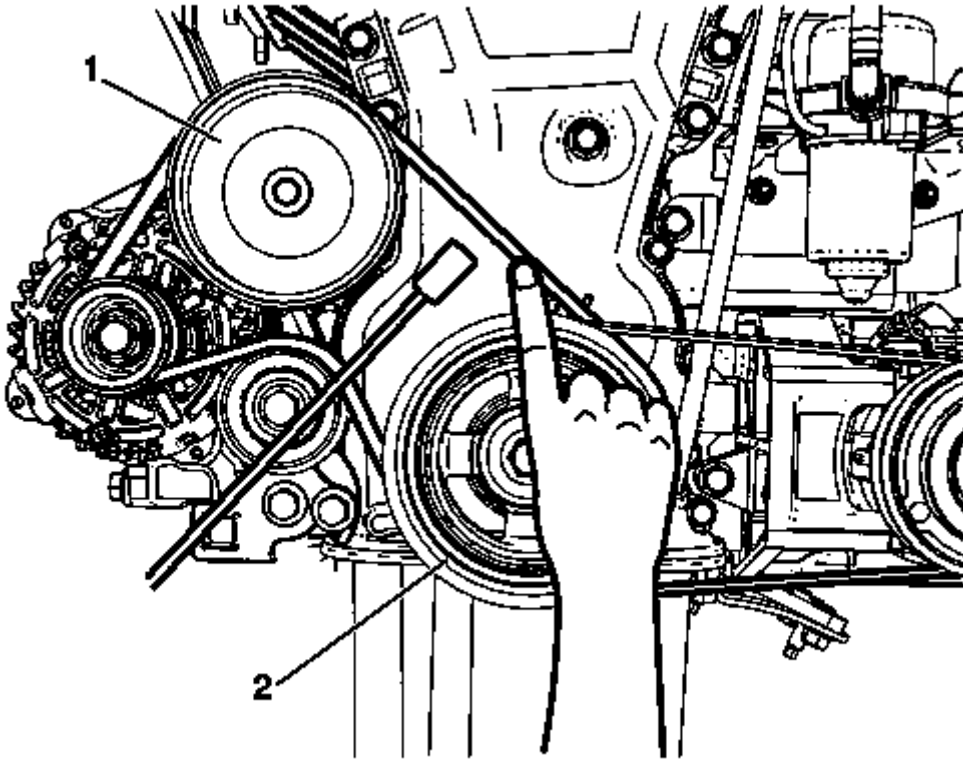


Fig. 18: Locating Finger On Center Of Belt Span Between Water Pump Pulley And Crankshaft Pulley

Courtesy of GENERAL MOTORS COMPANY

WARNING: Always allow the engine to cool before servicing the engine system. Failure to follow this instruction may result in serious personal injury.

NOTE: Space between tension gauge and the belt should be around 10 mm apart.

4. Use **GE-50576** acoustic belt tension tester to measure the water pump and generator belt tension.
 1. Locate **GE-50576** acoustic belt tension tester near the center of the belt span between the water pump pulley and crankshaft pulley.
 2. Locate a finger on the center of the belt span between water pump pulley (1) and crankshaft pulley (2). Pluck the belt between the water pump pulley and the crankshaft pulley. Repeat 3 times to get an average tension result on **GE-50576** acoustic belt tension tester.
 3. If water pump and generator belt tension is over 158 Hz the belt tension is within specification. Go to step 5.
 4. If water pump and generator belt tension is not within the specification, below 158 Hz, inspect the belt for excessive wear, fraying or cracking. Replace the belt as necessary. Refer to **Water Pump and Generator Belt Replacement**.

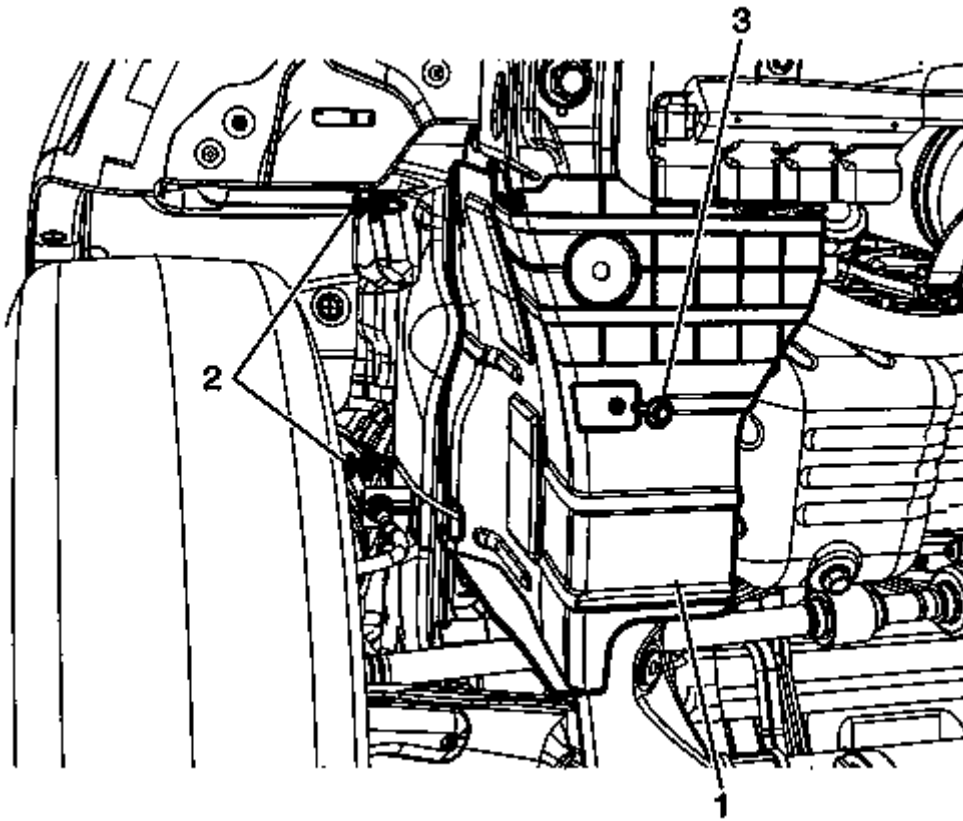


Fig. 19: Front Compartment Splash Shield Retainers And Bolt
Courtesy of GENERAL MOTORS COMPANY

5. Install the front compartment splash shield (1).
6. Install the front compartment splash shield retainers (2) and bolt (3). Tighten the bolt (3) to 9 (80 lb in).
7. Lower the vehicle.

ENGINE MOUNT REPLACEMENT

Removal Procedure

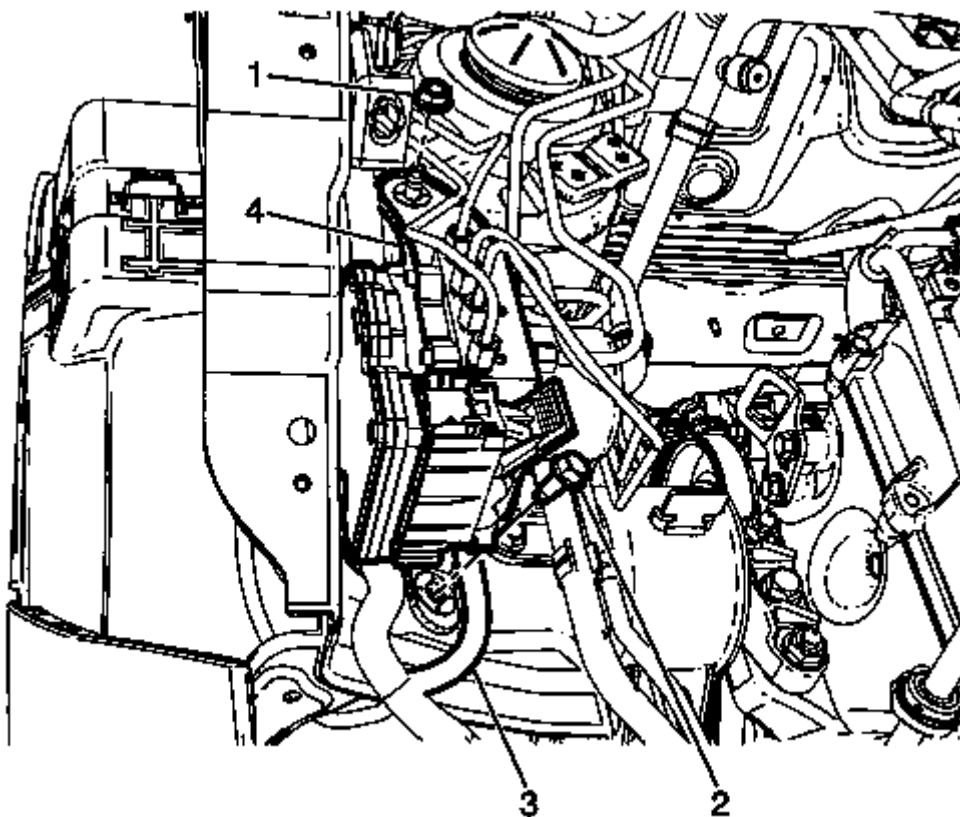


Fig. 20: Electrical Connector And Bracket Nut
Courtesy of GENERAL MOTORS COMPANY

1. Remove the radiator surge tank. Refer to **Radiator Surge Tank Replacement (LL0)** , **Radiator Surge Tank Replacement (LFM)** .
2. Remove the electrical connector (3) from the electronic brake control module (EBCM).
3. Remove the EBCM/BPMV (brake pressure modular valve) bracket nut (1), bolt (2).
4. Reposition the EBCM/BPMV assembly (4) aside.
5. Install the engine support fixture. Refer to **Engine Support Fixture**.
6. Prior to removing the mount, mark the mount location using spray paint or a marker for correct positioning during installation.

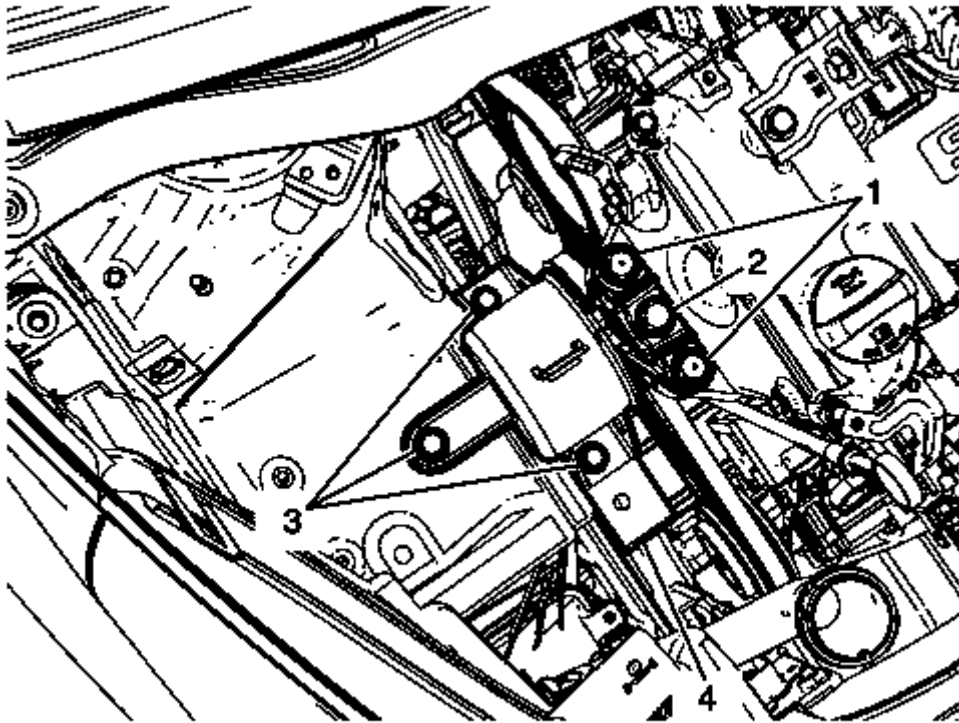


Fig. 21: Engine Mount Nuts

Courtesy of GENERAL MOTORS COMPANY

7. Remove the engine mount nuts (1).
8. Remove the engine mount bolt (2).
9. Remove the engine mount to body retaining bolts (3).
10. Remove the engine mount (4).
11. Transfer parts as necessary.

Installation Procedure

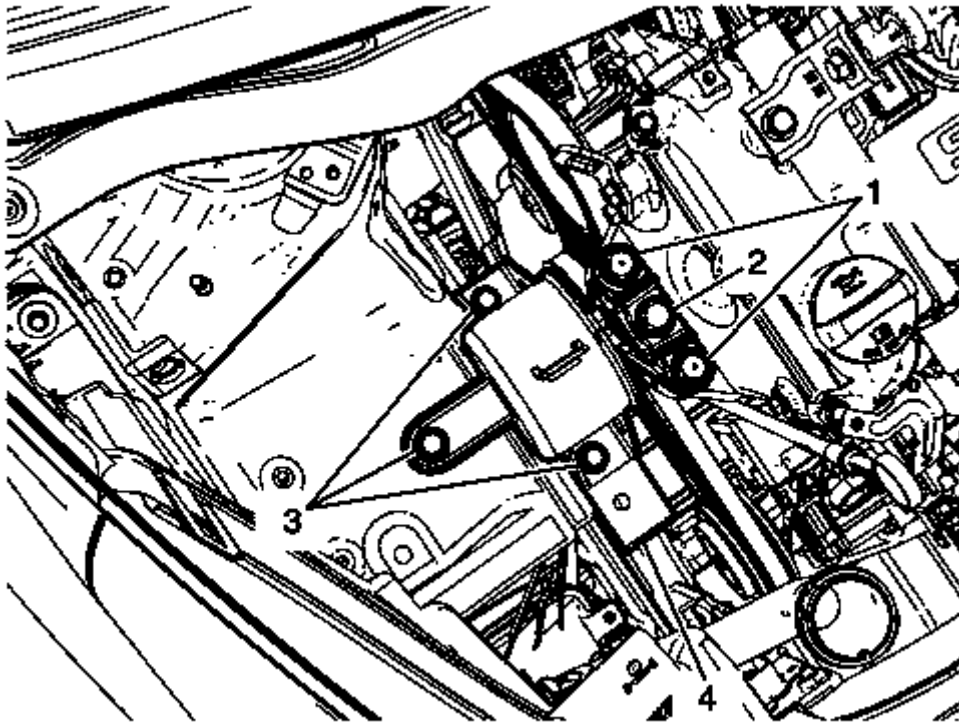


Fig. 22: Engine Mount Nuts

Courtesy of GENERAL MOTORS COMPANY

1. Install the engine mount (4).

CAUTION: Refer to Fastener Caution .

2. Install the engine mount to body retaining bolts (3) and tighten to 50 (37 lb ft).
3. Install the engine mount bolt (2), nuts (1) and tighten to 66 (49 lb ft).
4. Remove the engine support fixture. Refer to Engine Support Fixture.

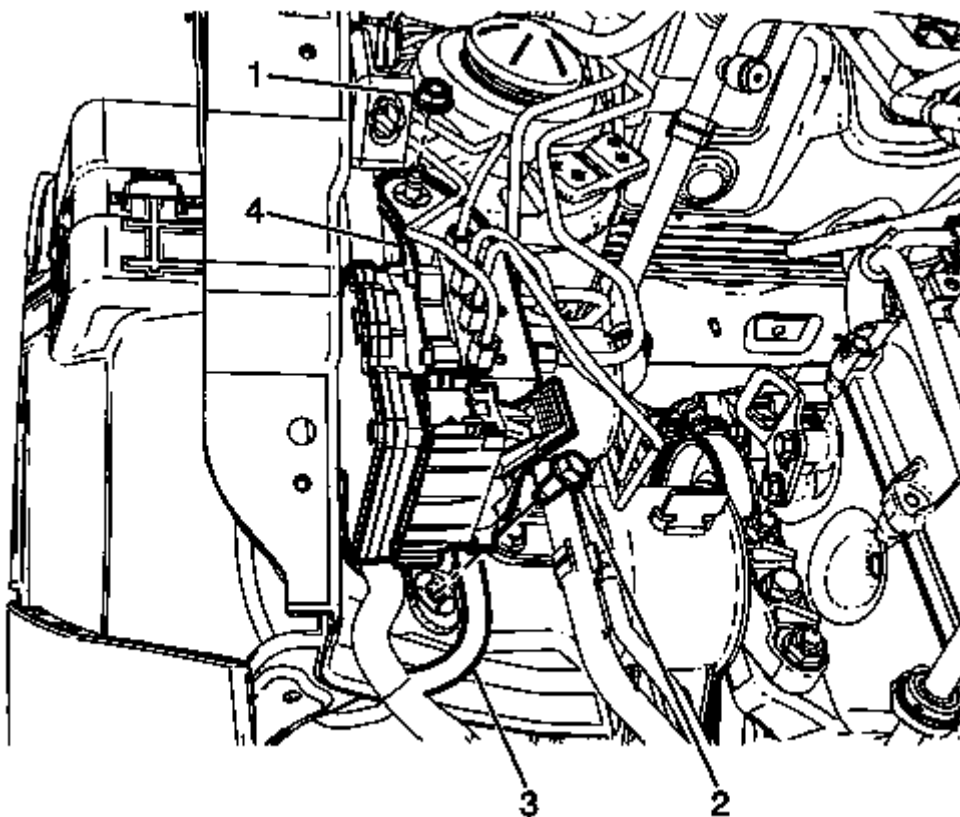


Fig. 23: Electrical Connector And Bracket Nut
Courtesy of GENERAL MOTORS COMPANY

5. Install the EBCM/BPMV assembly (4).
6. Install the EBCM/BPMV (brake pressure modular valve) bracket nut (1), bolt (2) and tighten to 22 (16 lb ft).
7. Connect the EBCM electrical connector (3) to the EBCM.
8. Install the radiator surge tank. Refer to **Radiator Surge Tank Replacement (LL0)** , **Radiator Surge Tank Replacement (LFM)** .

UPPER INTAKE MANIFOLD REPLACEMENT (LFM)

Removal Procedure

1. Open the hood.
2. Disconnect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection** .
3. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
4. Remove the throttle body assembly. Refer to **Throttle Body Assembly Replacement (LL0)** , **Throttle Body Assembly Replacement (LFM)** .
5. Remove the manifold absolute pressure sensor. Refer to **Manifold Absolute Pressure Sensor**

Replacement (LL0) , Manifold Absolute Pressure Sensor Replacement (LFM) .

6. Remove the evaporative emission canister purge solenoid valve. Refer to **Evaporative Emission Canister Purge Solenoid Valve Replacement (LL0) , Evaporative Emission Canister Purge Solenoid Valve Replacement (LFM) .**
7. Disconnect the power brake booster vacuum hose from intake manifold. Refer to **Power Brake Booster Vacuum Hose Replacement .**

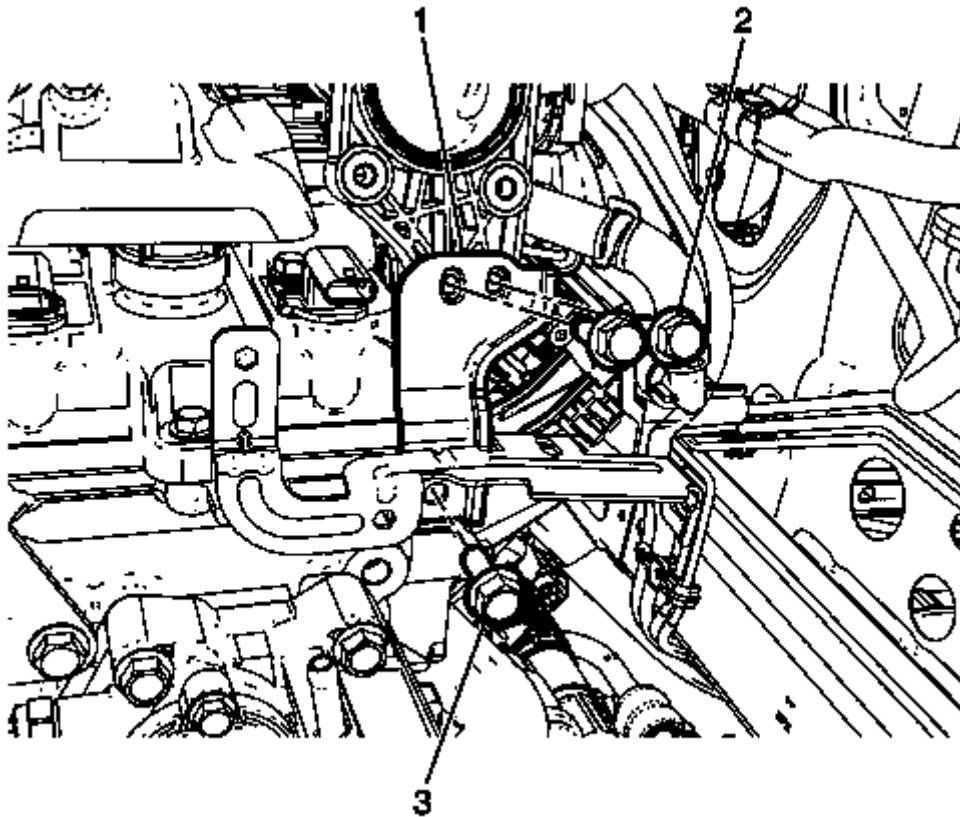


Fig. 24: Upper Intake Manifold Side Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

8. Remove the upper intake manifold side bracket bolts (2).
9. Remove the upper intake manifold side bracket bolt (3).
10. Remove the upper intake manifold side bracket (1).

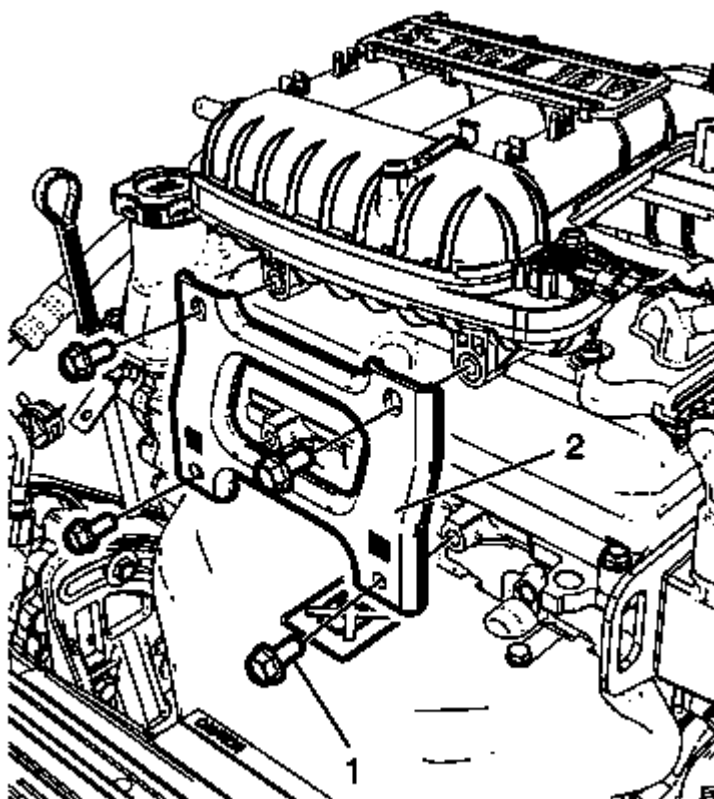


Fig. 25: Upper Intake Manifold Front Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

11. Remove the upper intake manifold front bracket bolts (1).
12. Remove the upper intake manifold front bracket (2).

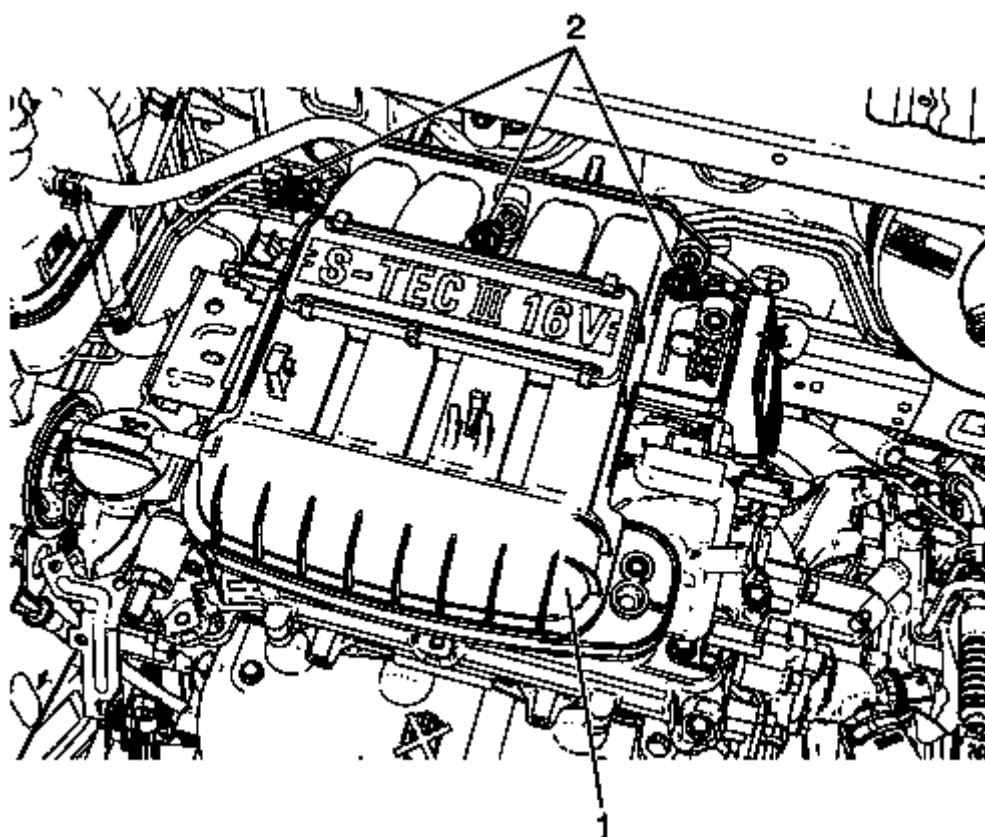


Fig. 26: Upper Intake Manifold 3 Bolts
Courtesy of GENERAL MOTORS COMPANY

13. Remove the upper intake manifold 3 bolts (2).
14. Remove the upper intake manifold (1).
15. Disconnect any electrical connectors as needed.
16. Transfer parts as necessary.

Installation Procedure

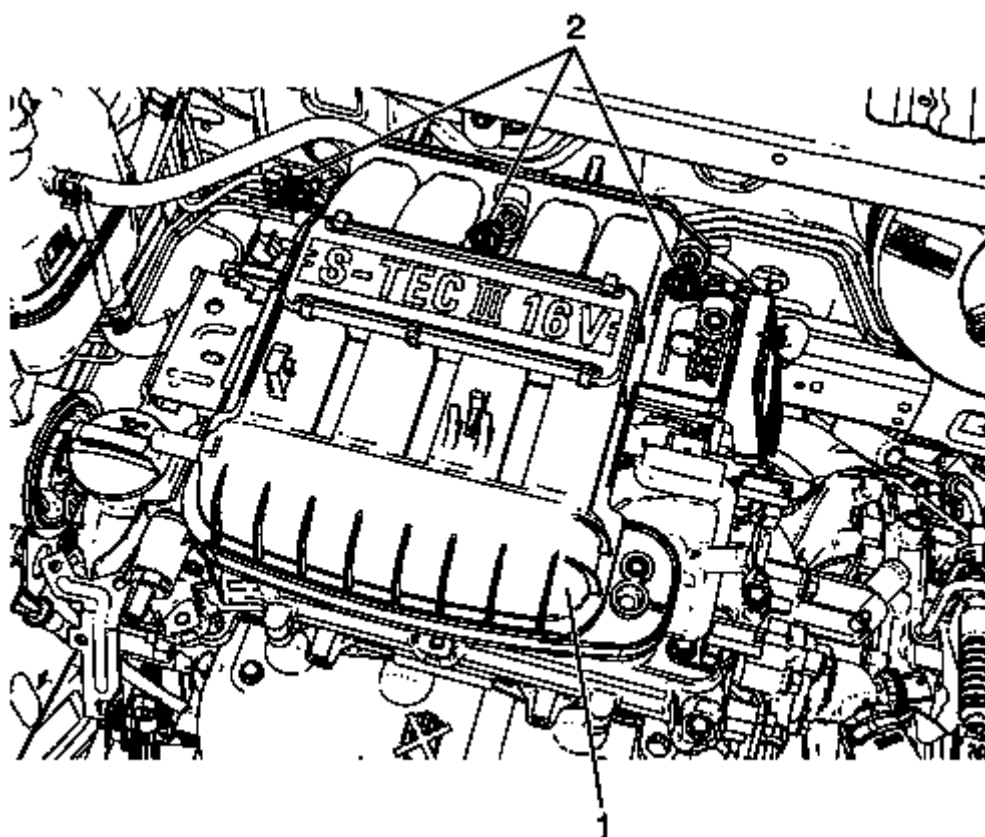


Fig. 27: Upper Intake Manifold 3 Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the upper intake manifold (1).

CAUTION: Refer to Fastener Caution .

2. Install the upper intake manifold 3 bolts (2) and tighten to 10 (89 lb in).

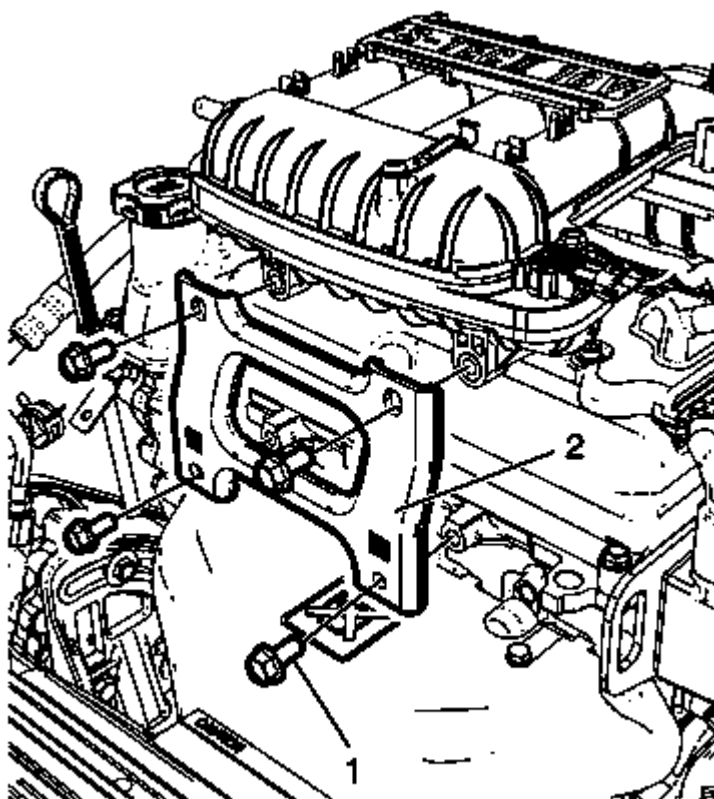


Fig. 28: Upper Intake Manifold Front Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Install the upper intake manifold front bracket (2).
4. Install the upper intake manifold front bracket bolts (1) and tighten to 25 (18 lb ft).

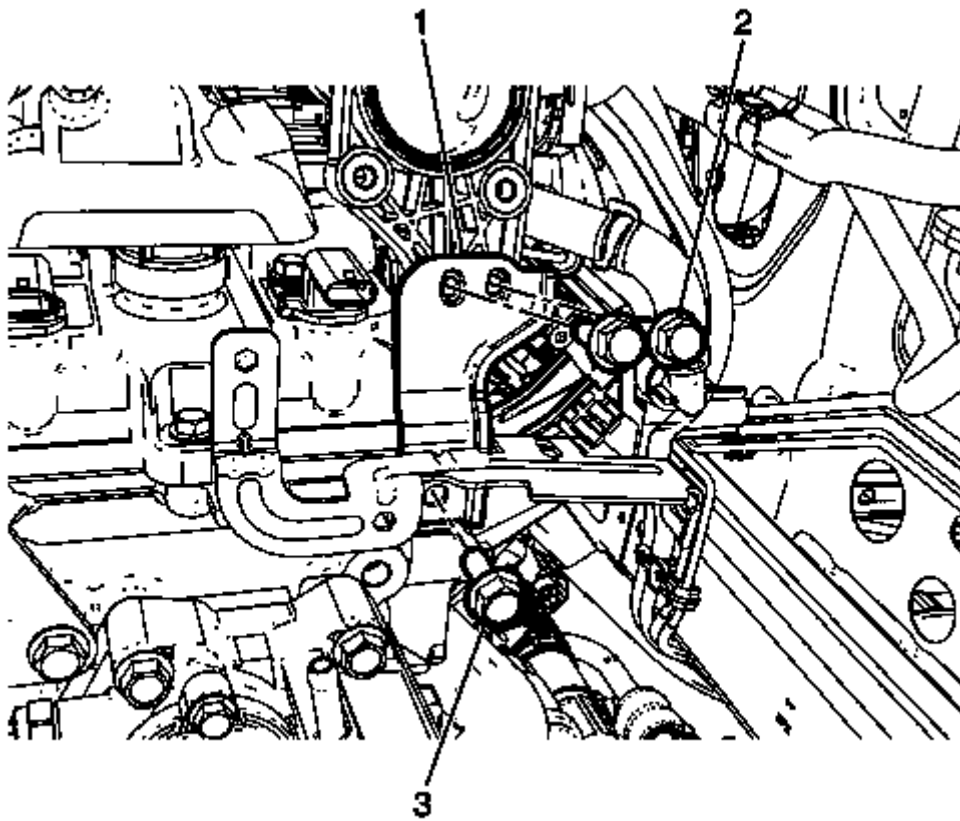


Fig. 29: Upper Intake Manifold Side Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Install the upper intake manifold side bracket (1).
6. Install the upper intake manifold side bracket bolts (2) and tighten to 10 (89 lb in).
7. Install the upper intake manifold side bracket bolt (3) and tighten to 25 (18 lb ft)
8. Connect the power brake booster vacuum hose to intake manifold. Refer to **Power Brake Booster Vacuum Hose Replacement** .
9. Install the evaporative emission canister purge solenoid valve. Refer to **Evaporative Emission Canister Purge Solenoid Valve Replacement (LL0)** , **Evaporative Emission Canister Purge Solenoid Valve Replacement (LFM)** .
10. Install the manifold absolute pressure sensor. Refer to **Manifold Absolute Pressure Sensor Replacement (LL0)** , **Manifold Absolute Pressure Sensor Replacement (LFM)** .
11. Install the throttle body assembly. Refer to **Throttle Body Assembly Replacement (LL0)** , **Throttle Body Assembly Replacement (LFM)** .
12. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
13. Connect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection** .
14. Close the hood.

LOWER INTAKE MANIFOLD REPLACEMENT (LFM)

Removal Procedure

1. Open the hood.
2. Remove the upper intake manifold housing. Refer to Upper Intake Manifold Replacement (LFM).

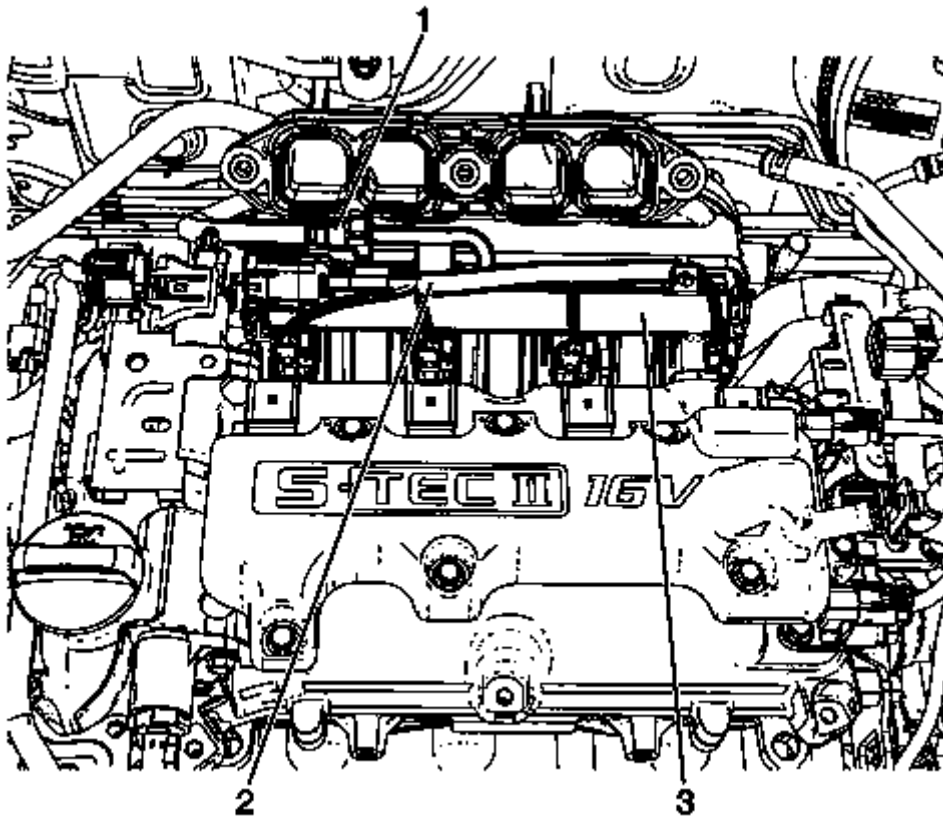


Fig. 30: Positive Crankcase Ventilation Hose
Courtesy of GENERAL MOTORS COMPANY

3. Remove the positive crankcase ventilation hose. Refer to Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (LL0), Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (LFM).
4. Disconnect the ignition coil connectors. Refer to Ignition Coil Removal.
5. Disconnect the fuel feed hose (1) from the fuel rail (3).
6. Disconnect the fuel injector electrical connector and remove the fuel injector rail wiring harness (2).
7. Raise the vehicle. Refer to Lifting and Jacking the Vehicle.
8. Remove the exhaust pipe assembly. Refer to Exhaust Pipe Replacement (LFM).
9. Remove any electrical retainers as needed.
10. Disconnect the starter connector. Refer to Starter Replacement.
11. Disconnect the generator connector. Refer to Generator Replacement.

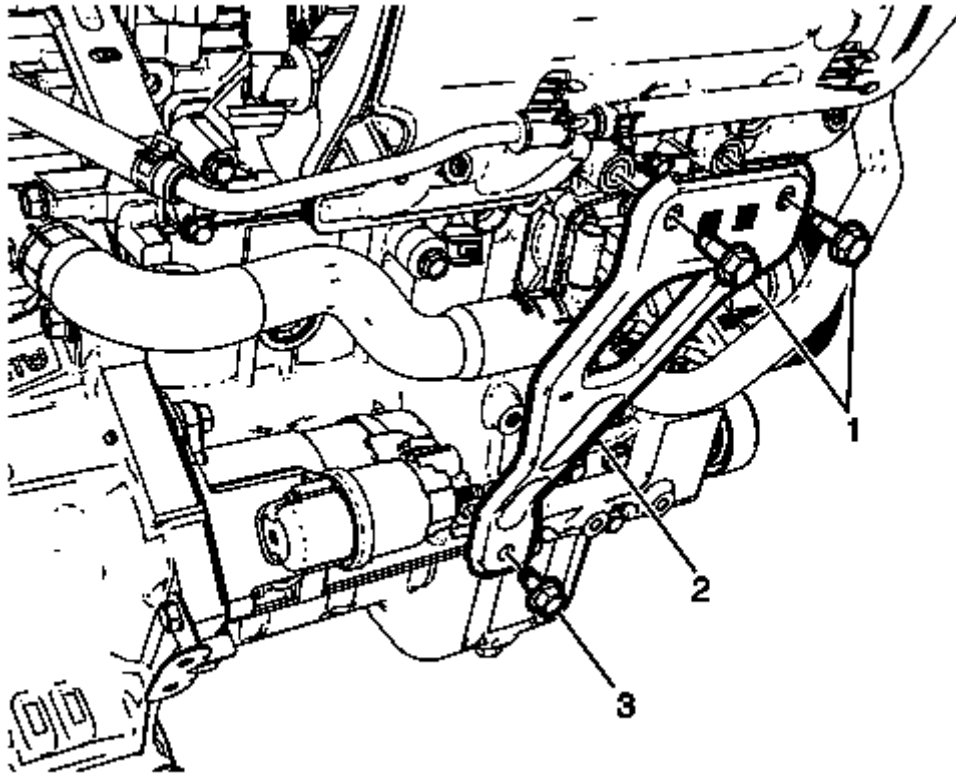


Fig. 31: Intake Manifold Rear Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

12. Remove the intake manifold rear bracket (2) and bolts (1, 3).

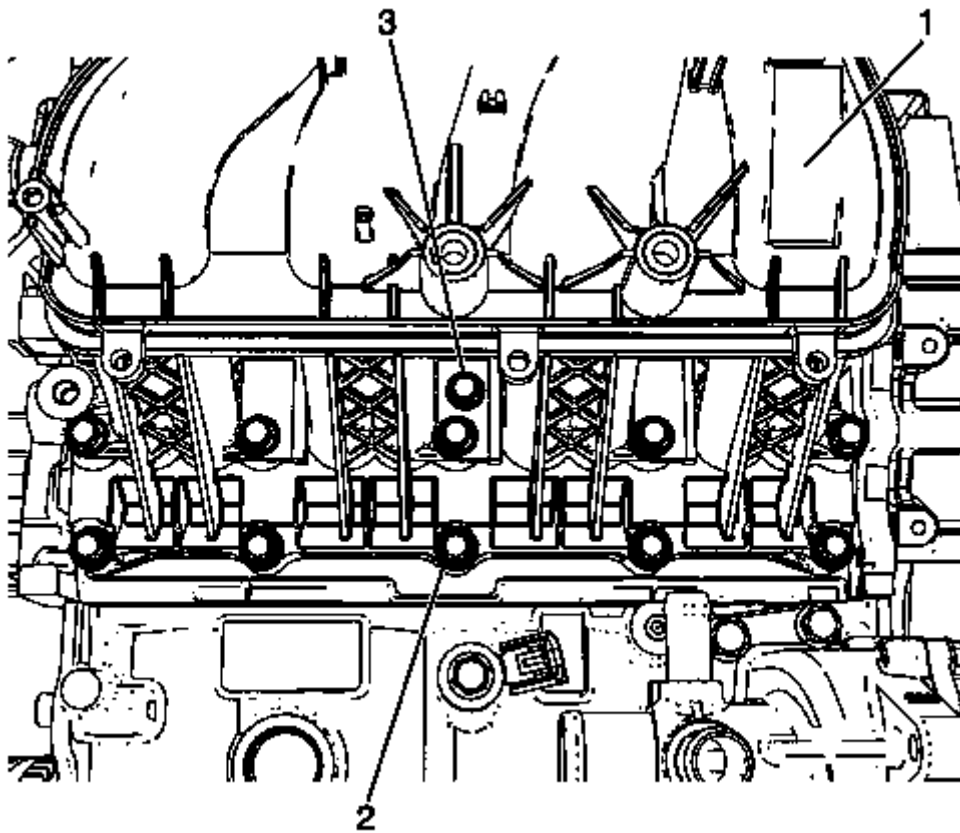


Fig. 32: Lower Intake Manifold And Bolts
Courtesy of GENERAL MOTORS COMPANY

13. Remove the lower intake manifold 11 bolts (2, 3).
14. Remove the lower intake manifold (1) and fuel injection fuel rail assembly.
15. Transfer parts as necessary.

Installation Procedure

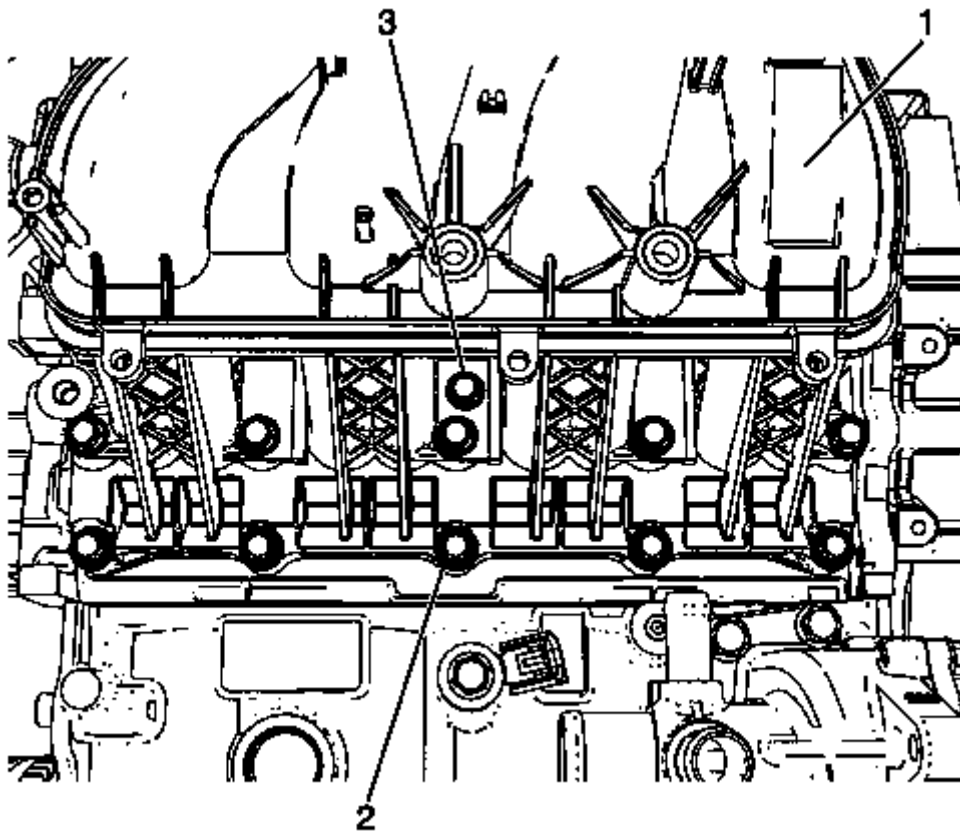


Fig. 33: Lower Intake Manifold And Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the lower intake manifold (1) and fuel injector fuel rail assembly.

CAUTION: Refer to Fastener Caution .

2. Install the lower intake manifold 11 bolts (2, 3) and tighten to 10 (89 lb in).

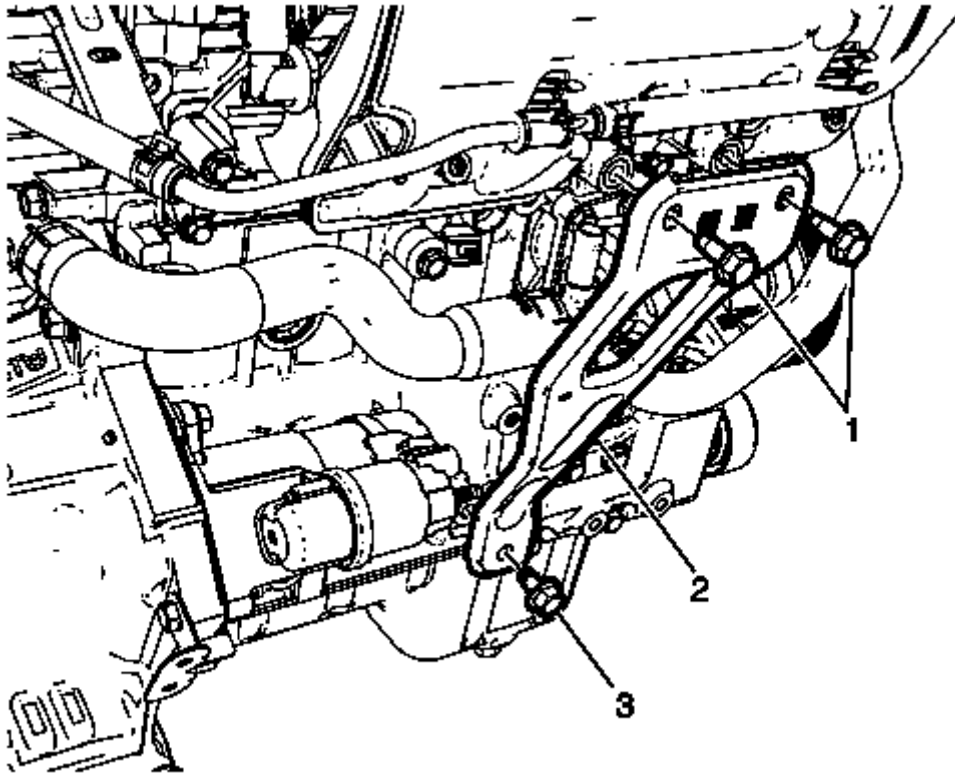


Fig. 34: Intake Manifold Rear Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Install the intake manifold support bracket (2).
4. Install the intake manifold rear bracket bolts (1) and tighten to 22 (16 lb ft).
5. Install the intake manifold rear bracket bolt (3) and tighten to 58 (42 lb ft).
6. Connect the generator connector. Refer to **Generator Replacement** .
7. Connect the starter connector. Refer to **Starter Replacement** .
8. Install any electrical retainers.
9. Install the exhaust pipe assembly. Refer to **Exhaust Pipe Replacement (LFM)** .
10. Lower the vehicle.

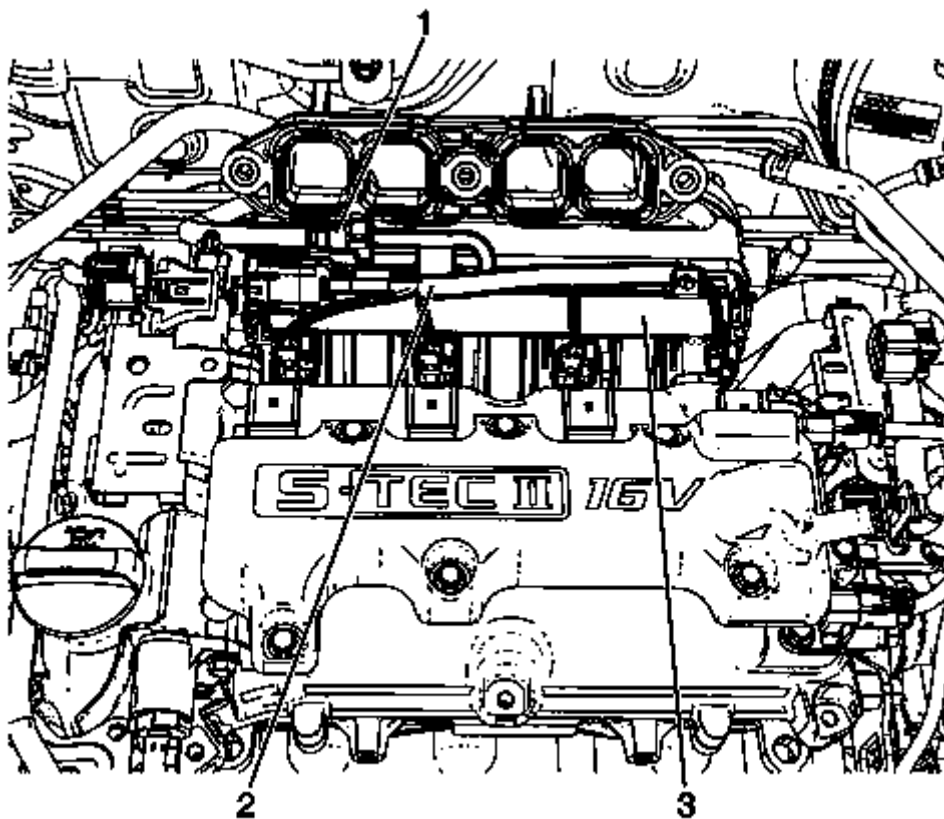


Fig. 35: Positive Crankcase Ventilation Hose
Courtesy of GENERAL MOTORS COMPANY

11. Connect the ignition coil connectors. Refer to **Ignition Coil Installation**.
12. Install the fuel injector rail wiring harness (2) and connect the fuel injector electrical connector.
13. Connect the fuel feed hose (1) to the fuel rail (3).
14. Install the positive crankcase ventilation hose. Refer to **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (LL0)**, **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (LFM)**.
15. Install the upper intake manifold housing. Refer to **Upper Intake Manifold Replacement (LFM)**.
16. Close the hood.

INTAKE MANIFOLD REPLACEMENT

Removal Procedure

1. Open the hood.
2. Disconnect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection**.
3. Drain the cooling system. Refer to **Cooling System Draining and Filling**.
4. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement**.
5. Remove the throttle body assembly. Refer to **Throttle Body Assembly Replacement (LL0)**, **Throttle**

Body Assembly Replacement (LFM) .

6. Remove the positive crankcase ventilation hose. Refer to **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (LL0)**, **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (LFM)**.
7. Remove the manifold absolute pressure sensor. Refer to **Manifold Absolute Pressure Sensor Replacement (LL0)** , **Manifold Absolute Pressure Sensor Replacement (LFM)** .
8. Remove the evaporative emission canister purge solenoid valve. Refer to **Evaporative Emission Canister Purge Solenoid Valve Replacement (LL0)** , **Evaporative Emission Canister Purge Solenoid Valve Replacement (LFM)** .

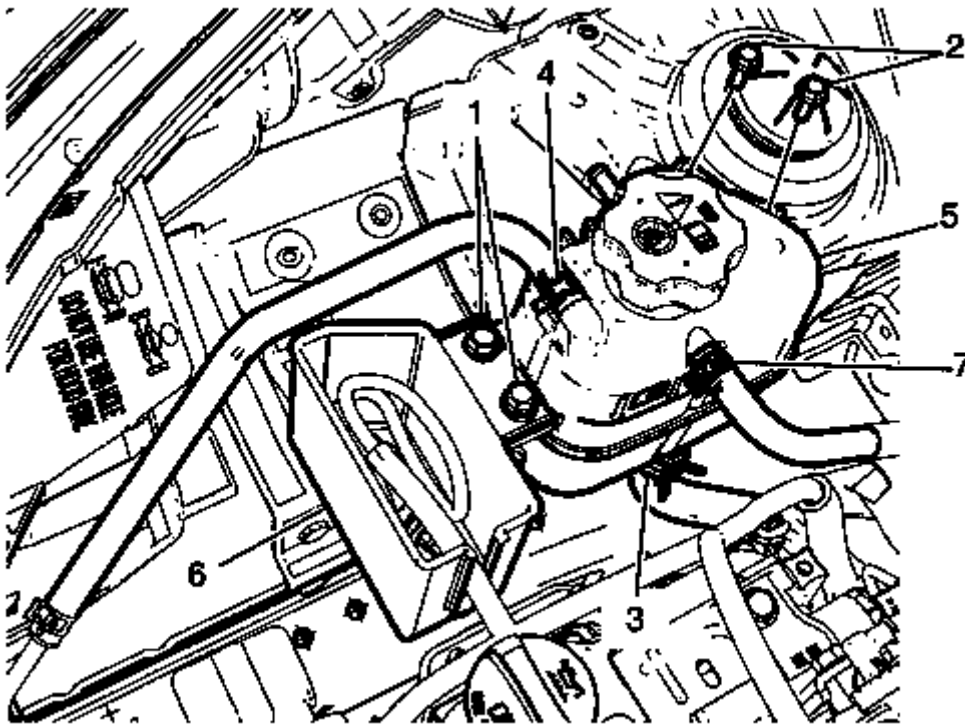


Fig. 36: Block Heater Connecting Plug Holder Bolt
Courtesy of GENERAL MOTORS COMPANY

9. Remove the coolant hose and clamp (7) from the radiator surge tank and intake manifold.
10. If equipped with a block heater, remove the block heater connecting plug holder bolts (1) and reposition block heater connecting plug holder (6) aside.
11. Remove the radiator surge tank mounting bolt (2) and reposition radiator surge tank (5) aside.
12. Disconnect the power brake booster vacuum hose from intake manifold. Refer to **Power Brake Booster Vacuum Hose Replacement** .
13. Disconnect the fuel feed line quick connect fitting from the fuel rail. Refer to **Metal Collar Quick Connect Fitting Service** .

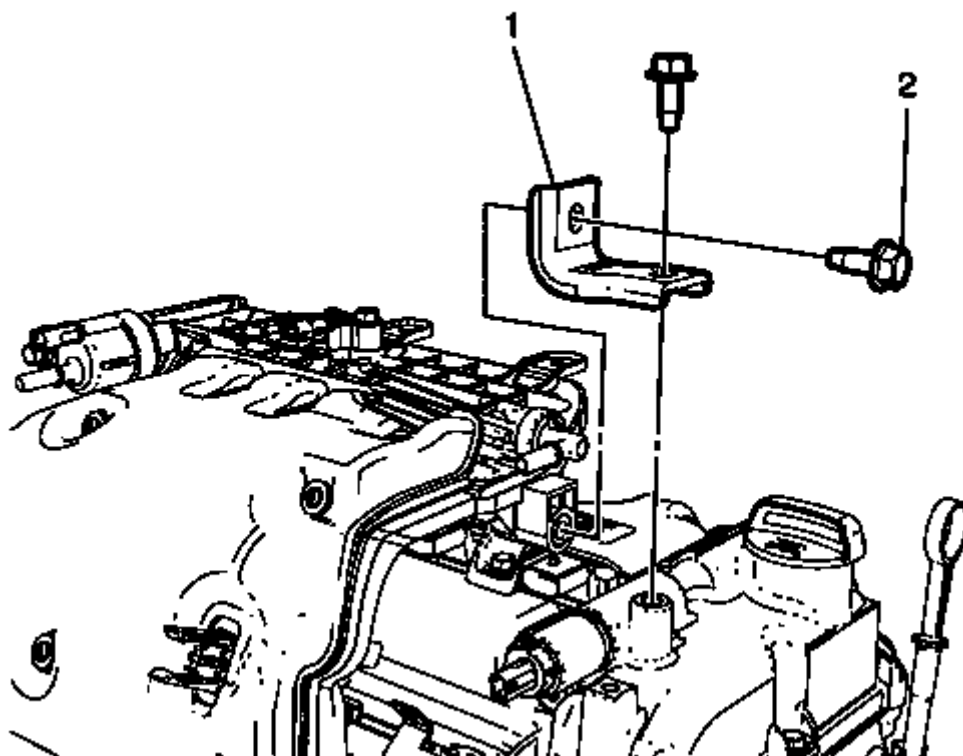


Fig. 37: Intake Manifold Upper Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

14. Remove the intake manifold upper bracket bolts (2).
15. Remove the intake manifold upper bracket (1).

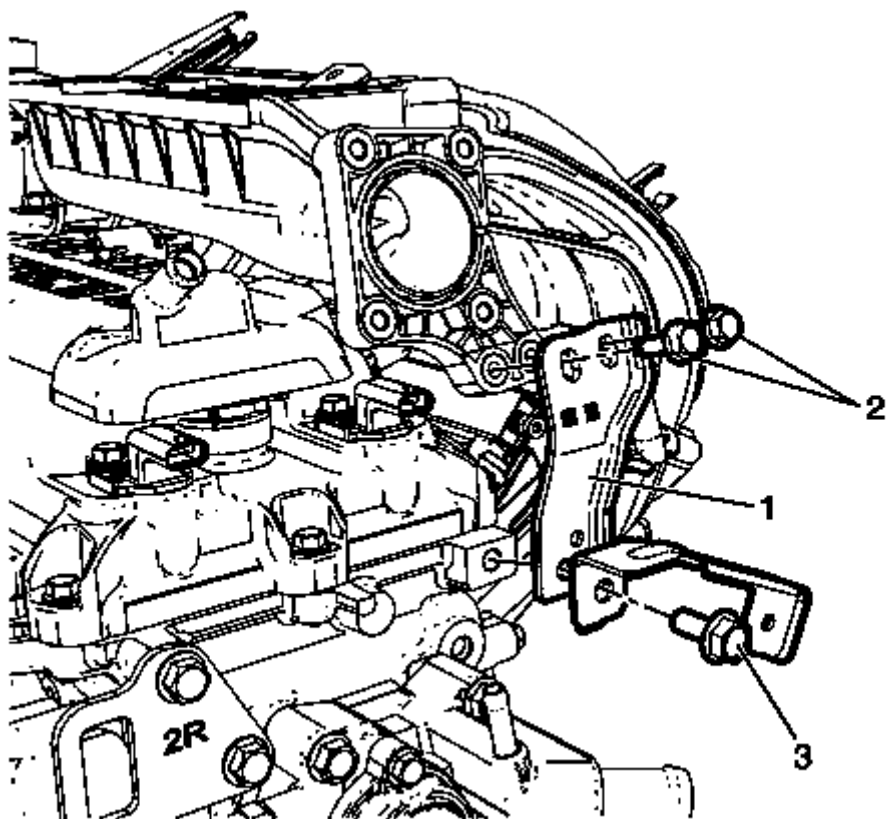


Fig. 38: Intake Manifold Side Bracket And Bolts
Courtesy of GENERAL MOTORS COMPANY

16. Remove the intake manifold side bracket (1) and bolts (2, 3).
17. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** .
18. Remove the exhaust front pipe assembly. Refer to **Exhaust Front Pipe Replacement (LL0)** .

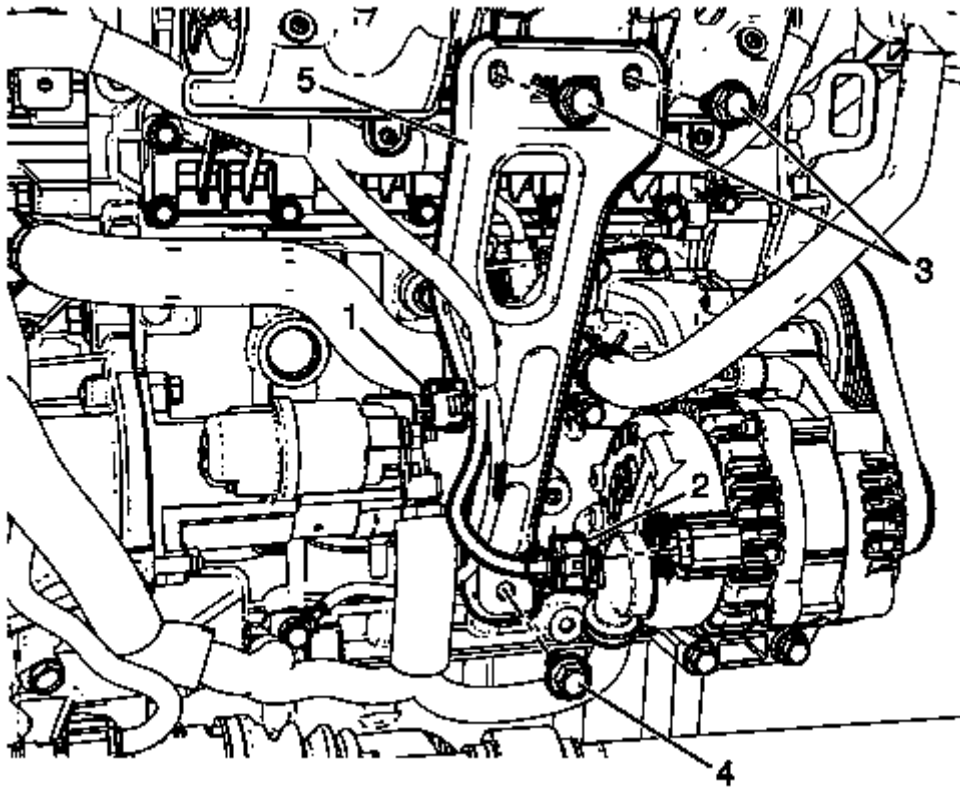


Fig. 39: Starter Connector Wiring Harness Plug
Courtesy of GENERAL MOTORS COMPANY

19. Disconnect the starter connector wiring harness plug (1).
20. Disconnect the generator connector wiring harness plug (2).
21. Remove the 2 intake manifold rear bracket bolts (up) (3).
22. Remove the intake manifold rear bracket bolt (down) (4).
23. Remove the intake manifold bracket (5).
24. Transfer parts as necessary.

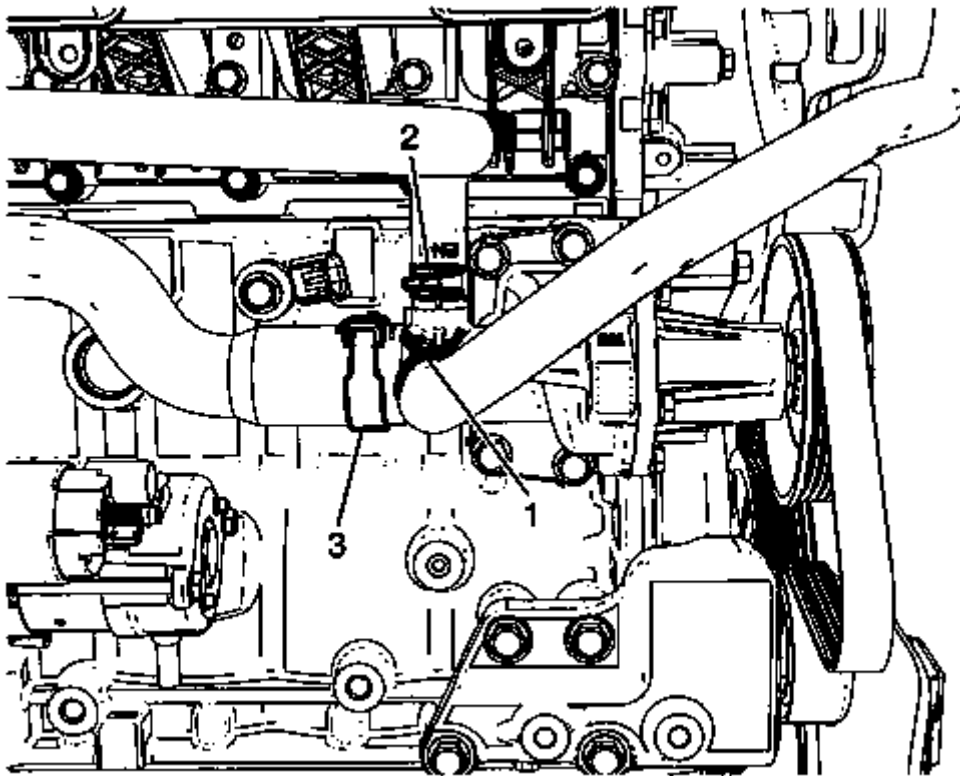


Fig. 40: Heater Outlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

25. Disconnect the heater outlet hose and clamp (2).

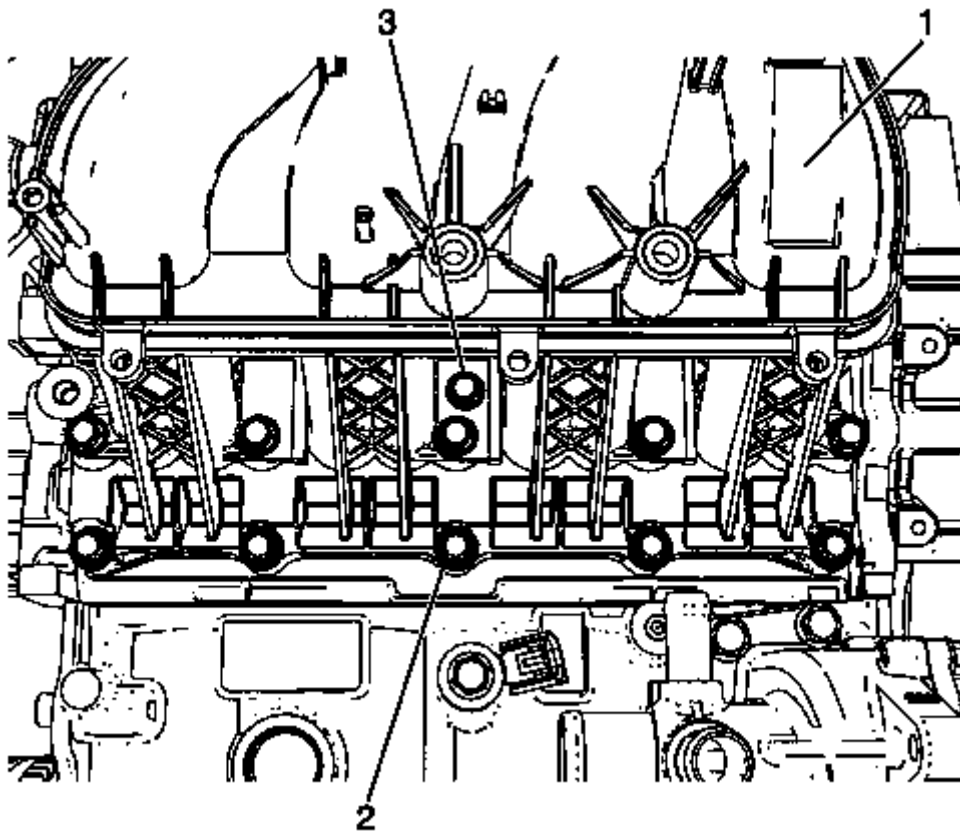


Fig. 41: Lower Intake Manifold And Bolts
Courtesy of GENERAL MOTORS COMPANY

26. Remove the intake manifold 11 bolts (2, 3).
27. Lower the vehicle.
28. Remove the ignition coil cover. Refer to **Ignition Coil Cover Replacement (LL0)**, **Ignition Coil Cover Replacement (LFM)**.
29. Remove the intake manifold (1).
30. Disconnect any electrical connectors as needed.
31. Transfer parts as necessary.

Installation Procedure

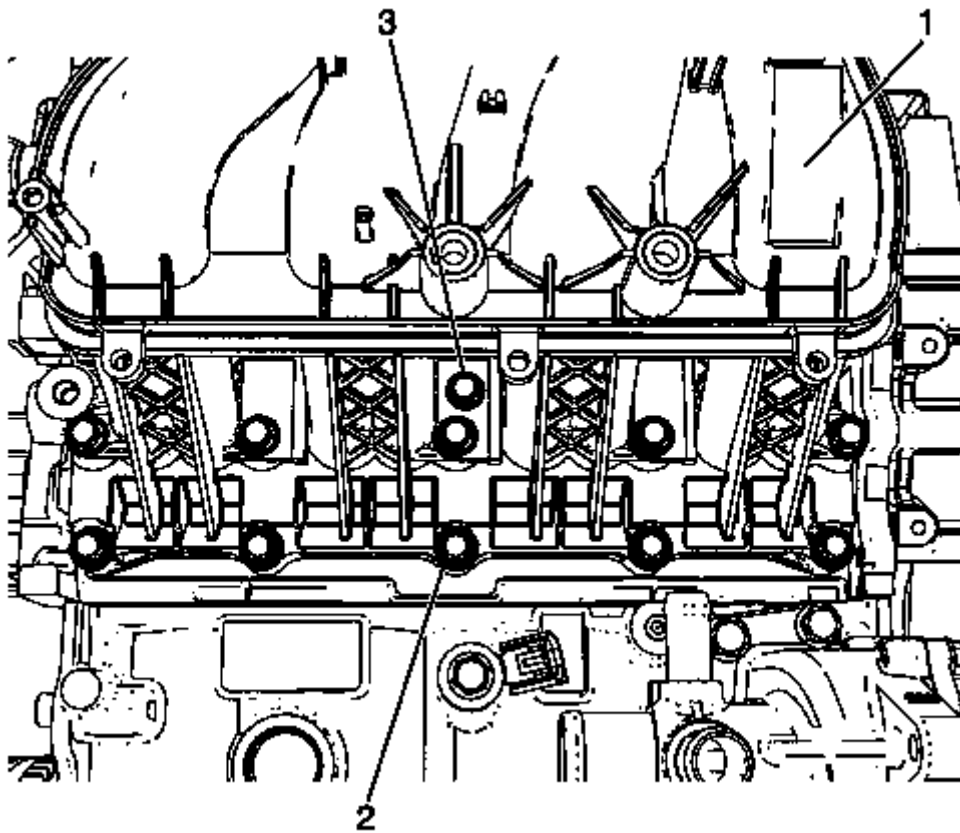


Fig. 42: Lower Intake Manifold And Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the intake manifold (1).
2. Install the ignition coil cover. Refer to **Ignition Coil Cover Replacement (LL0)**, **Ignition Coil Cover Replacement (LFM)**.
3. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** .

CAUTION: Refer to Fastener Caution .

4. Install the intake manifold 11 bolts (2, 3) and tighten to 10 (89 lb in).

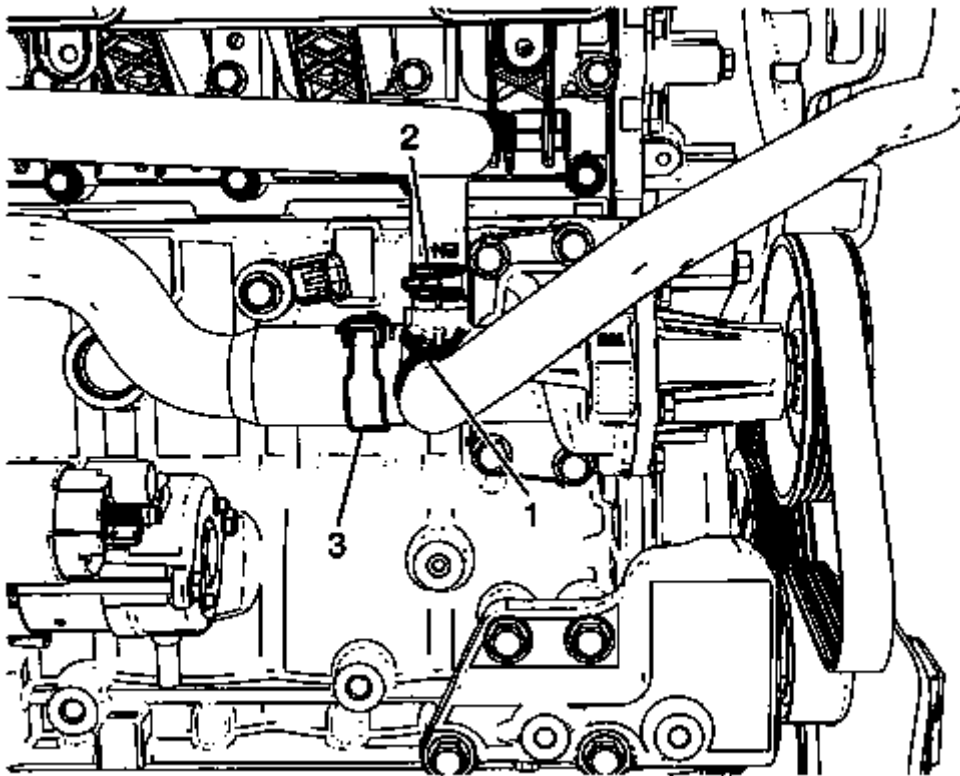


Fig. 43: Heater Outlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

5. Connect the heater outlet hose and clamp (2).

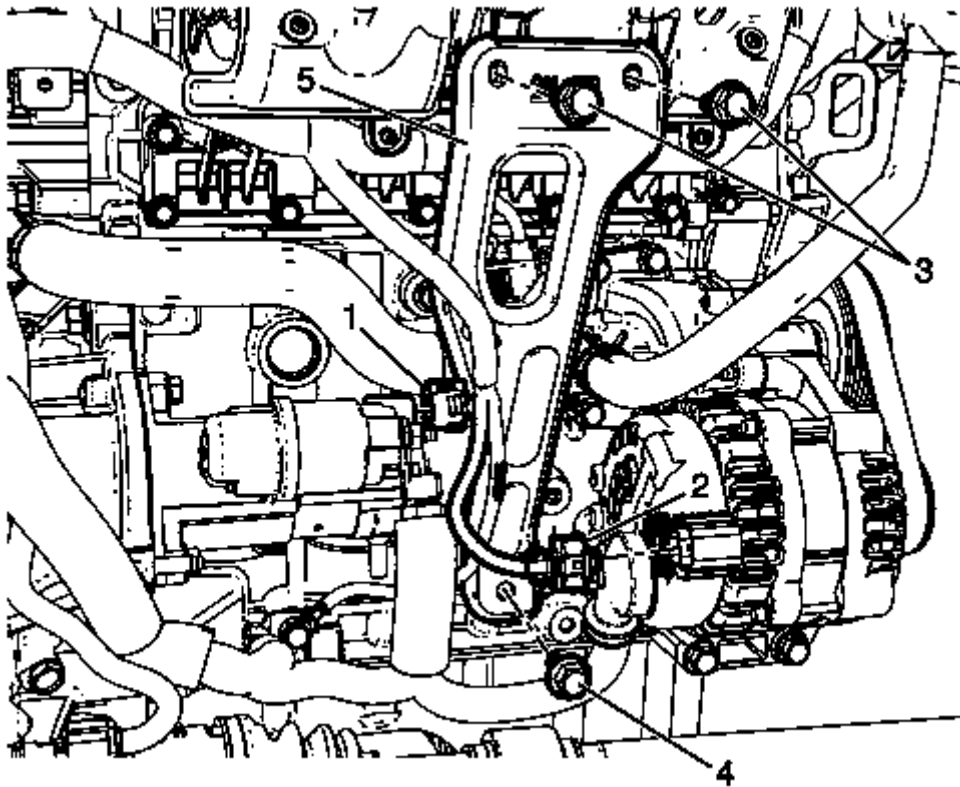


Fig. 44: Starter Connector Wiring Harness Plug
Courtesy of GENERAL MOTORS COMPANY

6. Install the intake manifold rear bracket (5).

CAUTION: Refer to Fastener Caution .

7. Install the 2 intake manifold rear bracket bolts (up) (3) and tighten to 22 (16 lb ft)
8. Install the intake manifold rear bracket bolt (down) (4) and tighten to 58 (42 lb ft)
9. Connect the starter connector wiring harness plug (1).
10. Connect the generator connector wiring harness plug (2).
11. Install the exhaust front pipe assembly. Refer to **Exhaust Front Pipe Replacement (LL0)** .
12. Lower the vehicle.

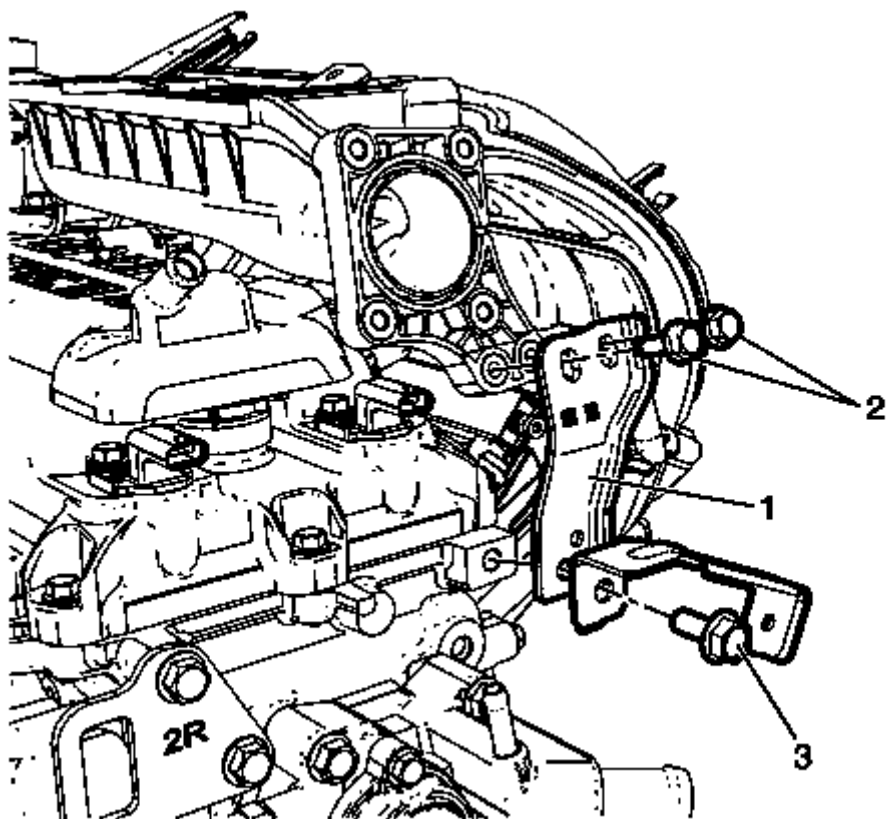


Fig. 45: Intake Manifold Side Bracket And Bolts
Courtesy of GENERAL MOTORS COMPANY

13. Install the intake manifold side bracket (1).
14. Install the intake manifold side bracket bolts (2) and tighten to 10 (89 lb in).
15. Install the intake manifold side bracket bolt (3) and tighten to 25 (18 lb ft).

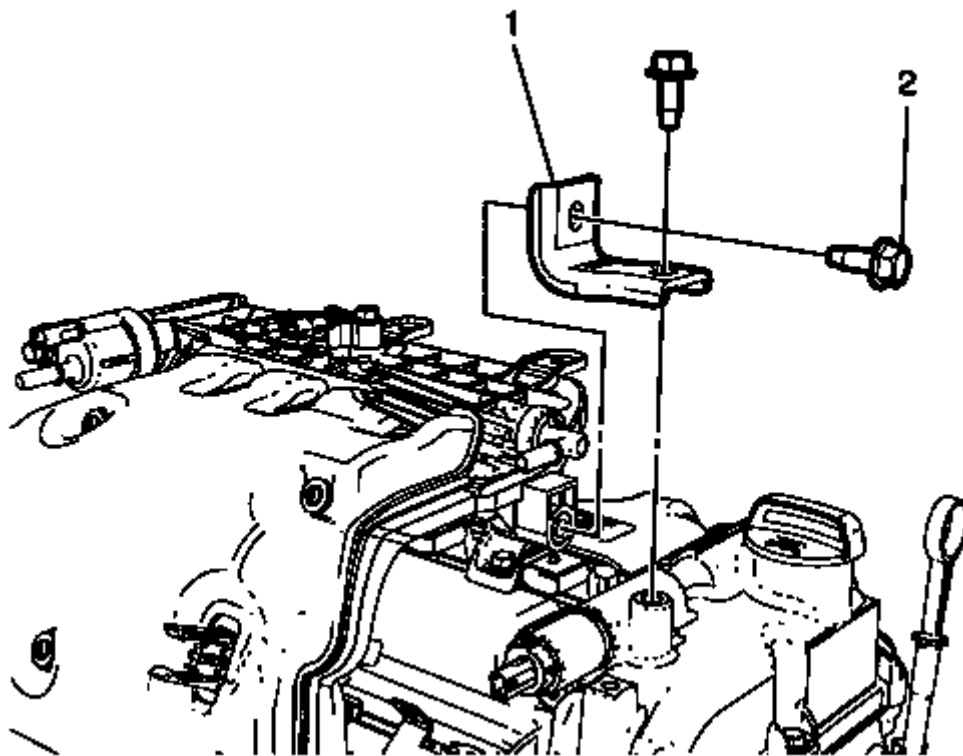


Fig. 46: Intake Manifold Upper Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

16. Install the intake manifold upper bracket (1).
17. Install the intake manifold upper bracket bolts (2) and tighten to 25 (18 lb ft).
18. Connect the fuel feed line quick connect fitting to the fuel rail. Refer to **Metal Collar Quick Connect Fitting Service** .
19. Connect the power brake booster vacuum hose to intake manifold. Refer to **Power Brake Booster Vacuum Hose Replacement** .

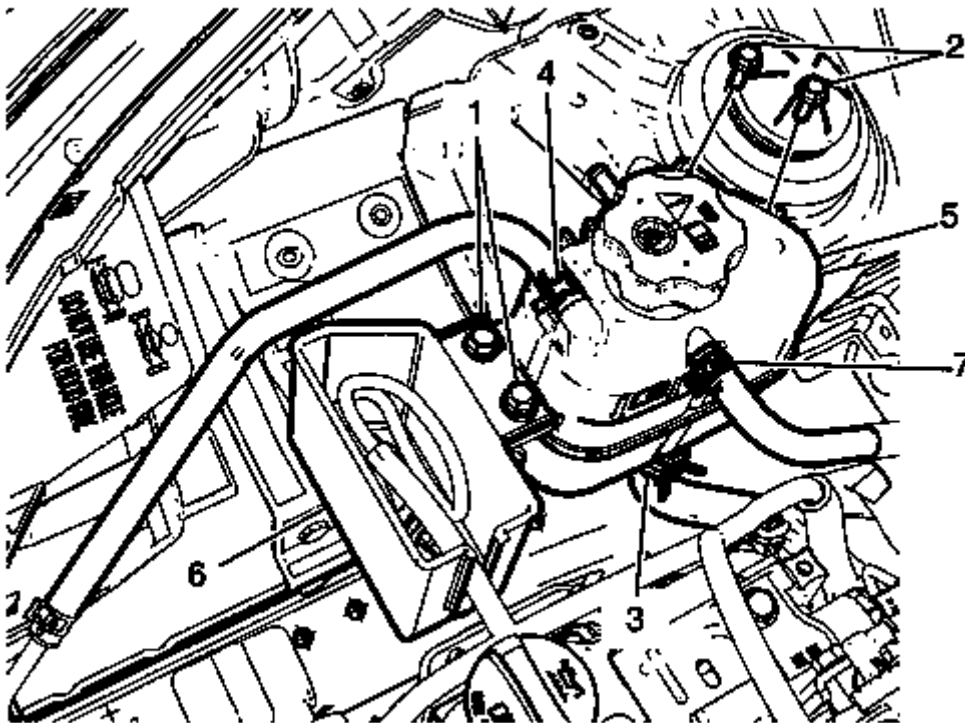


Fig. 47: Block Heater Connecting Plug Holder Bolt
Courtesy of GENERAL MOTORS COMPANY

20. Install the radiator surge tank mounting bolts (2) and tighten to 8 (71 lb in)
21. If equipped with a block heater, install the block heater connecting plug holder bolts (1) and tighten to 10 (89 lb in)
22. Install the coolant hose and clamp (7) to the radiator surge tank and intake manifold.
23. Install the evaporative emission canister purge solenoid valve. Refer to **Evaporative Emission Canister Purge Solenoid Valve Replacement (LL0)** , **Evaporative Emission Canister Purge Solenoid Valve Replacement (LFM)** .
24. Install the manifold absolute pressure sensor. Refer to **Manifold Absolute Pressure Sensor Replacement (LL0)** , **Manifold Absolute Pressure Sensor Replacement (LFM)** .
25. Install the positive crankcase ventilation hose. Refer to **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (LL0)**, **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (LFM)**.
26. Install the throttle body assembly. Refer to **Throttle Body Assembly Replacement (LL0)** , **Throttle Body Assembly Replacement (LFM)** .
27. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
28. Fill the cooling system. Refer to **Cooling System Draining and Filling** .
29. Connect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection** .
30. Close the hood.

CYLINDER HEAD REPLACEMENT (LL0)

Removal Procedure

1. Remove the engine from the vehicle. Refer to **Engine Replacement (LFM), Engine Replacement (LL0)**.
2. Remove the exhaust manifold. Refer to **Exhaust Manifold Removal**.
3. Remove the intake manifold. Refer to **Intake Manifold Removal (LL0), Intake Manifold Removal (LFM)**.
4. Remove the engine coolant outlet adapter. Refer to **Engine Water Outlet Adapter Removal**.
5. Remove the ignition coil. Refer to **Ignition Coil Removal**.
6. Remove the spark plug.
7. Remove the camshaft position actuator solenoid valve. Refer to **Camshaft Position Actuator Solenoid Valve Removal**.
8. Remove the camshaft cover. Refer to **Camshaft Cover Removal**.
9. Remove the oil level indicator and tube. Refer to **Oil Level Indicator and Tube Removal**.
10. Remove the generator. Refer to **Generator Replacement**.
11. Remove the generator bracket. Refer to **Generator Bracket Removal**.
12. Remove the water pump. Refer to **Water Pump Removal**.
13. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Removal**.
14. Remove the oil pan. Refer to **Oil Pan Removal**.
15. Remove the engine front cover. Refer to **Engine Front Cover and Oil Pump Removal**.
16. Remove the timing chain tensioner. Refer to **Timing Chain Tensioner Removal**.
17. Remove the timing chain guide. Refer to **Timing Chain Guide Removal**.
18. Remove the camshaft timing chain. Refer to **Camshaft Timing Chain Removal**.
19. Remove the crankshaft sprocket. Refer to **Crankshaft Sprocket Removal**.
20. Remove the camshaft. Refer to **Camshaft Removal (LL0), Camshaft Removal (LFM)**.
21. Remove the cylinder head. Refer to **Cylinder Head and Gasket Removal**.
22. For disassembly of the cylinder head, refer to **Cylinder Head Disassemble**.
23. Clean and inspect the cylinder head. Refer to **Cylinder Head Cleaning and Inspection**.

Installation Procedure

1. For assembly of the cylinder head, refer to **Cylinder Head Assemble**.
2. Install the cylinder head. Refer to **Cylinder Head and Gasket Installation**.
3. Install the camshaft. Refer to **Camshaft Installation (LL0), Camshaft Installation (LFM)**.
4. Install the crankshaft sprocket. Refer to **Crankshaft Sprocket Installation**.
5. Install the camshaft timing chain. Refer to **Camshaft Timing Chain Installation**.
6. Install the timing chain guide. Refer to **Timing Chain Guide Installation**.
7. Install the timing chain tensioner. Refer to **Timing Chain Tensioner Installation**.

8. Install the engine front cover. Refer to **Engine Front Cover and Oil Pump Installation**.
9. Install the oil pan. Refer to **Oil Pan Installation**.
10. Install the crankshaft balancer. Refer to **Crankshaft Balancer Installation**.
11. Install the water pump. Refer to **Water Pump Installation**.
12. Install the generator bracket. Refer to **Generator Bracket Installation**.
13. Install the generator. Refer to **Generator Replacement**.
14. Install the oil level indicator and tube. Refer to **Oil Level Indicator and Tube Installation**.
15. Install the camshaft cover. Refer to **Camshaft Cover Installation**.
16. Install the camshaft position actuator solenoid valve. Refer to **Camshaft Position Actuator Solenoid Valve Installation**.

CAUTION: Refer to Fastener Caution.

17. Install the spark plug and tighten to 20 (15 lb ft).
18. Install the ignition coil. Refer to **Ignition Coil Installation**.
19. Install the engine coolant outlet adapter. Refer to **Engine Water Outlet Adapter Removal**.
20. Install the intake manifold. Refer to **Intake Manifold Installation (LL0)**, **Intake Manifold Installation (LFM)**.
21. Install the exhaust manifold. Refer to **Exhaust Manifold Installation**.
22. Install the engine to the vehicle. Refer to **Engine Replacement (LFM)**, **Engine Replacement (LL0)**.

CYLINDER HEAD REPLACEMENT (LFM)

Removal Procedure

1. Remove the engine from the vehicle. Refer to **Engine Replacement (LFM)**, **Engine Replacement (LL0)**.
2. Remove the exhaust manifold. Refer to **Exhaust Manifold Removal**.
3. Remove the intake manifold. Refer to **Intake Manifold Removal (LL0)**, **Intake Manifold Removal (LFM)**.
4. Remove the engine coolant outlet adapter. Refer to **Engine Water Outlet Adapter Removal**.
5. Remove the ignition coil. Refer to **Ignition Coil Removal**.
6. Remove the spark plug.
7. Remove the camshaft position actuator solenoid valve. Refer to **Camshaft Position Actuator Solenoid Valve Removal**.
8. Remove the camshaft cover. Refer to **Camshaft Cover Removal**.
9. Remove the oil level indicator and tube. Refer to **Oil Level Indicator and Tube Removal**.
10. Remove the generator. Refer to **Generator Replacement**.
11. Remove the generator bracket. Refer to **Generator Bracket Removal**.

12. Remove the water pump. Refer to **Water Pump Removal**.
13. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Removal**.
14. Remove the oil pan. Refer to **Oil Pan Removal**.
15. Remove the engine front cover. Refer to **Engine Front Cover and Oil Pump Removal**.
16. Remove the timing chain tensioner. Refer to **Timing Chain Tensioner Removal**.
17. Remove the timing chain guide. Refer to **Timing Chain Guide Removal**.
18. Remove the camshaft timing chain. Refer to **Camshaft Timing Chain Removal**.
19. Remove the crankshaft sprocket. Refer to **Crankshaft Sprocket Removal**.
20. Remove the camshaft. Refer to **Camshaft Removal (LL0)**, **Camshaft Removal (LFM)**.
21. Remove the cylinder head. Refer to **Cylinder Head and Gasket Removal**.
22. For disassembly of the cylinder head, refer to **Cylinder Head Disassemble**.
23. Clean and inspect the cylinder head. Refer to **Cylinder Head Cleaning and Inspection**.

Installation Procedure

1. For assembly of the cylinder head, refer to **Cylinder Head Assemble**.
2. Install the cylinder head. Refer to **Cylinder Head and Gasket Installation**.
3. Install the camshaft. Refer to **Camshaft Installation (LL0)**, **Camshaft Installation (LFM)**.
4. Install the crankshaft sprocket. Refer to **Crankshaft Sprocket Installation**.
5. Install the camshaft timing chain. Refer to **Camshaft Timing Chain Installation**.
6. Install the timing chain guide. Refer to **Timing Chain Guide Installation**.
7. Install the timing chain tensioner. Refer to **Timing Chain Tensioner Installation**.
8. Install the engine front cover. Refer to **Engine Front Cover and Oil Pump Installation**.
9. Install the oil pan. Refer to **Oil Pan Installation**.
10. Install the crankshaft balancer. Refer to **Crankshaft Balancer Installation**.
11. Install the water pump. Refer to **Water Pump Installation**.
12. Install the generator bracket. Refer to **Generator Bracket Installation**.
13. Install the generator. Refer to **Generator Replacement**.
14. Install the oil level indicator and tube. Refer to **Oil Level Indicator and Tube Installation**.
15. Install the camshaft cover. Refer to **Camshaft Cover Installation**.
16. Install the camshaft position actuator solenoid valve. Refer to **Camshaft Position Actuator Solenoid Valve Installation**.

CAUTION: Refer to Fastener Caution .

17. Install the spark plug and tighten to 20 (15 lb ft).
18. Install the ignition coil. Refer to **Ignition Coil Installation**.
19. Install the engine coolant outlet adapter. Refer to **Engine Water Outlet Adapter Installation**.

20. Install the intake manifold. Refer to **Intake Manifold Installation (LL0)**, **Intake Manifold Installation (LFM)**.
21. Install the exhaust manifold. Refer to **Exhaust Manifold Installation**.
22. Install the engine to the vehicle. Refer to **Engine Replacement (LFM)**, **Engine Replacement (LL0)**.

OIL PAN REPLACEMENT

Removal Procedure

1. Open the hood.
2. Raise the vehicle by its full height. Refer to **Lifting and Jacking the Vehicle** .
3. Place collecting basin underneath.
4. Remove the oil drain bolt.
5. Collect the engine oil.
6. Install the oil drain bolt.
7. Lower the vehicle by its full height.
8. Remove the oil level indicator tube. Refer to **Oil Level Indicator Tube Replacement**.
9. Raise the vehicle by its full height.
10. Remove the front compartment splash shield. Refer to **Front Compartment Splash Shield Replacement** .
11. If equipped with an exhaust front pipe assembly, refer to **Exhaust Front Pipe Replacement (LL0)** .
12. If equipped with an exhaust pipe assembly, refer to **Exhaust Pipe Replacement (LFM)** .

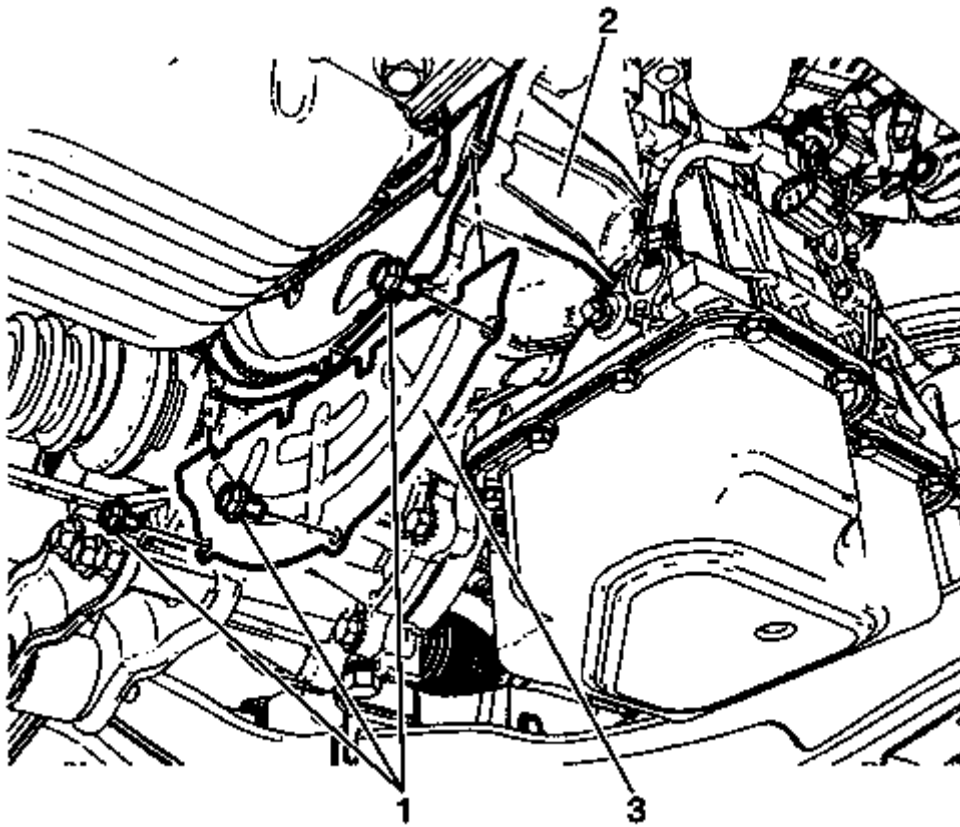


Fig. 48: Housing Lower Plate Bolts
Courtesy of GENERAL MOTORS COMPANY

13. Remove the 3 housing lower plate bolts (1) from the transmission (2).
14. Remove the transmission housing lower plate (3).

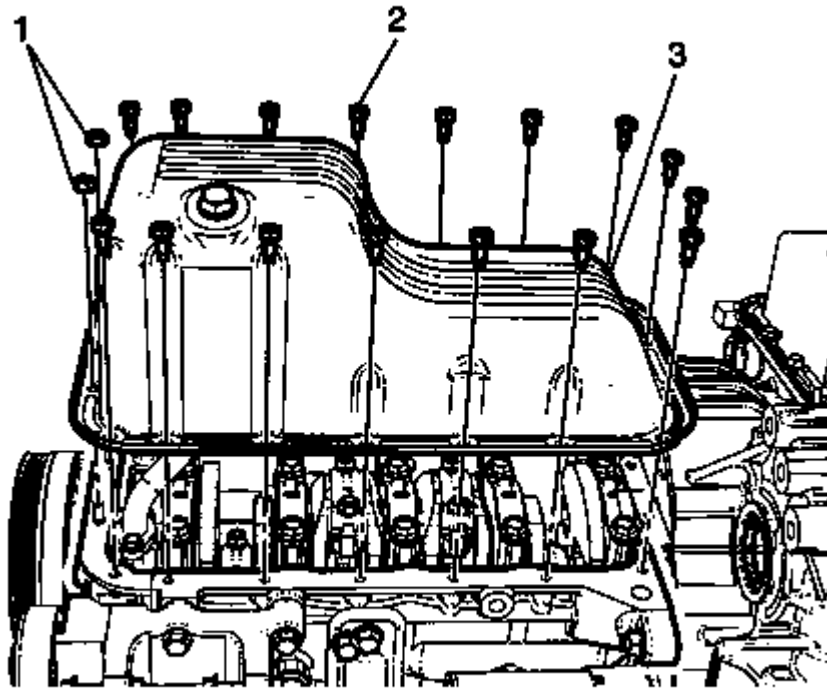


Fig. 49: Oil Pan Bolts And Nuts
Courtesy of GENERAL MOTORS COMPANY

NOTE: Remove the oil pan evenly all the way around with a suitable tool. Do not damage sealing surfaces on block.

15. Remove the 16 oil pan bolts (2), 2 nuts (1) and remove the oil pan (3) and discard oil pan.

Installation Procedure

NOTE: Cleaning of the sealing surfaces (1-4): Refer to Replacing Engine Gaskets.

1. Remove any old thread sealant, gasket material or sealant.
2. Clean the sealing surfaces of front cover and front cover components with solvent.

NOTE: Ensure that the sealing surface is clear of oil, grease and oil sealant material.

3. Clean out debris from the bolt holes.

WARNING: Refer to Safety Glasses and Compressed Air Warning .

4. Dry the front cover and front cover components with compressed air.

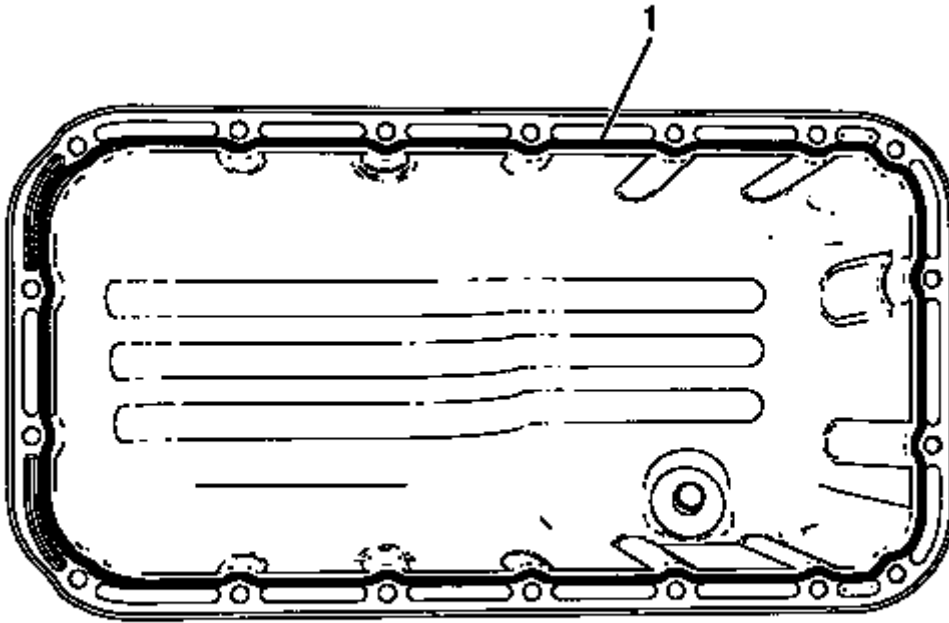


Fig. 50: Oil Pan Sealant
Courtesy of GENERAL MOTORS COMPANY

NOTE: Use a new oil pan.

NOTE: Do not coat sealant (RTV) on the front cover bolt holes and bolt threads

5. Apply approximately a 4.5 mm (0.177 in) thick bead of oil pan sealant (1) to the oil pan.

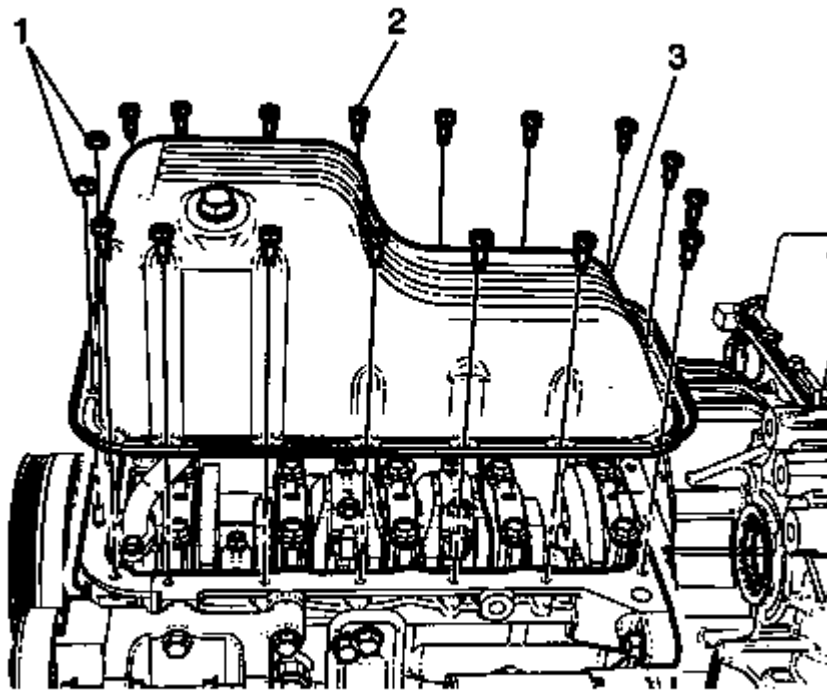


Fig. 51: Oil Pan Bolts And Nuts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

NOTE: After sealant (RTV) dispensing, the assembly completion time including torque check must be done within 8 minutes.

6. Install the 16 oil pan bolts (2), 2 nuts (1) to the oil pan (3) and tighten to 10 (89 lb in).
7. Install the oil drain bolt, tighten to 25 (18 lb ft).

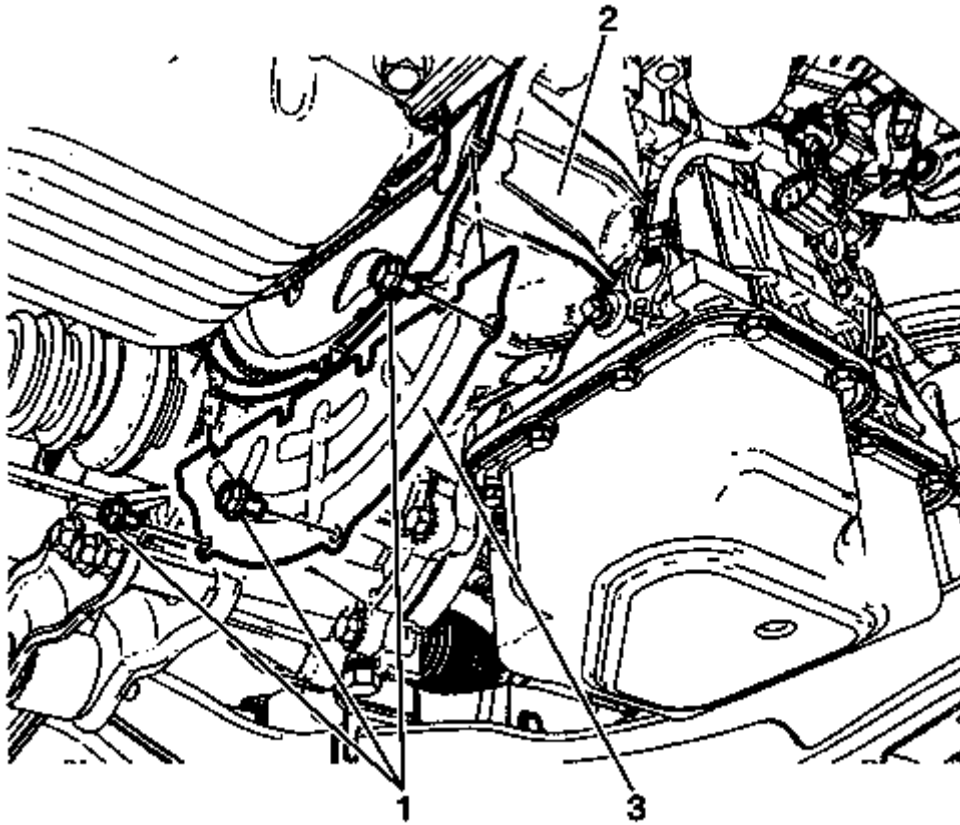


Fig. 52: Housing Lower Plate Bolts
Courtesy of GENERAL MOTORS COMPANY

8. Install the transmission housing lower plate (3).
9. Install the 3 housing lower plate bolts (1) to the transmission (2) and tighten to 9 (80 lb in).
10. If equipped with an exhaust front pipe assembly, refer to **Exhaust Front Pipe Replacement (LL0)** .
11. If equipped with an exhaust pipe assembly, refer to **Exhaust Pipe Replacement (LFM)** .
12. Install the front compartment splash shield. Refer to **Front Compartment Splash Shield Replacement** .
13. Lower the vehicle.
14. Install the oil level indicator tube. Refer to **Oil Level Indicator Tube Replacement**.

NOTE: **Inspect the engine oil level and correct if necessary.**

15. Refill the collected engine oil.
16. Close the hood.

AUTOMATIC TRANSMISSION FLEX PLATE REPLACEMENT

Removal Procedure

1. Remove the automatic transmission. Refer to **Transmission Replacement** .

2. Remove the automatic transmission flex plate. Refer to **Automatic Transmission Flex Plate Removal**.

Installation Procedure

1. Install the automatic transmission flex plate. Refer to **Automatic Transmission Flex Plate Installation**.
2. Install the automatic transmission. Refer to **Transmission Replacement** .

ENGINE FLYWHEEL REPLACEMENT

Removal Procedure

1. Remove the manual transmission. Refer to **Transmission Replacement (MX2, MFM)** .
2. Remove the clutch pressure and driven plate. Refer to **Clutch Pressure and Driven Plate Replacement** .
3. Remove the engine flywheel. Refer to **Engine Flywheel Removal**.

Installation Procedure

1. Install the engine flywheel. Refer to **Engine Flywheel Installation**.
2. Install the clutch pressure and driven plate. Refer to **Clutch Pressure and Driven Plate Replacement** .
3. Install the manual transmission. Refer to **Transmission Replacement (MX2, MFM)** .

AIR CONDITIONING COMPRESSOR BELT REPLACEMENT

Removal Procedure

1. Remove the right front compartment splash. Refer to **Front Compartment Splash Shield Replacement**

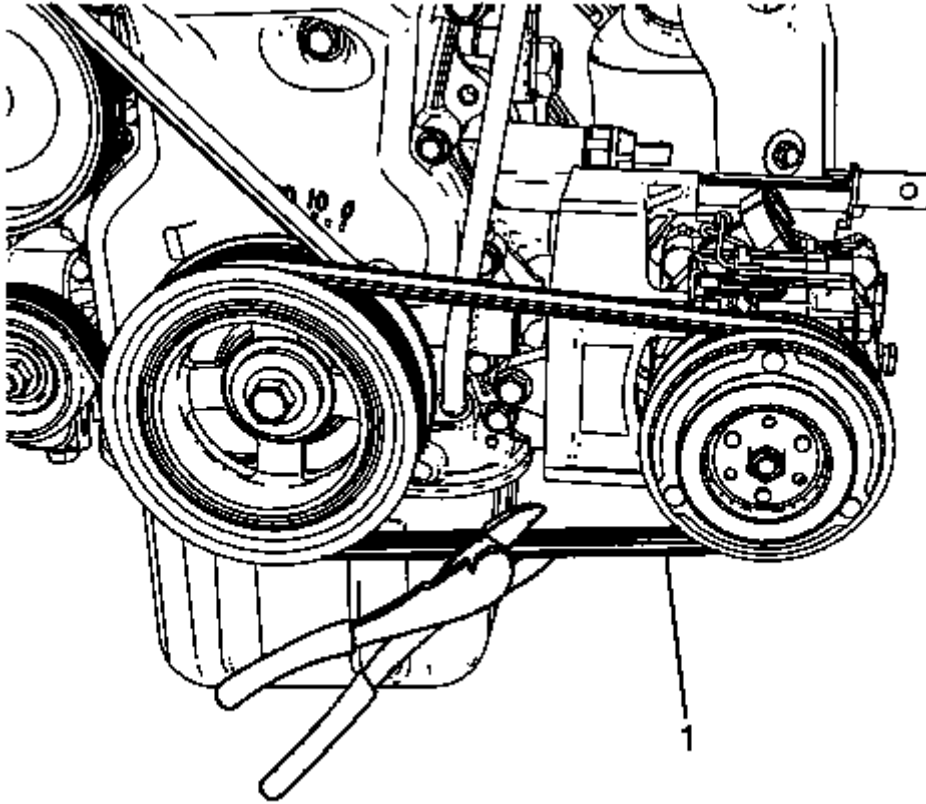


Fig. 53: Air Conditioning (A/C) Belt
Courtesy of GENERAL MOTORS COMPANY

2. Cut the air conditioning (A/C) belt (1) with a appropriate cutting tool as shown.
3. Remove and discard the air conditioning (A/C) belt (1).

Installation Procedure

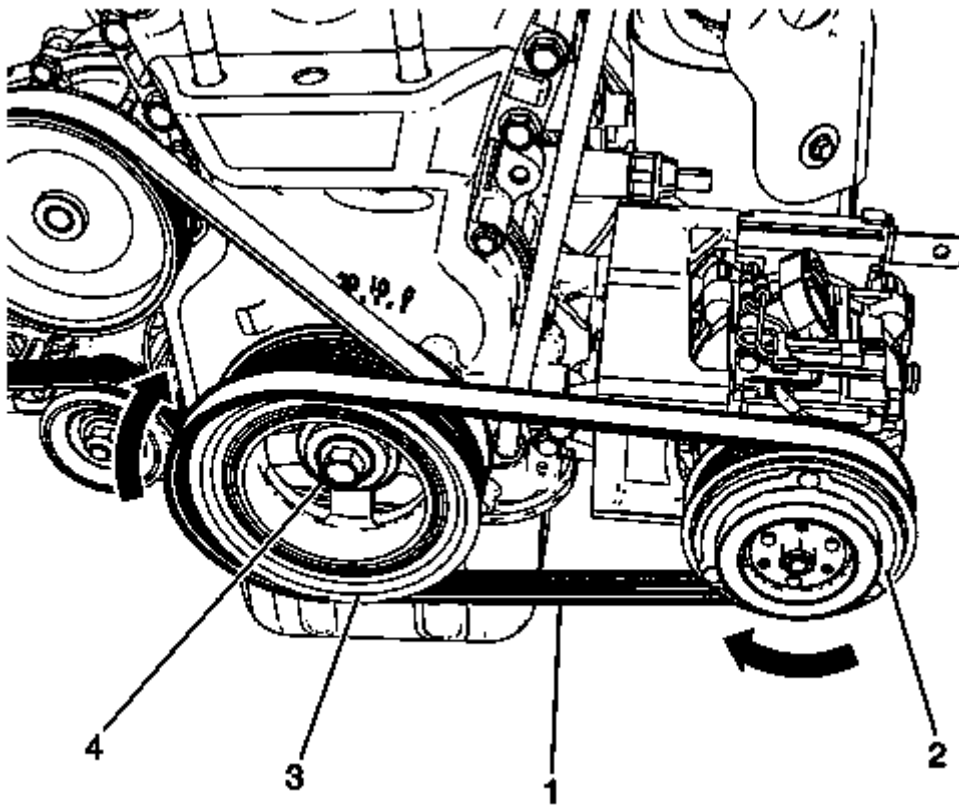


Fig. 54: New Air Conditioning (A/C) Belt
Courtesy of GENERAL MOTORS COMPANY

1. Position a NEW air conditioning (A/C) belt (1) on the crankshaft pulley (3) and air conditioning (A/C) compressor (2) as shown.

NOTE: Push the on belt while rotating the crankshaft pulley.

2. Using a socket and ratchet on the crankshaft pulley bolt (4), rotate the crankshaft in the direction of the arrow until the belt (1) is fully installed on the air conditioning (A/C) compressor (2).
3. After the belt is on the air conditioning (A/C) compressor pulley (2), rotate the crankshaft (3) an additional complete revolution and ensure the air conditioning (A/C) belt (1) is fully seated on the crankshaft (3) and air conditioning (A/C) compressor (2).
4. Install the front wheelhouse liner inner front extension. Refer to **Front Compartment Splash Shield Replacement** .

CRANKSHAFT BALANCER REPLACEMENT

Special Tools

- EN 50175 Crankshaft Locking Device
- EN-51218 Crankshaft Balancer Installer

- **J-22888-20A** Crankshaft Balancer Puller

For equivalent regional tools, refer to **Special Tools**.

Removal Procedure

1. Open the hood.
2. Raise the vehicle by its full height. Refer to **Lifting and Jacking the Vehicle** .

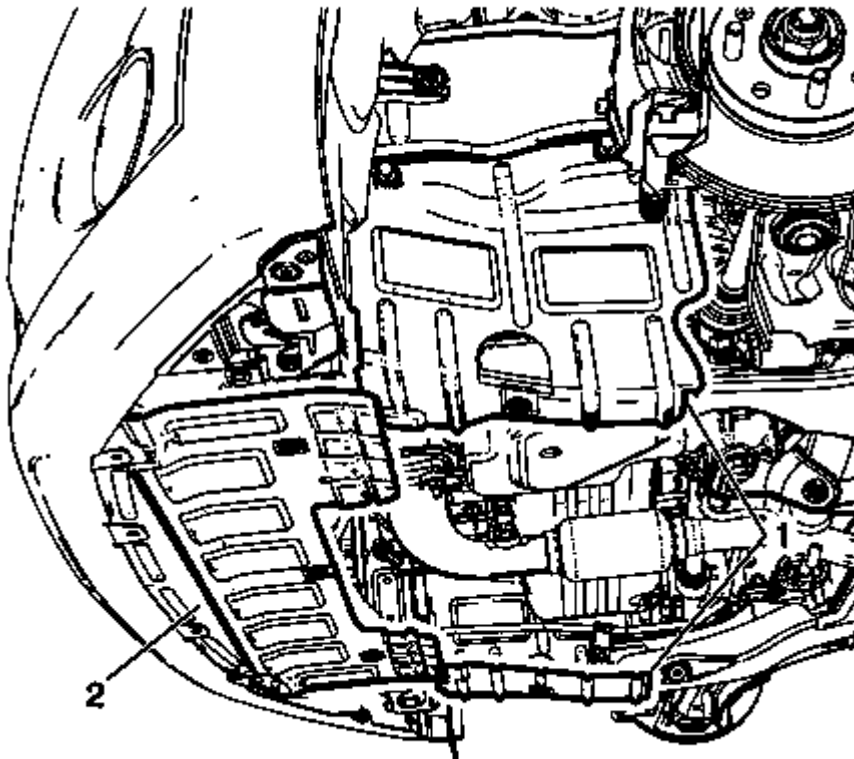


Fig. 55: Compartment Splash Shield
Courtesy of GENERAL MOTORS COMPANY

3. Remove the compartment splash shield (1) right side only. Refer to **Front Compartment Splash Shield Replacement** .
4. Remove the water pump and generator belt. Refer to **Water Pump and Generator Belt Replacement**.

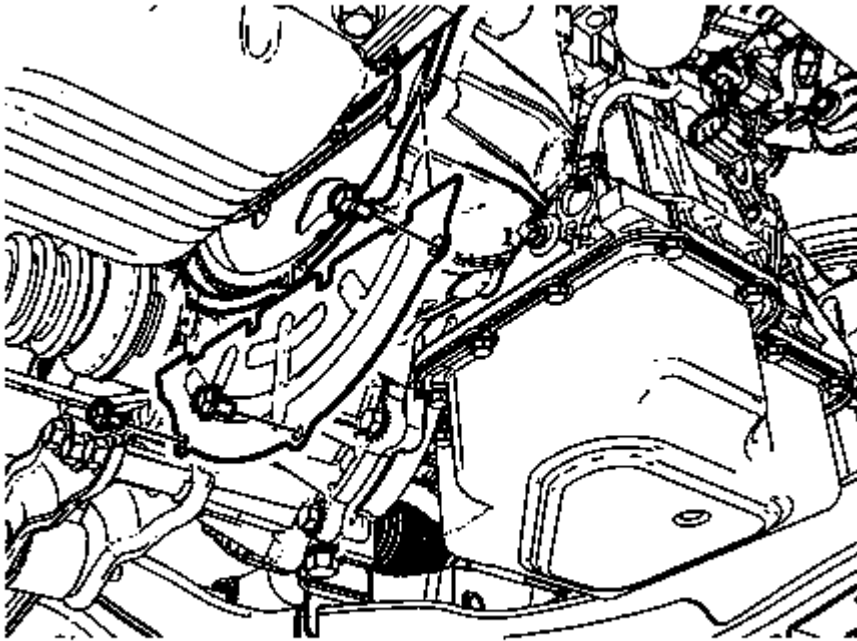


Fig. 56: Housing Lower Plate Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the 3 housing lower plate bolts from the transmission.
6. Remove the transmission housing lower plate.

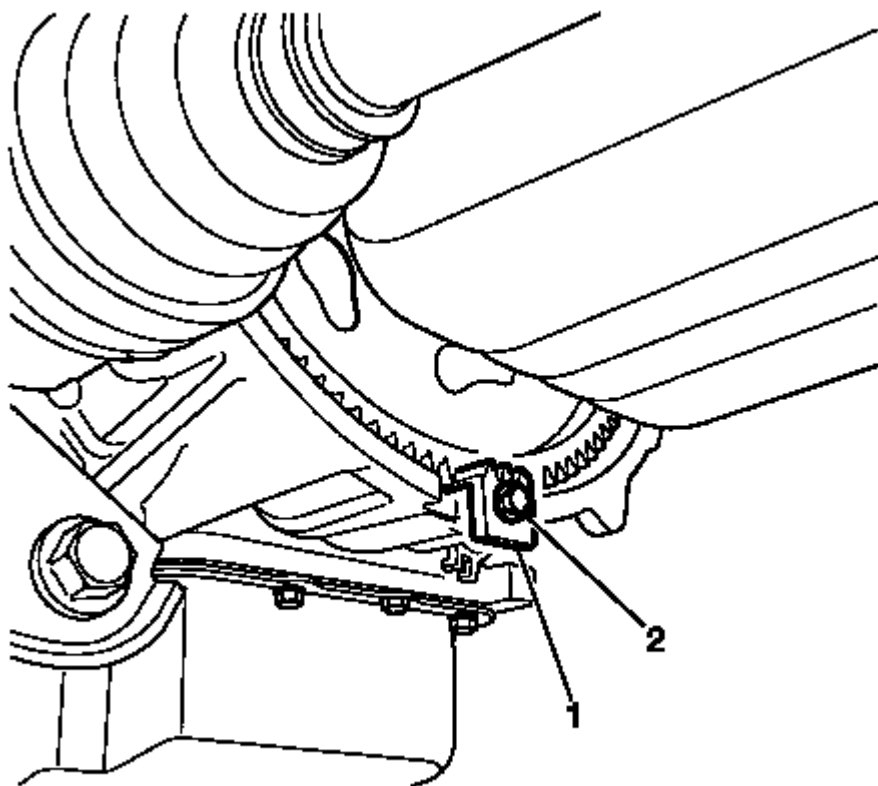


Fig. 57: EN-50175 Crankshaft Locking Device
Courtesy of GENERAL MOTORS COMPANY

7. Install the **EN-50175** crankshaft locking device (1) to lock the crankshaft.
8. Install the bolt (2).

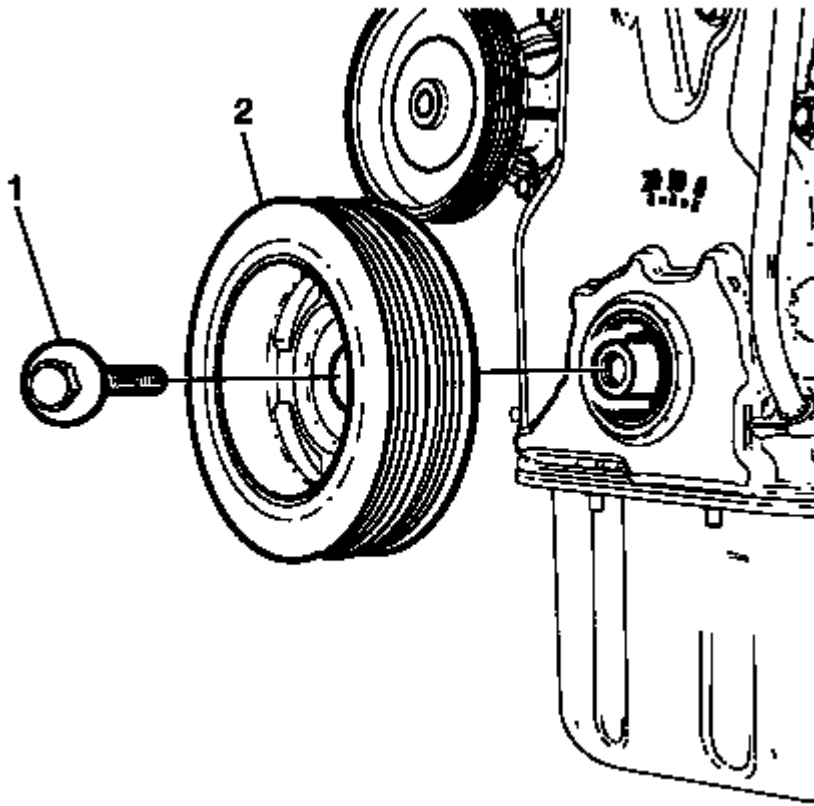


Fig. 58: Crankshaft Balancer Bolt
Courtesy of GENERAL MOTORS COMPANY

9. Remove the crankshaft balancer bolt (1).
10. Install **J-22888-20A** crankshaft balancer puller to the crankshaft balancer (2).
11. Remove the crankshaft balancer (2).

Installation Procedure

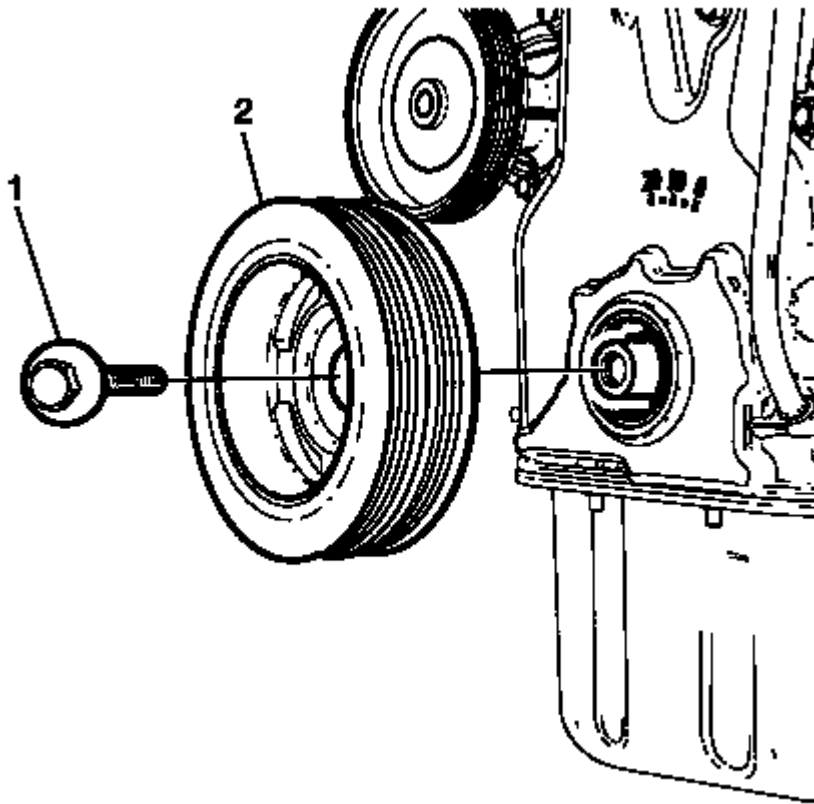


Fig. 59: Crankshaft Balancer Bolt
Courtesy of GENERAL MOTORS COMPANY

1. Install **EN-51218** crankshaft balancer installer or equivalent to the crankshaft balancer (2).
2. Install the crankshaft balancer (2).

CAUTION: Refer to Fastener Caution .

3. Install the NEW crankshaft balancer bolt (1) and tighten to $95 + 55^\circ$ (70 lb ft + 55°).

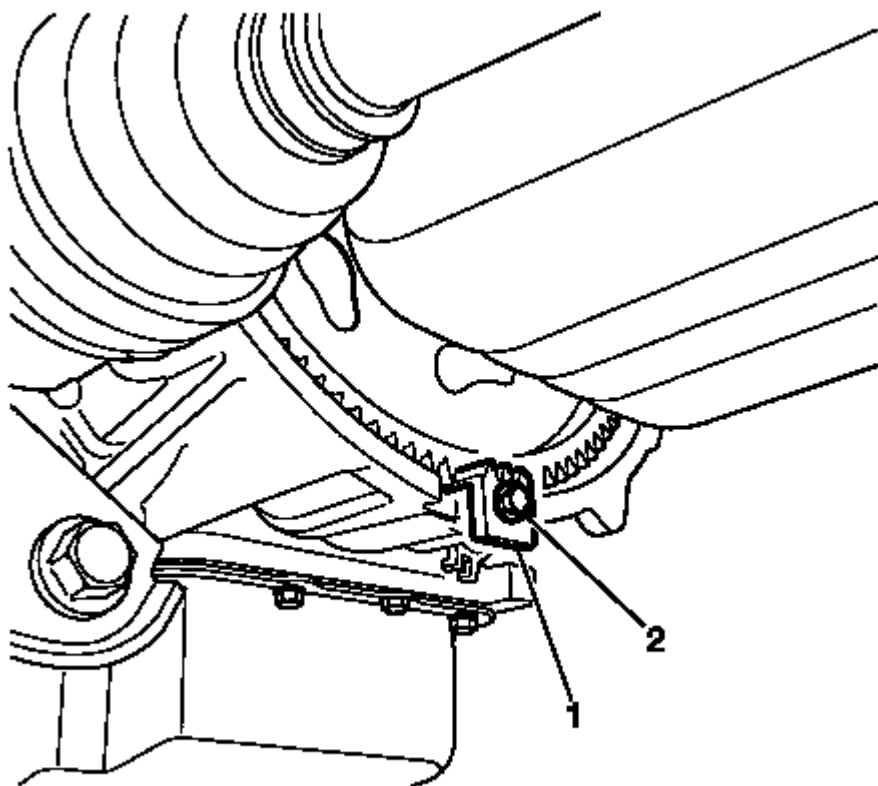


Fig. 60: EN-50175 Crankshaft Locking Device
Courtesy of GENERAL MOTORS COMPANY

4. Remove the bolt (1).
5. Remove the **EN 50175** crankshaft locking device (1).

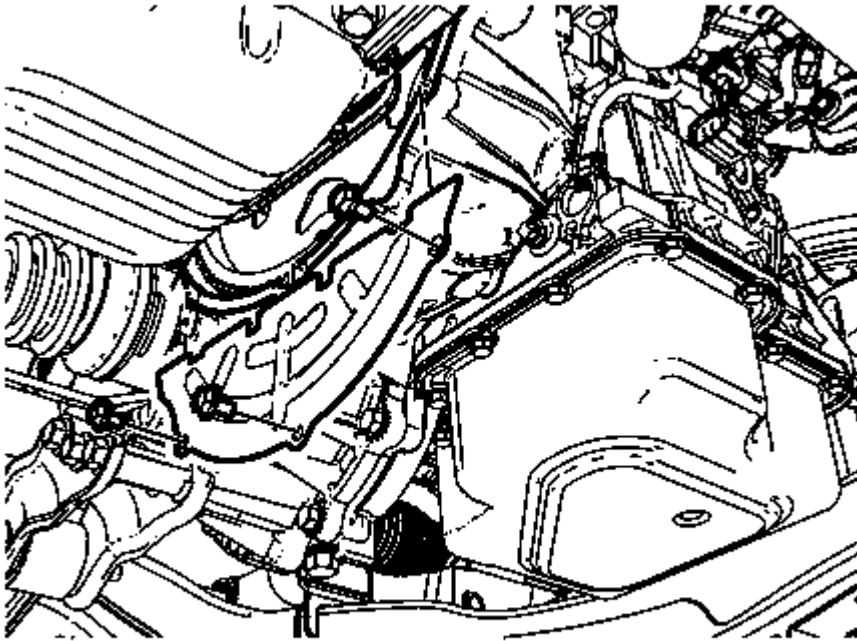


Fig. 61: Housing Lower Plate Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Install the transmission housing lower plate.
7. Install the 3 housing lower plate bolts to the transmission and tighten to 9 (80 lb in).
8. Install the water pump and generator belt. Refer to **Water Pump and Generator Belt Replacement**.

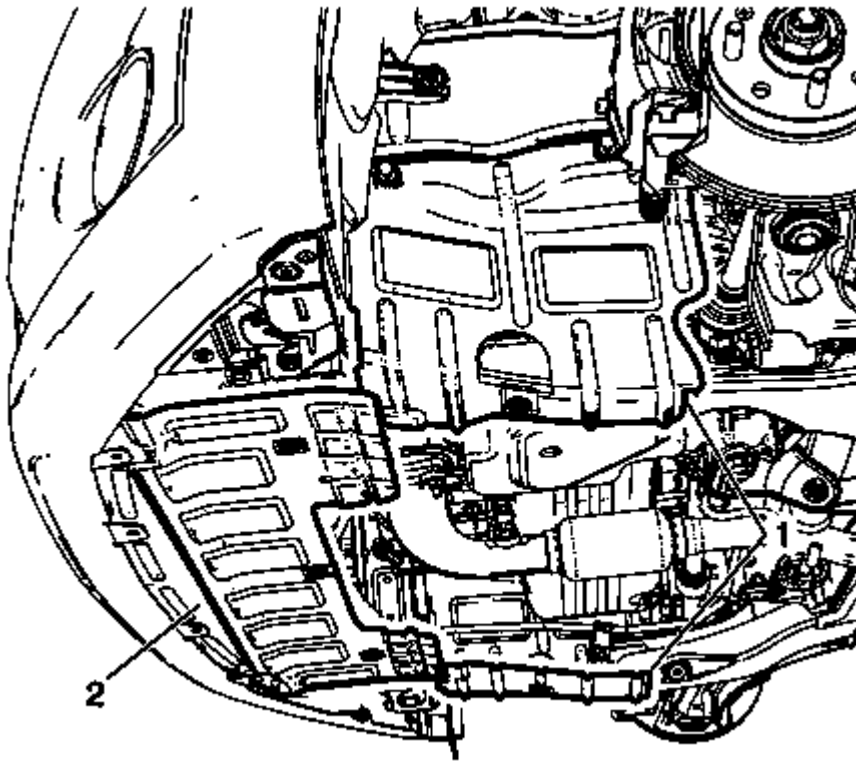


Fig. 62: Compartment Splash Shield
Courtesy of GENERAL MOTORS COMPANY

9. Install the compartment splash shield (1) right side only. Refer to **Front Compartment Splash Shield Replacement** .
10. Lower the vehicle. Refer to **Lifting and Jacking the Vehicle** .
11. Close the hood.

CRANKSHAFT FRONT OIL SEAL REPLACEMENT

Special Tool

J-50172 Crankshaft Front Oil Seal Installer

For equivalent regional tools, refer to **Special Tools**.

Removal Procedure

1. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.

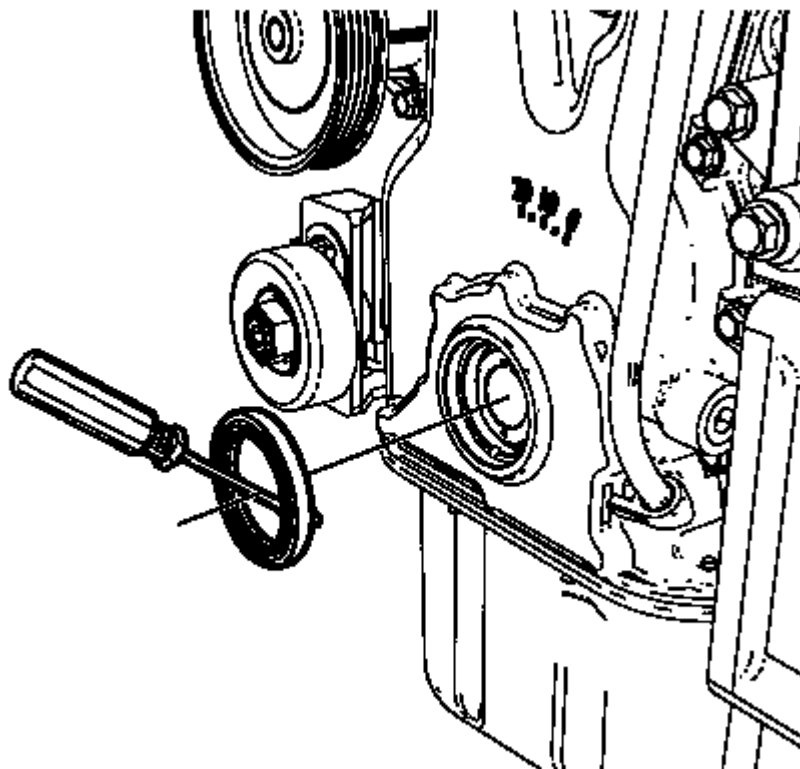


Fig. 63: Using Flat-Bladed Tool To Remove Seal From Front Cover
Courtesy of GENERAL MOTORS COMPANY

2. Use a flat-bladed tool to remove the seal from the front cover.

Installation Procedure

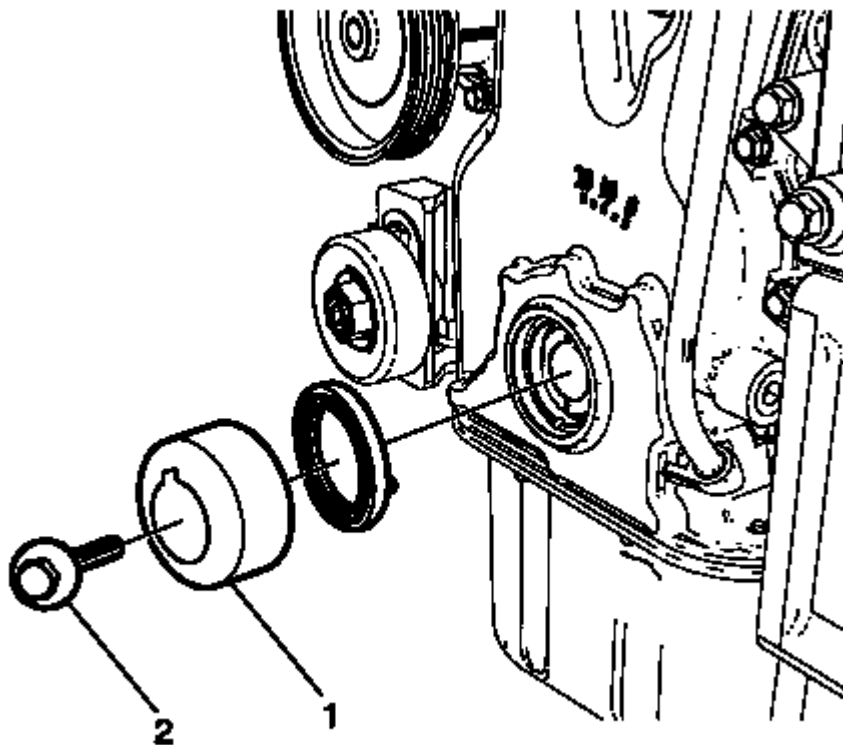


Fig. 64: Crankshaft Bolt And Crankshaft Front Oil Seal Installer
Courtesy of GENERAL MOTORS COMPANY

NOTE: Use the J-50172 crankshaft front oil seal installer in order to install the crankshaft front oil seal to the engine front cover.

1. Install the new crankshaft front oil seal to crankshaft with J-50172 crankshaft front oil seal installer (1).
2. Tighten the crankshaft bolt (2) till the J-50172 crankshaft front oil seal installer seats on the engine front cover.
3. Remove the crankshaft bolt (2).
4. Install the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.

POSITIVE CRANKCASE VENTILATION HOSE/PIPE/TUBE REPLACEMENT (LL0)

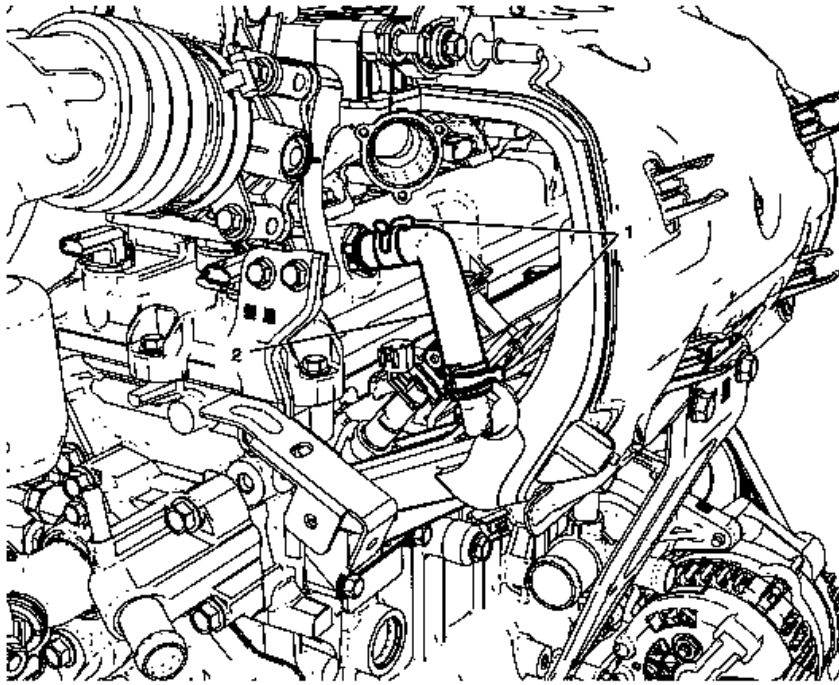


Fig. 65: Positive Crankcase Ventilation Hose/Pipe/Tube
Courtesy of GENERAL MOTORS COMPANY

Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (LL0)

Callout	Component Name
1	Positive Crankcase Ventilation Hose Clamp (Qty: 2) Procedure Remove the positive crankcase ventilation hose clamp.
2	Positive Crankcase Ventilation Hose

POSITIVE CRANKCASE VENTILATION HOSE/PIPE/TUBE REPLACEMENT (LFM)

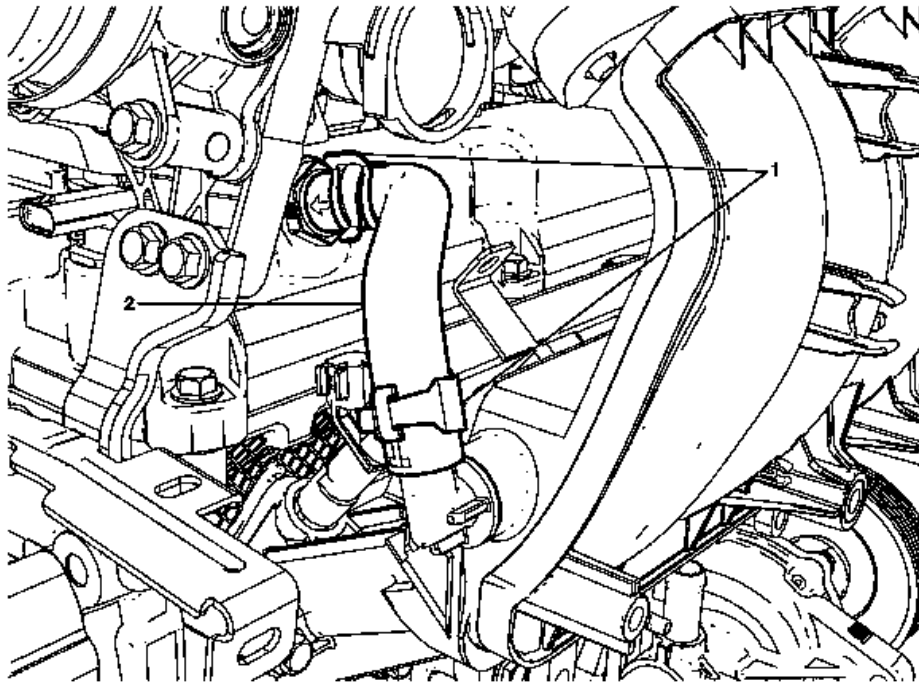


Fig. 66: Positive Crankcase Ventilation Hose/Pipe/Tube (LFM)
 Courtesy of GENERAL MOTORS COMPANY

Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (LFM)

Callout	Component Name
1	Positive Crankcase Ventilation Hose Clamp (Qty: 2) Procedure Remove the positive crankcase ventilation hose clamp.
2	Positive Crankcase Ventilation Hose

ENGINE FRONT COVER WITH OIL PUMP REPLACEMENT

Removal Procedure

1. Remove the engine from the vehicle. Refer to **Engine Replacement (LFM)**, **Engine Replacement (LL0)**.
2. Remove the intake manifold. Refer to **Intake Manifold Removal (LL0)**, **Intake Manifold Removal (LFM)**.
3. Remove the ignition coil. Refer to **Ignition Coil Removal**.
4. Remove the camshaft position actuator solenoid valve. Refer to **Camshaft Position Actuator Solenoid Valve Removal**.
5. Remove the camshaft cover. Refer to **Camshaft Cover Removal**.
6. Remove the engine oil level indicator and tube. Refer to **Oil Level Indicator and Tube Removal**.
7. Remove the engine lift rear bracket. Refer to **Engine Lift Rear Bracket Removal**.
8. Remove the generator. Refer to **Generator Replacement** .

9. Remove the generator bracket. Refer to Generator Bracket Removal.
10. Remove the water pump. Refer to Water Pump Removal.
11. Remove the crankshaft balancer. Refer to Crankshaft Balancer Removal.
12. Remove the oil pan and discard. Refer to Oil Pan Removal.

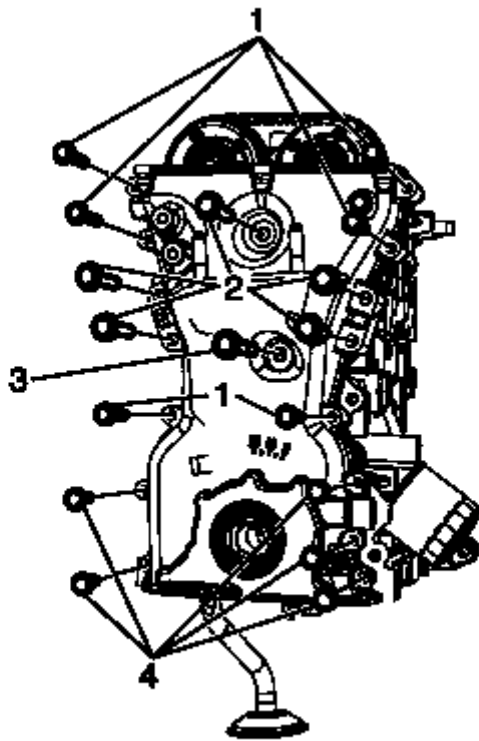


Fig. 67: Engine Front Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

13. Remove the engine front cover bolts (1, 2, 3, 4).

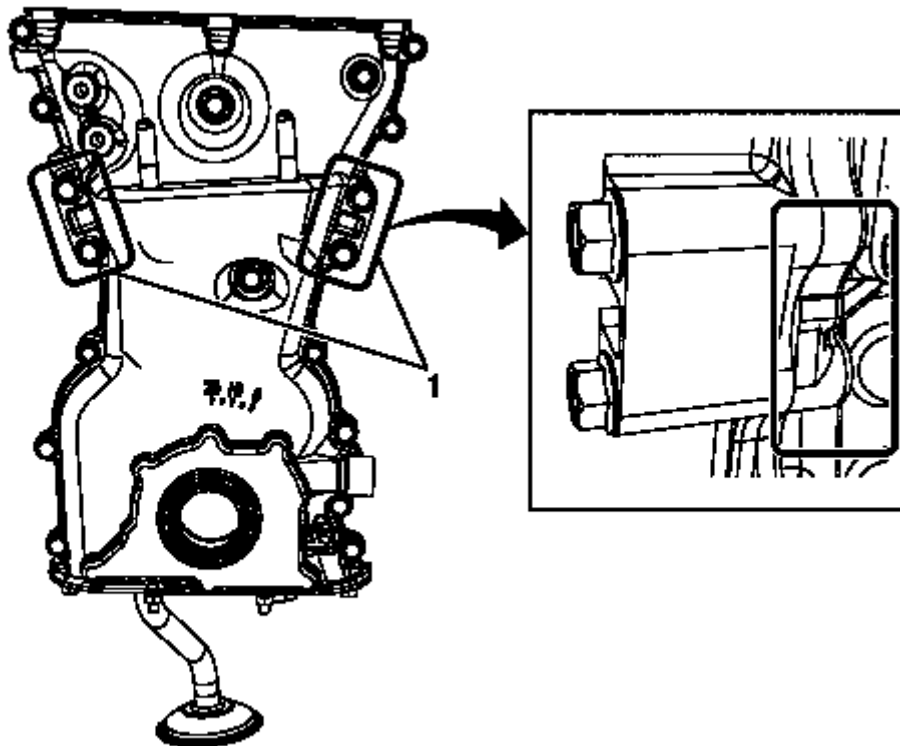


Fig. 68: View Of Pry Points

Courtesy of GENERAL MOTORS COMPANY

NOTE: Use the pry points and a bolt in the jackscrew hole in order to remove the engine front cover.

14. Using the pry points (1) located at the edge of the front cover, shear the room temperature vulcanizing (RTV) sealant.
15. Remove the engine front cover evenly all the way around with a suitable tool.
16. Disassemble the engine front cover and inspect the oil pump. Refer to **Oil Pump Disassemble**.

Installation Procedure

NOTE: DO NOT use sharp and/or gasket scrapers in order to clean the sealing surfaces.

NOTE: Cleaning of the sealing surfaces (1-4): Refer to **Replacing Engine Gaskets**.

1. Remove any old thread sealant, gasket material or sealant using remover such as chisel or scraper.
2. Clean the sealing surfaces of front cover and front cover components with solvent.

NOTE: Ensure that the sealing surface is clear of oil, grease and oil sealant material.

3. Clean out debris from the bolt holes.

WARNING: Refer to Safety Glasses and Compressed Air Warning .

4. Dry the front cover and front cover components with compressed air.
5. Assemble the engine front cover with the oil pump. Refer to Oil Pump Assemble.

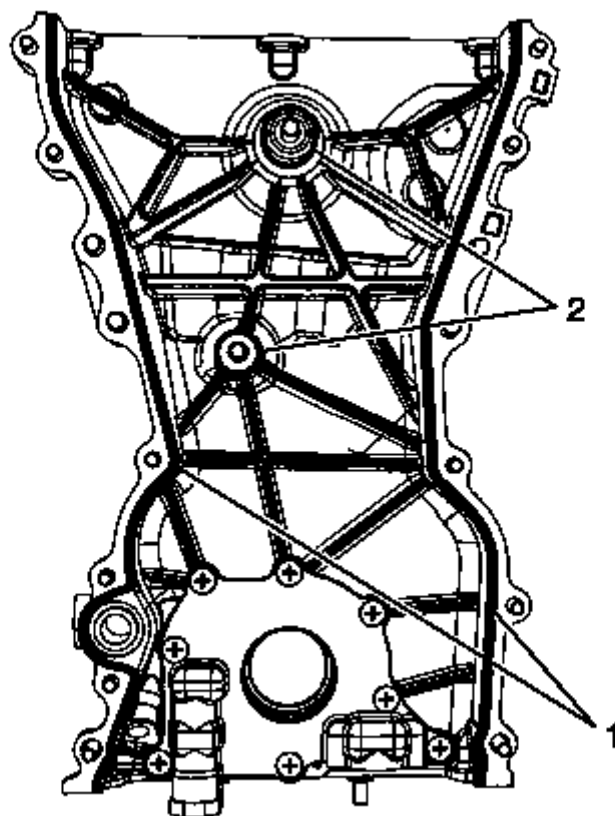


Fig. 69: Engine Front Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: Apply sealant (RTV) on lines (1) and 2 hole faces (2). Apply sealant (RTV) to the edges of top and bottom step chamfers.

6. Apply approximately a 4.5 mm (0.177 in) thick bead of front cover sealant.

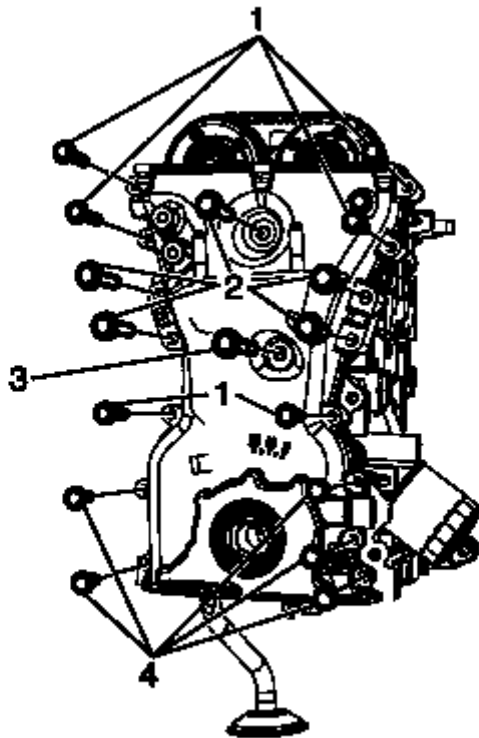


Fig. 70: Engine Front Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Install the engine front cover.

NOTE: Check the different screw lengths.

8. Install the engine front cover bolts (1, 2, 3, 4).

CAUTION: Refer to Fastener Caution .

9. Tighten the engine front cover bolts (1, 4) to 10 (89 lb in).

NOTE: After sealant (RTV) dispensing, the assembly completion time including torque check must be done within 8 minutes.

10. Tighten the engine front cover bolts (2, 3) to 22 (16 lb ft).
11. Install a new oil pan. Refer to Oil Pan Installation.
12. Install the crankshaft balancer. Refer to Crankshaft Balancer Installation.
13. Install the water pump. Refer to Water Pump Installation.

14. Install the generator bracket. Refer to **Generator Bracket Installation**.
15. Install the generator. Refer to **Generator Replacement**.
16. Install the engine lift rear bracket. Refer to **Engine Lift Rear Bracket Installation**.
17. Install the engine oil level indicator and tube. Refer to **Oil Level Indicator and Tube Installation**.
18. Install the camshaft cover. Refer to **Camshaft Cover Installation**.
19. Install the camshaft position actuator solenoid valve. Refer to **Camshaft Position Actuator Solenoid Valve Installation**.
20. Install the ignition coil. Refer to **Ignition Coil Installation**.
21. Install the intake manifold. Refer to **Intake Manifold Installation (LL0)**, **Intake Manifold Installation (LFM)**.
22. Install the engine to the vehicle. Refer to **Engine Replacement (LFM)**, **Engine Replacement (LL0)**.

CAMSHAFT TIMING CHAIN REPLACEMENT AND ADJUSTMENT

Removal Procedure

1. Remove the engine front cover evenly all the way around with a suitable tool. Refer to **Engine Front Cover with Oil Pump Replacement**.
2. Install the crankshaft balancer bolt to crankshaft.

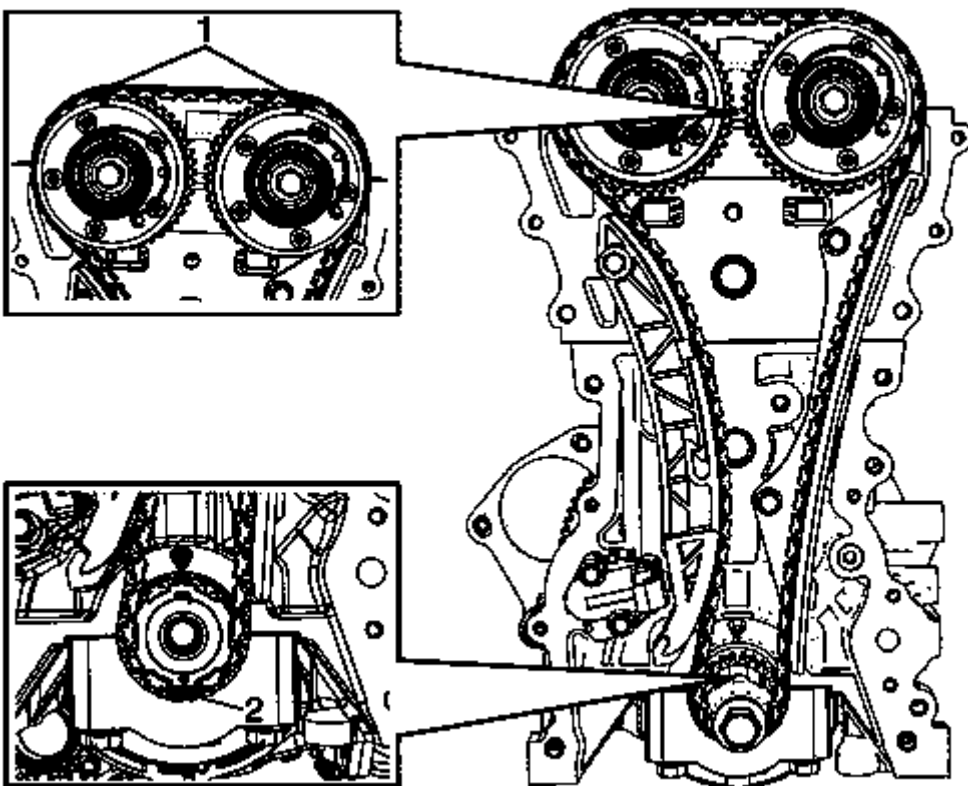


Fig. 71: Rotating Crankshaft To TDC (Top Dead Center) Position
Courtesy of GENERAL MOTORS COMPANY

3. Rotate the crankshaft to the TDC (Top Dead Center) position.

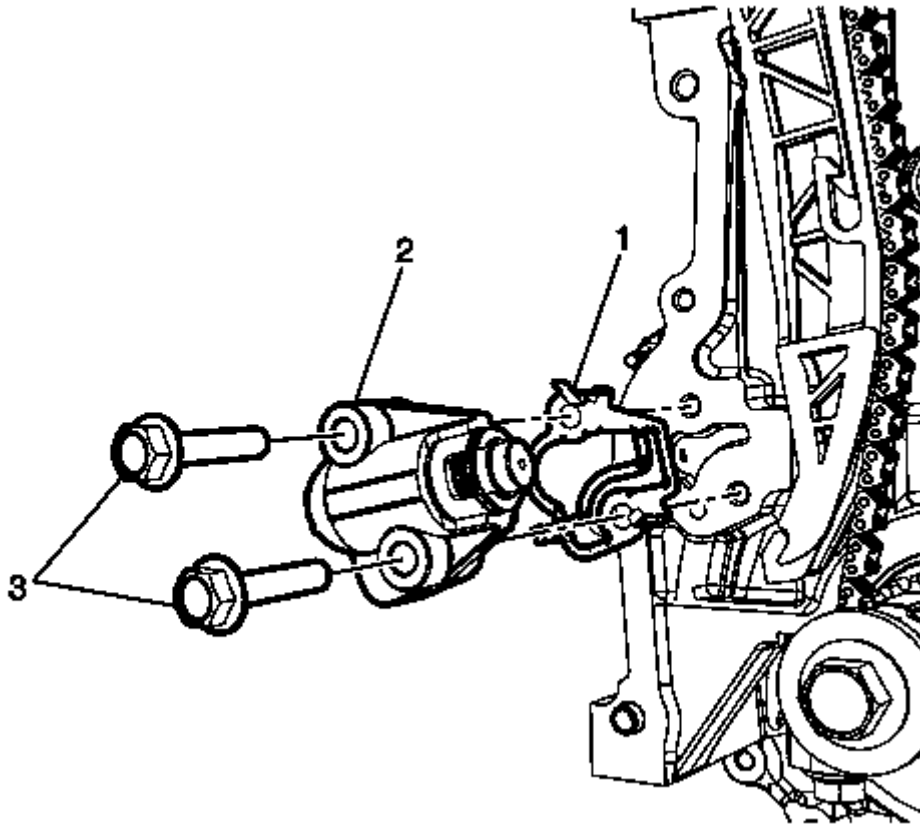


Fig. 72: Timing Chain Tensioner Bolts And Tensioner
Courtesy of GENERAL MOTORS COMPANY

4. Remove the timing chain tensioner bolts (3) and the timing chain tensioner (2) with the timing chain tensioner gasket (1).

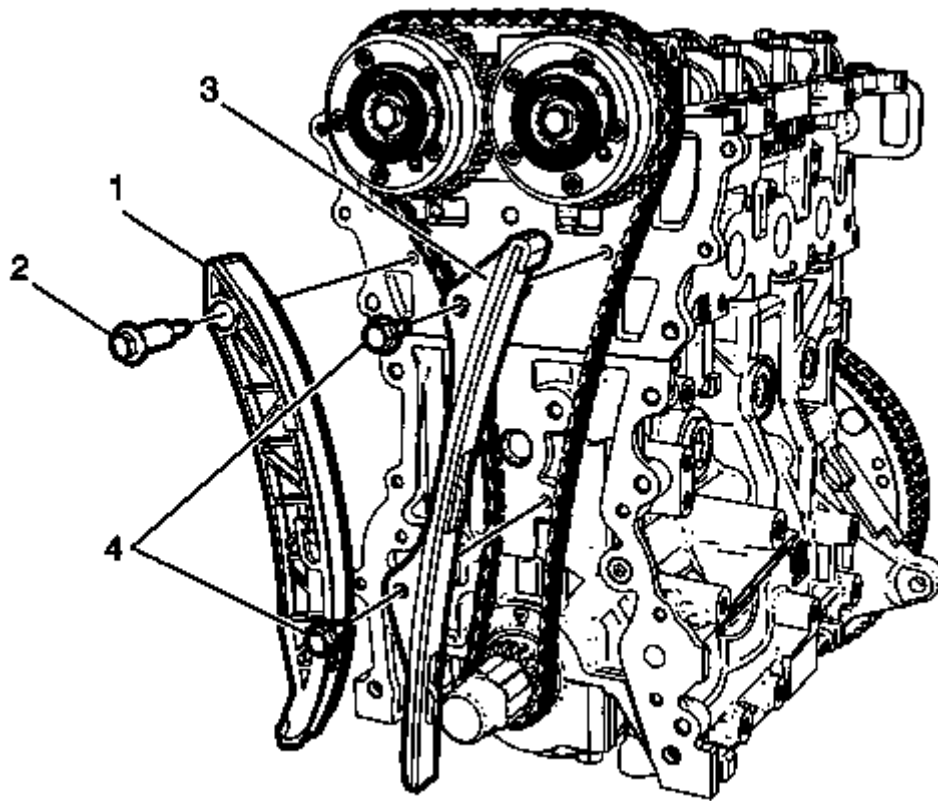


Fig. 73: Left Timing Chain Shoe Retaining Bolt
Courtesy of GENERAL MOTORS COMPANY

5. Remove the left timing chain shoe retaining bolt (2) and the left timing chain shoe (1).
6. Remove the right timing chain guide retaining bolts (4) and the right timing chain guide (3).

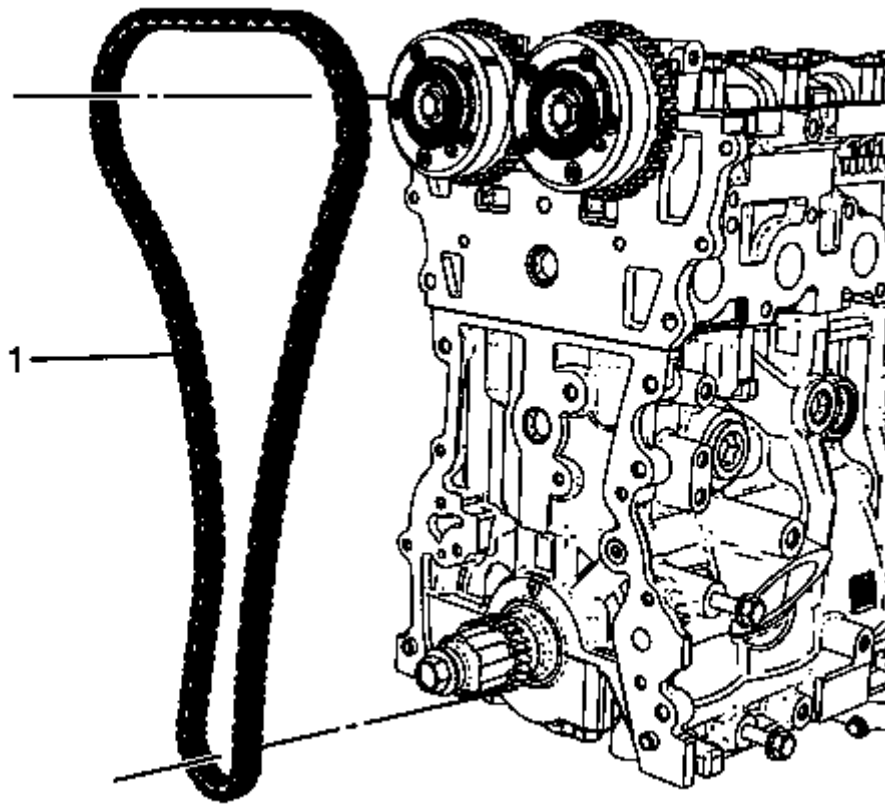


Fig. 74: Timing Chain
Courtesy of GENERAL MOTORS COMPANY

7. Remove the timing chain (1).

Installation Procedure

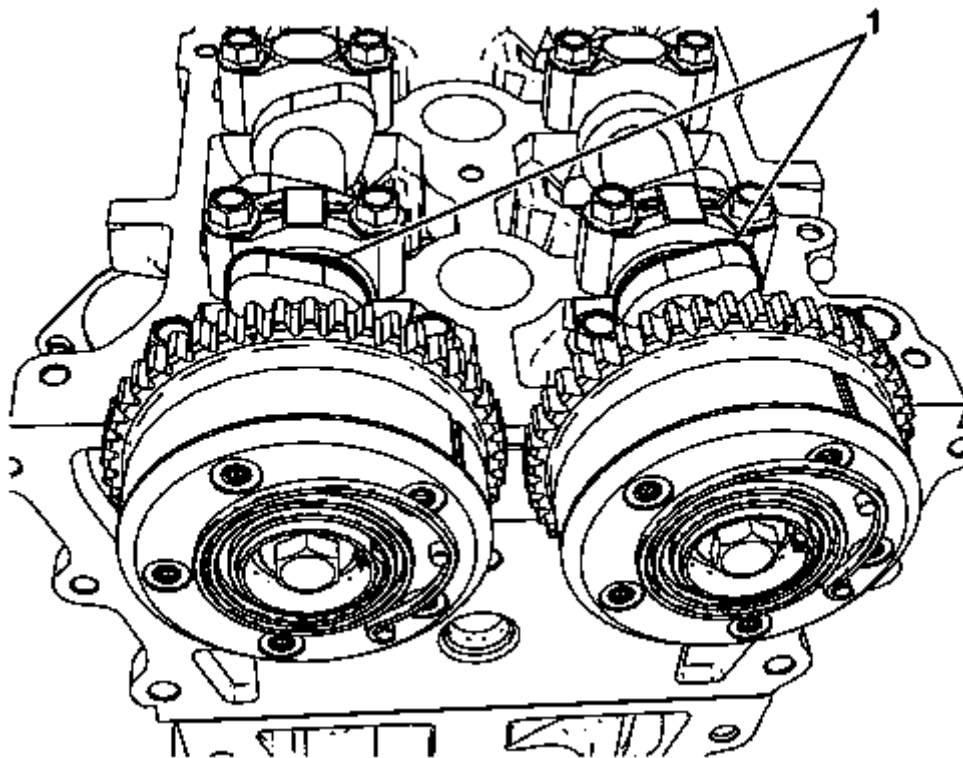


Fig. 75: Camshaft Lobes

Courtesy of GENERAL MOTORS COMPANY

1. Ensure that the camshaft lobes (1) are in a neutral position.

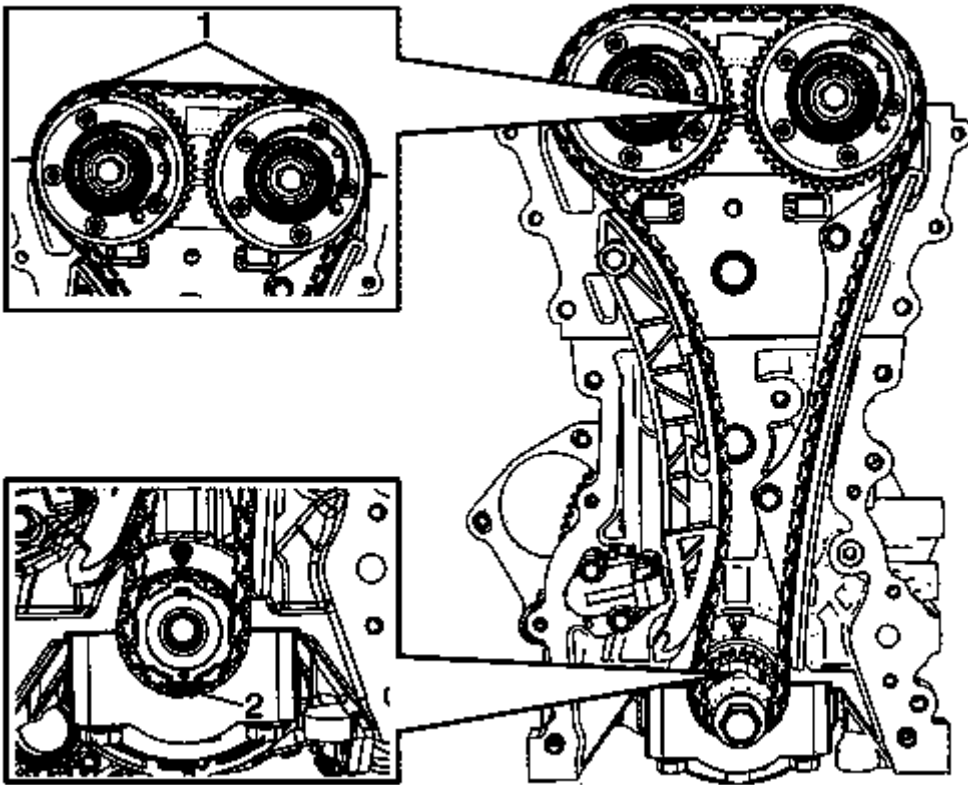


Fig. 76: Rotating Crankshaft To TDC (Top Dead Center) Position
Courtesy of GENERAL MOTORS COMPANY

2. Install the timing chain after aligning both the marks (1) on the camshaft sprockets and on the timing chain.
3. Align the colored link with the timing mark on the camshaft sprocket (2).

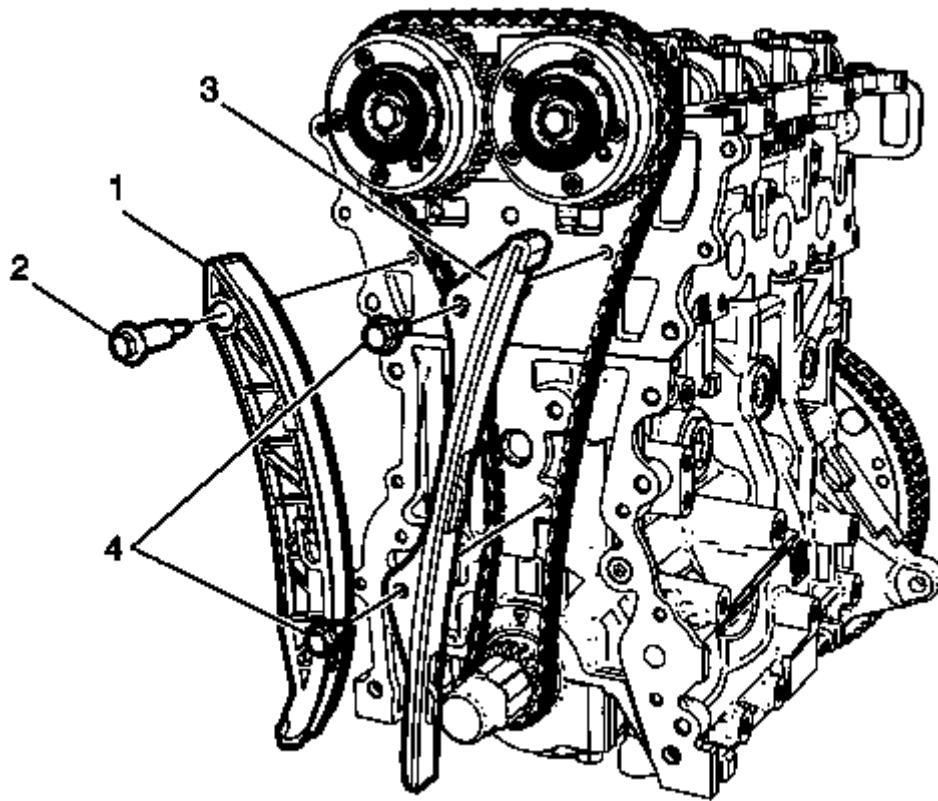


Fig. 77: Left Timing Chain Shoe Retaining Bolt
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

4. Install the timing chain guide (3) and tighten the timing chain guide retaining bolts (4) to 10 (89 lb in).
5. Install the timing chain shoe (1) and tighten the timing chain shoe retaining bolt (2) to 10 (89 lb in).

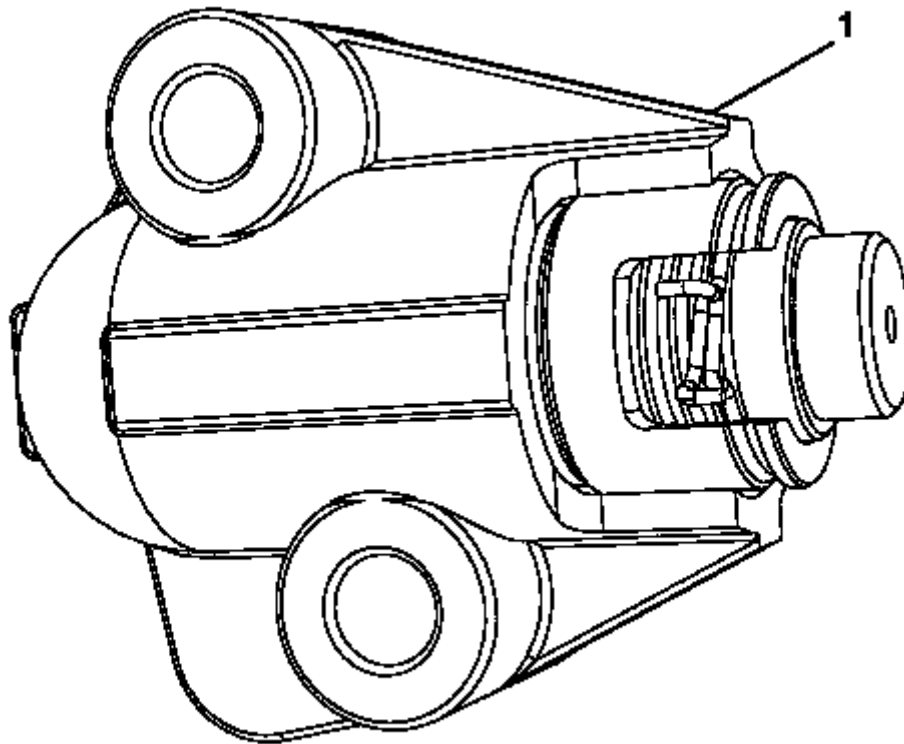


Fig. 78: Timing Chain Tensioner

Courtesy of GENERAL MOTORS COMPANY

6. Push the timing chain shoe towards the timing chain and hold the timing chain shoe. Using the other hand, push the timing chain tensioner (1) with a new timing chain tensioner gasket towards the timing chain shoe. The timing chain tensioner plunger might be pushed into the timing chain tensioner housing. While holding the timing chain tensioner, install the timing chain tensioner bolts and tighten the timing chain tensioner retaining bolts to 10 (89 lb in). - Old Tensioner

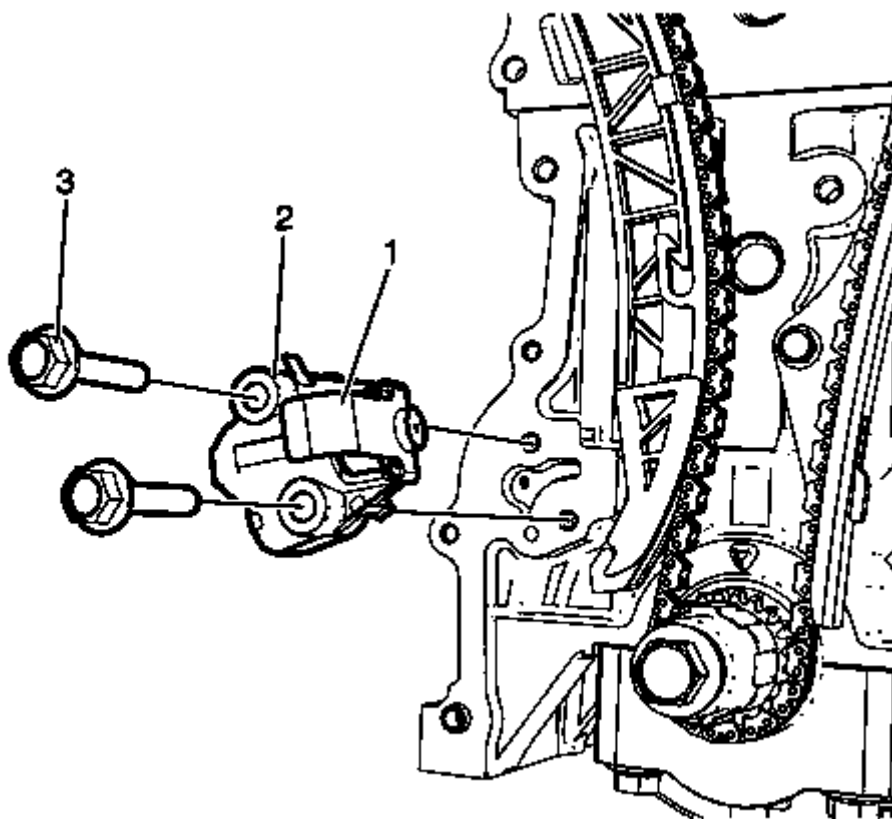


Fig. 79: New Timing Tensioner

Courtesy of GENERAL MOTORS COMPANY

7. Install a new timing tensioner (2) with a new timing chain tensioner gasket and tighten the timing tensioner retaining bolts (3) to 10 (89 lb in). - New Tensioner
8. Remove the timing tensioner plunger holder (1).
9. Remove the crankshaft balancer bolt.
10. Install the engine front cover. Refer to **Engine Front Cover with Oil Pump Replacement**.

OIL PUMP REPLACEMENT

Removal Procedure

1. Remove the engine front cover. Refer to **Engine Front Cover with Oil Pump Replacement**.

NOTE: There are no serviceable components within the oil pump. Disassemble the pump only to diagnose an oiling concern. A disassembled oil pump must not be reused. A disassembled oil pump must be replaced.

2. Remove the oil pump bolts and the oil pump.
3. Perform the following steps as necessary:

- Disassemble the oil pump. Refer to Oil Pump Disassemble
- Clean and inspect the oil pump. Refer to Oil Pump Disassemble

Installation Procedure

1. Assemble the oil pump as necessary. Refer to Oil Pump Assemble.
2. Install the oil pump. Refer to Oil Pump Assemble.
3. Install the engine front cover. Refer to Engine Front Cover with Oil Pump Replacement.

OIL LEVEL INDICATOR TUBE REPLACEMENT

Removal Procedure

1. Open the hood.

NOTE: If the engine oil level is at maximum, some oil may emerge when drawing out the oil dipstick guide tube.

2. Place collecting basin underneath.

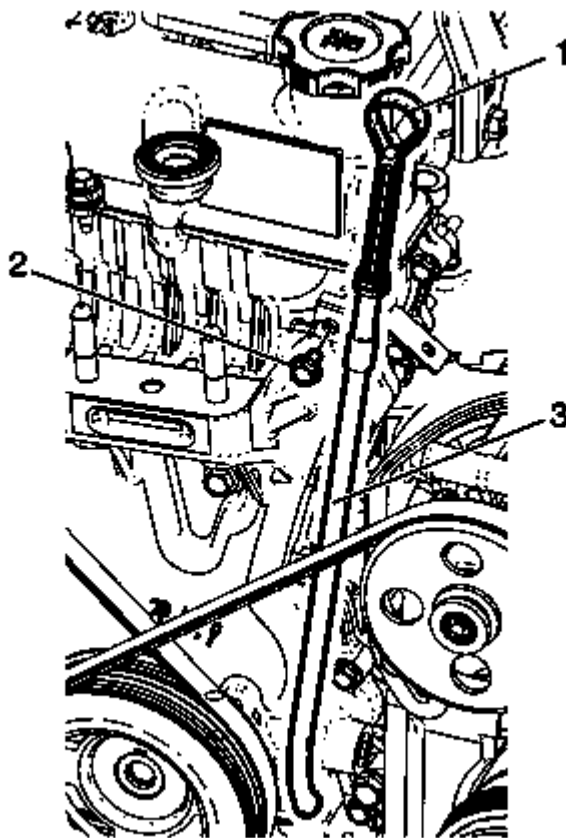


Fig. 80: Oil Level Indicator

Courtesy of GENERAL MOTORS COMPANY

3. Remove the oil level indicator (1).
4. Remove the oil level indicator tube bolt (2).
5. Remove the oil level indicator tube (3).

Installation Procedure

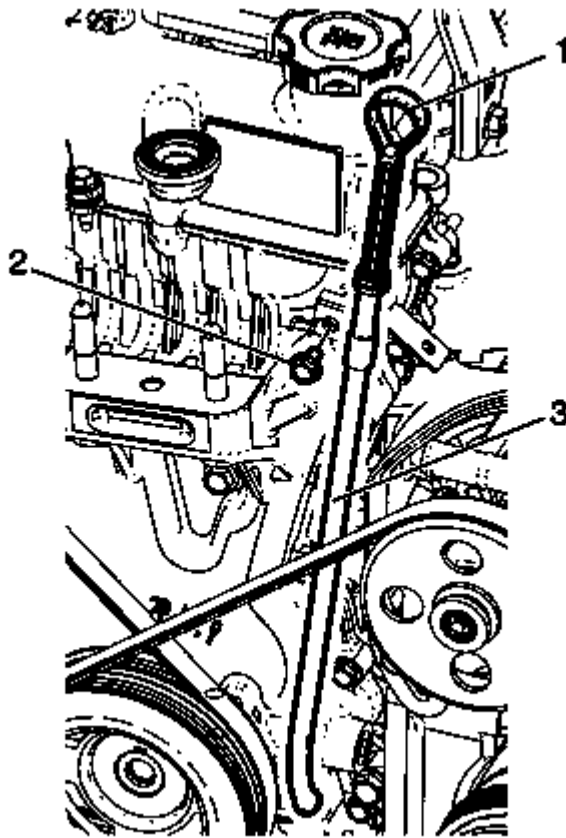


Fig. 81: Oil Level Indicator

Courtesy of GENERAL MOTORS COMPANY

1. Install the oil level indicator tube (3).

Use a NEW oil level indicator tube gasket.

CAUTION: Refer to Fastener Caution .

2. Install the oil level indicator tube bolt (2) and tighten to 10 (89 lb in).
3. Install the oil level indicator (1).
4. Close the hood.

ENGINE REPLACEMENT (LFM)

Removal Procedure

1. Open the hood.
2. Relieve the fuel system pressure. Refer to Fuel Pressure Relief .
3. Disconnect the battery negative cable. Refer to Battery Negative Cable Disconnection and Connection .
4. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
5. Drain the cooling system. Refer to Cooling System Draining and Filling .
6. Recover the refrigerant. Refer to Refrigerant Recovery and Recharging .
7. Remove the front wheels and tires. Refer to Tire and Wheel Removal and Installation .
8. Remove the air cleaner assembly. Refer to Air Cleaner Assembly Replacement .
9. Remove the battery. Refer to Battery Replacement .
10. Remove the engine control module. Refer to Engine Control Module Replacement .
11. Remove the battery tray. Refer to Battery Tray Replacement .

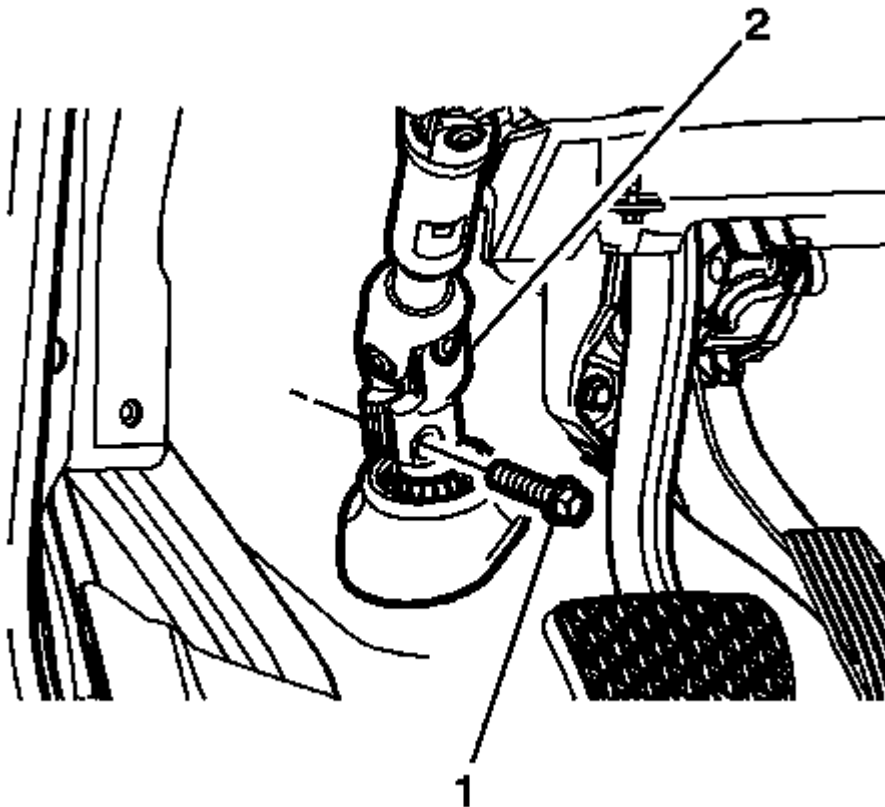


Fig. 82: Lower Intermediate Steering Shaft Bolt
Courtesy of GENERAL MOTORS COMPANY

12. Remove the lower intermediate steering shaft bolt (1) and detach the lower intermediate steering shaft (2).

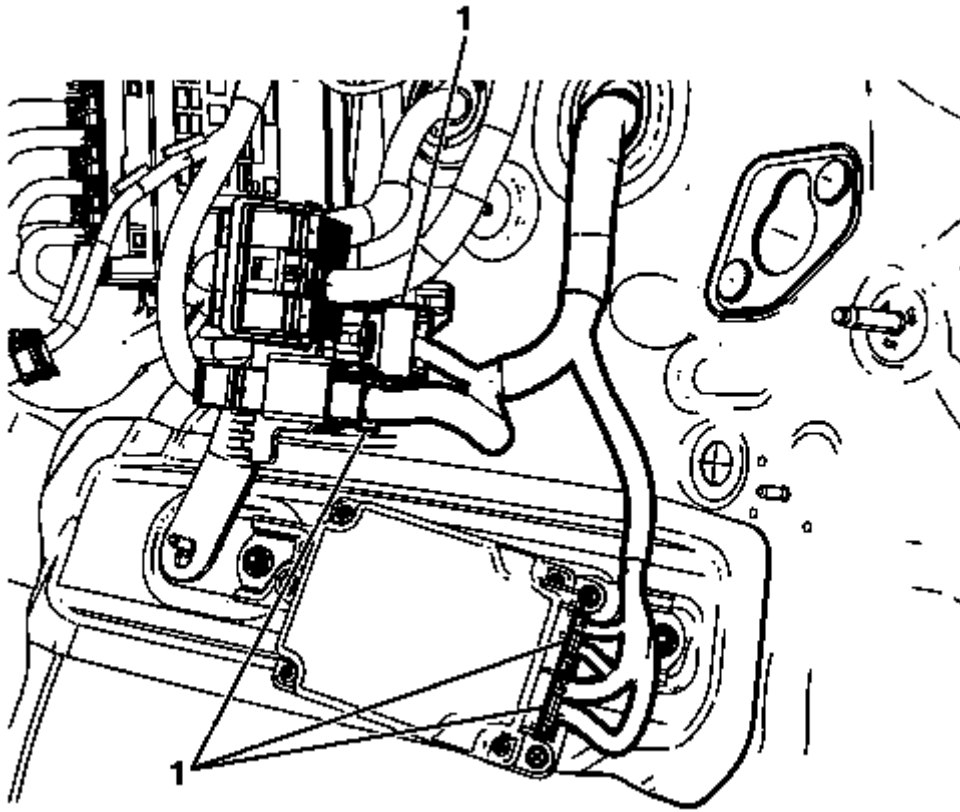


Fig. 83: Engine Wiring Harnesses Connectors
Courtesy of GENERAL MOTORS COMPANY

13. Disconnect 4 engine wiring harnesses connectors (1) from under dash, left of the steering shaft and pull out the engine wiring harnesses through the front of dash to the engine compartment.

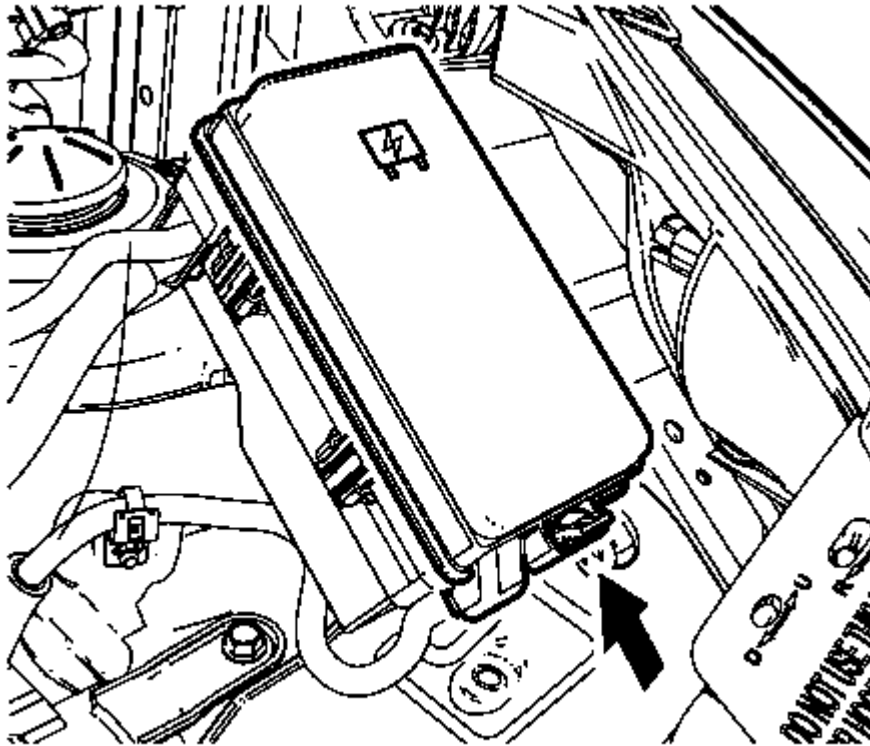


Fig. 84: Front Compartment Fuse Block Cover
Courtesy of GENERAL MOTORS COMPANY

14. Remove the engine wiring harness fuse block cover.

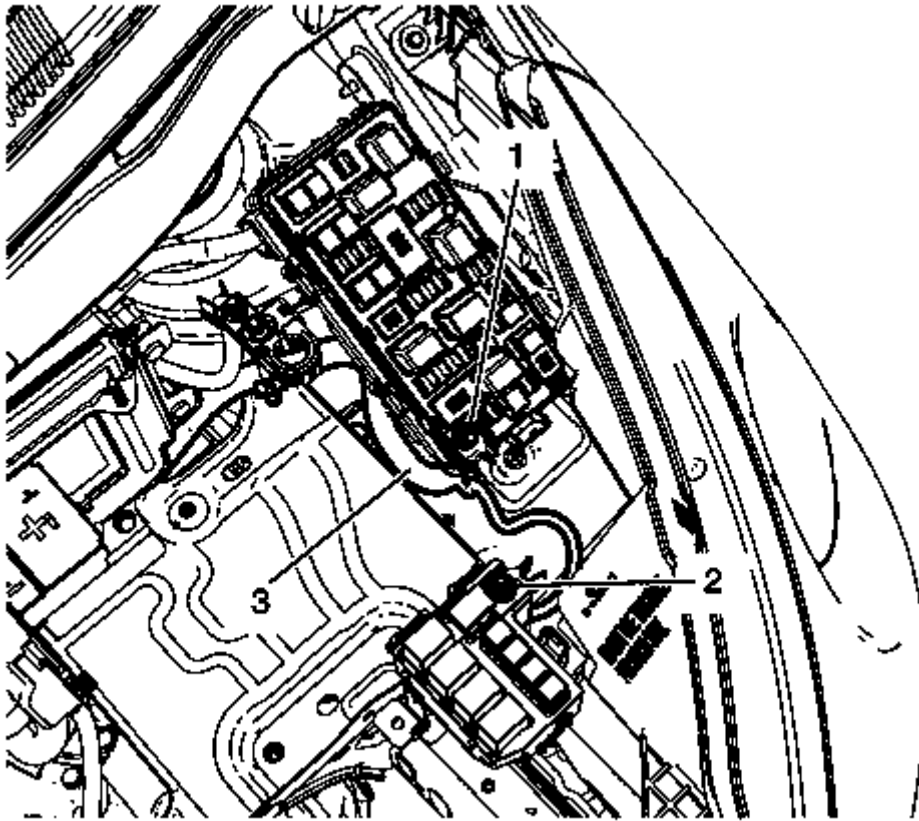


Fig. 85: Positive Battery Cable Nut
Courtesy of GENERAL MOTORS COMPANY

15. Remove the positive cable retaining nut (1, 2) and the positive cable (3).

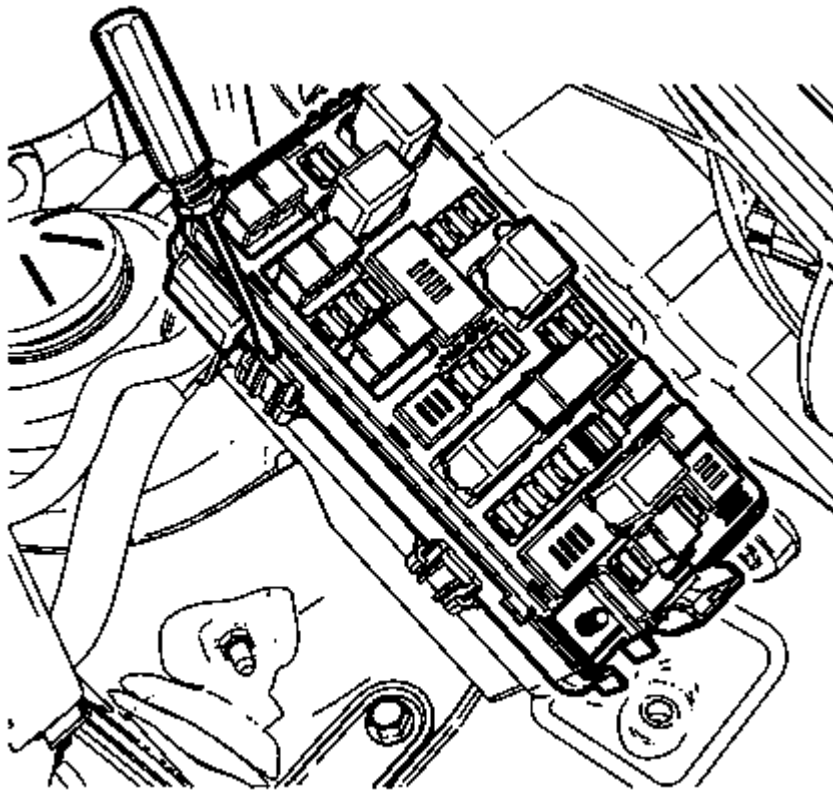


Fig. 86: Detaching Upper Plate With Suitable Tool
Courtesy of GENERAL MOTORS COMPANY

16. Detach the upper plate with suitable tool.

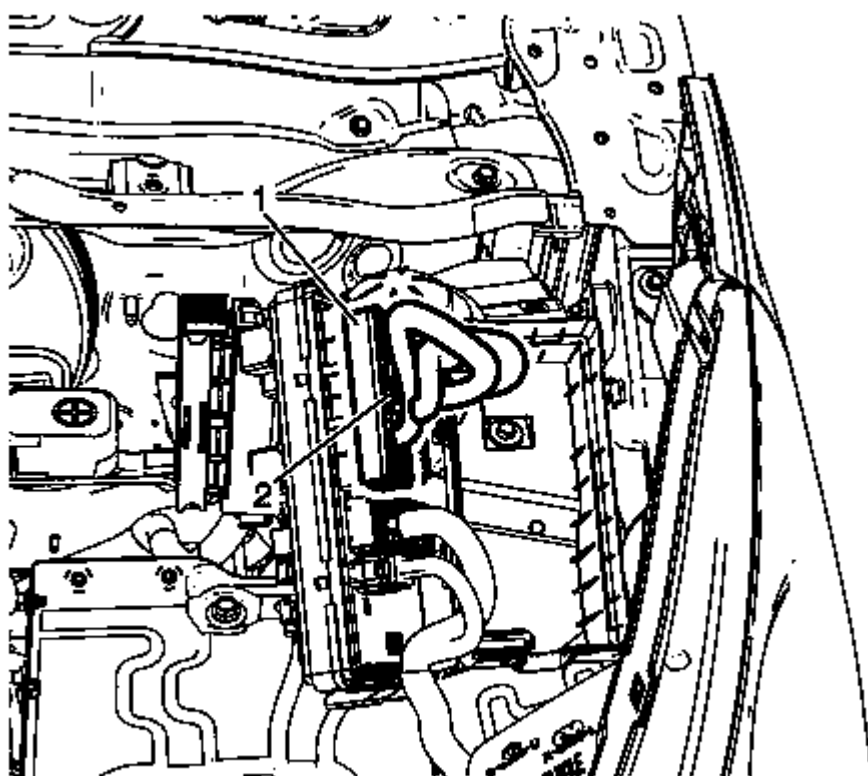


Fig. 87: Front Compartment Fuse Block
Courtesy of GENERAL MOTORS COMPANY

17. Lift up the engine wiring harness fuse block from the lower plate.
18. Loosen the wiring harness connector retaining bolt (2) and disconnect the wiring harness connector (1) from the engine wiring harness fuse block. Repeat for remaining connector.
19. Disconnect remaining wiring harness.

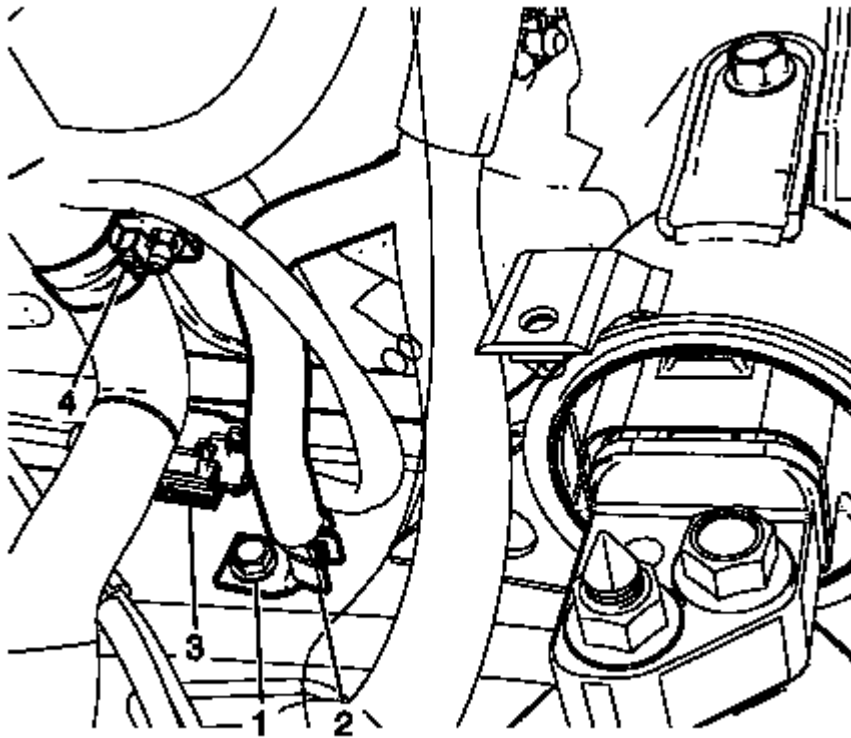


Fig. 88: Ground Bolt And Put Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

20. Remove the ground bolt (1) and put the wiring harness (2) aside.
21. Disconnect the wheel speed sensor connector (3).
22. Remove the wiring harness retainer (4).
23. Disconnect the heater inlet hose. Refer to **Heater Inlet Hose Replacement (1.0L LMT, 1.19L LC5 and 1.2L LMU)** .
24. Disconnect the heater outlet hose. Refer to **Heater Outlet Hose Replacement (1.0L LMT, 1.19L LC5 and 1.2L LMU)** .
25. Plug or cap the cooling system hoses and inlets.

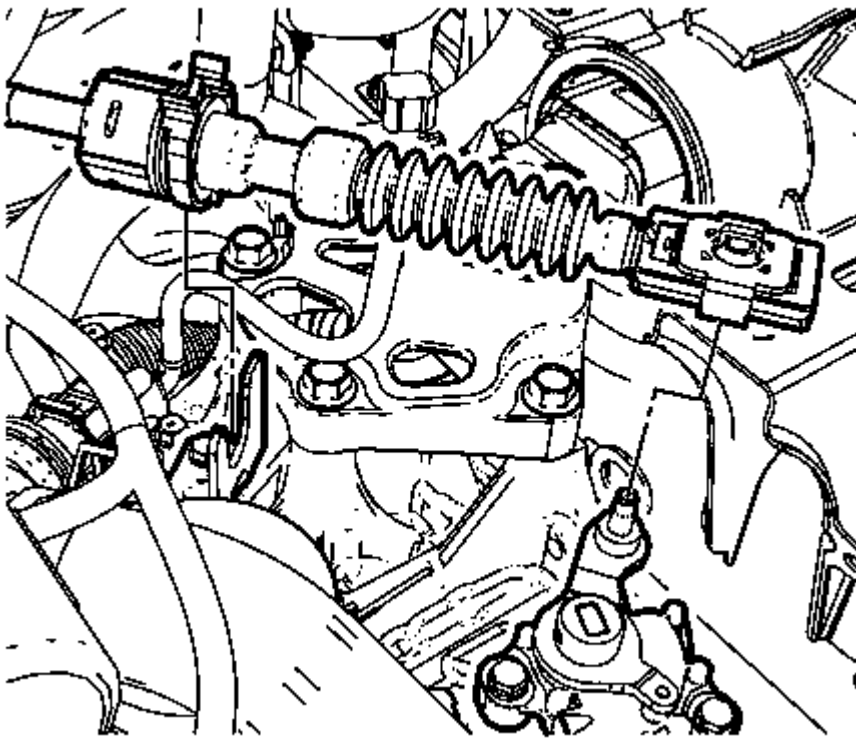


Fig. 89: Transmission Range Selector Lever Cable Terminal
Courtesy of GENERAL MOTORS COMPANY

26. Disconnect the transmission range selector lever cable terminal from the transmission lever pin.
27. Press the locking tabs inward in order to release the transmission range selector lever cable from the cable bracket.

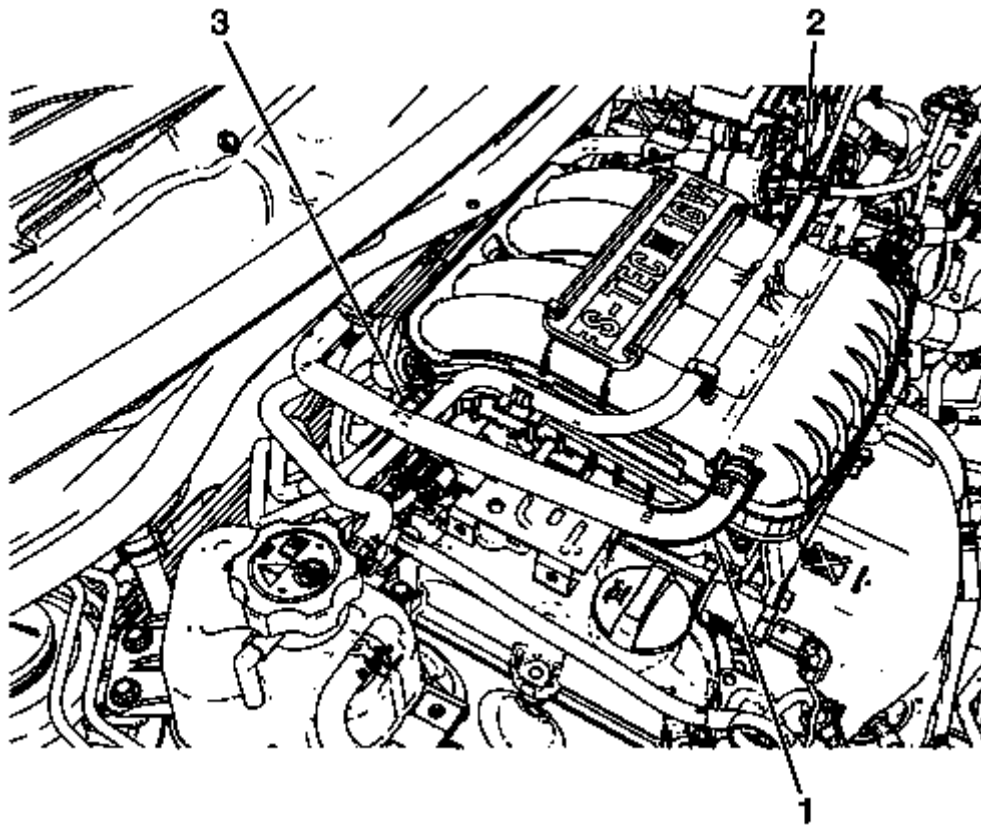


Fig. 90: Vacuum Hose
Courtesy of GENERAL MOTORS COMPANY

28. Disconnect the vacuum hose (1) from the intake manifold.
29. Disconnect the evaporative canister purge solenoid valve hose (2).
30. Disconnect the fuel feed hose (3).

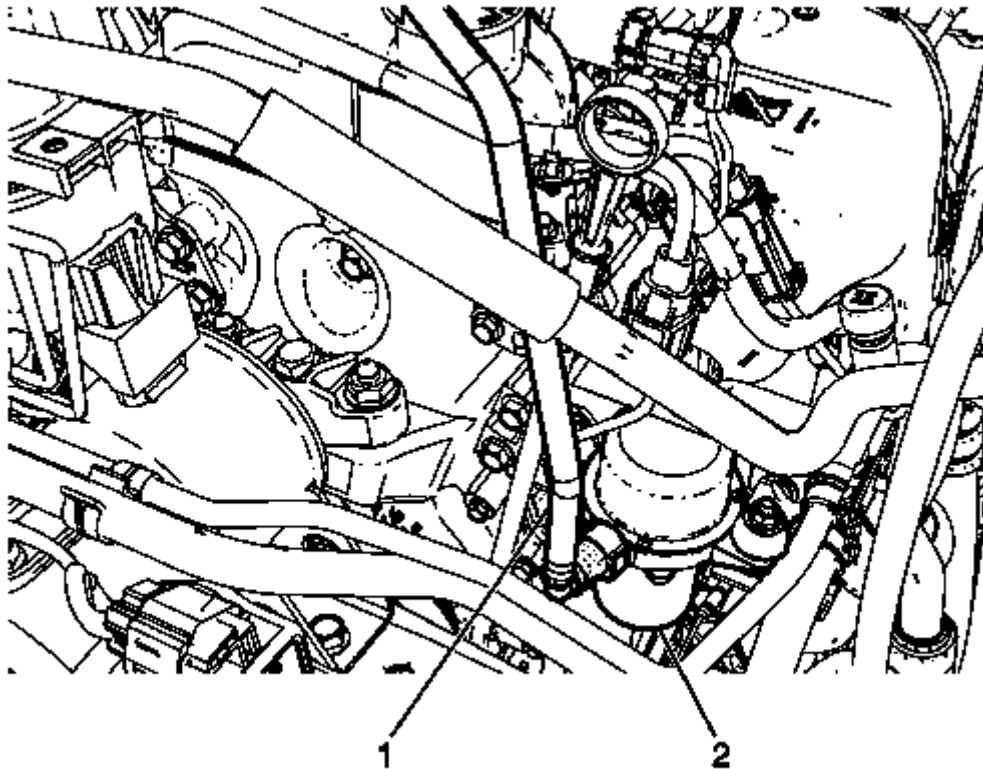


Fig. 91: Vacuum Pump Hose And Vacuum Pump
Courtesy of GENERAL MOTORS COMPANY

31. Remove the vacuum pump hose (1) from the vacuum pump (2).

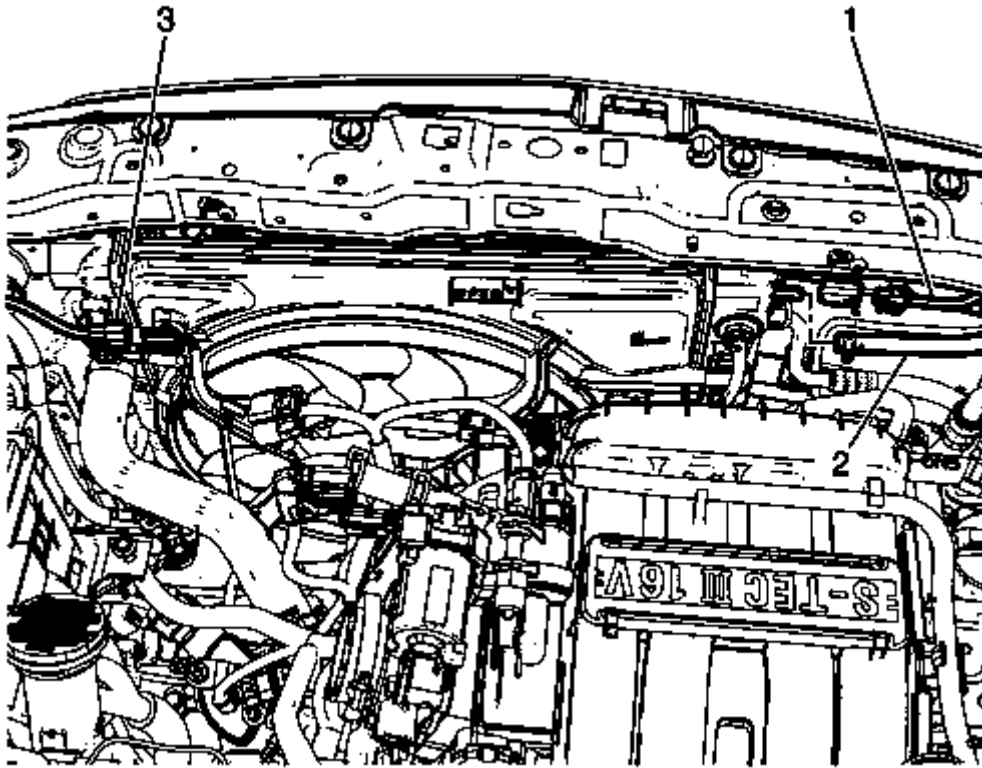


Fig. 92: Ambient Air Temperature Sensor Connector
Courtesy of GENERAL MOTORS COMPANY

32. Disconnect the wiring harness connector (3) from the engine cooling fan harness connector.
33. Disconnect the ambient air temperature sensor connector (1) from the ambient air temperature sensor if equipped.
34. Disconnect the coolant hose (2) from the radiator.

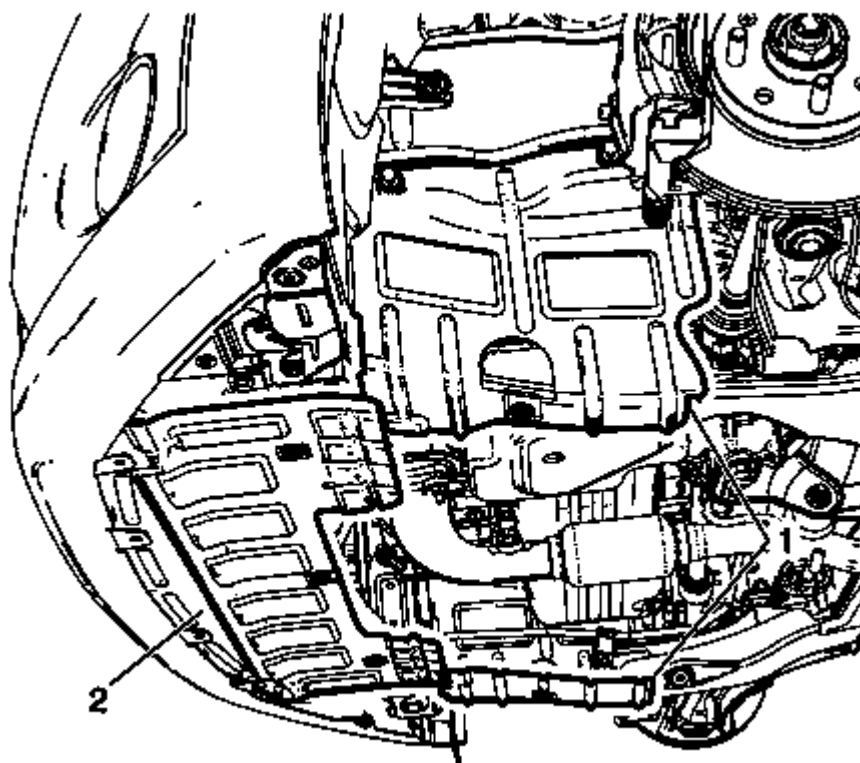


Fig. 93: Compartment Splash Shield

Courtesy of GENERAL MOTORS COMPANY

35. Remove the compartment splash shield (1, 2). Refer to **Front Compartment Splash Shield Replacement** .
36. Remove the front bumper fascia. Refer to **Front Bumper Fascia Replacement** .

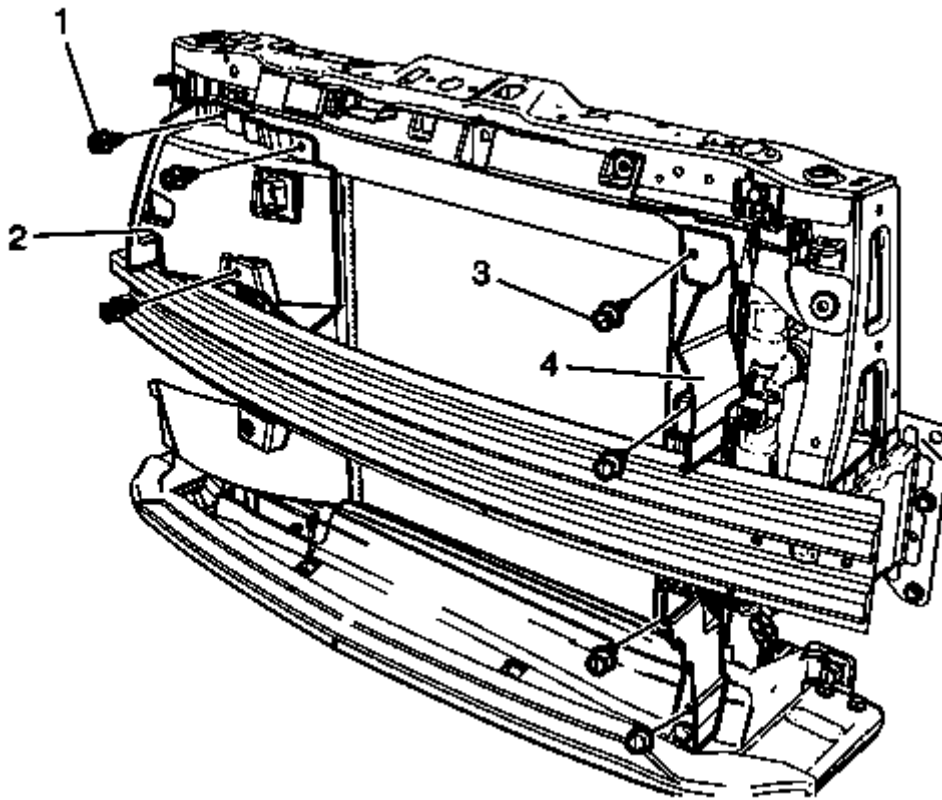


Fig. 94: Front Side Air Baffle Retainers
Courtesy of GENERAL MOTORS COMPANY

37. Remove the front side air baffle retainers (1, 3) and the front side air baffles (2, 4).

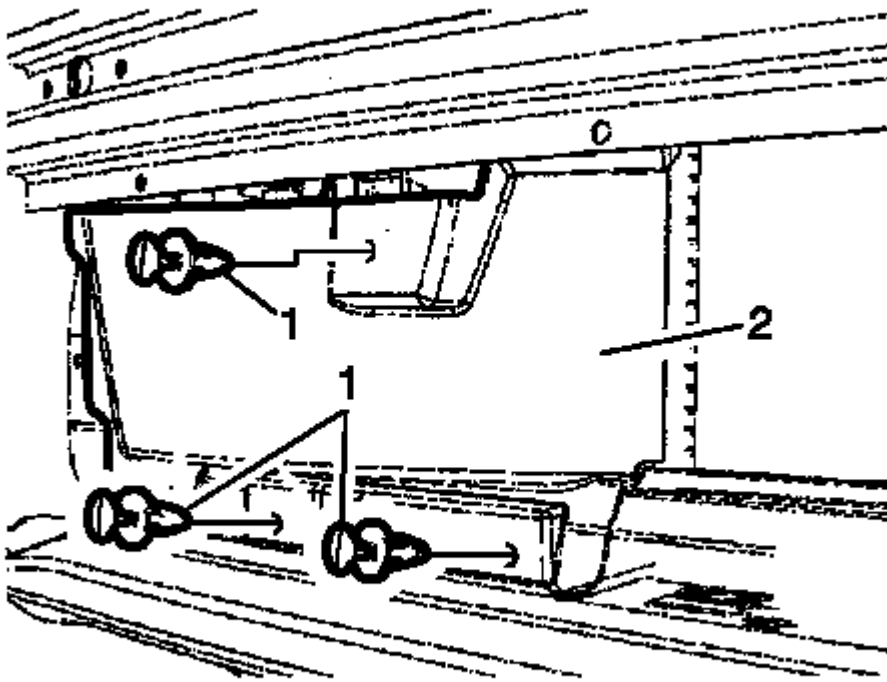


Fig. 95: Front Lower Air Baffle Retainers
Courtesy of GENERAL MOTORS COMPANY

38. Remove the front lower air baffle retainers (1) and the front lower air baffle (2).

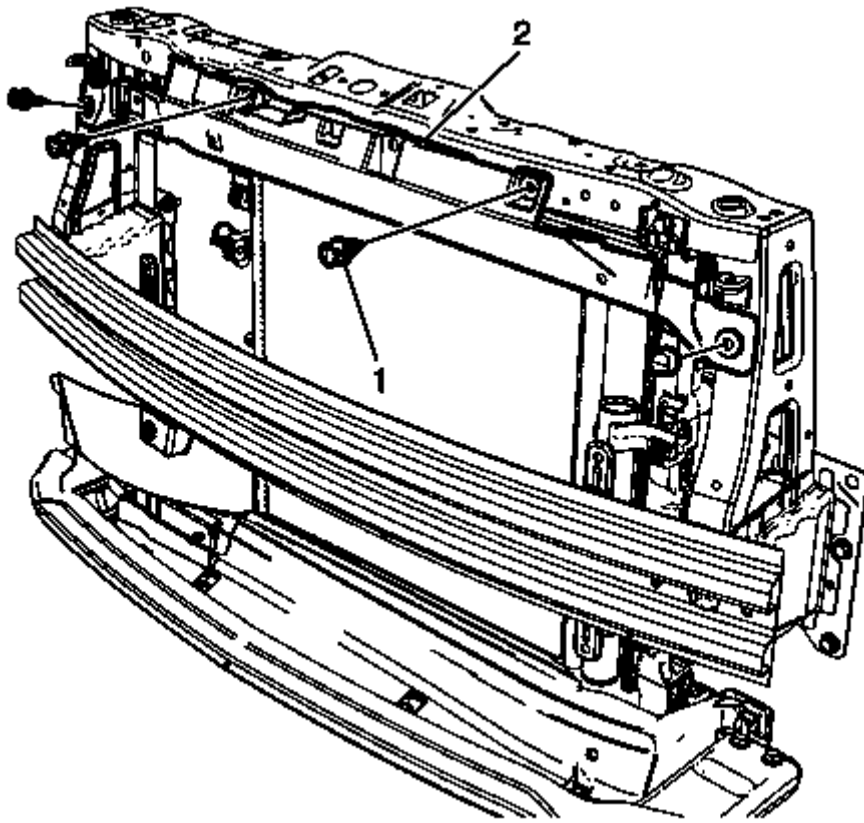


Fig. 96: Upper Air Guard Retainers
Courtesy of GENERAL MOTORS COMPANY

39. Remove the upper air guard retainers (1) and the upper air guard (2).

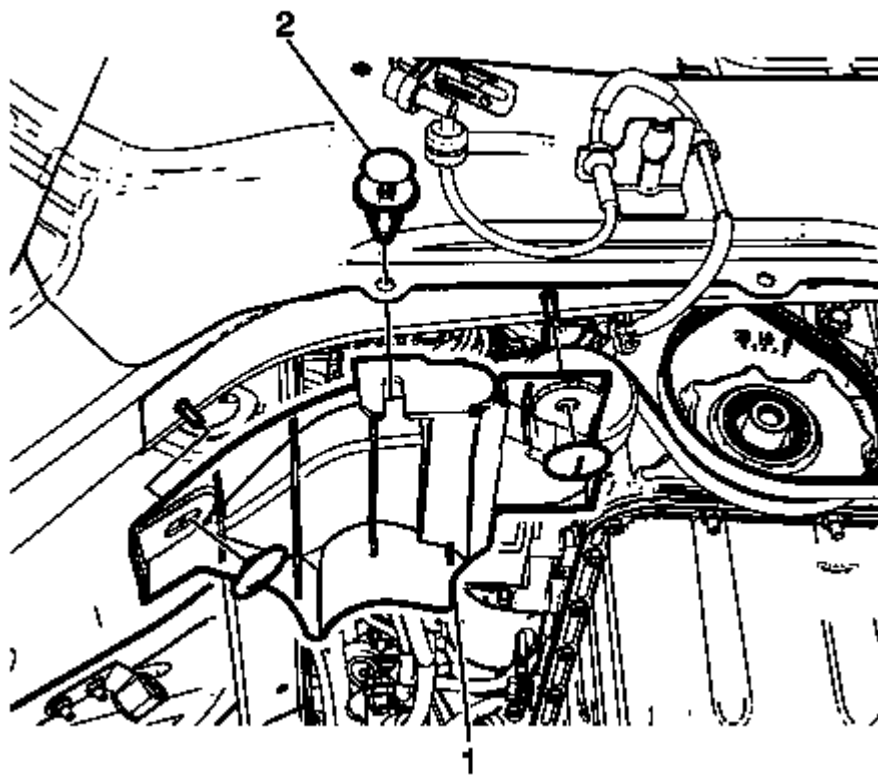


Fig. 97: Retainers And Water Deflector
Courtesy of GENERAL MOTORS COMPANY

40. Remove the retainers (2) and the water deflector (1).

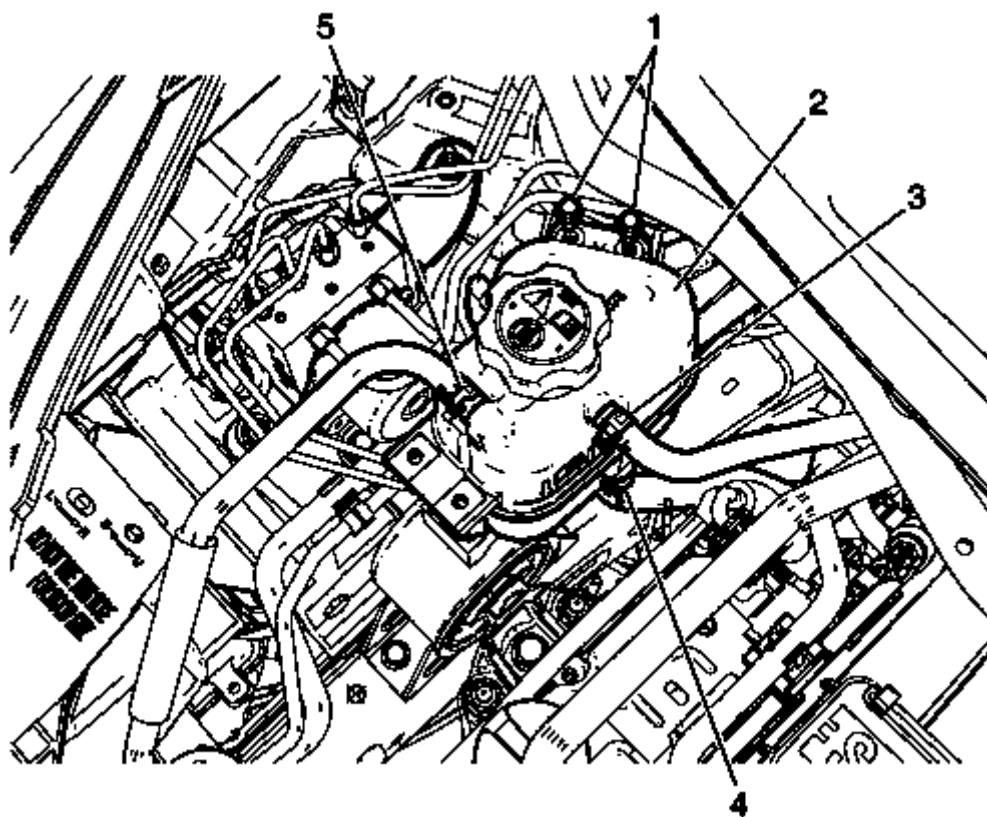


Fig. 98: Coolant Surge Tank

Courtesy of GENERAL MOTORS COMPANY

41. Remove coolant surge tank retaining bolts (1).
42. Remove the coolant hose clips (3, 4, 5) and coolant surge tank (2).
43. Plug or cap the cooling system hoses and inlets.

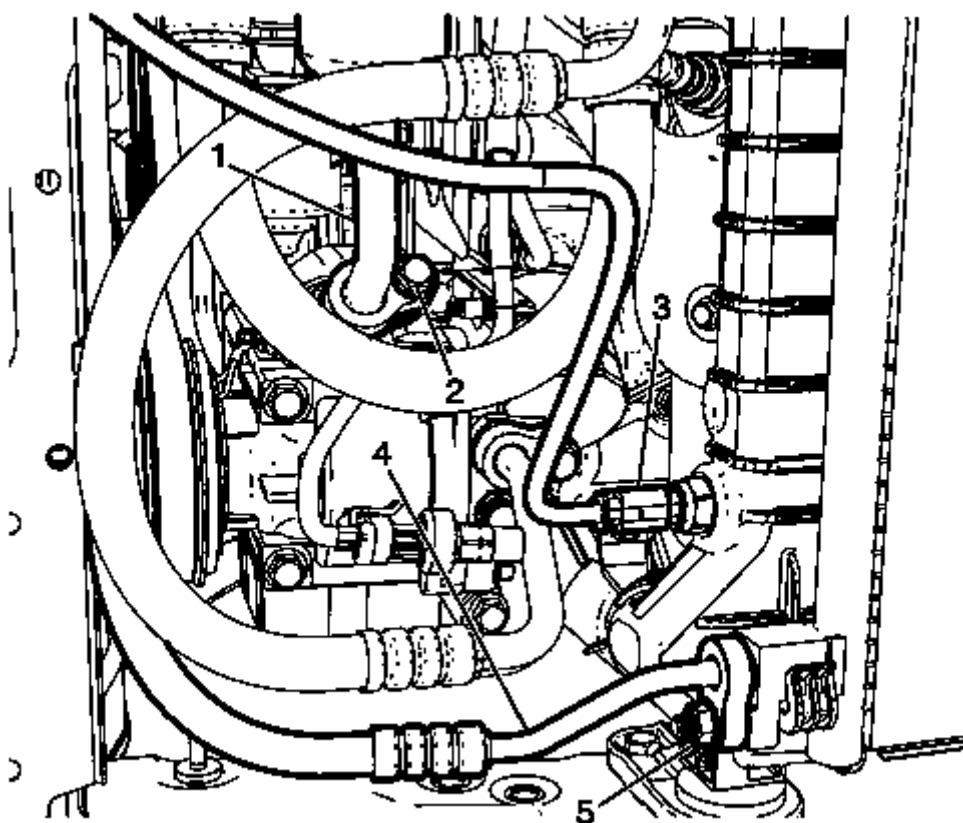


Fig. 99: Suction Pipe Bolt

Courtesy of GENERAL MOTORS COMPANY

44. Remove the suction pipe bolt (2) from the A/C compressor.
45. Remove the suction pipe (1) from the A/C compressor.
46. Remove the discharge pipe nut (5) from the A/C condenser.
47. Remove the discharge pipe (4) from the A/C condenser.
48. Disconnect the coolant temperature sensor wiring connector (3) from the radiator.

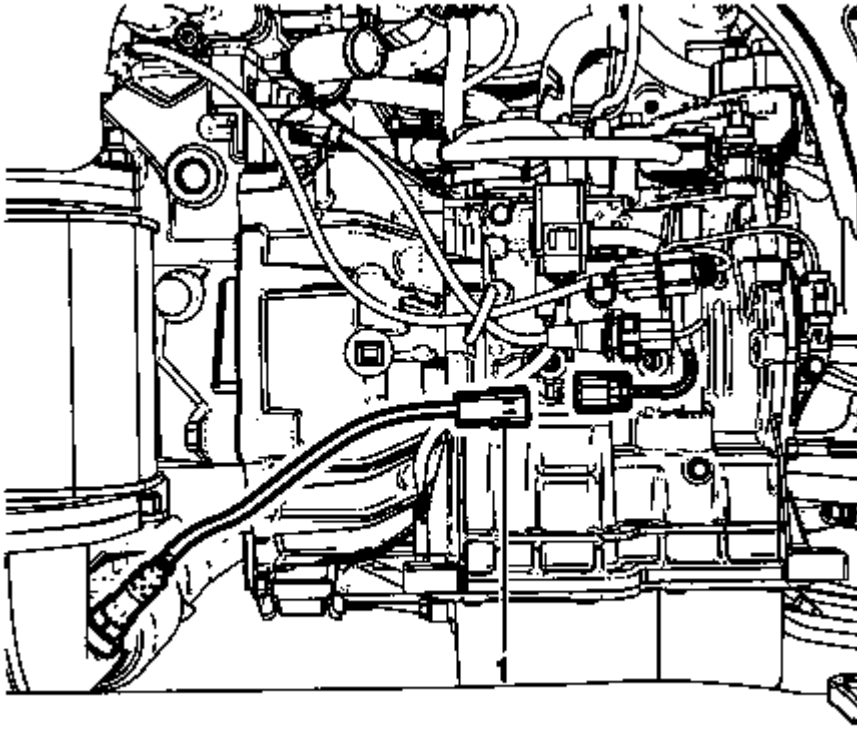


Fig. 100: Oxygen Sensor Connector

Courtesy of GENERAL MOTORS COMPANY

49. Disconnect the oxygen sensor connector (1).
50. Remove the exhaust pipe. Refer to **Exhaust Pipe Replacement (LFM)** .
51. Remove the transmission rear mount bracket. Refer to **Transmission Rear Mount Bracket Replacement** .

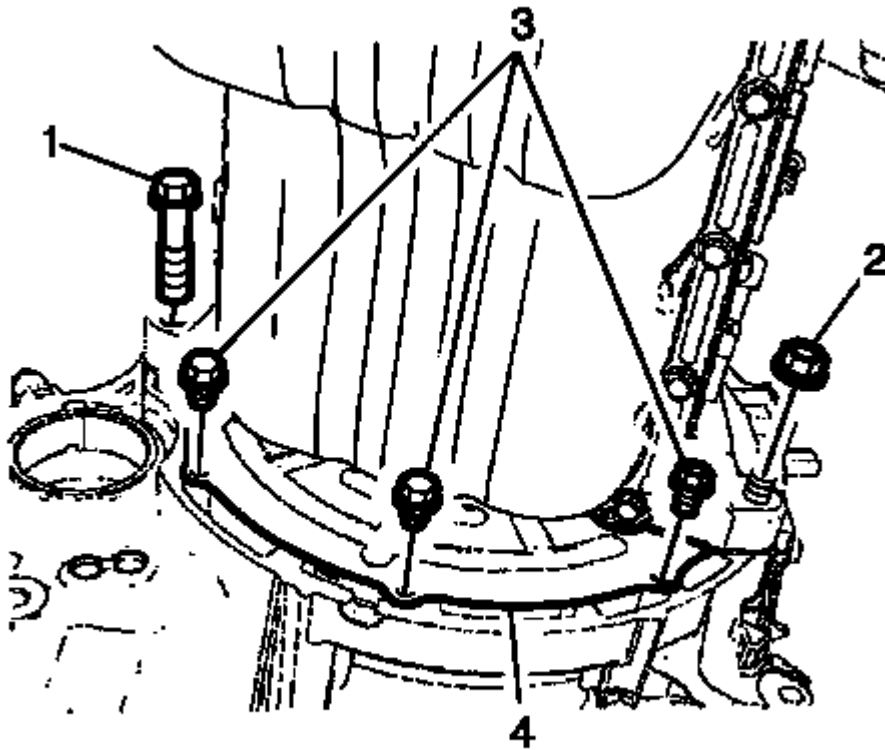


Fig. 101: Lower Transmission Housing Bolt
Courtesy of GENERAL MOTORS COMPANY

52. Remove the transmission dust cover bolts (3) and the transmission dust cover (4).

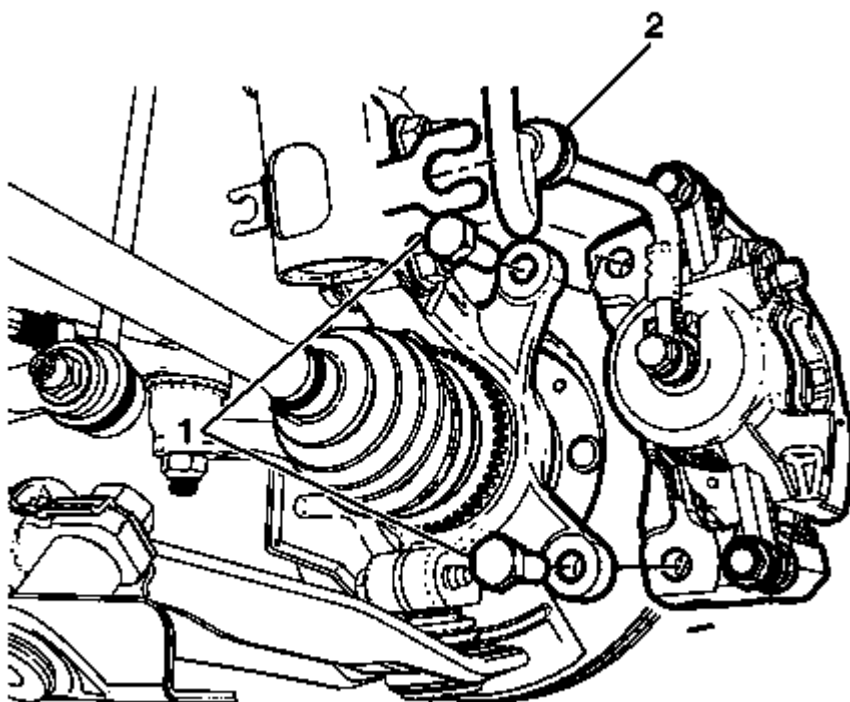


Fig. 102: Front Brake Hose And Front Brake Caliper Retaining Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: **DO NOT** disconnect the hydraulic brake flexible hose from the brake caliper otherwise complete bleeding of the braking system will be necessary.

53. Detach the front brake hose (2) from the strut mounted brake hose retaining bracket and remove the front brake caliper retaining bolts (1) from the front steering knuckle. Repeat for opposite side.

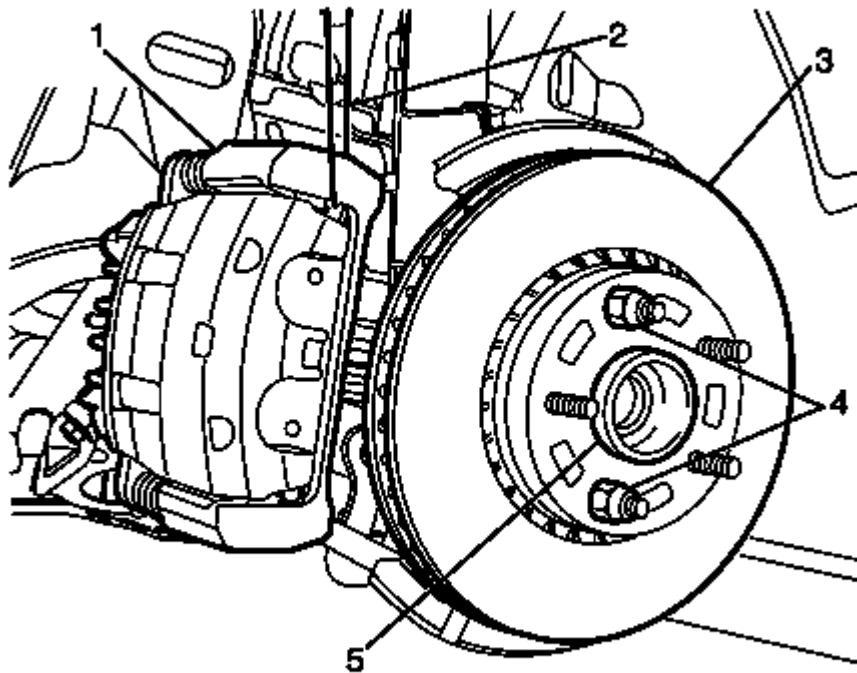


Fig. 103: View Of Hub, Wheel Nuts, Front Brake Disc, Heavy Mechanic's Wire & Front Brake Caliper

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Support the brake caliper with heavy mechanic wire or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

54. Support the front brake caliper (1) with heavy mechanics wire or equivalent (2). Repeat for opposite side.
55. Disconnect the outer tie rod assembly from the steering knuckle. Repeat for opposite side. Refer to **Steering Linkage Outer Tie Rod Replacement** .
56. Remove the wheel drive shaft nut and washer from the wheel drive shaft and discard. Repeat for opposite side. Refer to **Front Wheel Drive Shaft Replacement** .
57. Separate the control arm ball joint from the steering knuckle. Repeat for opposite side. Refer to **Lower Control Arm Replacement** .

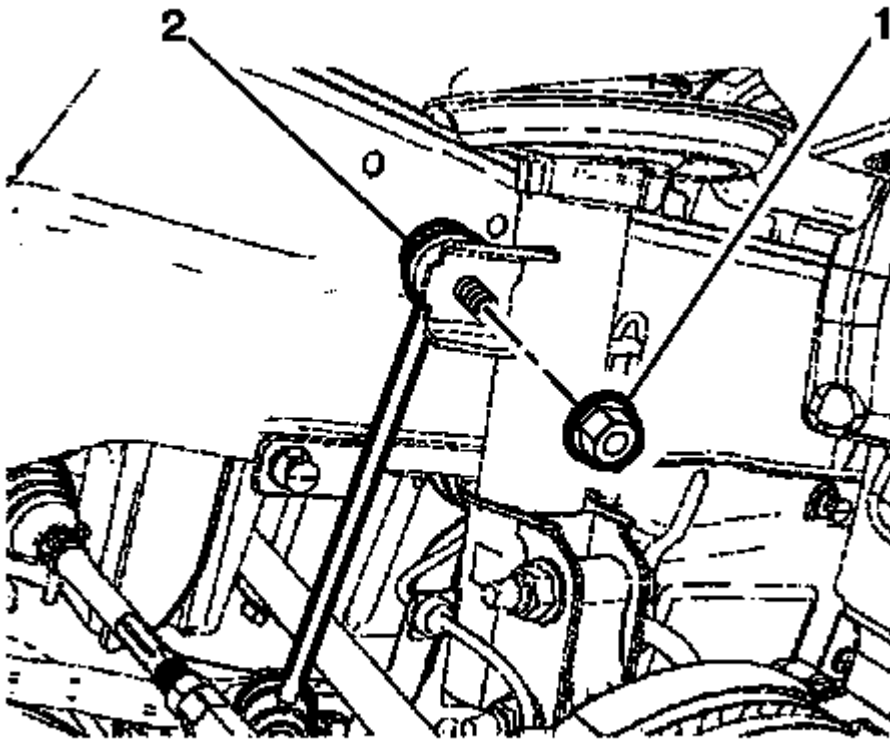


Fig. 104: Front Upper Stabilizer Shaft Link Nut
Courtesy of GENERAL MOTORS COMPANY

58. Remove the front upper stabilizer shaft link nut (1) and push the front upper stabilizer shaft link (2) aside. Repeat for opposite side.
59. Disconnect any additional electrical connections as necessary.

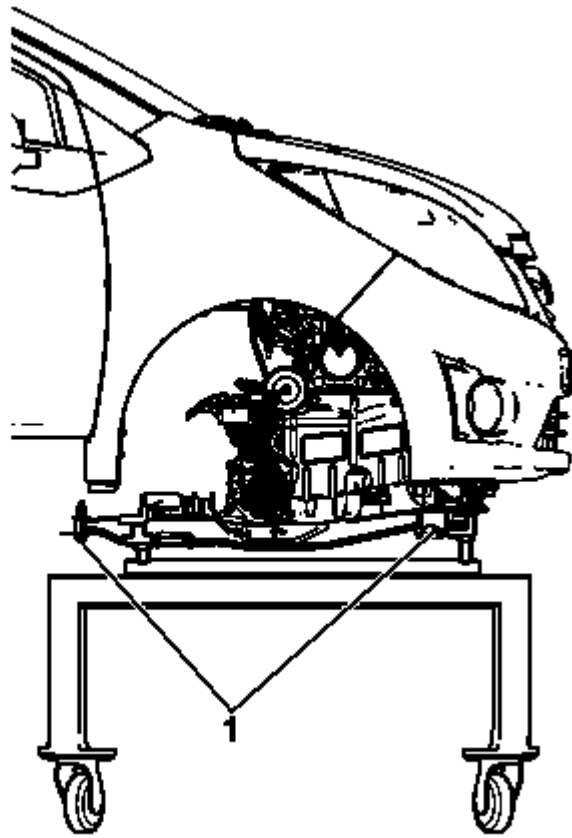


Fig. 105: View Of Cradle Bolts

Courtesy of GENERAL MOTORS COMPANY

60. Position the engine assembly on a suitable powertrain table or an engine lifter below the cradle with suitable woodblocks or suitable rubber blocks as shown.
61. Lower the vehicle until the suitable powertrain table or the engine lifter with suitable woodblocks or suitable rubber blocks.
62. Remove the 4 cradle bolts (1).

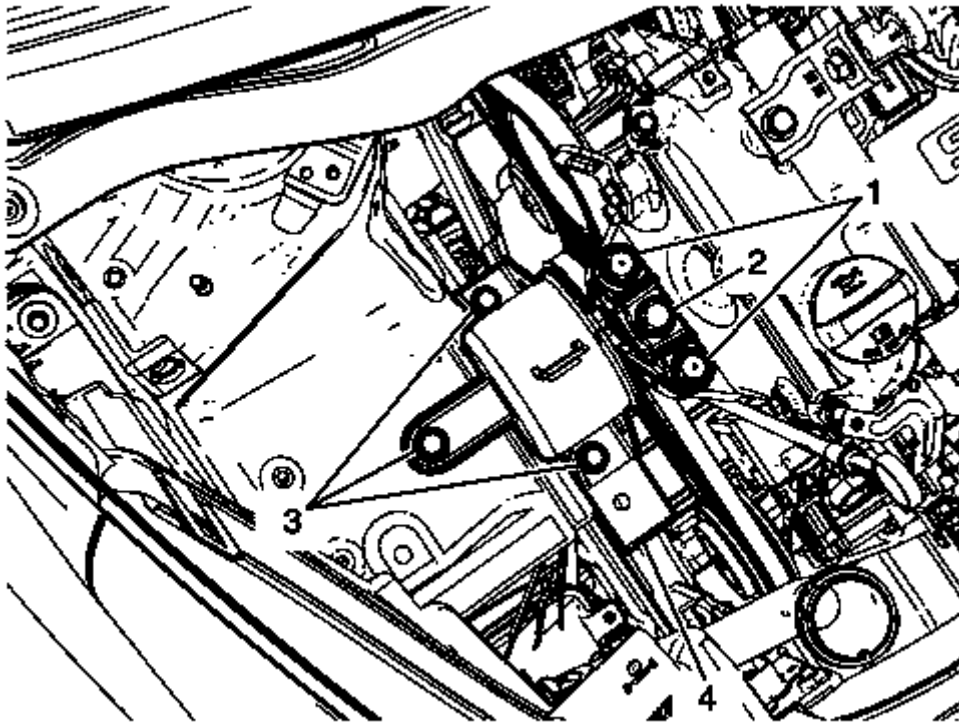


Fig. 106: Engine Mount Nuts

Courtesy of GENERAL MOTORS COMPANY

63. Mark the location of the bolts before removing.
64. Remove the engine mount retaining bolts (2, 3), nuts (1) and the engine mount.

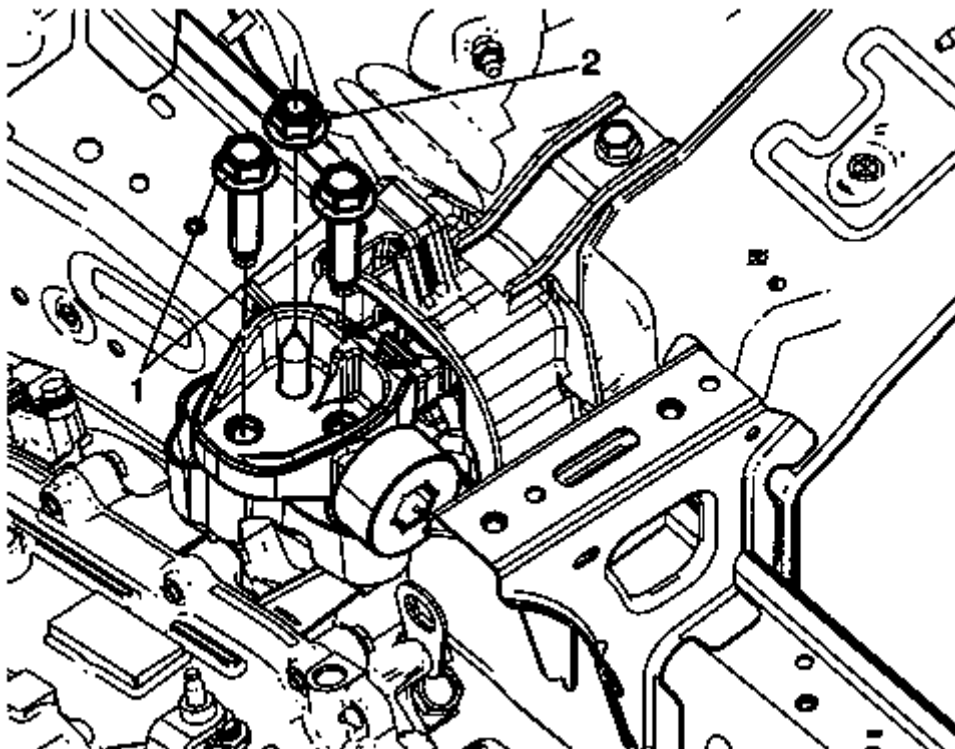


Fig. 107: Location Of Bolts And Nut
Courtesy of GENERAL MOTORS COMPANY

NOTE: Mark the location of the bolts (1) and nut (2) before removing.

65. Remove the left transmission mount bolts (1) and nut (2) from the transmission mount bracket.

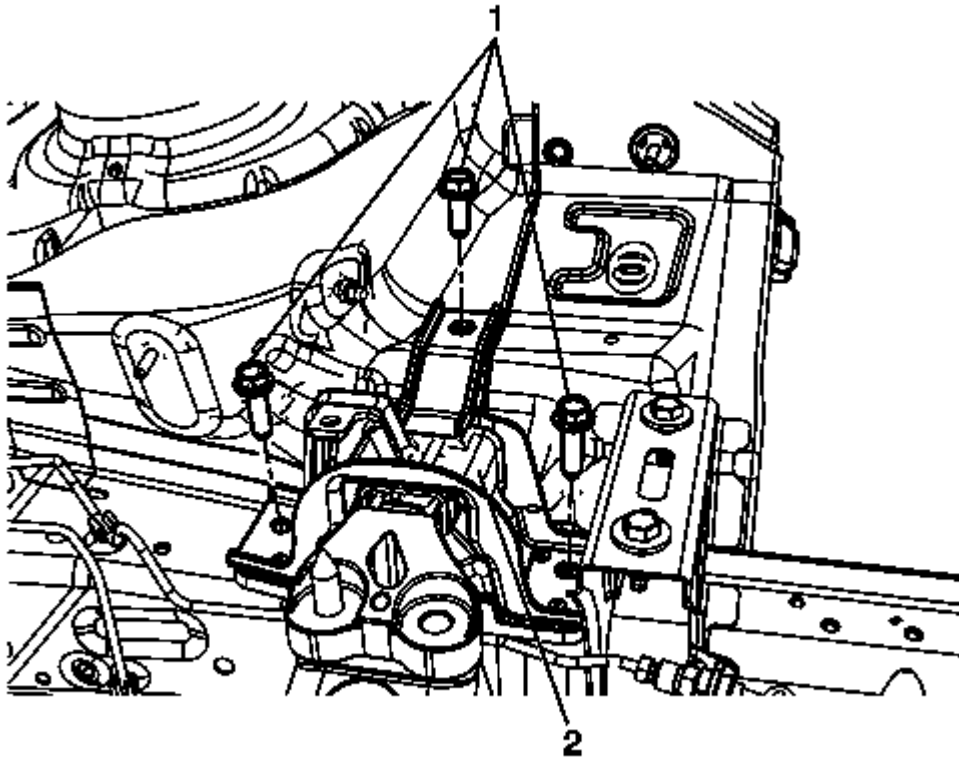


Fig. 108: Left Transmission Mount And Body Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: Mark the location of the bolts (1) and nut (2) before removing.

66. Remove the transmission mount retaining bolts (1) and the transmission mount (2).
67. Transfer parts as needed.

NOTE: Make sure that all the hoses, wires, pipes and front struts clear the vehicle during the removal process.

68. With the aid of an assistant, lower the engine lifter or raise the vehicle to remove the engine, transmission and cradle assembly from the vehicle.
69. Remove the starter. Refer to **Starter Replacement** .

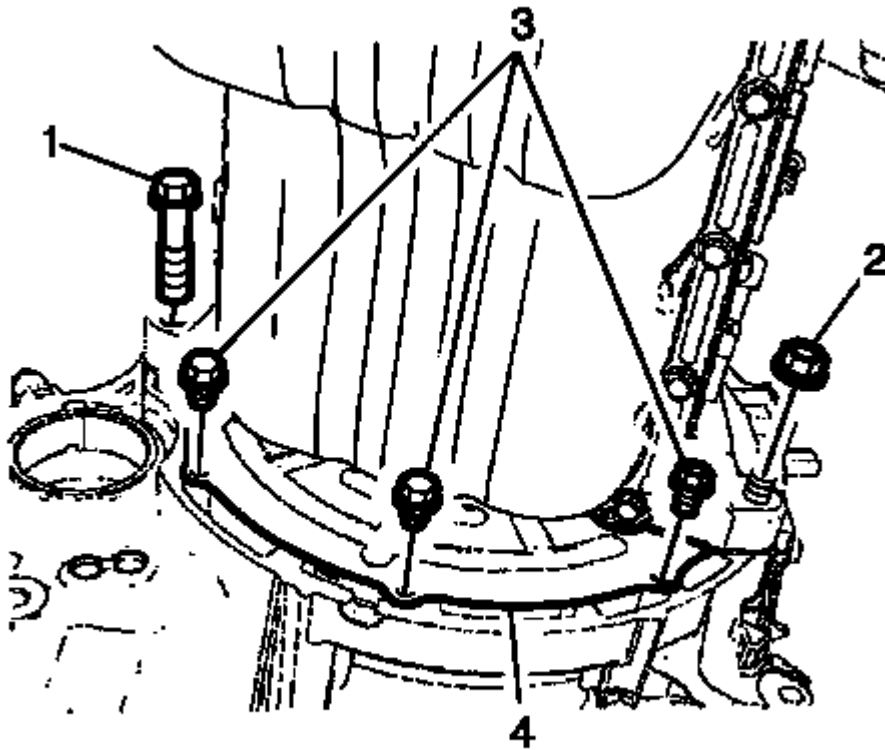


Fig. 109: Lower Transmission Housing Bolt
Courtesy of GENERAL MOTORS COMPANY

70. Remove the lower transmission housing bolt (1) and nut (2).

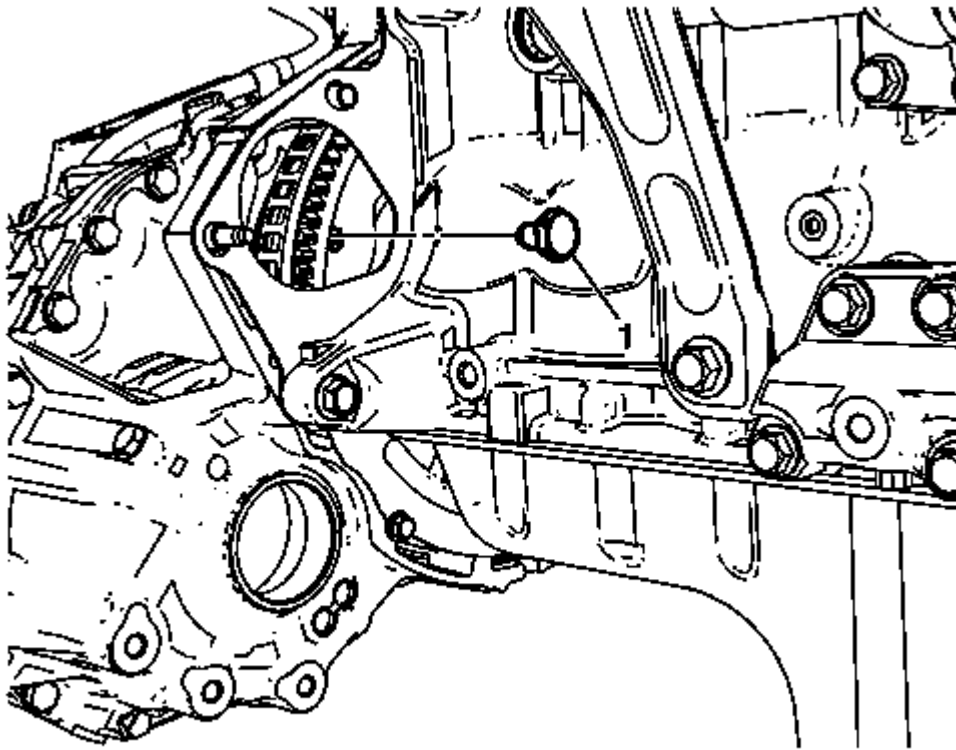


Fig. 110: Torque Converter Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: Only rotate the engine in a clockwise direction only or engine damage will occur.

71. Remove the 3 torque converter bolts (1).

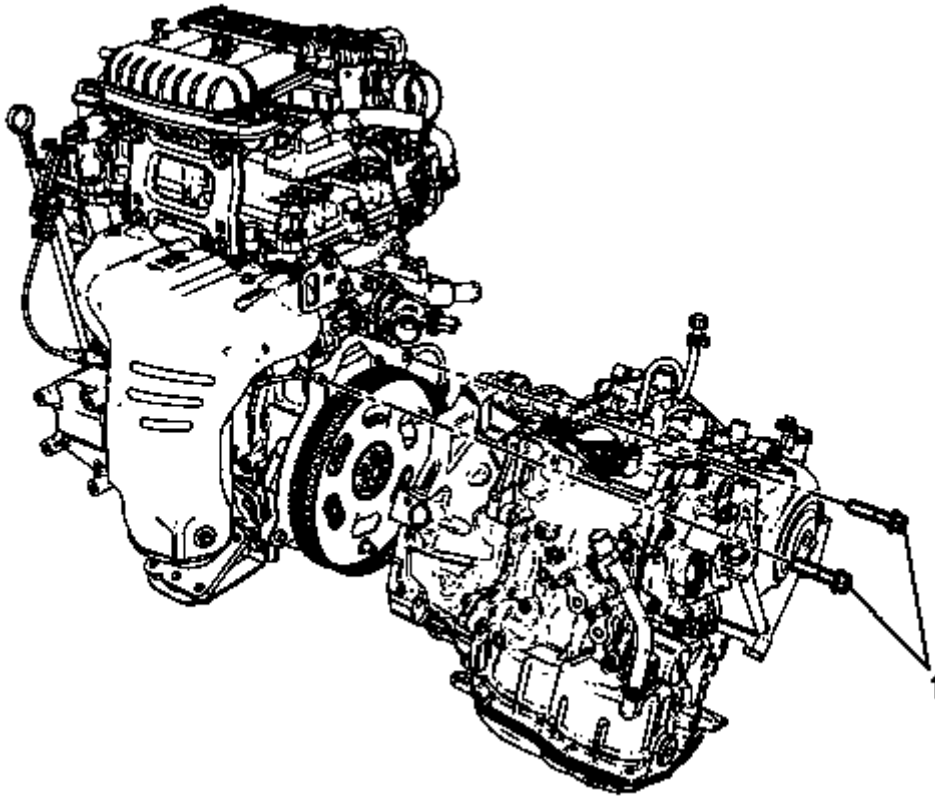


Fig. 111: Upper Transmission Housing Bolts
Courtesy of GENERAL MOTORS COMPANY

72. Remove the upper transmission housing bolts (1) and separate the transmission from the engine.
73. Install the engine to an engine stand. (Using M10 x 1.25 approximately 130 mm long)
74. Transfer parts as needed.

Installation Procedure

1. Remove the engine from the engine stand.

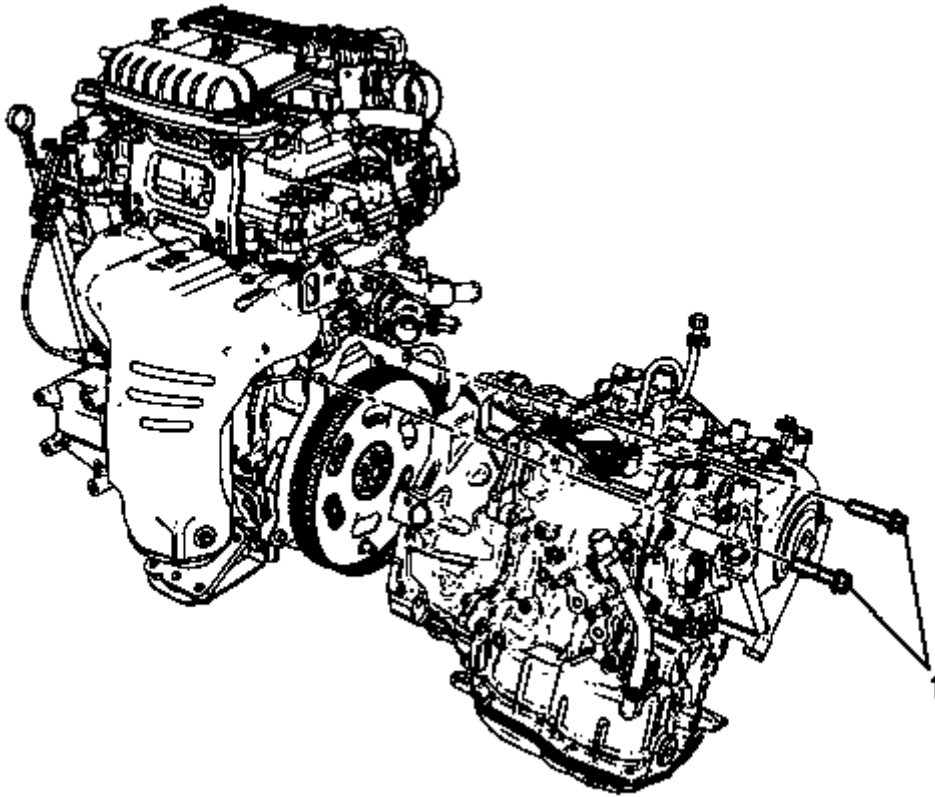


Fig. 112: Upper Transmission Housing Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Combine the engine with the transmission and tighten upper auto transmission housing bolts (1) to 61 (44 lb ft).

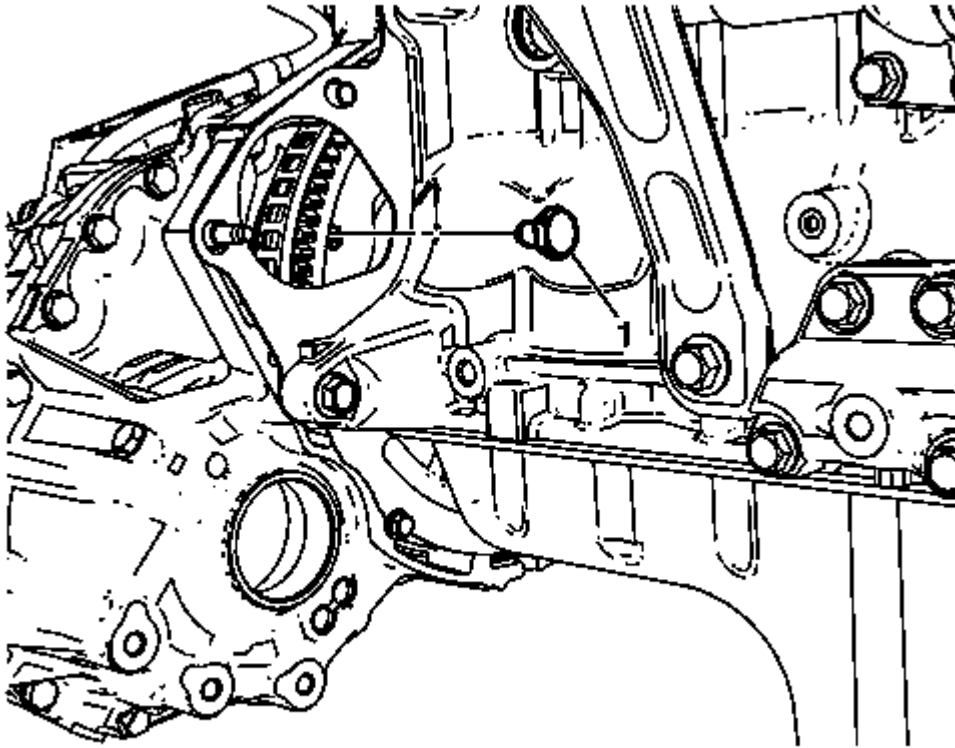


Fig. 113: Torque Converter Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: Only rotate the engine in a clockwise direction only or engine damage will occur.

3. Install the torque converter bolts (1) and tighten to 60 (44 lb ft).

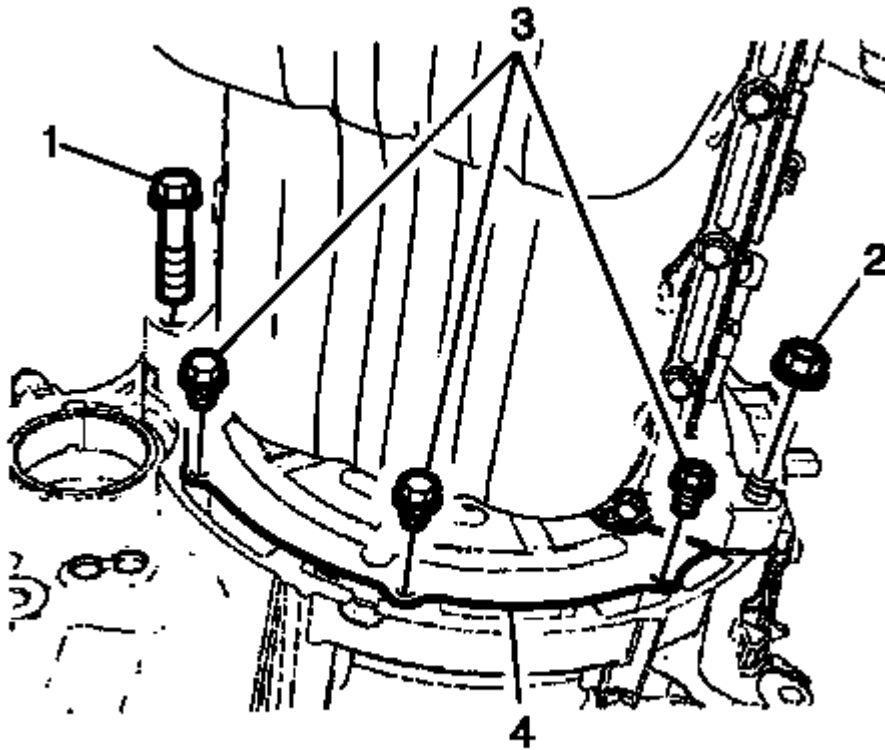


Fig. 114: Lower Transmission Housing Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Install the lower transmission housing bolt (1) and nut (2) and tighten to 61 (45 lb ft).
5. Install the starter. Refer to **Starter Replacement** .

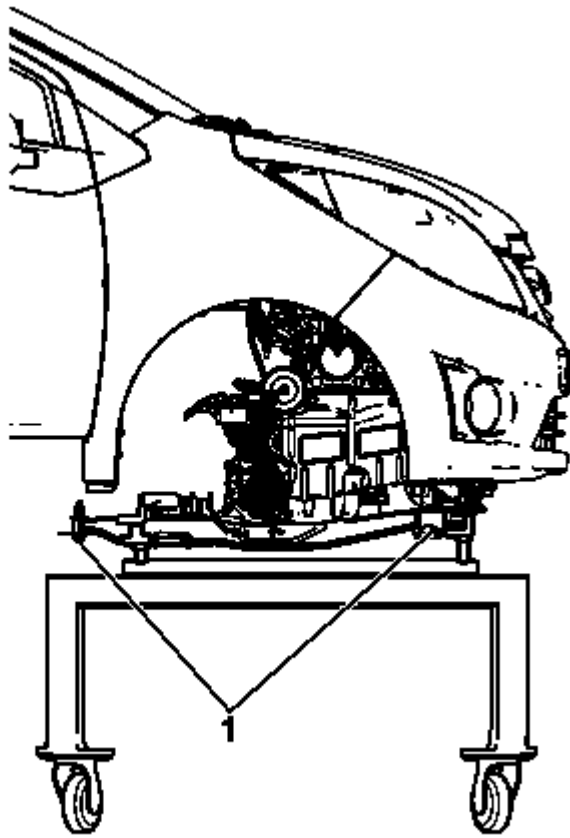


Fig. 115: View Of Cradle Bolts

Courtesy of GENERAL MOTORS COMPANY

6. With the aid of an assistant, raise the engine lifter or lower the vehicle to install the engine, transmission and cradle assembly to the vehicle.
7. Tighten the 4 cradle bolt (1) to 135 (100 lb ft).

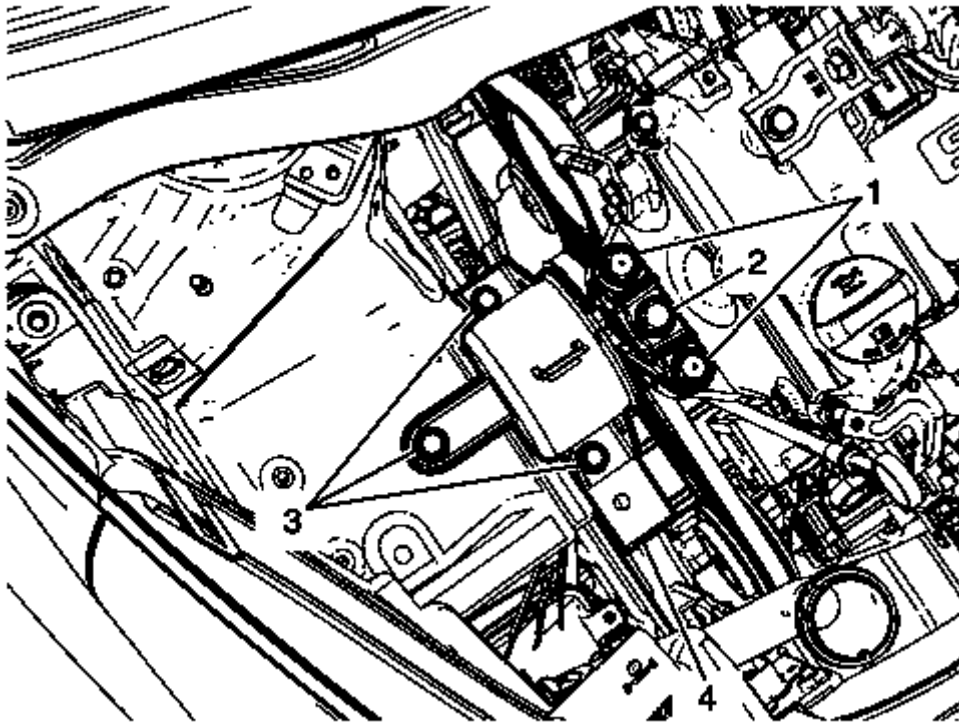


Fig. 116: Engine Mount Nuts

Courtesy of GENERAL MOTORS COMPANY

8. Install the engine mount and the engine mount bolts and nuts.
9. Tighten the engine mount retaining nuts (1) to 66 (49 lb ft).
10. Tighten the engine mount retaining bolt (2) to 66 (49 lb ft).
11. Tighten the engine mount retaining bolts (3) to 50 (37 lb ft).

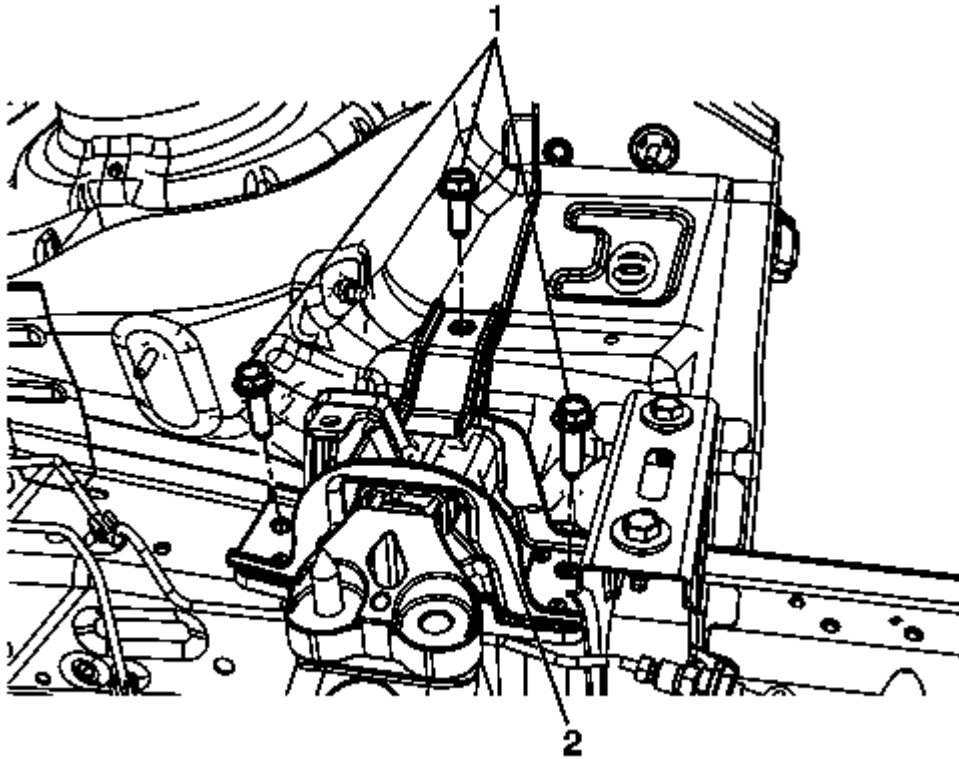


Fig. 117: Left Transmission Mount And Body Bolts
Courtesy of GENERAL MOTORS COMPANY

12. Install the transmission mount (2) and the transmission mount bolts (1).
13. Tighten to 50 (37 lb ft).

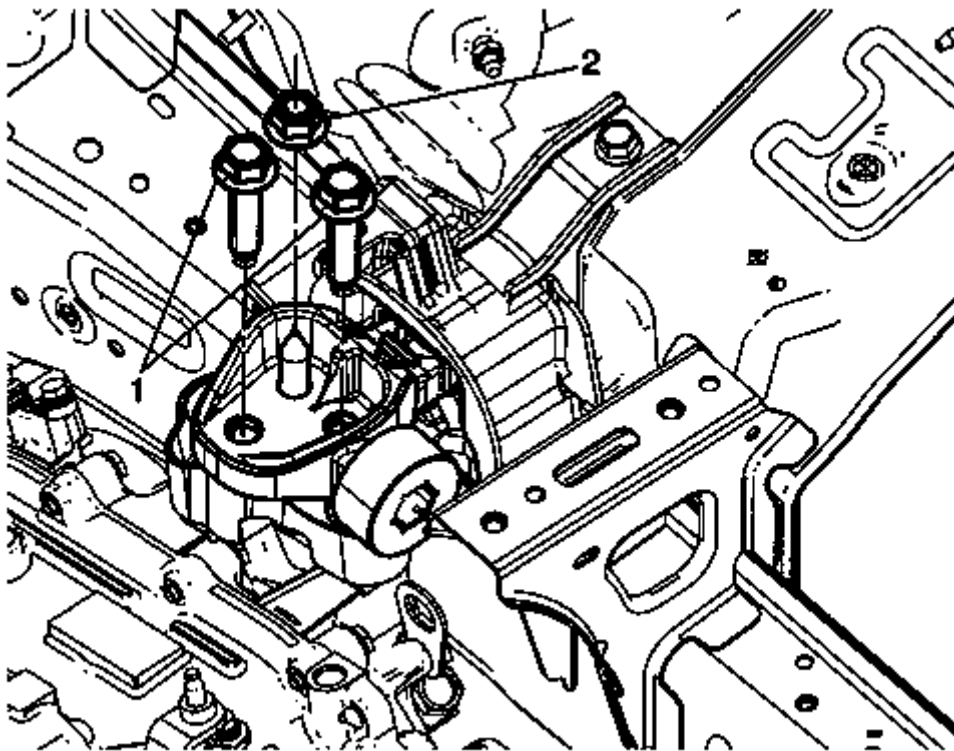


Fig. 118: Location Of Bolts And Nut
Courtesy of GENERAL MOTORS COMPANY

14. Install the left transmission mount bolts (1) and nut (2) to the transmission mount bracket (2) and tighten to 95 (70 lb ft).
15. Connect additional electrical connections as necessary.

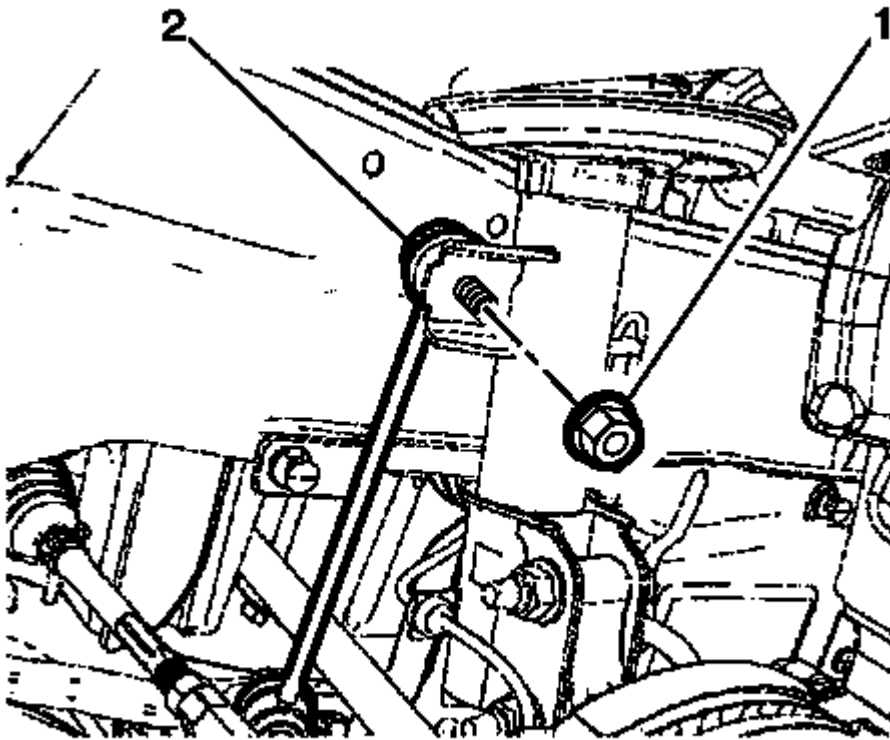


Fig. 119: Front Upper Stabilizer Shaft Link Nut
Courtesy of GENERAL MOTORS COMPANY

16. Install the front upper stabilizer shaft link (2) and the front upper stabilizer shaft link nut (1).
17. Tighten to 43 (32 lb ft). Repeat for opposite side.

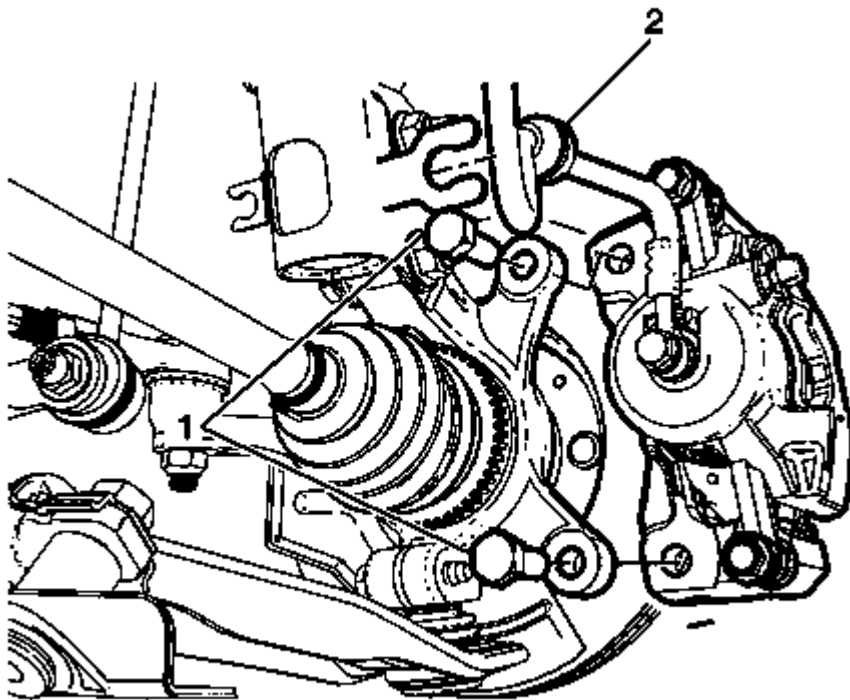


Fig. 120: Front Brake Hose And Front Brake Caliper Retaining Bolts
Courtesy of GENERAL MOTORS COMPANY

18. Install the front brake caliper and tighten the front brake caliper bolts (1) to 95 (70 lb ft).
19. Install the front brake hose (2) to the strut mounted brake hose retaining bracket. Repeat for opposite side.
20. Install the outer tie rod assembly from the steering knuckle. Repeat for opposite side. Refer to **Steering Linkage Outer Tie Rod Replacement** .
21. Install the wheel drive shaft to the front steering knuckle. Refer to **Front Wheel Drive Shaft Replacement** .
22. Install the wheel drive shaft nut and washer to the wheel drive shaft. Repeat for opposite side. Refer to **Front Wheel Drive Shaft Replacement** .
23. Install the control arm ball joint to the steering knuckle. Repeat for opposite side. Refer to **Lower Control Arm Replacement** .

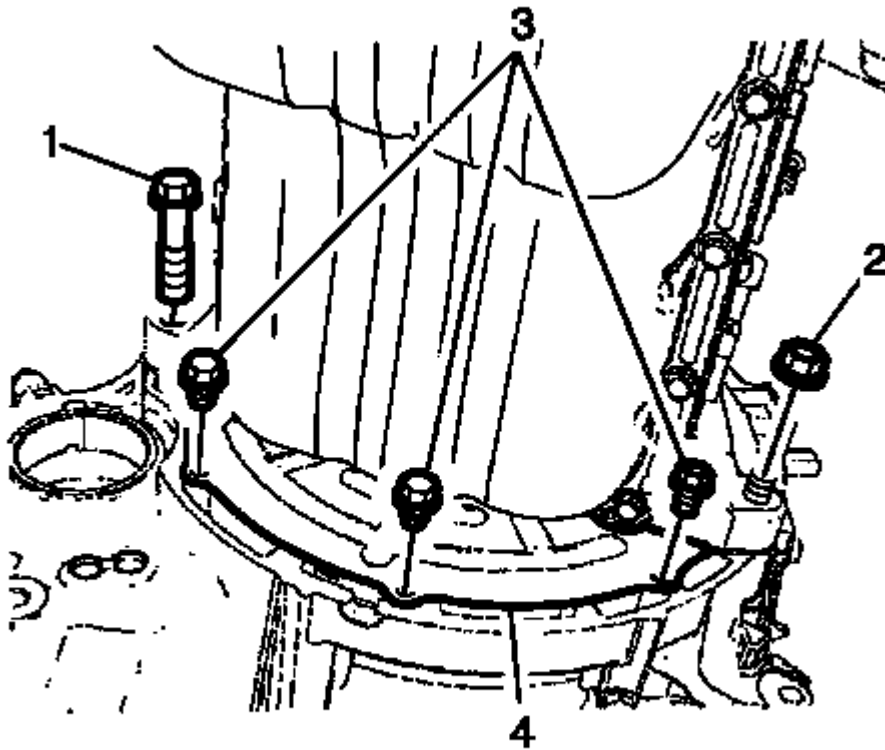


Fig. 121: Lower Transmission Housing Bolt
Courtesy of GENERAL MOTORS COMPANY

24. Install the transmission dust cover (4) and tighten the transmission dust cover bolts (3) to 9 (80 lb ft).
25. Install the transmission rear mount bracket. Refer to **Transmission Rear Mount Bracket Replacement** .
26. Install the exhaust pipe. Refer to **Exhaust Pipe Replacement (LFM)** .

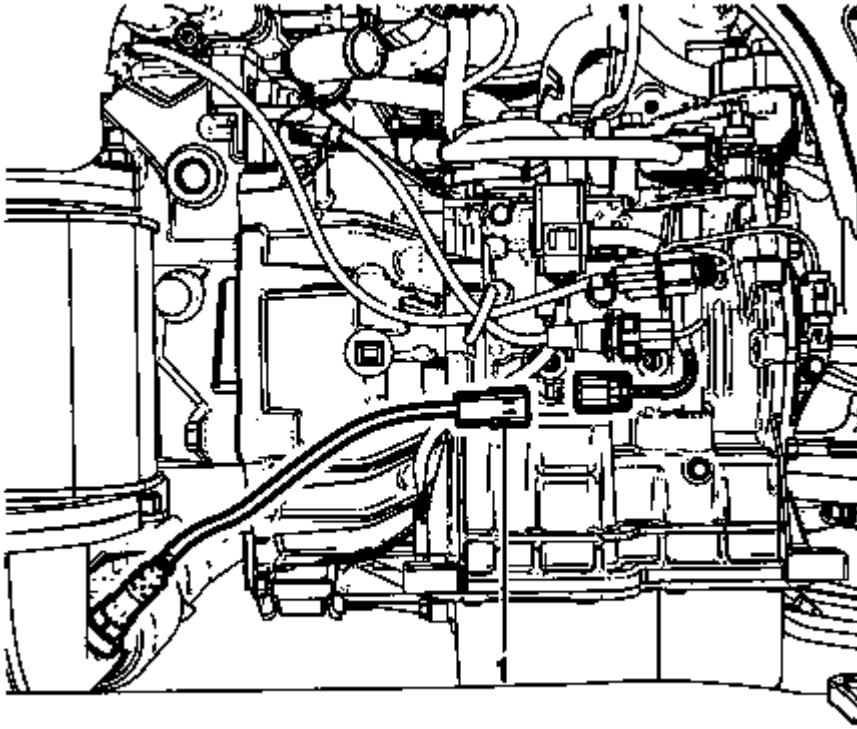


Fig. 122: Oxygen Sensor Connector
Courtesy of GENERAL MOTORS COMPANY

27. Connect the oxygen sensor connector.

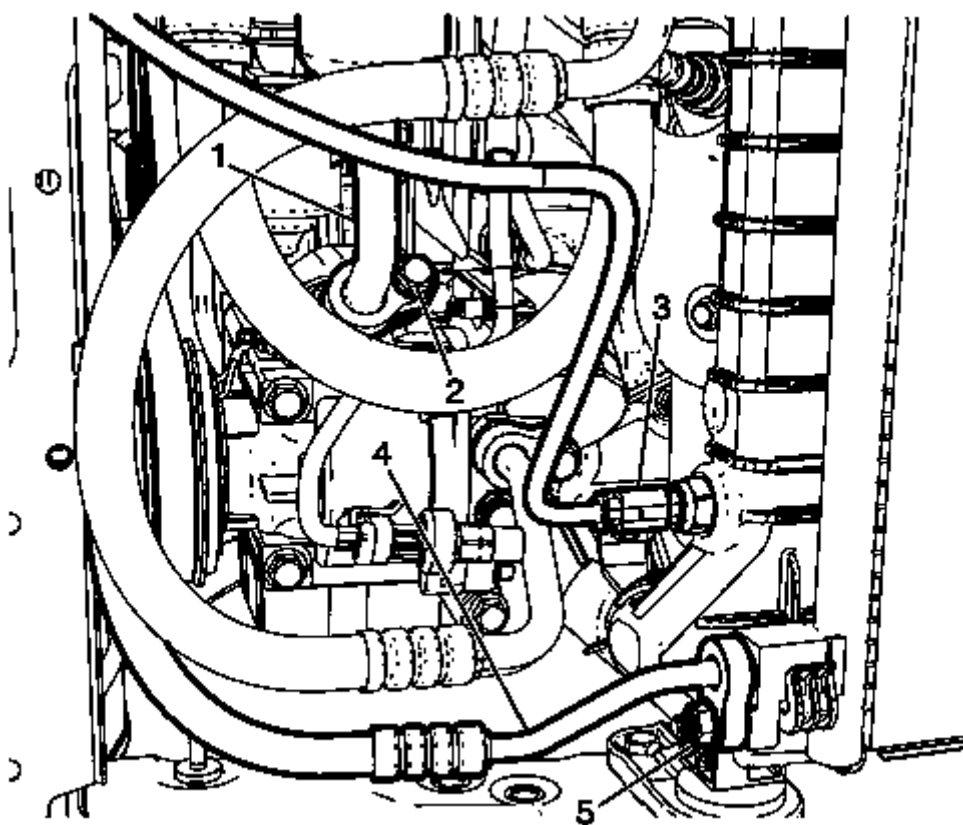


Fig. 123: Suction Pipe Bolt

Courtesy of GENERAL MOTORS COMPANY

28. Install the suction pipe (1) to the A/C compressor.
29. Install the suction pipe bolt (2) to the A/C compressor and tighten to 22 (16 lb ft).
30. Install the discharge pipe (4) to the A/C condenser.
31. Install the discharge pipe nut (5) to the A/C condenser and tighten to 10 (89 lb in).
32. Connect the coolant temperature sensor wiring connector (3) from the radiator.

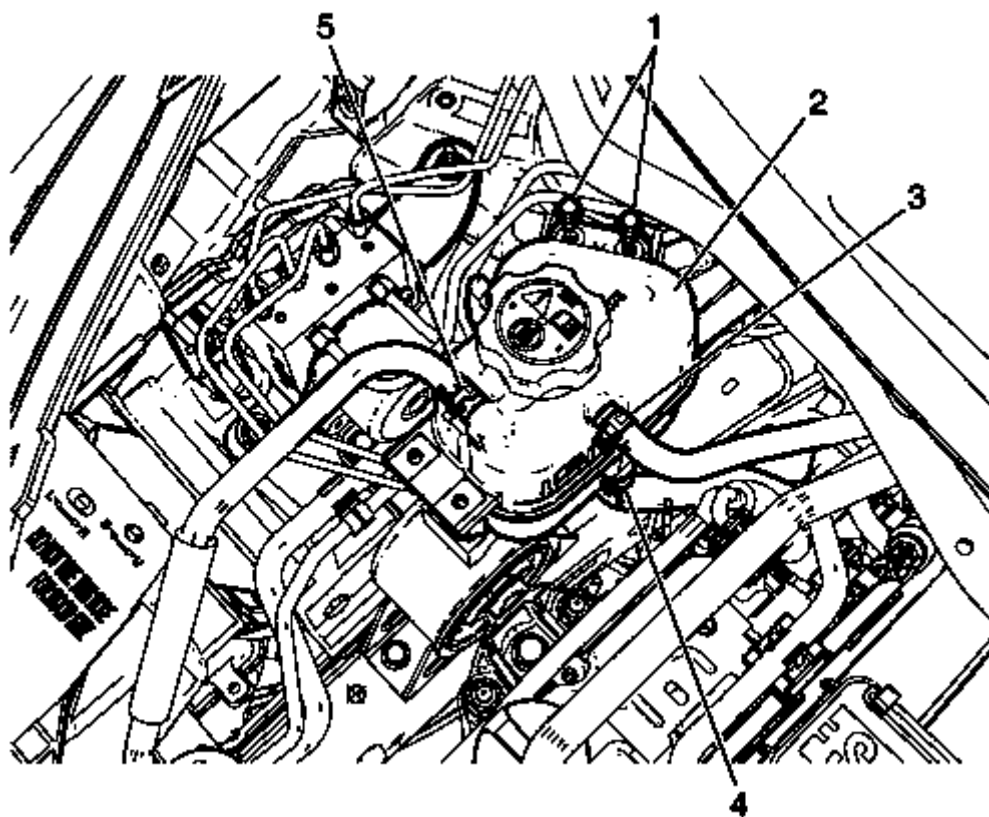


Fig. 124: Coolant Surge Tank

Courtesy of GENERAL MOTORS COMPANY

33. Install the coolant surge tank (2) and coolant hoses with the coolant hose clips (3, 4, 5).
34. Install the coolant surge tank retaining bolts (1) and tighten to 8 (71 lb in).

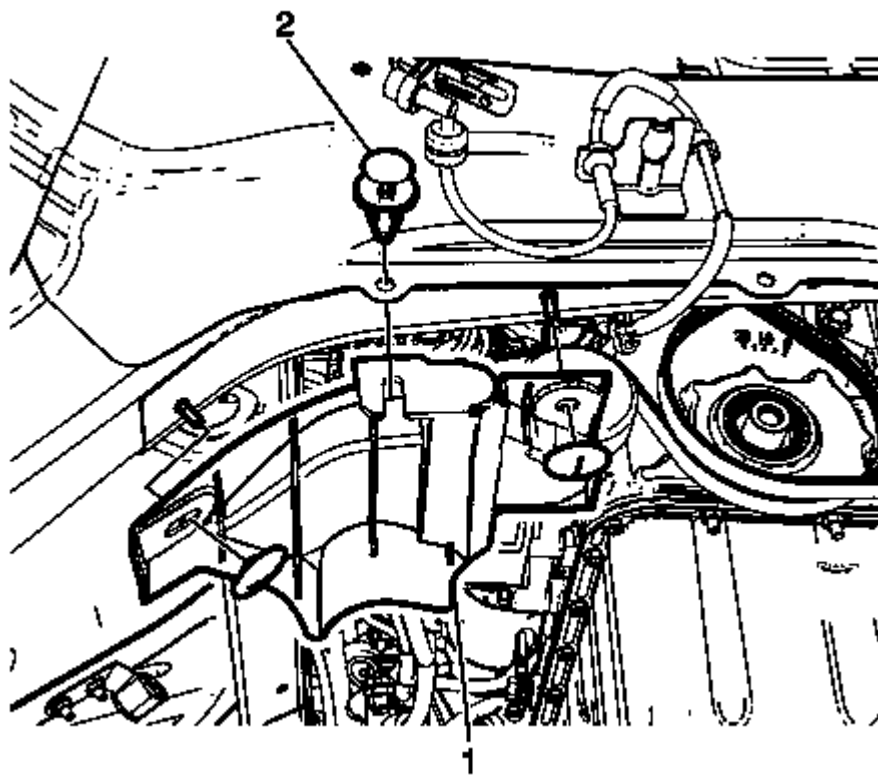


Fig. 125: Retainers And Water Deflector
Courtesy of GENERAL MOTORS COMPANY

35. Install the water deflector (1) with retainers (2).

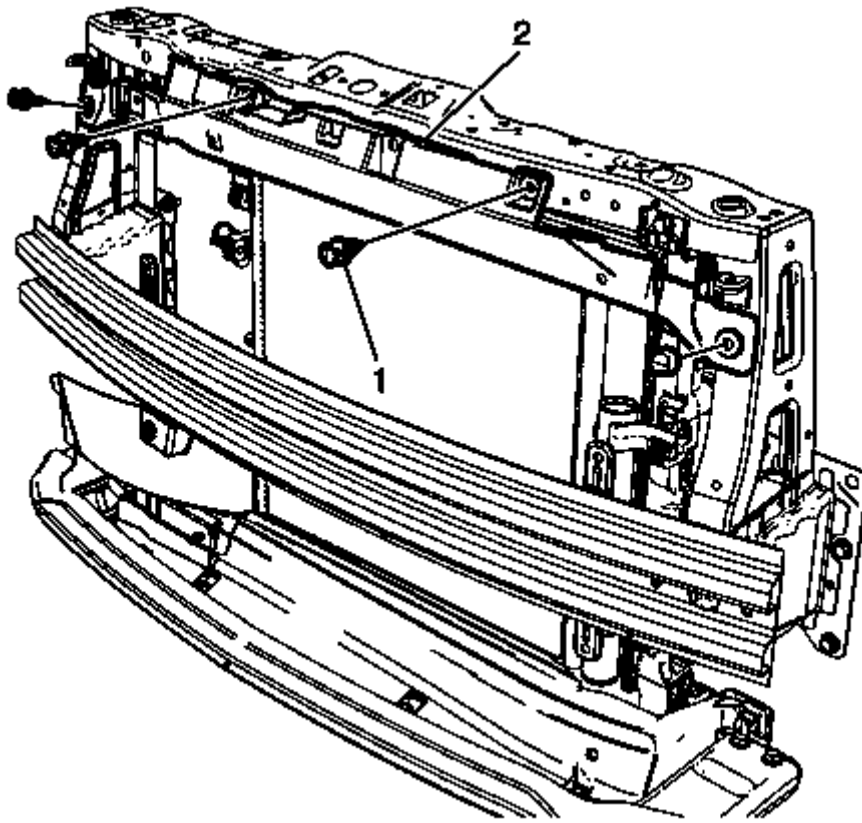


Fig. 126: Upper Air Guard Retainers
Courtesy of GENERAL MOTORS COMPANY

36. Install the upper air guard (2) and the upper air guard retainers (1).

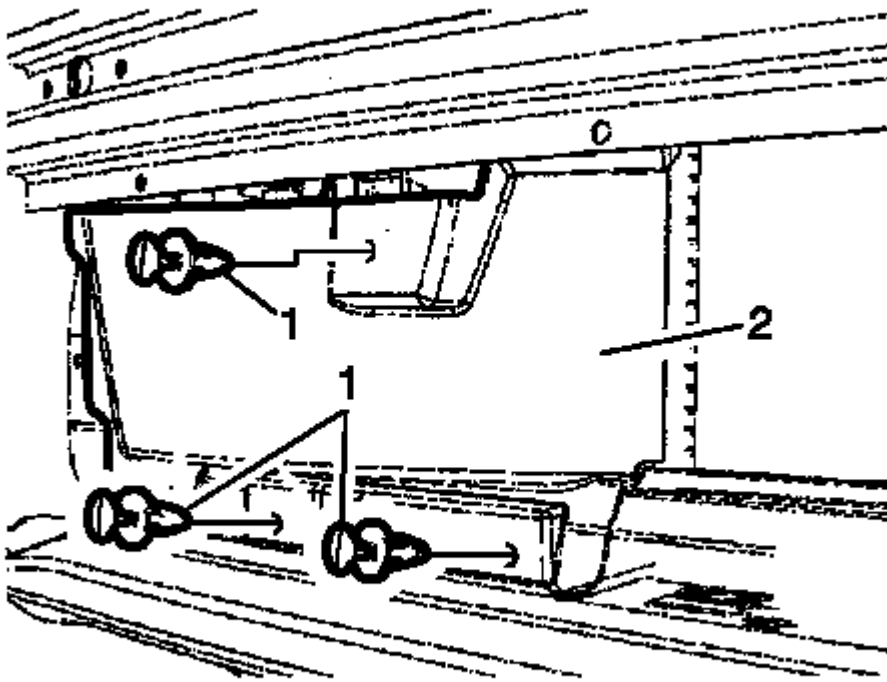


Fig. 127: Front Lower Air Baffle Retainers
Courtesy of GENERAL MOTORS COMPANY

37. Install the front lower air baffles (2) and the front lower air baffle retainers (1).

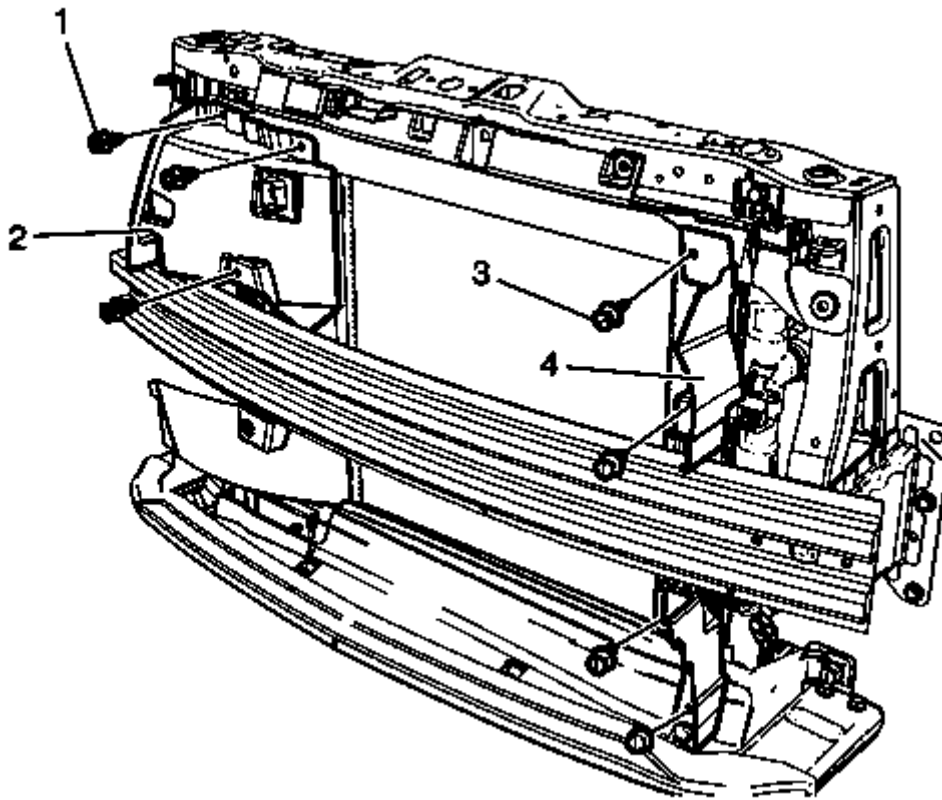


Fig. 128: Front Side Air Baffle Retainers
Courtesy of GENERAL MOTORS COMPANY

38. Install the front side air baffles (2, 4) and the front side air baffle retainers (1, 3).
39. Install the front bumper fascia. Refer to **Front Bumper Fascia Replacement** .

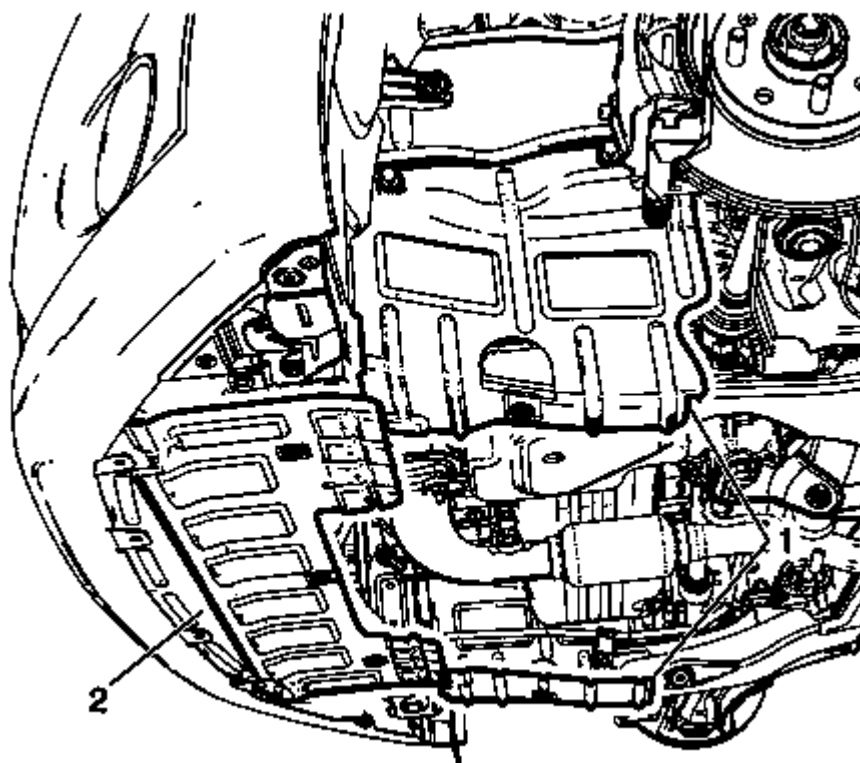


Fig. 129: Compartment Splash Shield
Courtesy of GENERAL MOTORS COMPANY

40. Install the compartment splash shield (1, 2). Refer to **Front Compartment Splash Shield Replacement** .

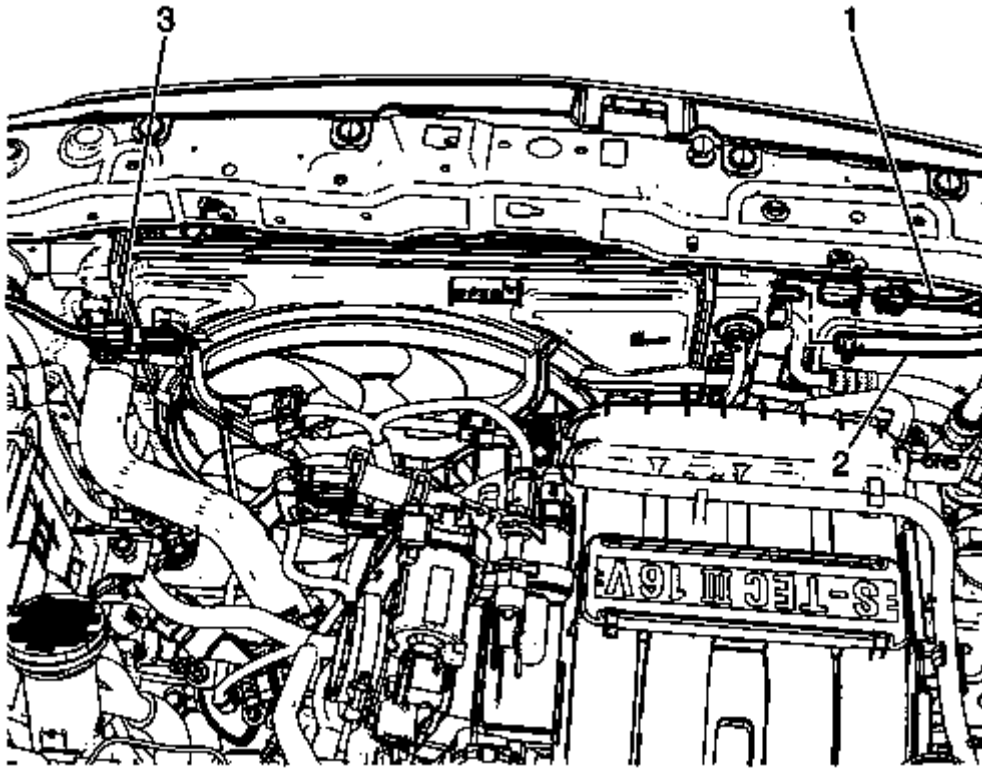


Fig. 130: Ambient Air Temperature Sensor Connector
Courtesy of GENERAL MOTORS COMPANY

41. Connect the coolant hose (2) to the radiator.
42. Connect the ambient air temperature sensor connector (1) to the ambient air temperature sensor if equipped.
43. Install the wiring harness connector (3) to the engine cooling fan harness connector.

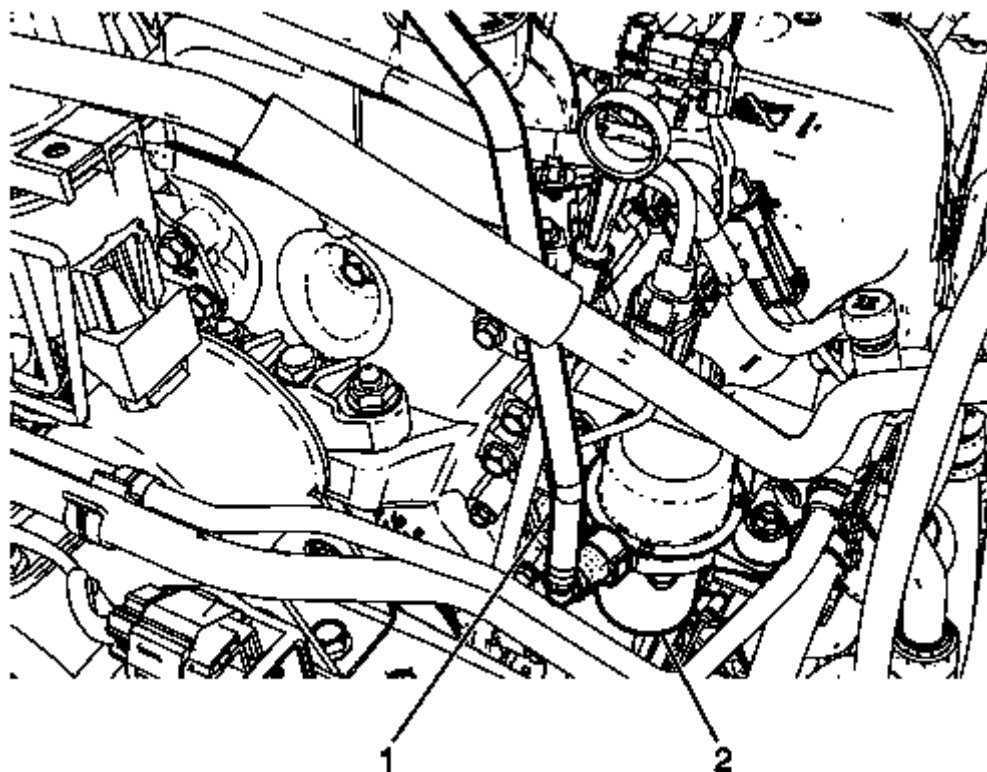


Fig. 131: Vacuum Pump Hose And Vacuum Pump
Courtesy of GENERAL MOTORS COMPANY

44. Install the vacuum pump hose (1) to the vacuum pump (2).

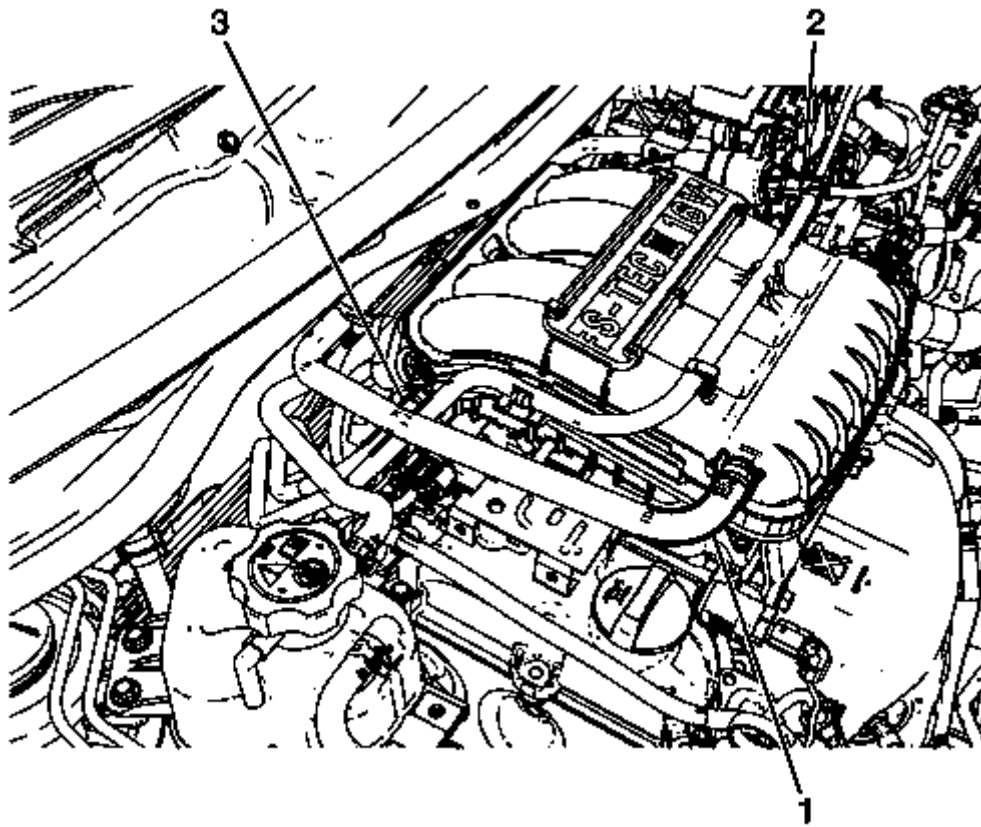


Fig. 132: Vacuum Hose

Courtesy of GENERAL MOTORS COMPANY

45. Connect the fuel feed hose (3).
46. Connect the evaporative canister purge solenoid valve hose (2).
47. Connect the vacuum hose (1) to the intake manifold.

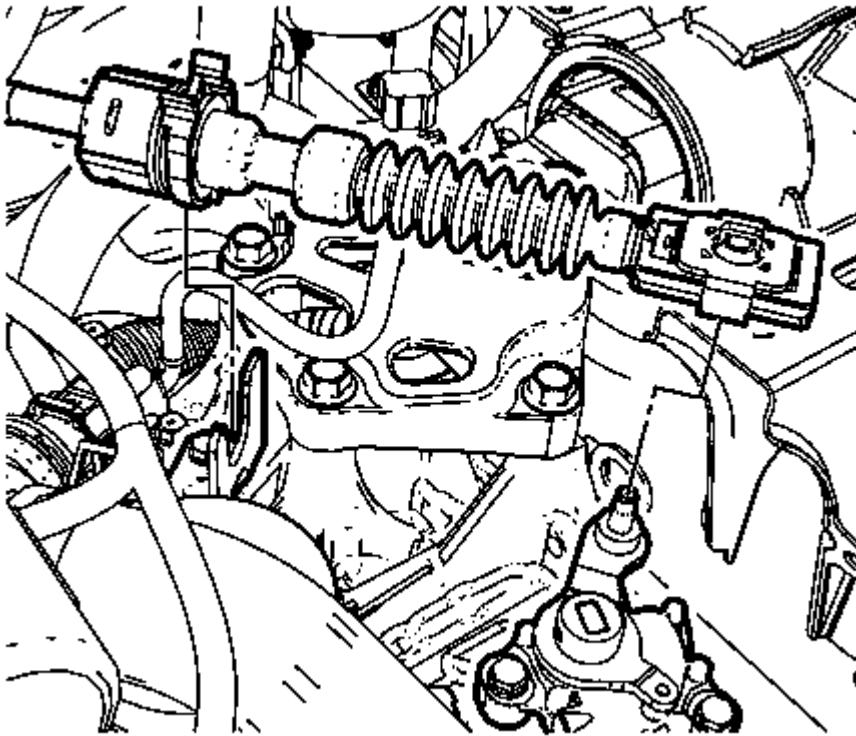


Fig. 133: Transmission Range Selector Lever Cable Terminal
Courtesy of GENERAL MOTORS COMPANY

48. Connect the transmission range selector lever cable terminal to the transmission lever pin.
49. Install the transmission range selector lever cable to the cable bracket.
50. Install the heater inlet hose. Refer to **Heater Inlet Hose Replacement (1.0L LMT, 1.19L LC5 and 1.2L LMU)** .
51. Install the heater outlet hose. Refer to **Heater Outlet Hose Replacement (1.0L LMT, 1.19L LC5 and 1.2L LMU)** .

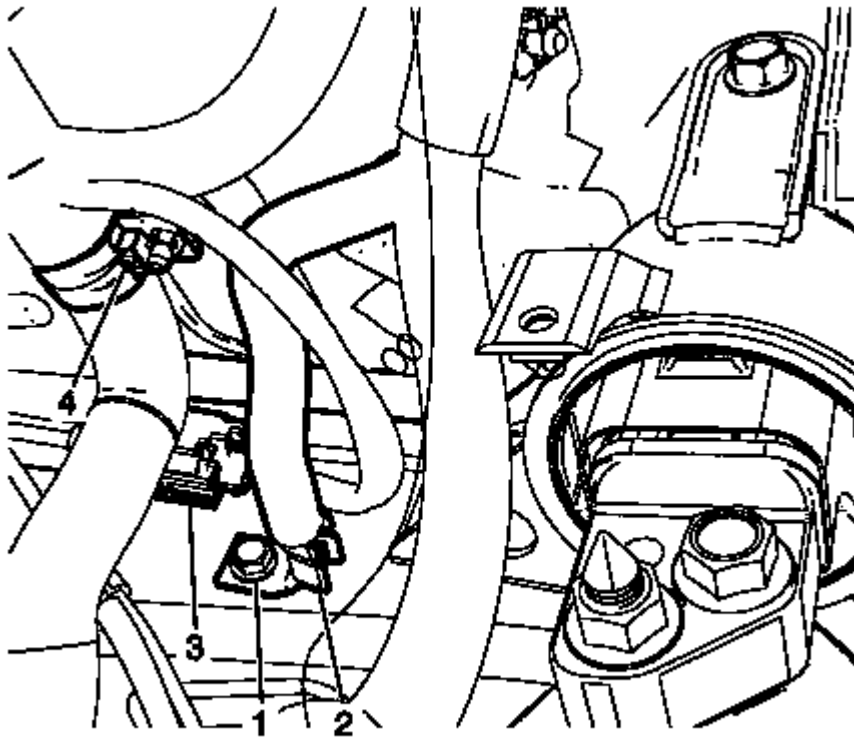


Fig. 134: Ground Bolt And Put Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

52. Install the wiring harness retainer (4).
53. Connect the wheel speed sensor connector (3).
54. Install the ground wiring harness and bolt (1) and tighten to 10 (89 lb in).

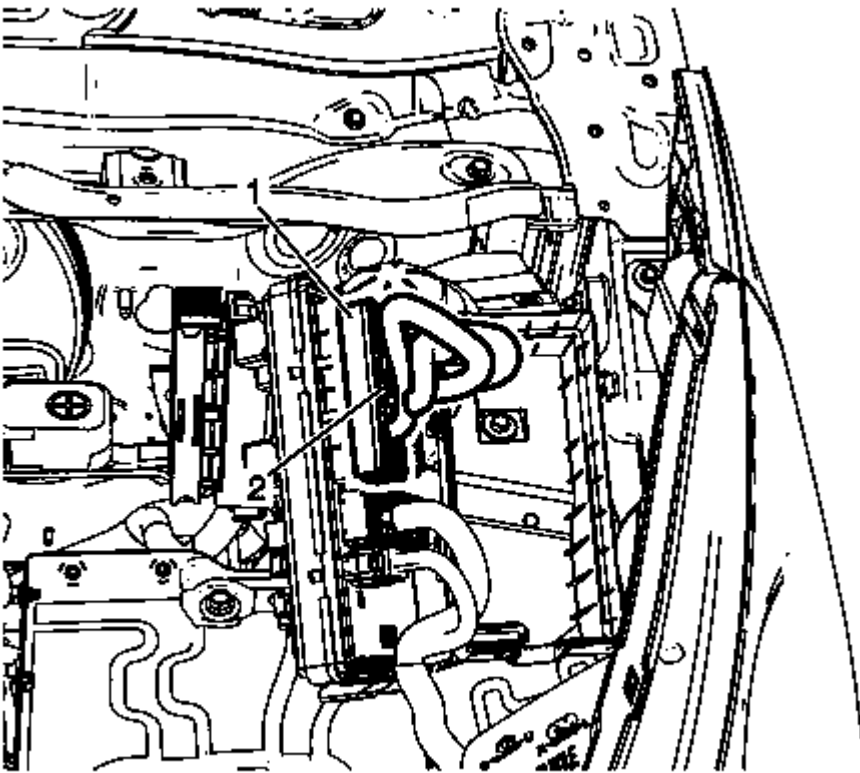


Fig. 135: Front Compartment Fuse Block
Courtesy of GENERAL MOTORS COMPANY

55. Connect the engine wiring harness connector (1) to the fuse block and tighten the wiring harness connector retaining bolt (2) to 6 (53 lb in). Repeat for remaining connector.
56. Connect the remaining wiring harness to the compartment fuse block.
57. Install the engine wiring harness fuse block to the lower plate.

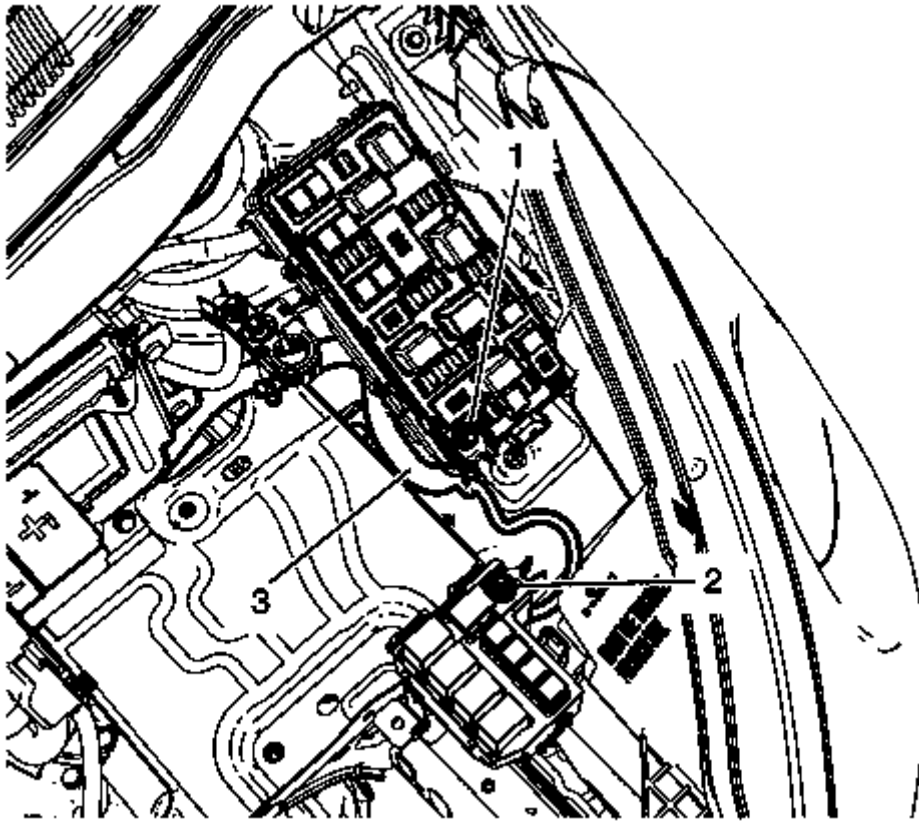


Fig. 136: Positive Battery Cable Nut

Courtesy of GENERAL MOTORS COMPANY

58. Install the positive cable (3) to the engine wiring harness fuse block and tighten the positive cable retaining nut (1, 2) to 10 (89 lb in).

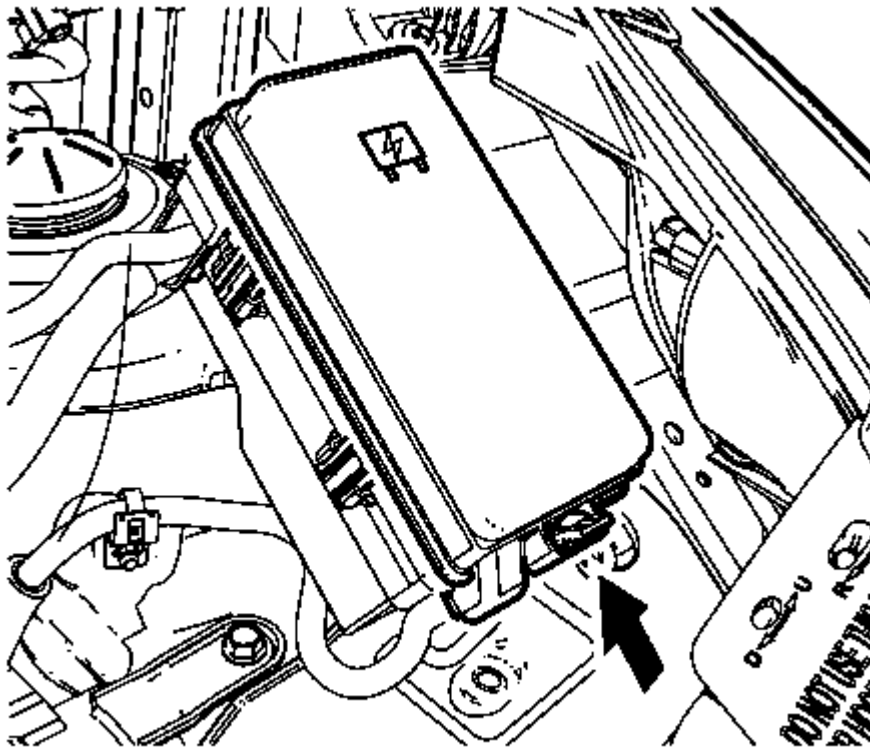


Fig. 137: Front Compartment Fuse Block Cover
Courtesy of GENERAL MOTORS COMPANY

59. Install the engine wiring harness fuse block cover.

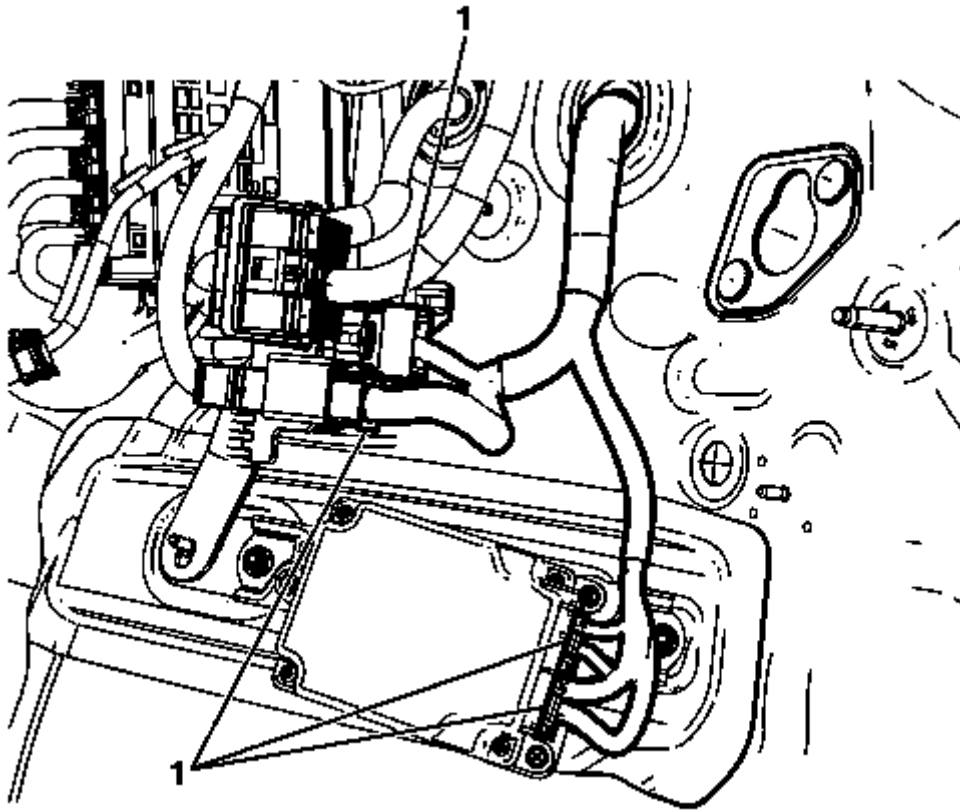


Fig. 138: Engine Wiring Harnesses Connectors
Courtesy of GENERAL MOTORS COMPANY

60. Install the engine wiring harness through the front of dash on the left of the steering shaft under the dash and connect the 4 engine wiring harnesses connectors (1).

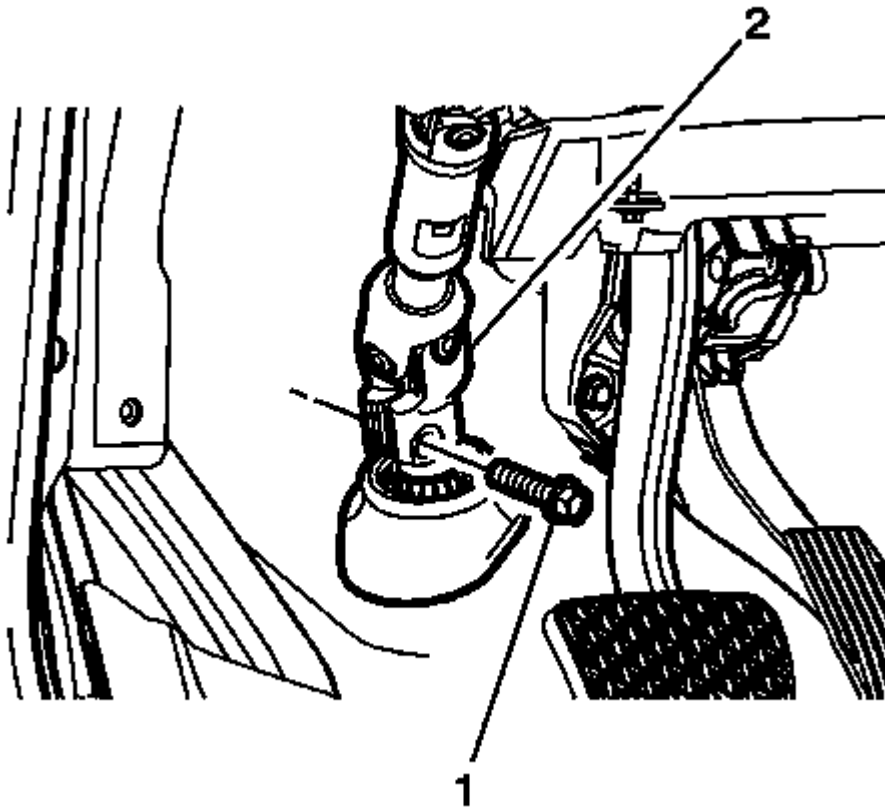


Fig. 139: Lower Intermediate Steering Shaft Bolt
Courtesy of GENERAL MOTORS COMPANY

61. Install the lower intermediate steering shaft (2) and tighten the lower intermediate steering shaft bolt (1) to 27 (20 lb ft).
62. Install the battery tray. Refer to **Battery Tray Replacement** .
63. Install the engine control module. Refer to **Engine Control Module Replacement** .
64. Install the battery. Refer to **Battery Replacement** .
65. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
66. Install the front wheels and tires. Refer to **Tire and Wheel Removal and Installation** .
67. Recharge the refrigerant. Refer to **Refrigerant Recovery and Recharging** .
68. Refill the cooling system. Refer to **Cooling System Draining and Filling** .
69. Check the engine oil level and fill new engine oil up if necessary.
70. Connect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection** .
71. Close the hood.

ENGINE REPLACEMENT (LL0)

Removal Procedure

1. Open the hood.
2. Relieve the fuel system pressure. Refer to Fuel Pressure Relief .
3. Disconnect the battery negative cable. Refer to Battery Negative Cable Disconnection and Connection .
4. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
5. Drain the cooling system. Refer to Cooling System Draining and Filling .
6. Recover the refrigerant. Refer to Refrigerant Recovery and Recharging .
7. Remove the front wheels and tires. Refer to Tire and Wheel Removal and Installation .
8. Remove the air cleaner assembly. Refer to Air Cleaner Assembly Replacement .
9. Remove the battery. Refer to Battery Replacement .
10. Remove the engine control module. Refer to Engine Control Module Replacement .
11. Remove the battery tray. Refer to Battery Tray Replacement .

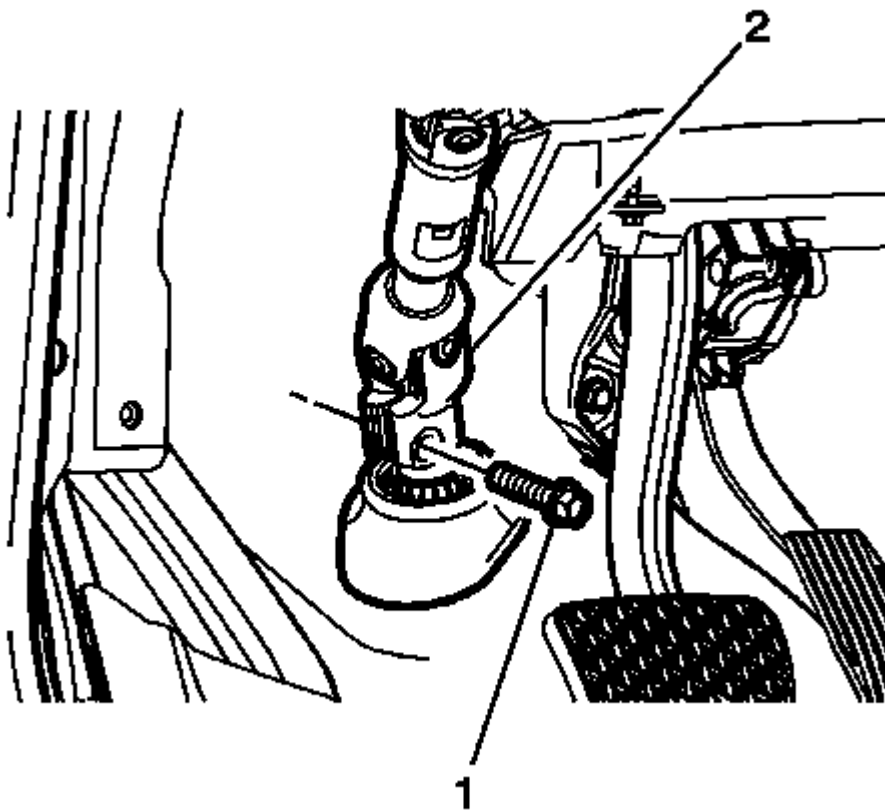


Fig. 140: Lower Intermediate Steering Shaft Bolt
Courtesy of GENERAL MOTORS COMPANY

12. Remove the lower intermediate steering shaft bolt (1) and detach the lower Intermediate steering shaft (2).

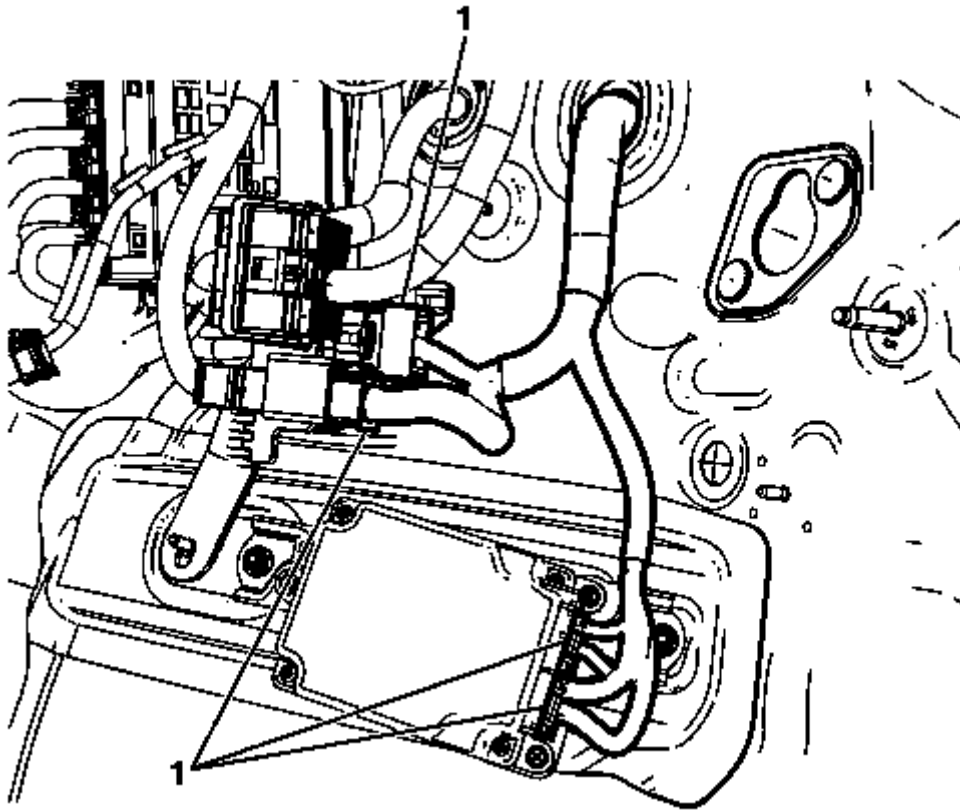


Fig. 141: Engine Wiring Harnesses Connectors
Courtesy of GENERAL MOTORS COMPANY

13. Disconnect 4 engine wiring harnesses connectors (1) from under dash, left of the steering shaft and pull out the engine wiring harnesses through the front of dash to the engine compartment.

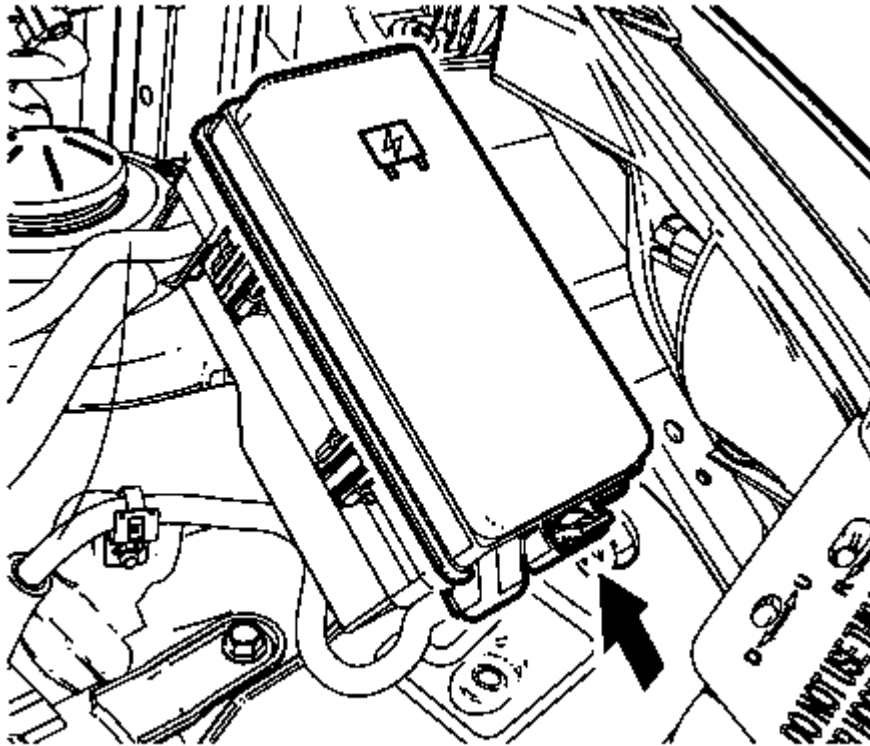


Fig. 142: Front Compartment Fuse Block Cover
Courtesy of GENERAL MOTORS COMPANY

14. Remove the engine wiring harness fuse block cover.

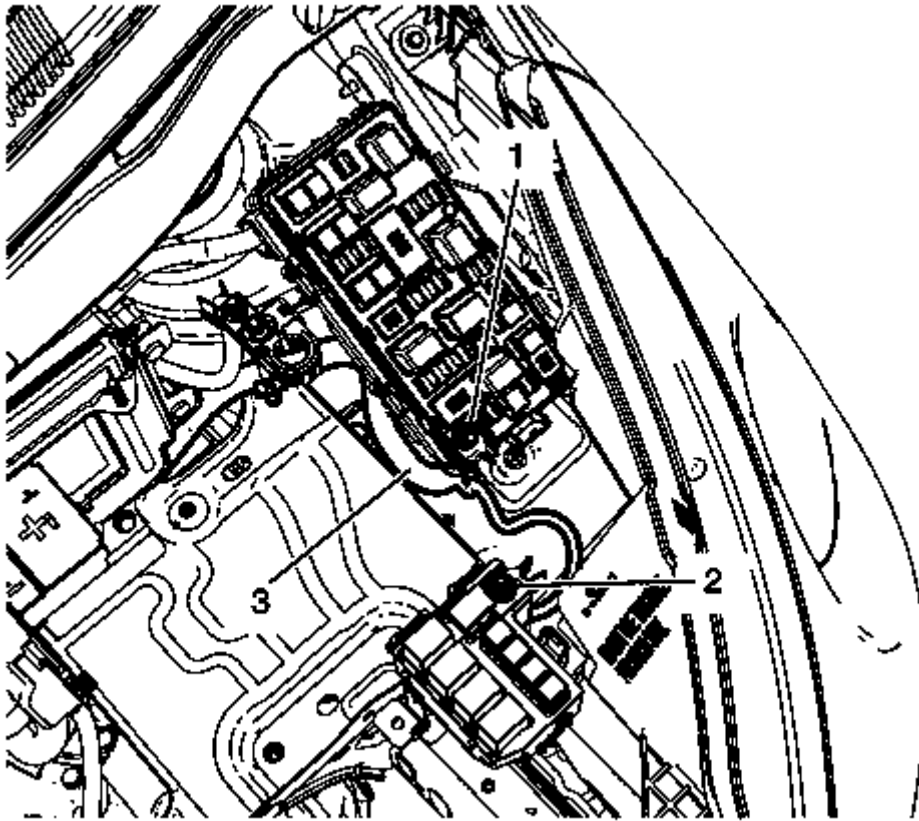


Fig. 143: Positive Battery Cable Nut
Courtesy of GENERAL MOTORS COMPANY

15. Remove the positive cable retaining nut (1, 2) and the positive cable (3).

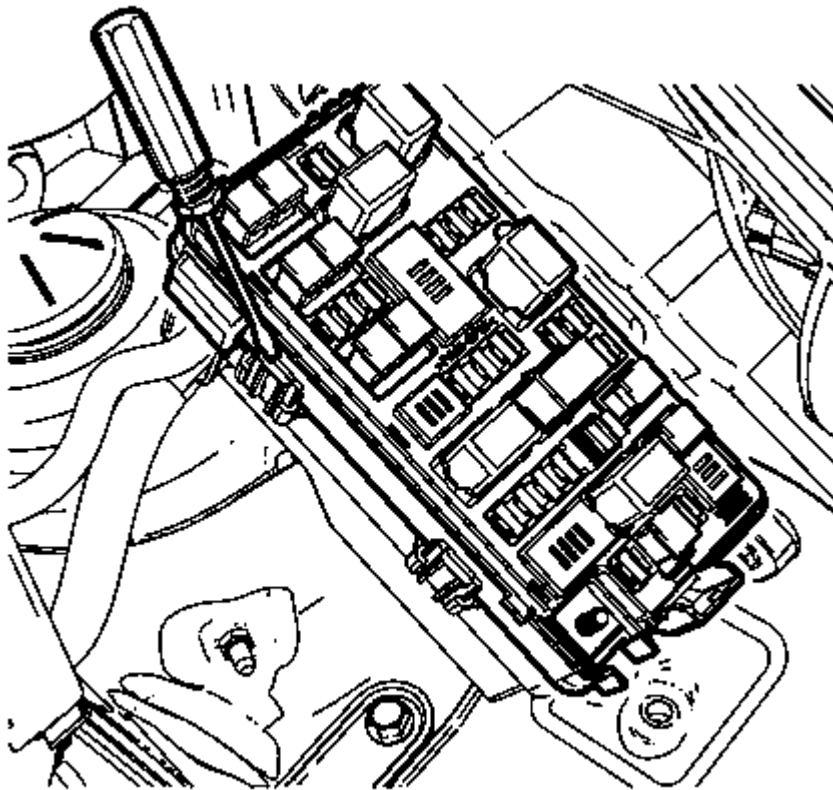


Fig. 144: Detaching Upper Plate With Suitable Tool
Courtesy of GENERAL MOTORS COMPANY

16. Detach the upper plate with suitable tool.

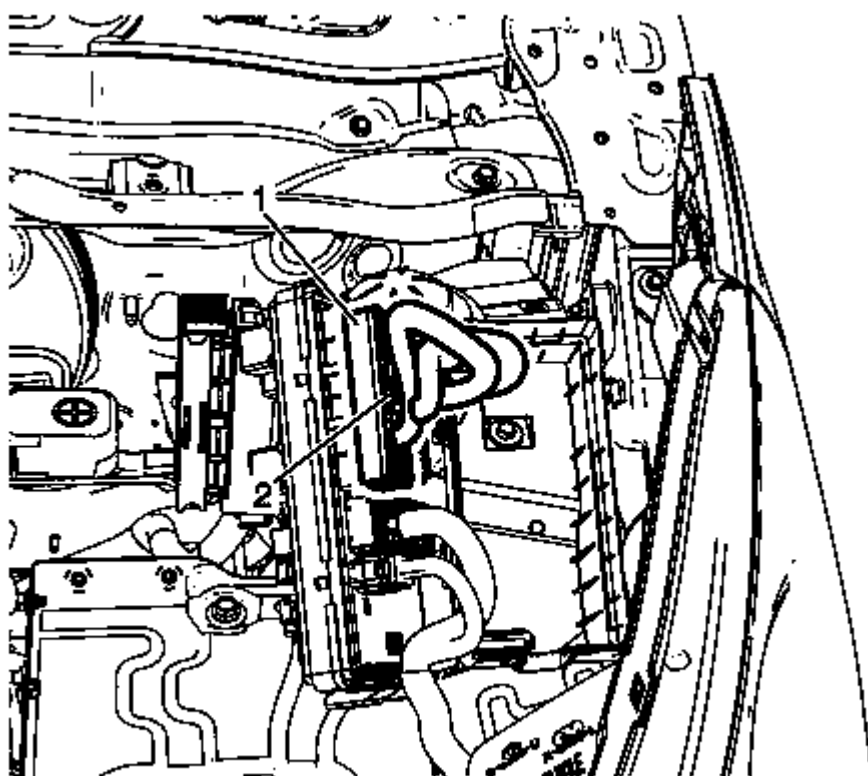


Fig. 145: Front Compartment Fuse Block
Courtesy of GENERAL MOTORS COMPANY

17. Lift up the engine wiring harness fuse block from the lower plate.
18. Loosen the wiring harness connector retaining bolt (2) and disconnect the wiring harness connector (1) from the engine wiring harness fuse block. Repeat for remaining connector.
19. Disconnect remaining wiring harness.

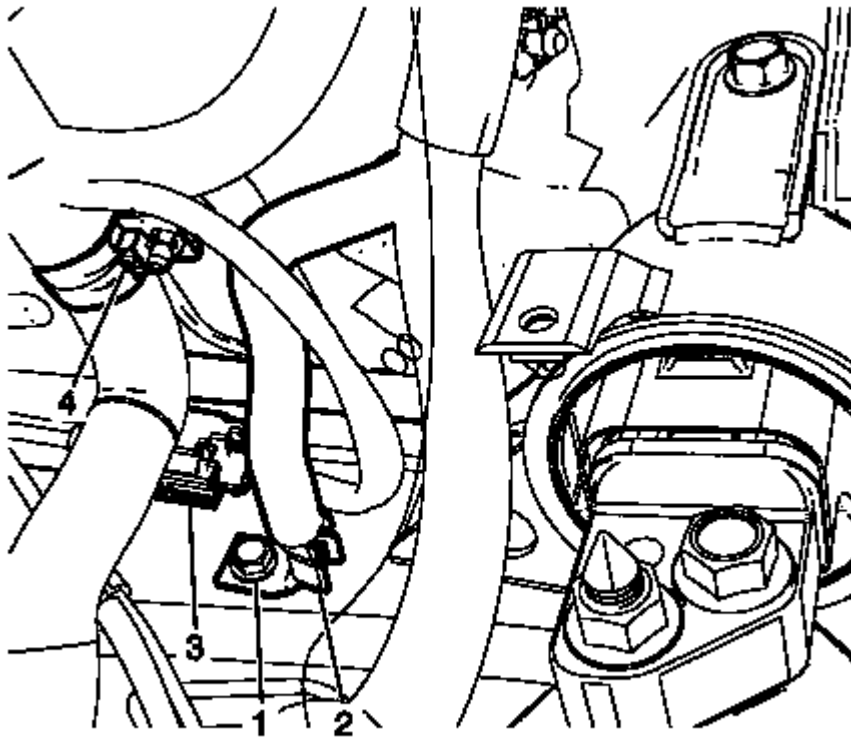


Fig. 146: Ground Bolt And Put Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

20. Remove the ground bolt (1) and put the wiring harness (2) aside.
21. Disconnect the wheel speed sensor connector (3).
22. Remove the wiring harness retainer (4).
23. Disconnect the heater inlet hose. Refer to **Heater Inlet Hose Replacement (1.0L LMT, 1.19L LC5 and 1.2L LMU)** .
24. Disconnect the heater outlet hose. Refer to **Heater Outlet Hose Replacement (1.0L LMT, 1.19L LC5 and 1.2L LMU)** .
25. Plug or cap the cooling system hoses and inlets.

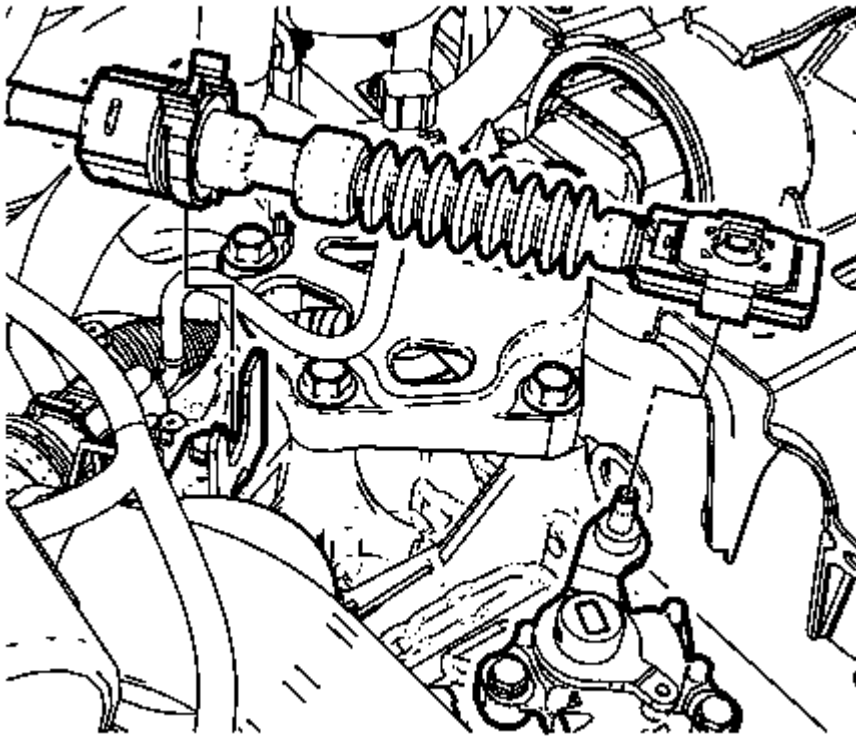


Fig. 147: Transmission Range Selector Lever Cable Terminal
Courtesy of GENERAL MOTORS COMPANY

26. Disconnect the transmission range selector lever cable terminal from the transmission lever pin. For manual transmission refer to **Manual Transmission Shift Lever and Selector Lever Cable Replacement (MX2, MFM)** .
27. Press the locking tabs inward in order to release the transmission range selector lever cable from the cable bracket.
28. Remove the clutch actuator cylinder if equipped. Refer to **Clutch Actuator Cylinder Replacement** .

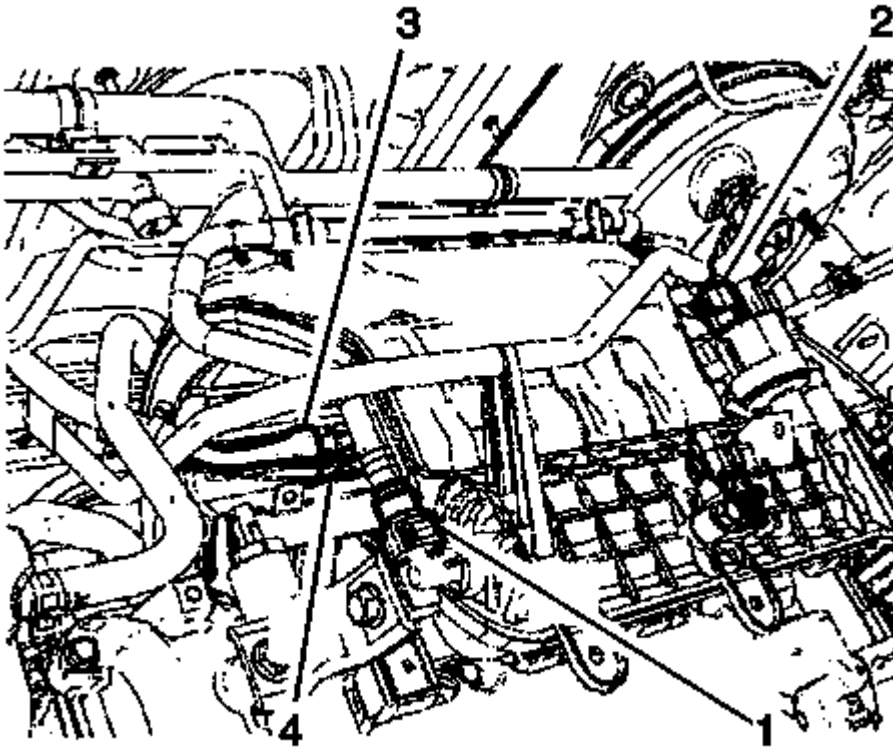


Fig. 148: Vacuum Hose

Courtesy of GENERAL MOTORS COMPANY

29. Disconnect the vacuum hose (1) from the intake manifold.
30. Disconnect the evaporative canister purge solenoid valve hose (2).
31. Remove the fuel feed hose retaining clip (4) and disconnect the fuel feed hose (3). Refer to **Metal Collar Quick Connect Fitting Service** .

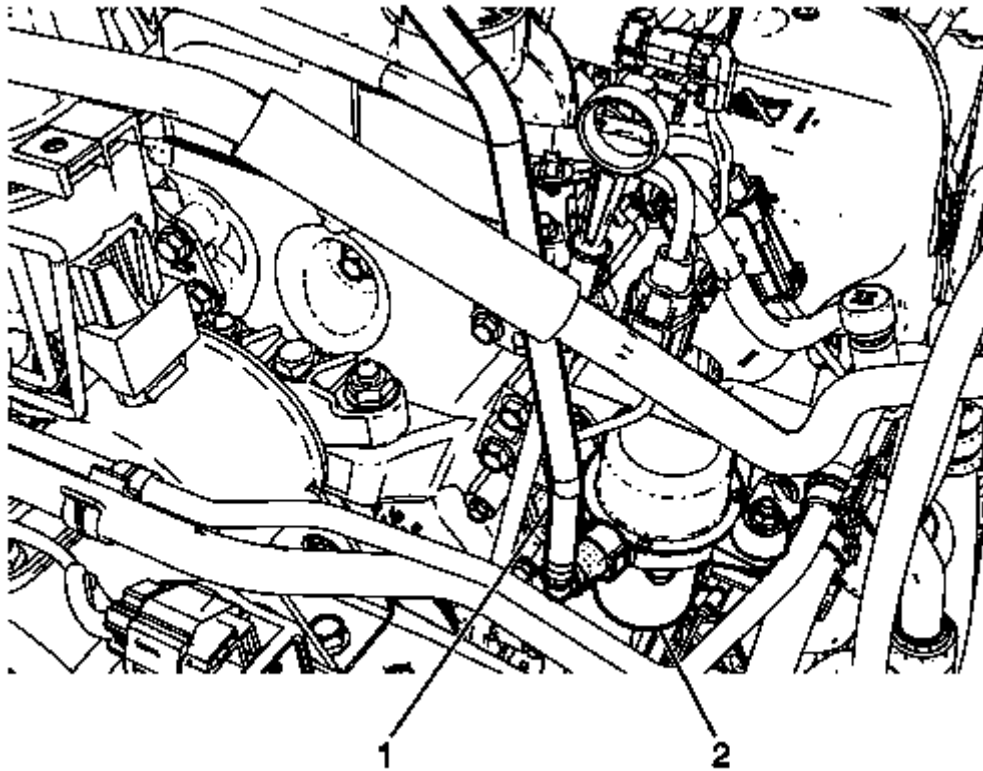


Fig. 149: Vacuum Pump Hose And Vacuum Pump
Courtesy of GENERAL MOTORS COMPANY

32. Remove the vacuum pump hose (1) from the vacuum pump (2).

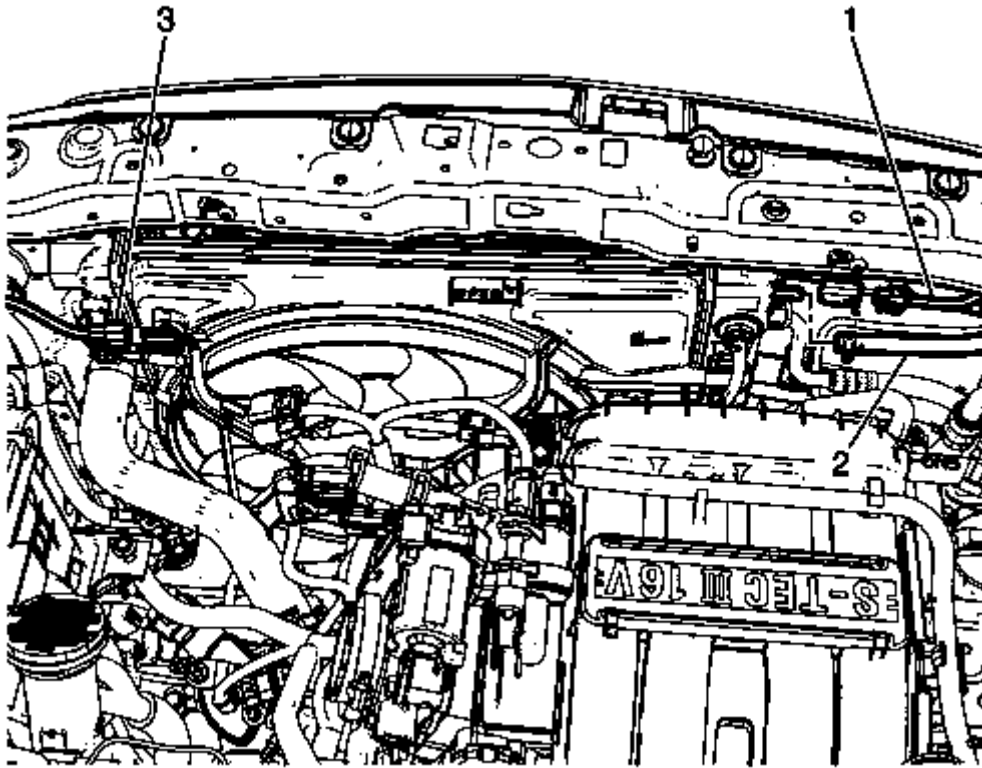


Fig. 150: Ambient Air Temperature Sensor Connector
Courtesy of GENERAL MOTORS COMPANY

33. Disconnect the wiring harness connector (3) from the engine cooling fan harness connector.
34. Disconnect the ambient air temperature sensor connector (1) from the ambient air temperature sensor if equipped.
35. Disconnect the coolant hose (2) from the radiator.

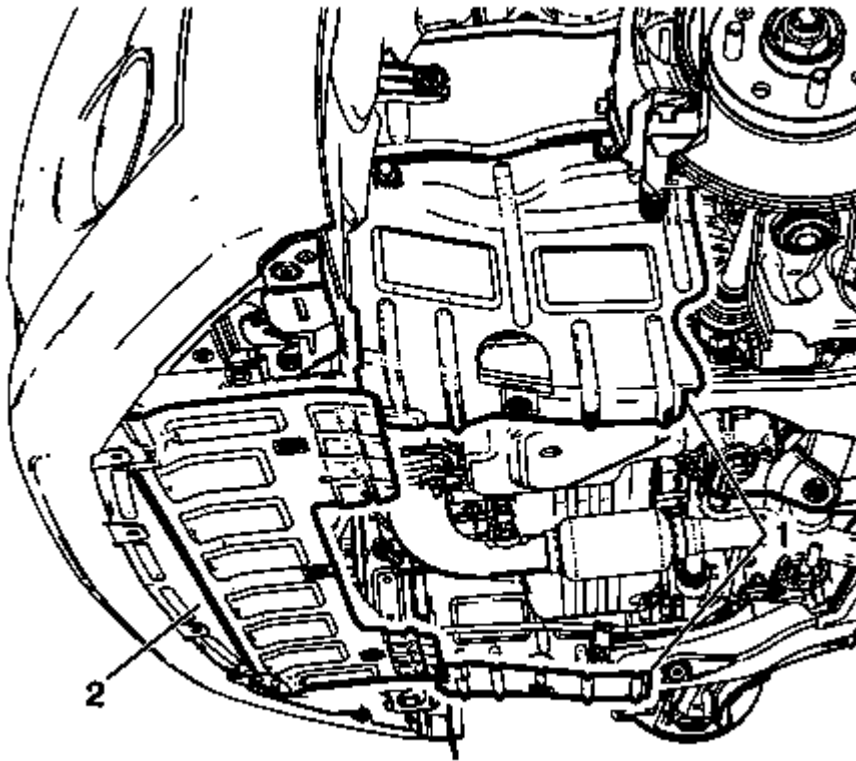


Fig. 151: Compartment Splash Shield
Courtesy of GENERAL MOTORS COMPANY

36. Remove the compartment splash shield (1, 2). Refer to **Front Compartment Splash Shield Replacement** .
37. Remove the front bumper fascia. Refer to **Front Bumper Fascia Replacement** .

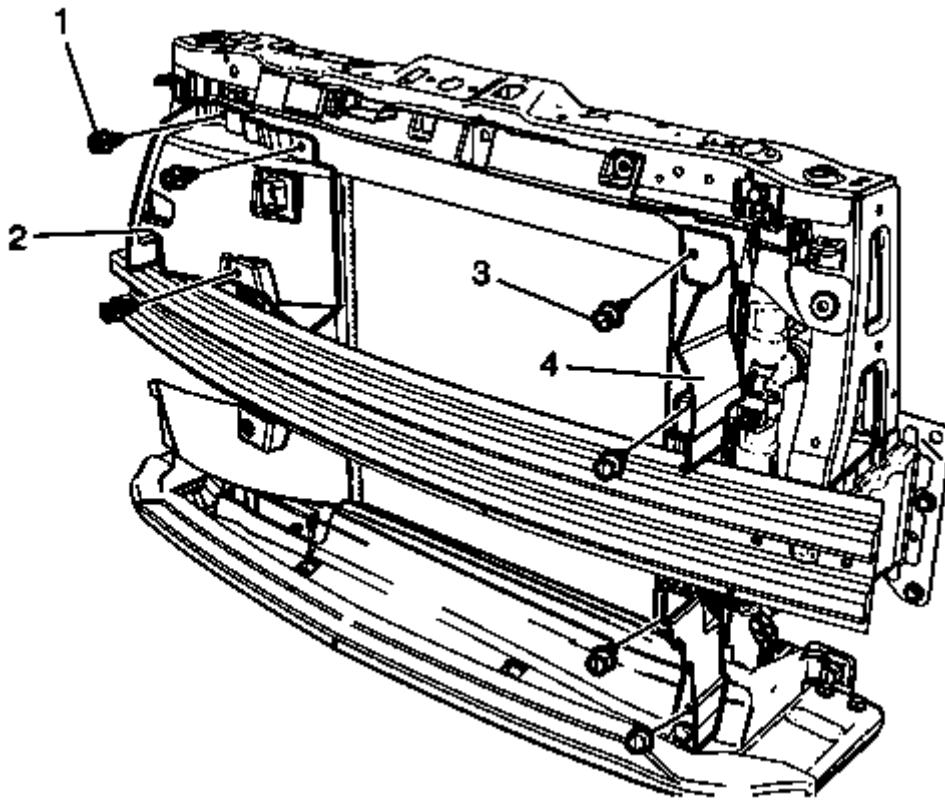


Fig. 152: Front Side Air Baffle Retainers
Courtesy of GENERAL MOTORS COMPANY

38. Remove the front side air baffle retainers (1, 3) and the front side air baffles (2, 4).

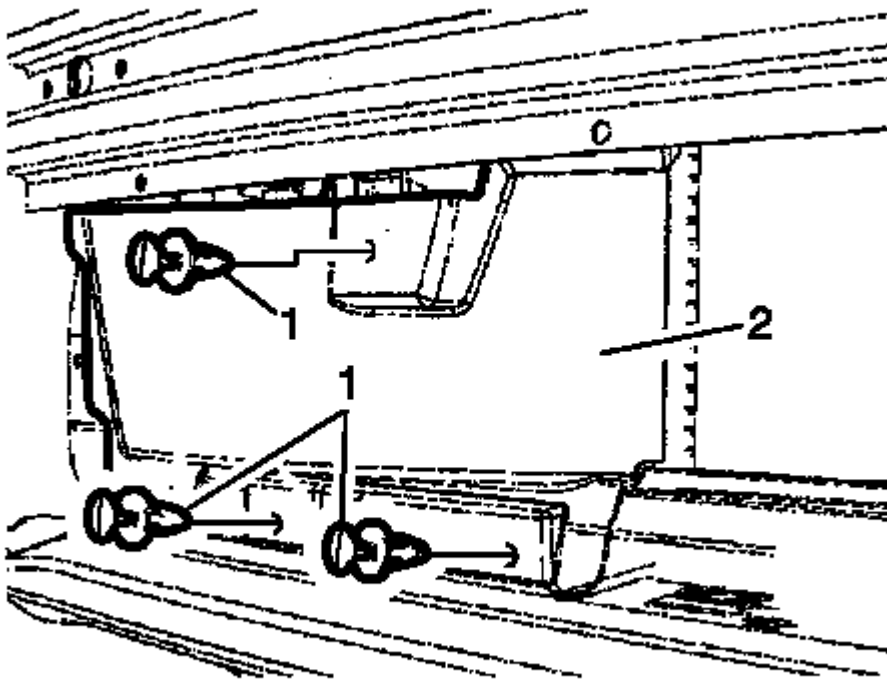


Fig. 153: Front Lower Air Baffle Retainers
Courtesy of GENERAL MOTORS COMPANY

39. Remove the front lower air baffle retainers (1) and the front lower air baffle (2).

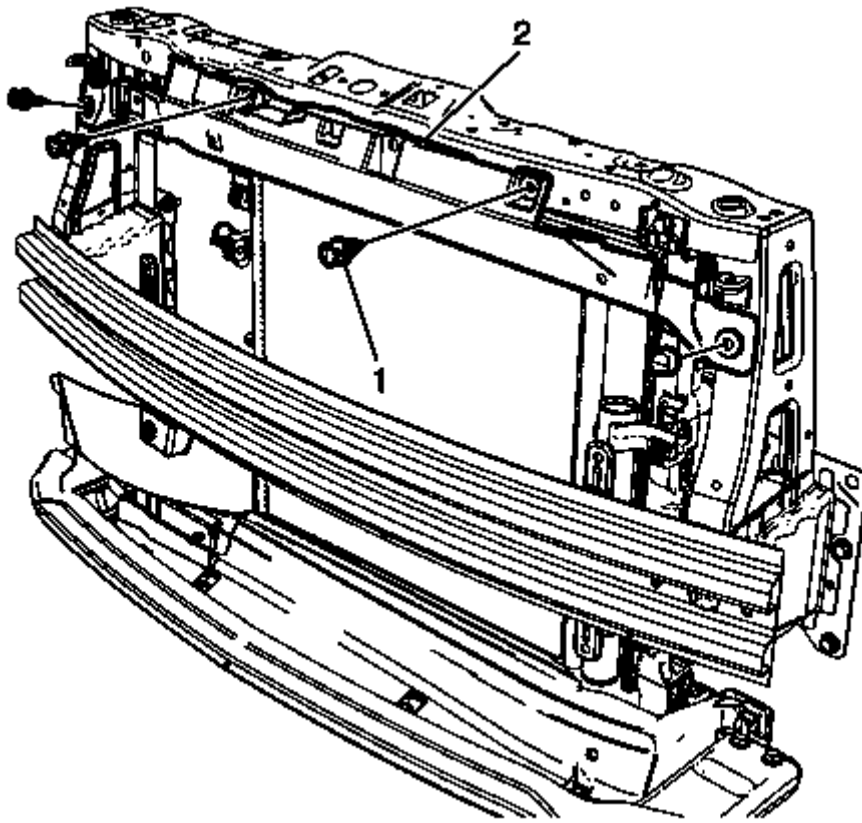


Fig. 154: Upper Air Guard Retainers
Courtesy of GENERAL MOTORS COMPANY

40. Remove the upper air guard retainers (1) and the upper air guard (2).

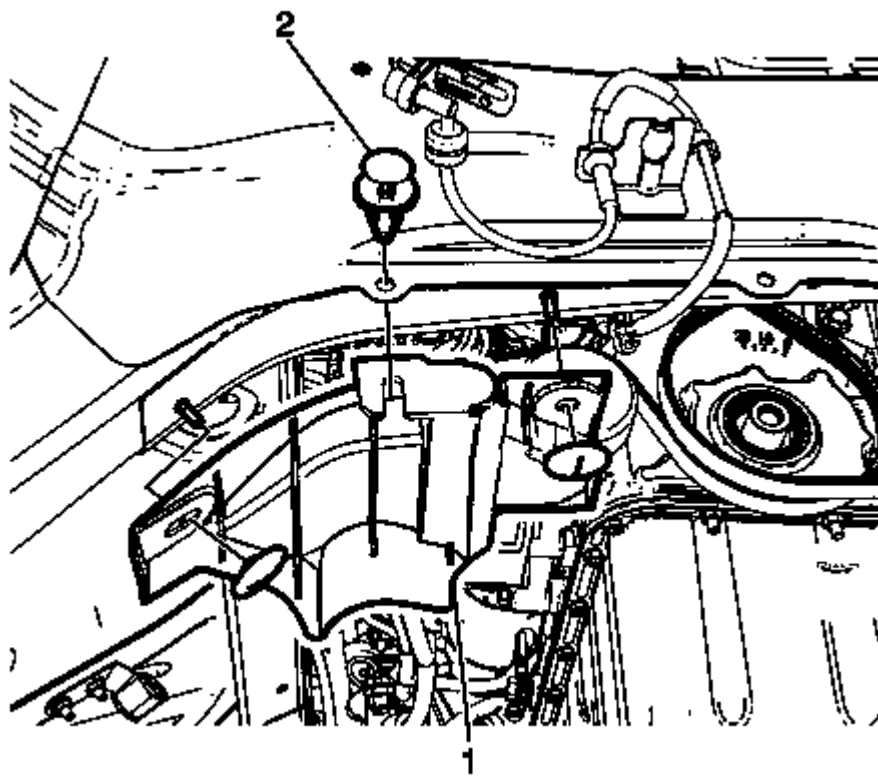


Fig. 155: Retainers And Water Deflector
Courtesy of GENERAL MOTORS COMPANY

41. Remove the retainers (2) and the water deflector (1).

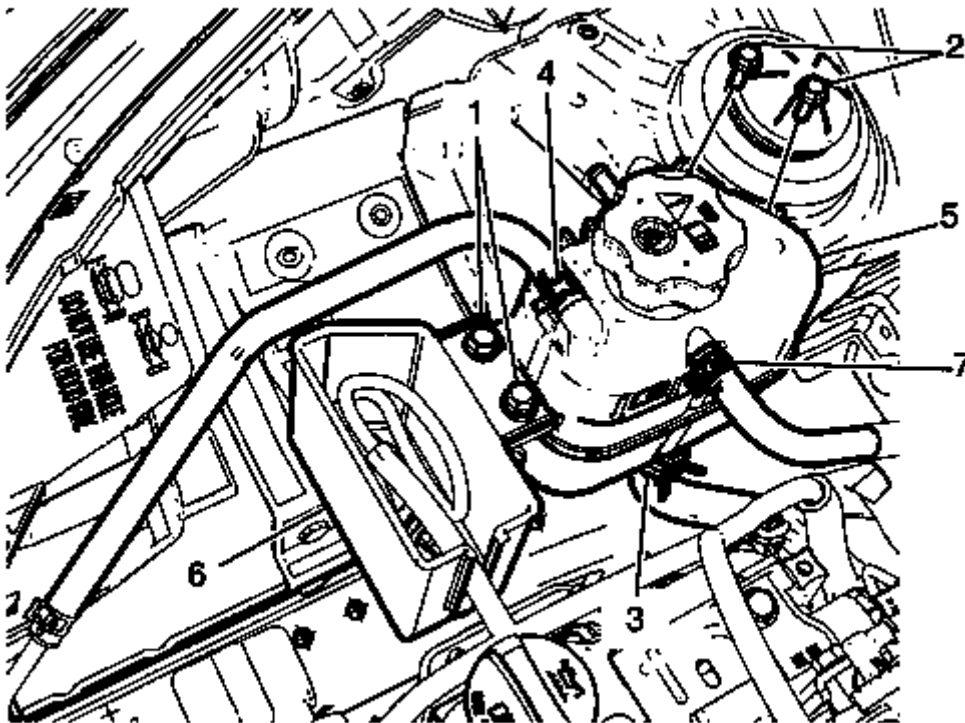


Fig. 156: Block Heater Connecting Plug Holder Bolt
Courtesy of GENERAL MOTORS COMPANY

42. Remove the block heater cord container bolts (1) if equipped and coolant surge tank retaining bolts (2).
43. Remove the block heater code container (6) if equipped.
44. Remove the coolant hose clips (3, 4, 7) and coolant surge tank (5).
45. Plug or cap the cooling system hoses and inlets.

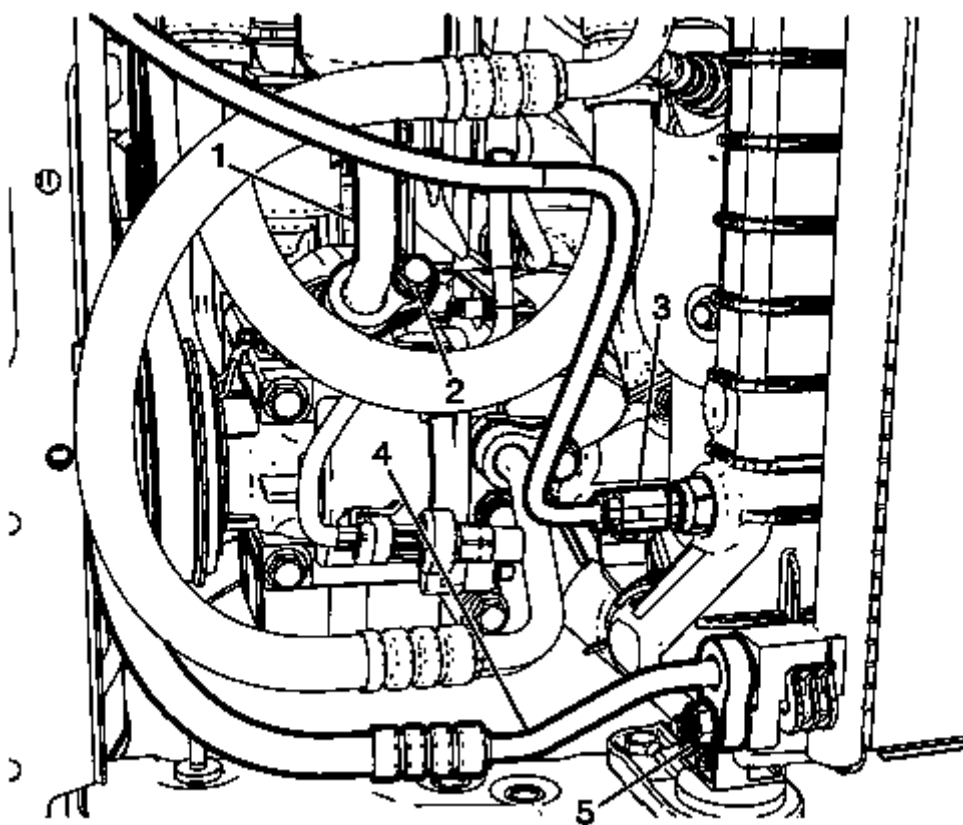


Fig. 157: Suction Pipe Bolt

Courtesy of GENERAL MOTORS COMPANY

46. Remove the suction pipe bolt (2) from the A/C compressor.
47. Remove the suction pipe (1) from the A/C compressor.
48. Remove the discharge pipe nut (5) from the A/C condenser.
49. Remove the discharge pipe (4) from the A/C condenser.
50. Disconnect the coolant temperature sensor wiring connector (3) from the radiator.

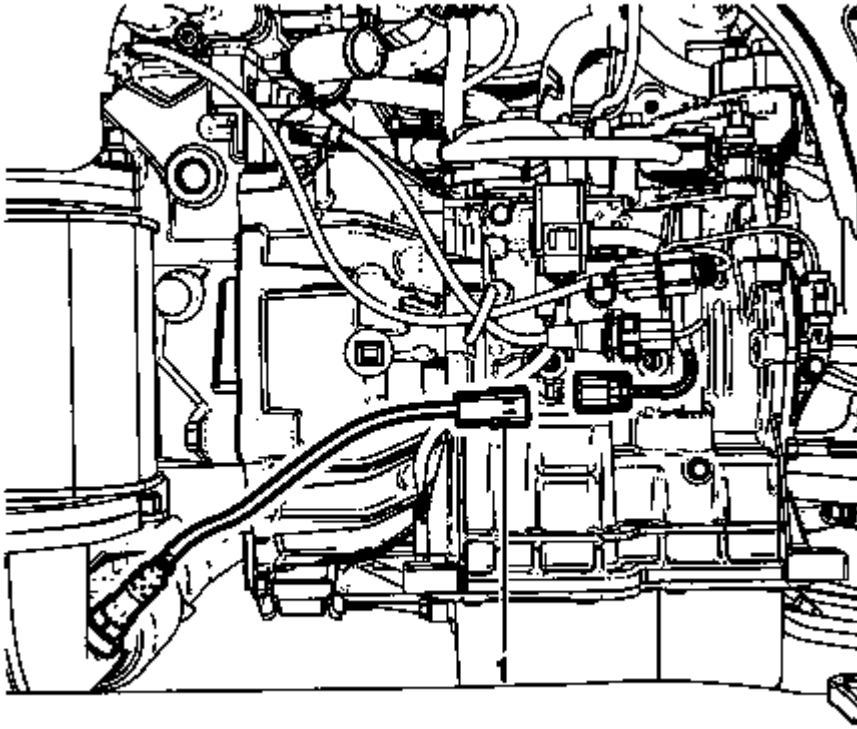


Fig. 158: Oxygen Sensor Connector
Courtesy of GENERAL MOTORS COMPANY

51. Disconnect the oxygen sensor connector (1).
52. Remove the exhaust front pipe. Refer to **Exhaust Front Pipe Replacement (LL0)** .
53. Remove the transmission rear mount bracket. Refer to **Transmission Rear Mount Bracket Replacement** .

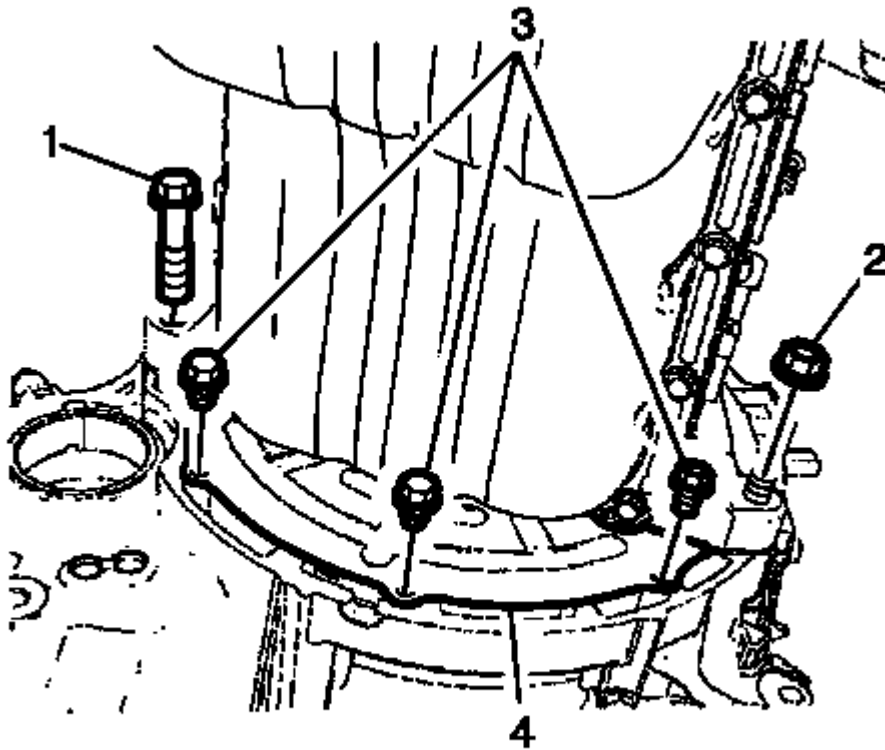


Fig. 159: Lower Transmission Housing Bolt
Courtesy of GENERAL MOTORS COMPANY

54. Remove the transmission dust cover bolts (3) and the transmission dust cover (4).

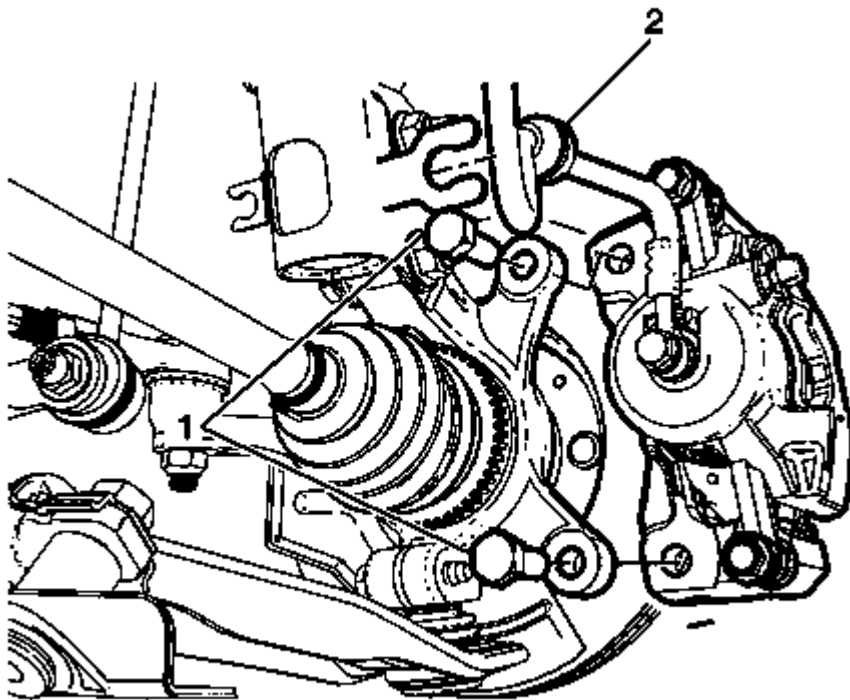


Fig. 160: Front Brake Hose And Front Brake Caliper Retaining Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: **DO NOT** disconnect the hydraulic brake flexible hose from the brake caliper otherwise complete bleeding of the braking system will be necessary.

55. Detach the front brake hose (2) from the strut mounted brake hose retaining bracket and remove the front brake caliper retaining bolts (1) from the front steering knuckle. Repeat for opposite side.

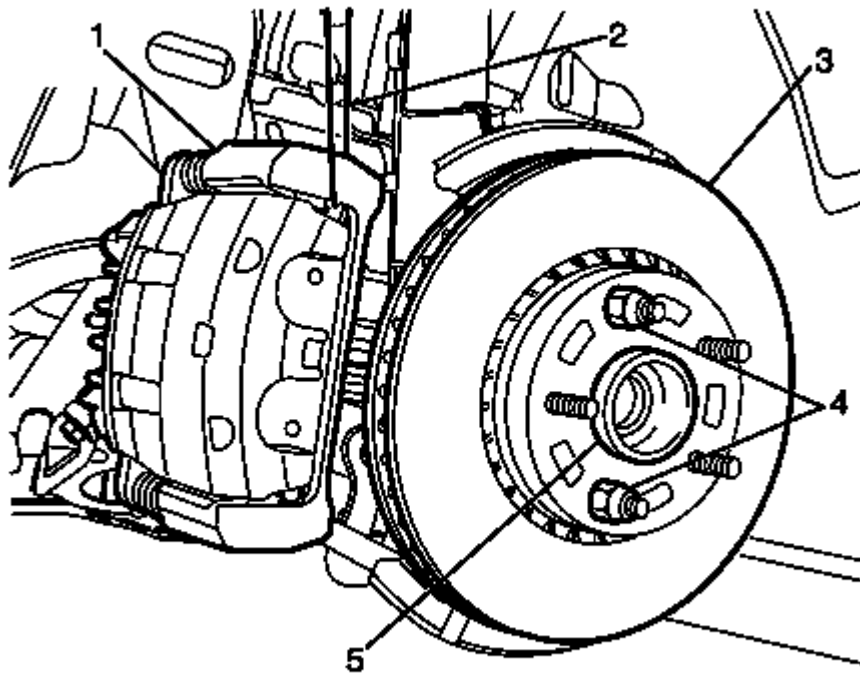


Fig. 161: View Of Hub, Wheel Nuts, Front Brake Disc, Heavy Mechanic's Wire & Front Brake Caliper

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Support the brake caliper with heavy mechanic wire or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

56. Support the front brake caliper (1) with heavy mechanics wire or equivalent (2). Repeat for opposite side.
57. Disconnect the outer tie rod assembly from the steering knuckle. Repeat for opposite side. Refer to **Steering Linkage Outer Tie Rod Replacement** .
58. Remove the wheel drive shaft nut and washer from the wheel drive shaft and discard. Repeat for opposite side. Refer to **Front Wheel Drive Shaft Replacement** .
59. Separate the control arm ball joint from the steering knuckle. Repeat for opposite side. Refer to **Lower Control Arm Replacement** .

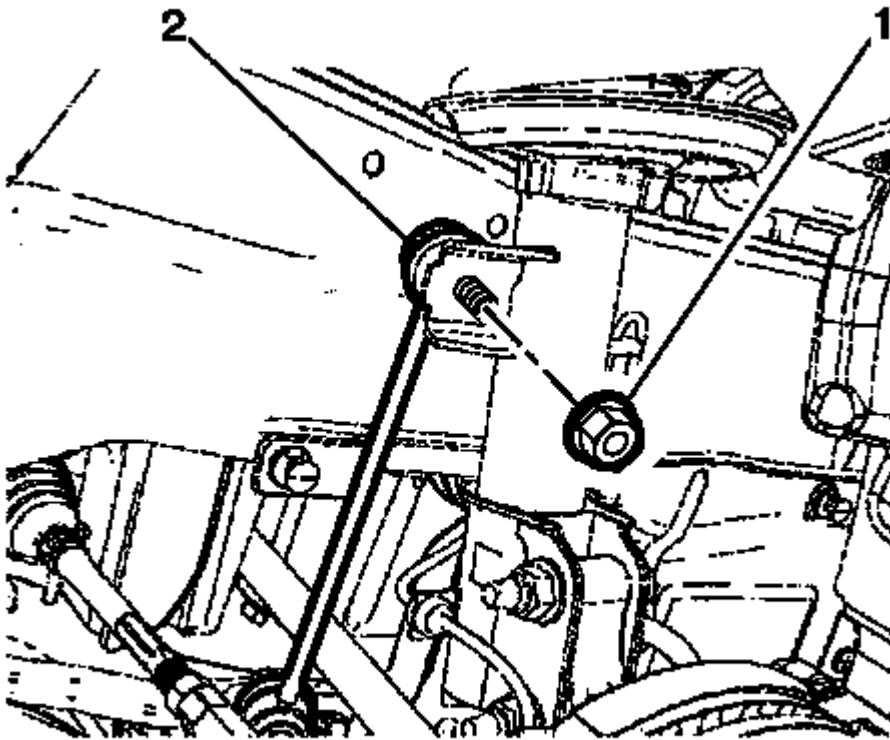


Fig. 162: Front Upper Stabilizer Shaft Link Nut
Courtesy of GENERAL MOTORS COMPANY

60. Remove the front upper stabilizer shaft link nut (1) and push the front upper stabilizer shaft link (2) aside. Repeat for opposite side.
61. Disconnect any additional electrical connections as necessary.

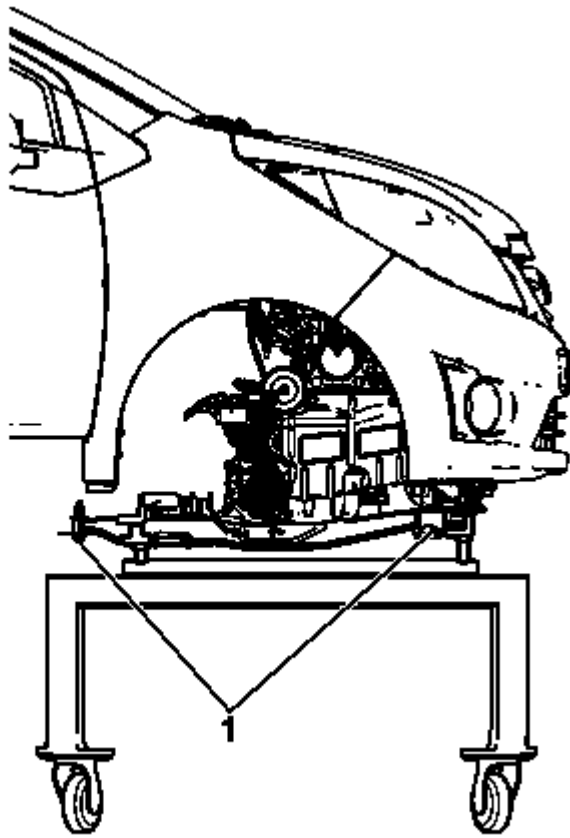


Fig. 163: View Of Cradle Bolts

Courtesy of GENERAL MOTORS COMPANY

62. Position the engine assembly on a suitable powertrain table or an engine lifter below the cradle with suitable woodblocks or suitable rubber blocks as shown.
63. Lower the vehicle until the suitable powertrain table or the engine lifter with suitable woodblocks or suitable rubber blocks.
64. Remove the 4 cradle bolts (1).

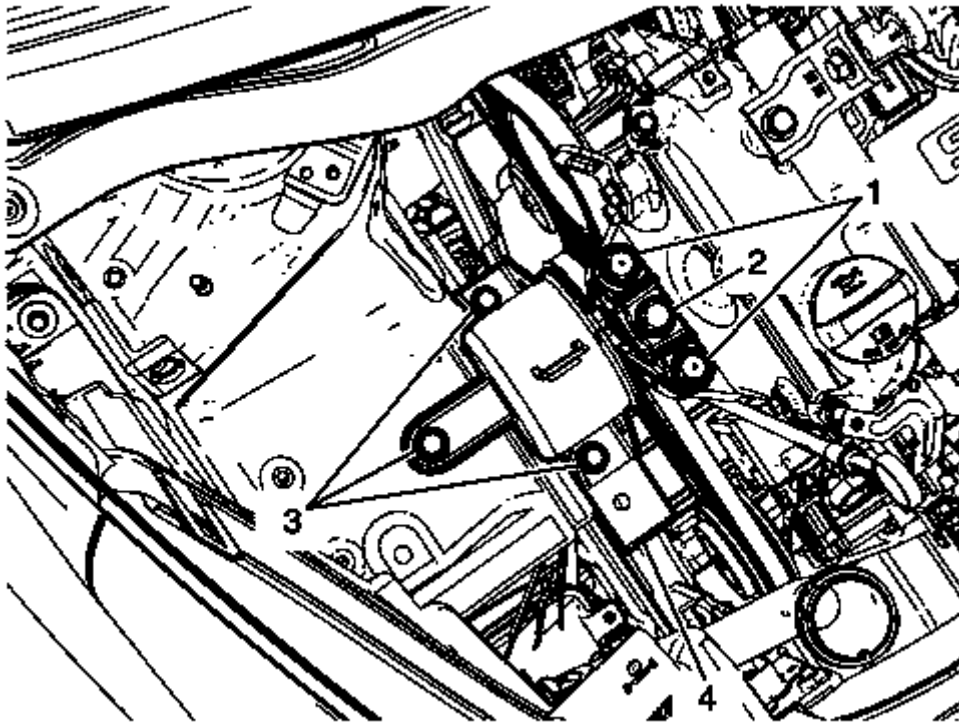


Fig. 164: Engine Mount Nuts

Courtesy of GENERAL MOTORS COMPANY

65. Mark the location of the bolts before removing.
66. Remove the engine mount retaining bolts (2, 3), nuts (1) and the engine mount.

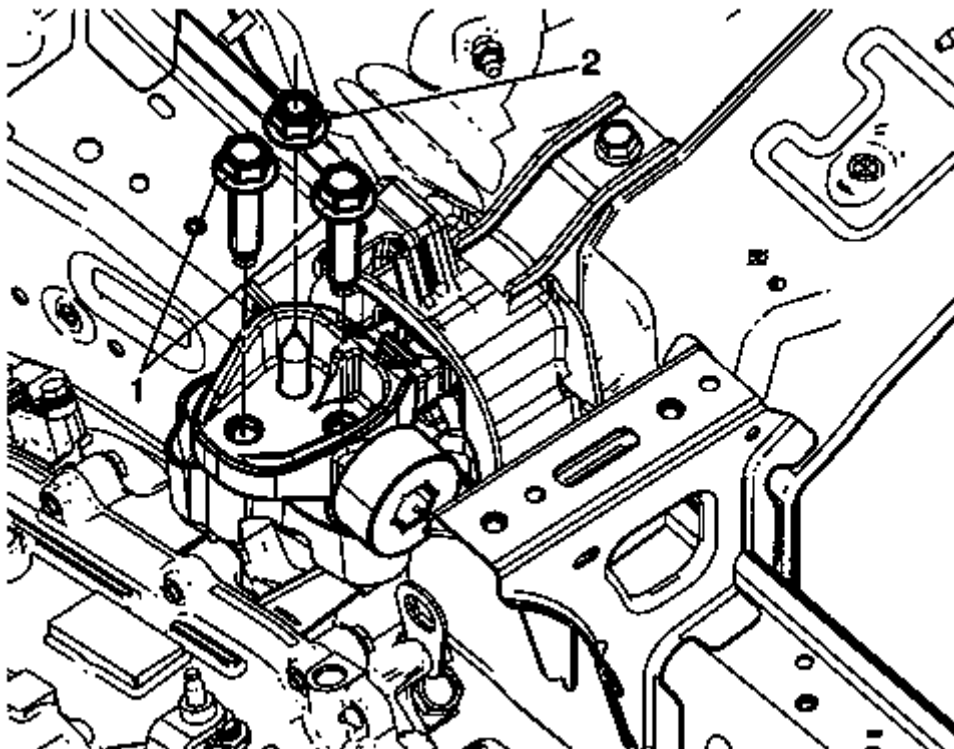


Fig. 165: Location Of Bolts And Nut
Courtesy of GENERAL MOTORS COMPANY

NOTE: Mark the location of the bolts (1) and nut (2) before removing.

67. Remove the left transmission mount bolts (1) and nut (2) from the transmission mount bracket.

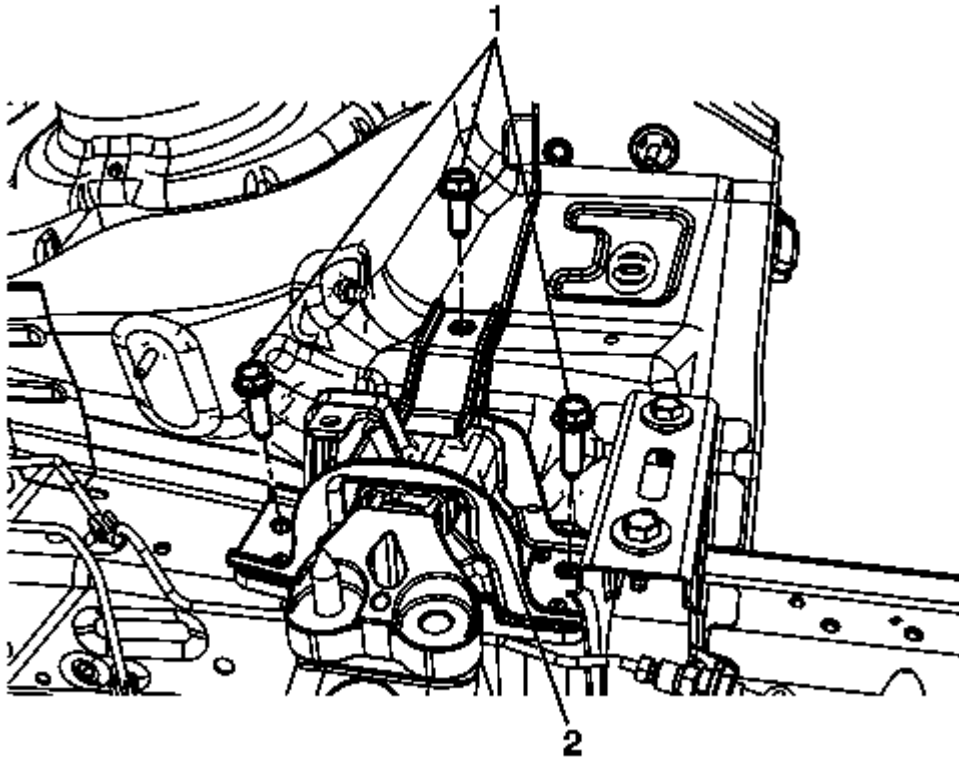


Fig. 166: Left Transmission Mount And Body Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: Mark the location of the bolts (1) and nut (2) before removing.

68. Remove the transmission mount retaining bolts (1) and the transmission mount (2).
69. Transfer parts as needed.

NOTE: Make sure that all the hoses, wires, pipes and front struts clear the vehicle during the removal process.

70. With the aid of an assistant, lower the engine lifter or raise the vehicle to remove the engine, transmission and cradle assembly from the vehicle.
71. Remove the starter. Refer to **Starter Replacement** .

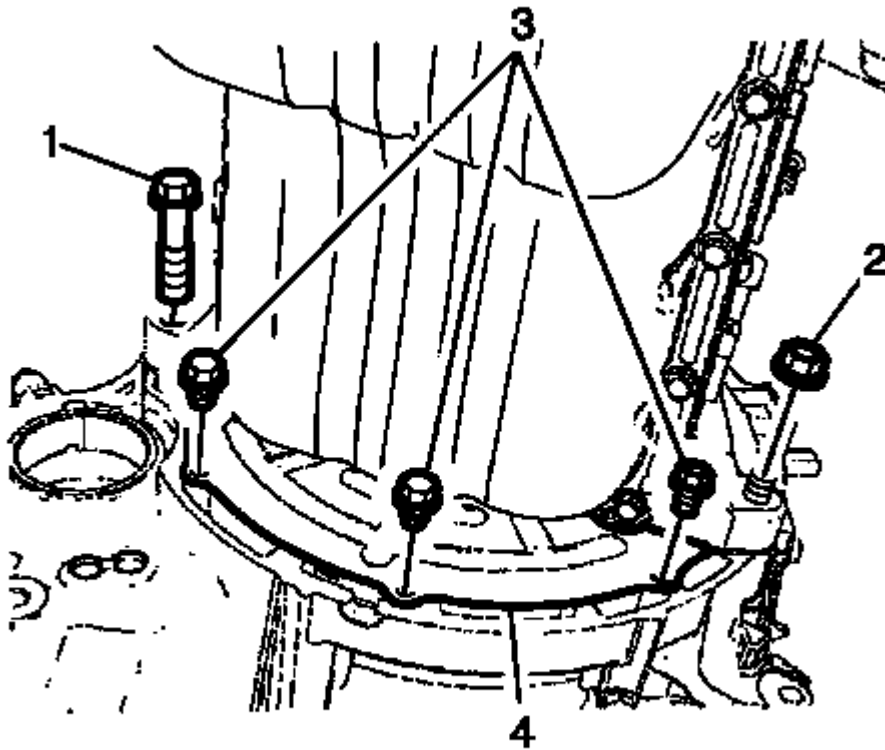


Fig. 167: Lower Transmission Housing Bolt
Courtesy of GENERAL MOTORS COMPANY

72. Remove the lower transmission housing bolt (1) and nut (2). (M/T)

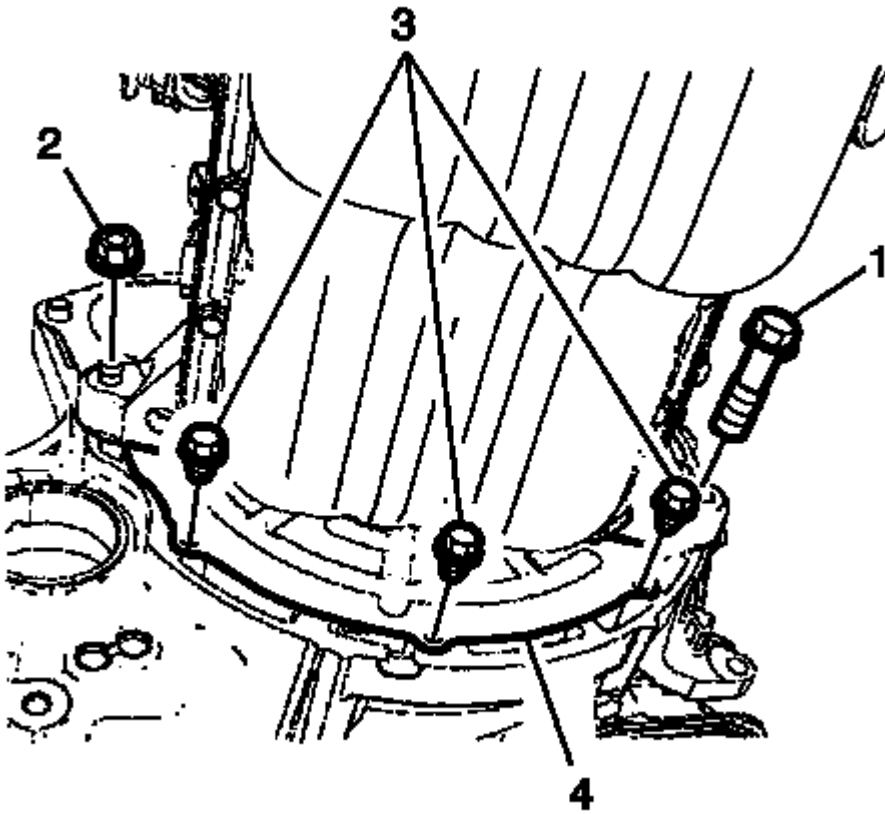


Fig. 168: Lower Transmission Housing Bolt And Nut
Courtesy of GENERAL MOTORS COMPANY

73. Remove the lower transmission housing bolt (1) and nut (2). (A/T)

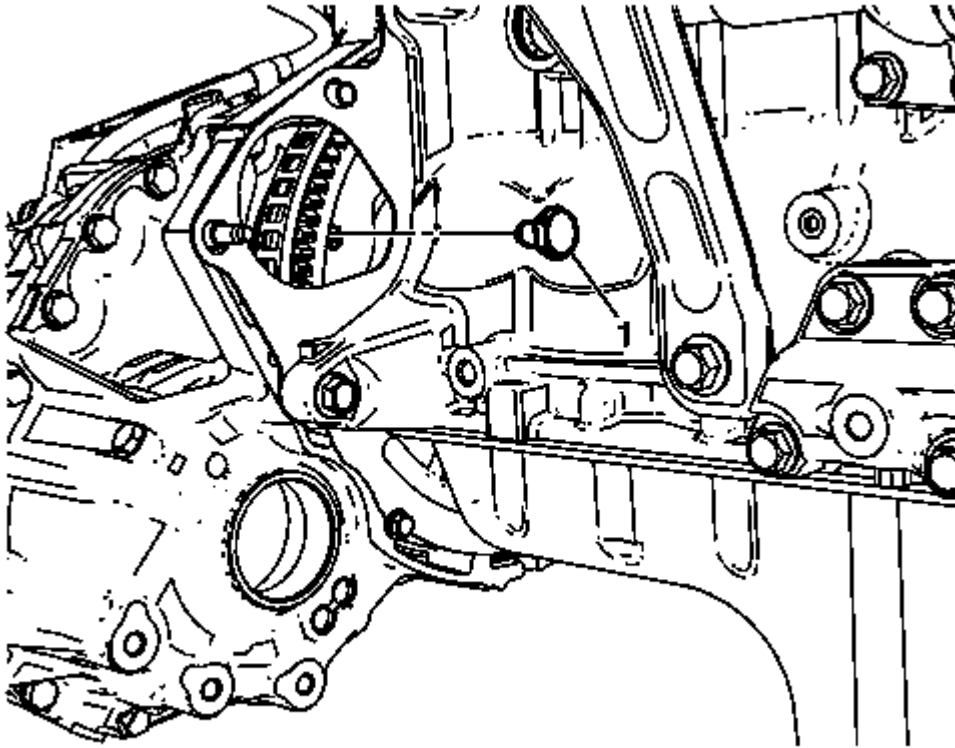


Fig. 169: Torque Converter Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: Only rotate the engine in a clockwise direction only or engine damage will occur.

74. Remove the torque converter bolts (1). (A/T)

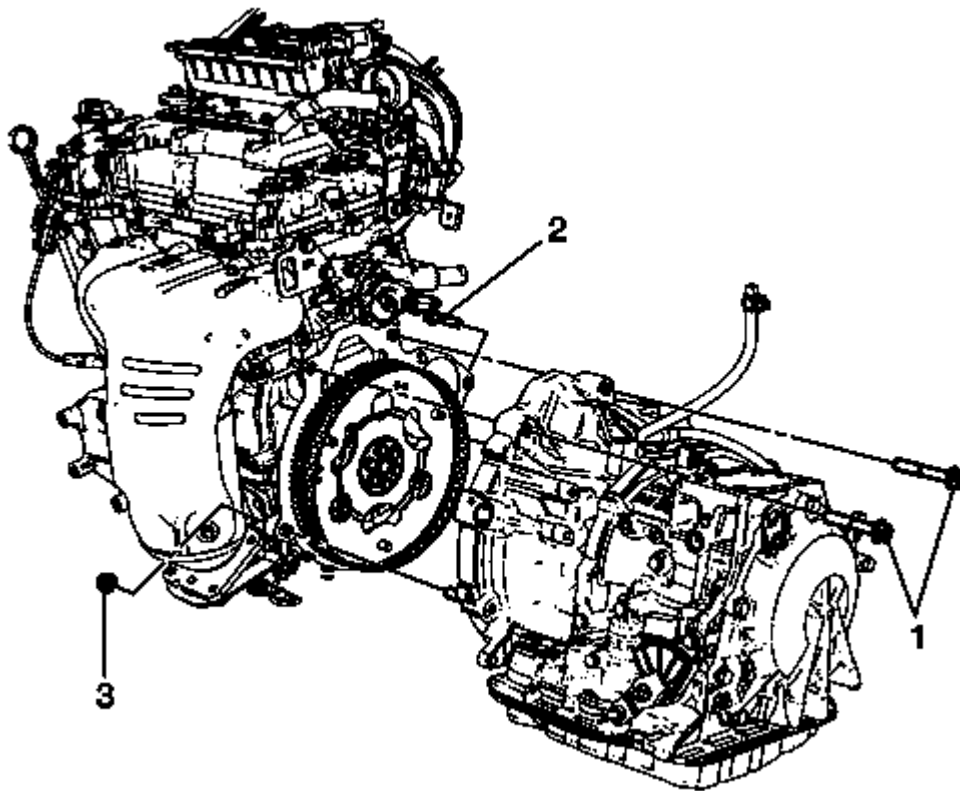


Fig. 170: Upper Transmission Housing Bolts
Courtesy of GENERAL MOTORS COMPANY

75. Remove the upper transmission housing bolts (1) and separate the transmission from the engine.
76. Install the engine to an engine stand. (Using M10 x 1.25 approximately 130 mm long)
77. Transfer parts as needed.

Installation Procedure

1. Remove the engine from the engine stand.

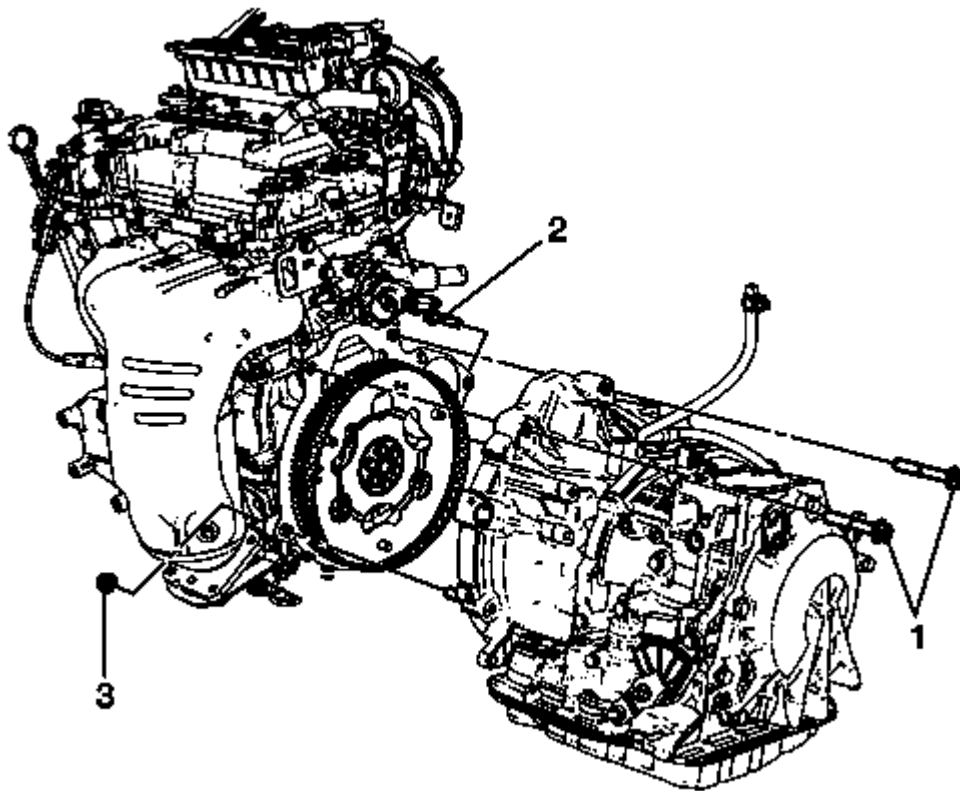


Fig. 171: Upper Transmission Housing Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Combine the engine with the transmission and tighten upper auto transmission housing bolts (1) to 61 (44 lb ft).

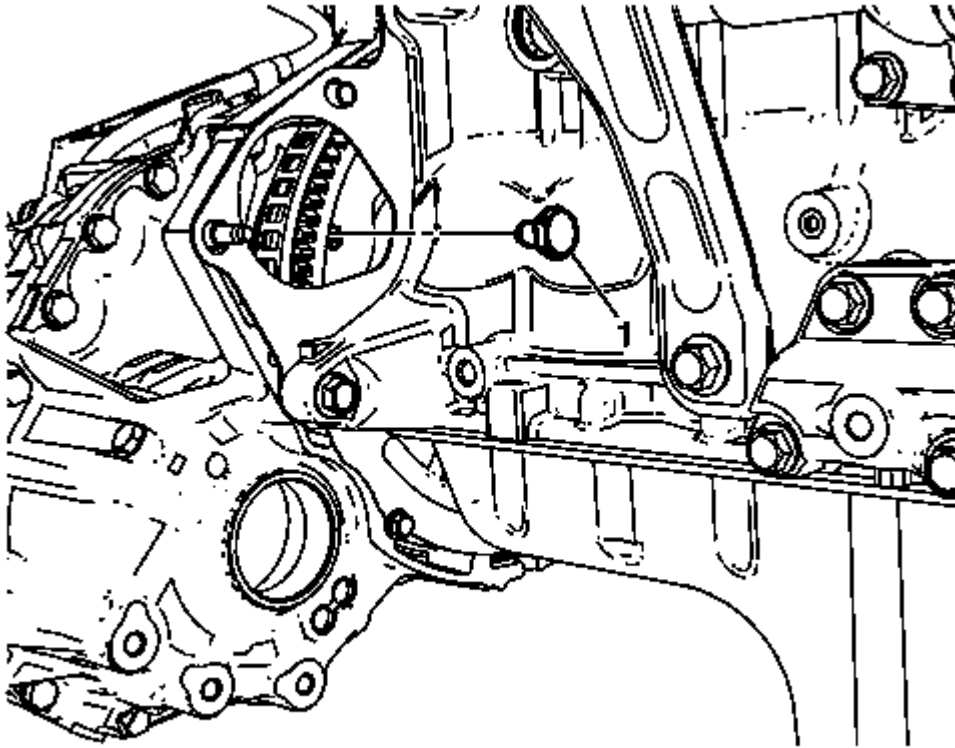


Fig. 172: Torque Converter Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: Only rotate the engine in a clockwise direction only or engine damage will occur.

3. Install the torque converter bolts (1) and tighten to 60 (44 lb ft). (A/T)

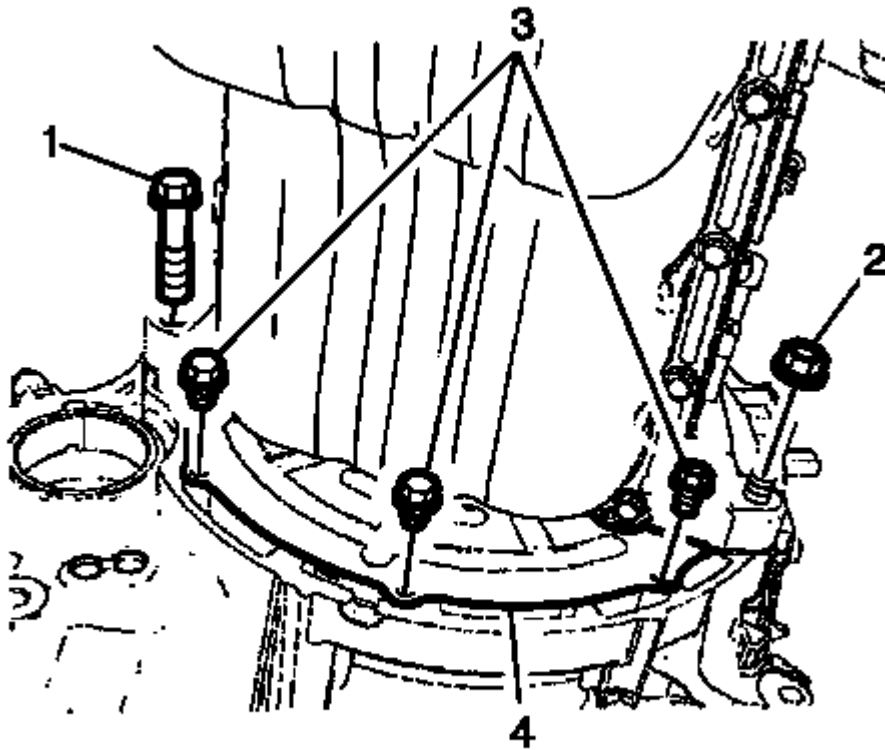


Fig. 173: Lower Transmission Housing Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Install the lower transmission housing bolt (1) and nut (2) and tighten to 61 (45 lb ft). (M/T)

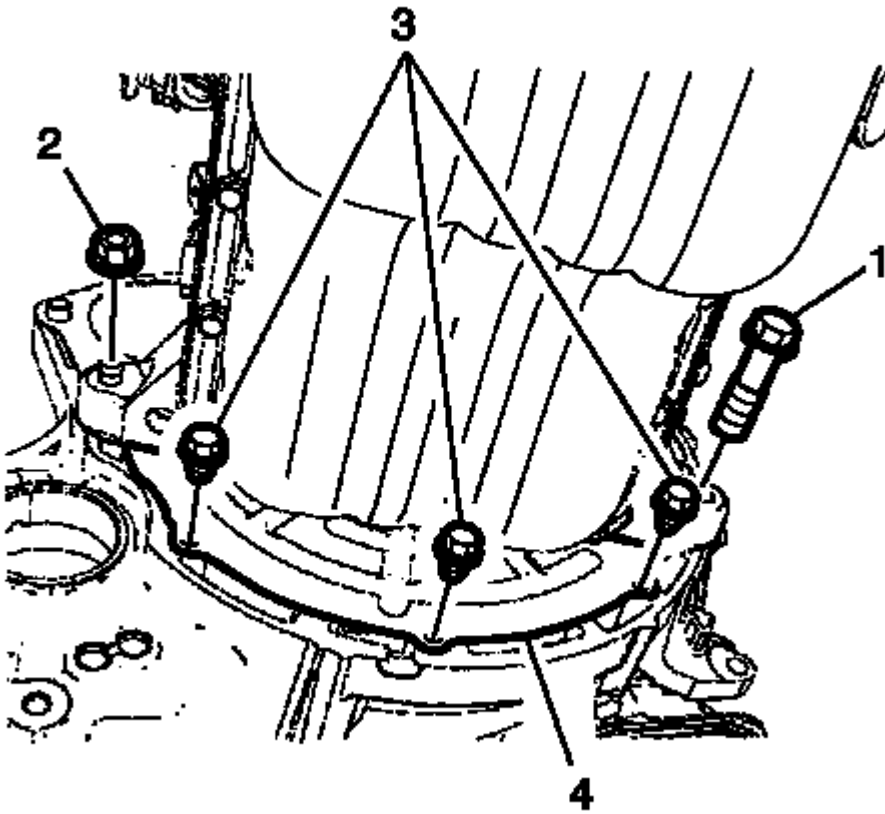


Fig. 174: Lower Transmission Housing Bolt And Nut
Courtesy of GENERAL MOTORS COMPANY

5. Install the lower transmission housing bolt (1) and nut (2) and tighten to 61 (45 lb ft). (A/T)
6. Install the starter. Refer to **Starter Replacement** .

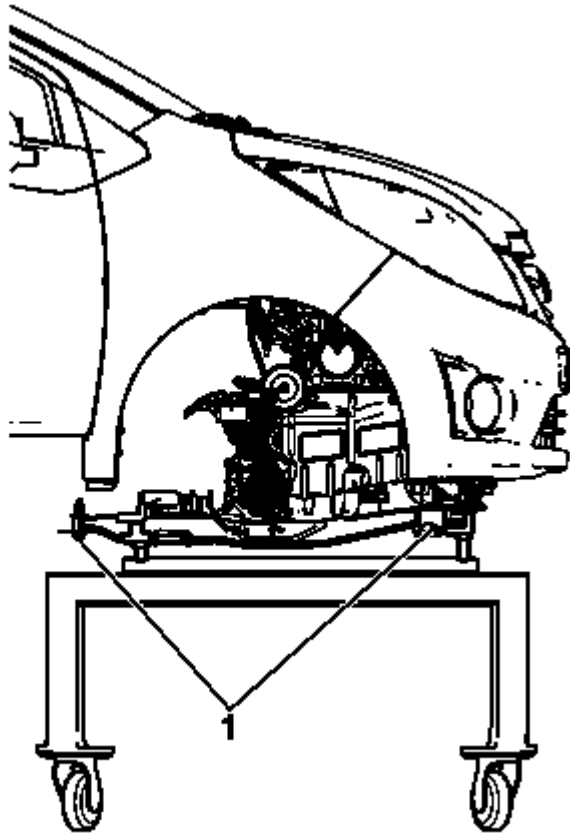


Fig. 175: View Of Cradle Bolts

Courtesy of GENERAL MOTORS COMPANY

7. With the aid of an assistant, raise the engine lifter or lower the vehicle to install the engine, transmission and cradle assembly to the vehicle.
8. Tighten the 4 cradle bolt (1) to 135 (100 lb ft).

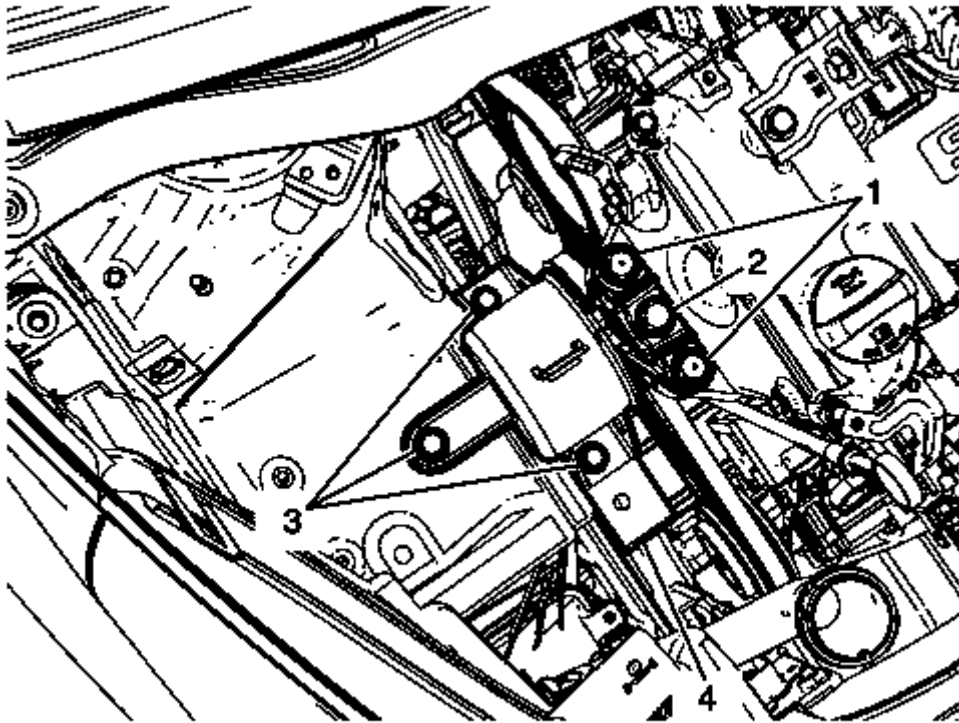


Fig. 176: Engine Mount Nuts

Courtesy of GENERAL MOTORS COMPANY

9. Install the engine mount and the engine mount bolts and nuts.
10. Tighten the engine mount retaining nuts (1) to 66 (49 lb ft).
11. Tighten the engine mount retaining bolt (2) to 66 (49 lb ft).
12. Tighten the engine mount retaining bolts (3) to 50 (37 lb ft).

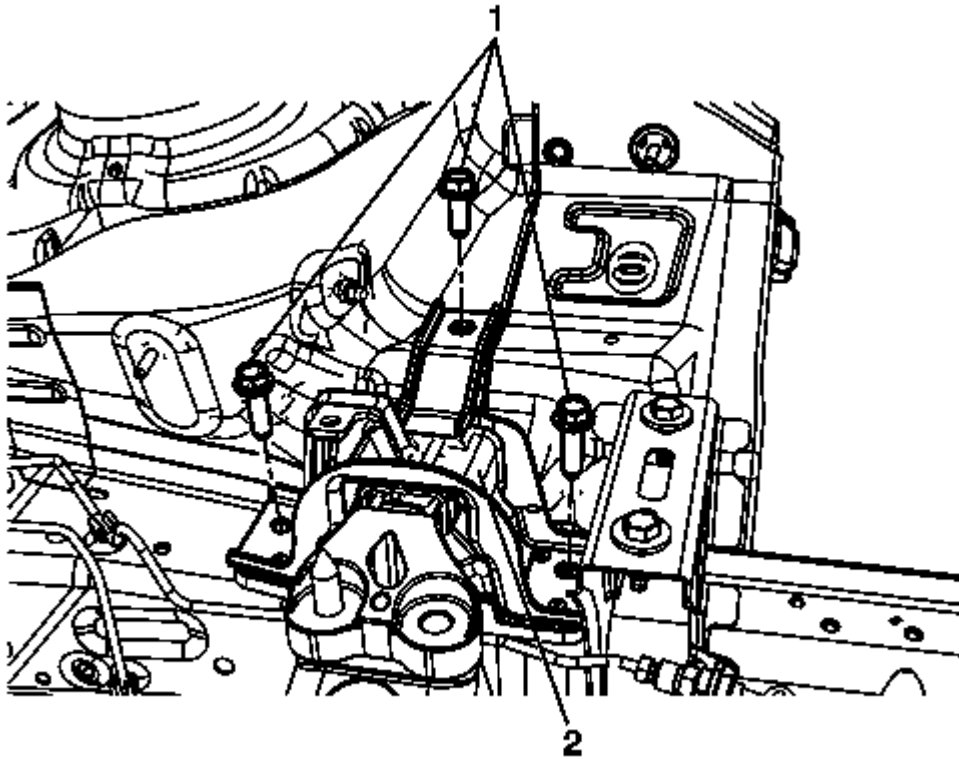


Fig. 177: Left Transmission Mount And Body Bolts
Courtesy of GENERAL MOTORS COMPANY

13. Install the transmission mount (2) and the transmission mount bolts (1).
14. Tighten to 50 (37 lb ft).

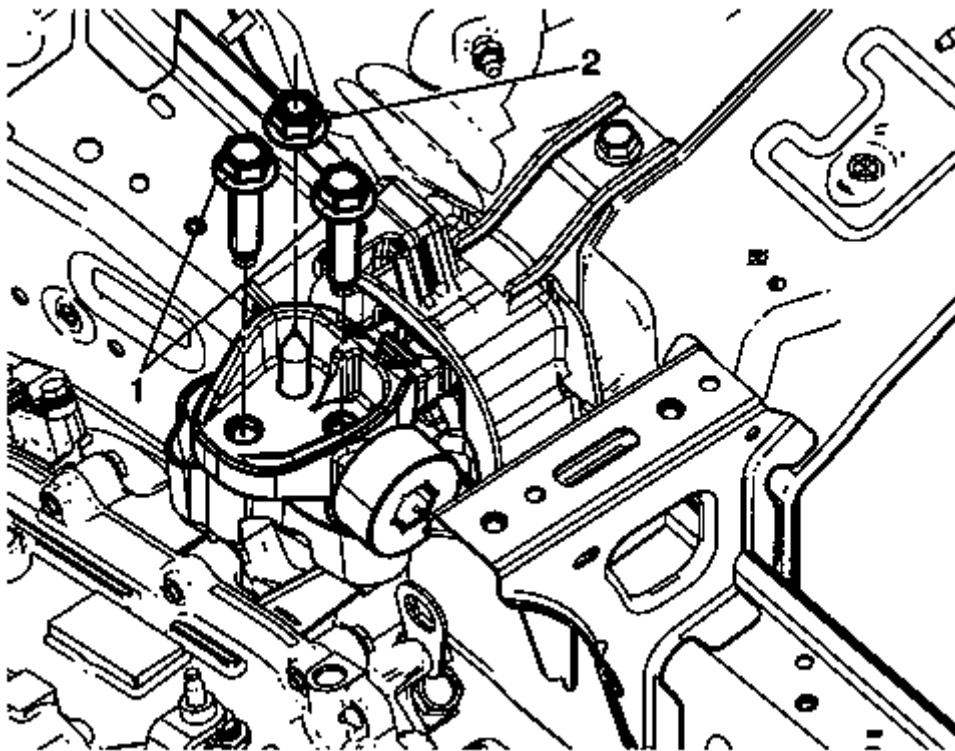


Fig. 178: Location Of Bolts And Nut
Courtesy of GENERAL MOTORS COMPANY

15. Install the left transmission mount bolts (1) and nut (2) to the transmission mount bracket (2) and tighten to 95 (70 lb ft).
16. Connect additional electrical connections as necessary.

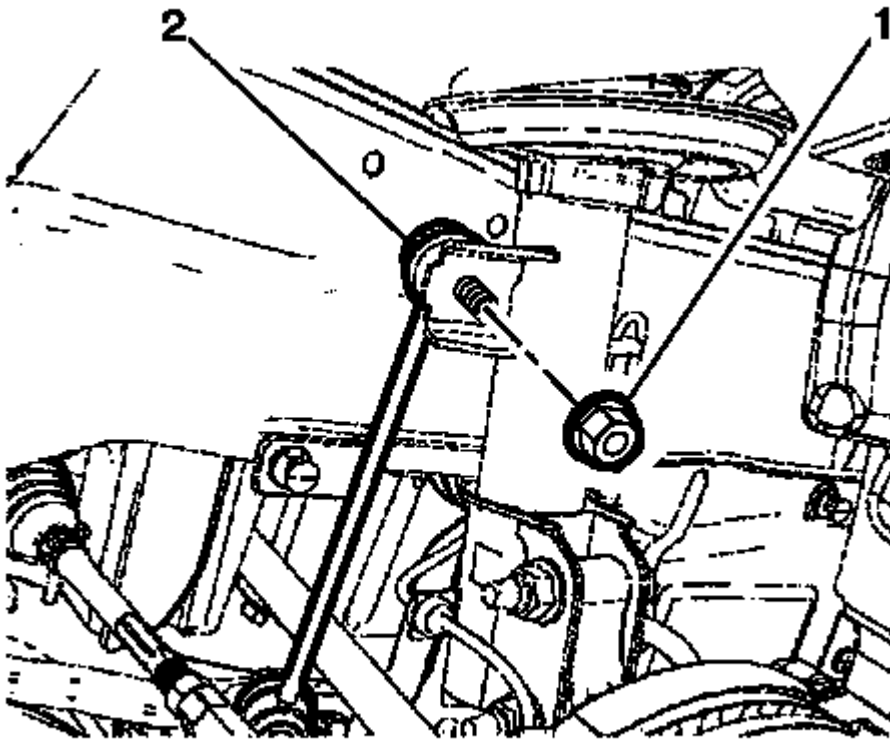


Fig. 179: Front Upper Stabilizer Shaft Link Nut
Courtesy of GENERAL MOTORS COMPANY

17. Install the front upper stabilizer shaft link (2) and the front upper stabilizer shaft link nut (1).
18. Tighten to 43 (32 lb ft). Repeat for opposite side.

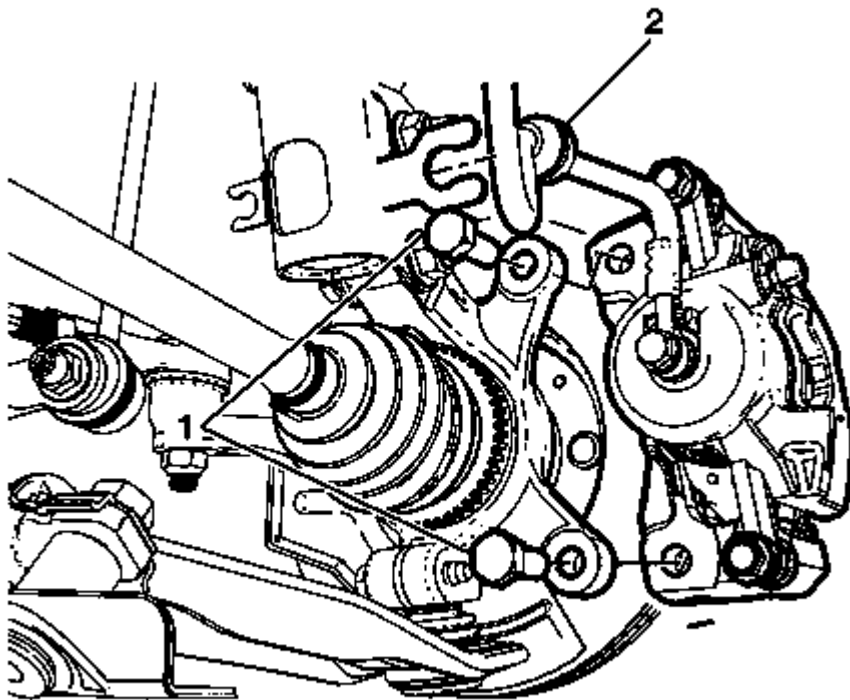


Fig. 180: Front Brake Hose And Front Brake Caliper Retaining Bolts
Courtesy of GENERAL MOTORS COMPANY

19. Install the front brake caliper and tighten the front brake caliper bolts (1) to 95 (70 lb ft).
20. Install the front brake hose (2) to the strut mounted brake hose retaining bracket. Repeat for opposite side.
21. Install the outer tie rod assembly from the steering knuckle. Repeat for opposite side. Refer to **Steering Linkage Outer Tie Rod Replacement** .
22. Install the wheel drive shaft to the front steering knuckle. Refer to **Front Wheel Drive Shaft Replacement** .
23. Install the wheel drive shaft nut and washer to the wheel drive shaft. Repeat for opposite side. Refer to **Front Wheel Drive Shaft Replacement** .
24. Install the control arm ball joint to the steering knuckle. Repeat for opposite side. Refer to **Lower Control Arm Replacement** .

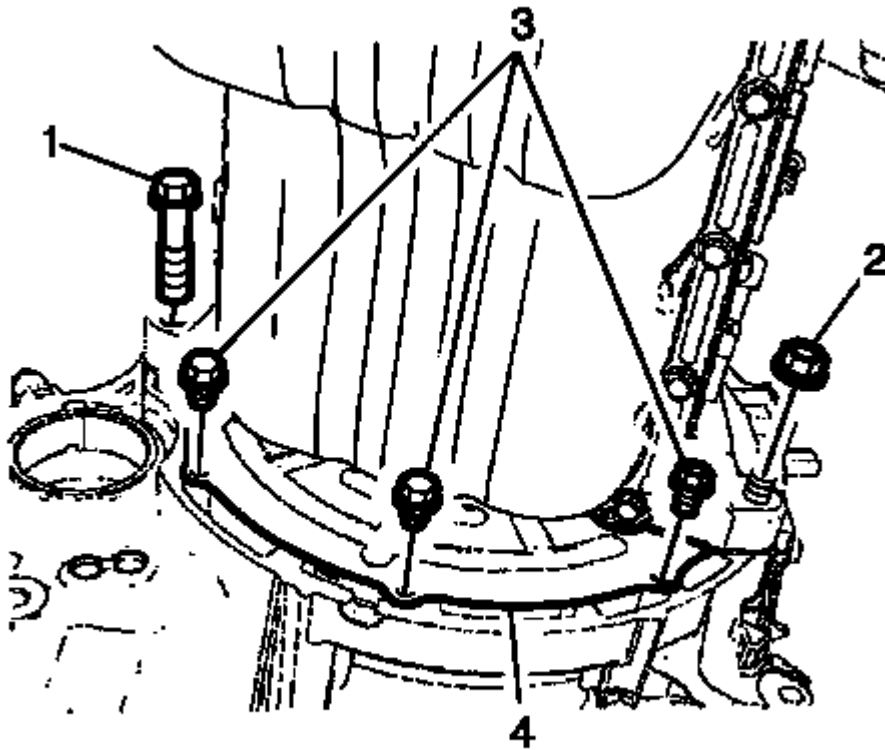


Fig. 181: Lower Transmission Housing Bolt
Courtesy of GENERAL MOTORS COMPANY

25. Install the transmission dust cover (4) and tighten the transmission dust cover bolts (3) to 9 (80 lb ft).
26. Install the transmission rear mount bracket. Refer to **Transmission Rear Mount Bracket Replacement** .
27. Install the exhaust front pipe. Refer to **Exhaust Front Pipe Replacement (LL0)** .

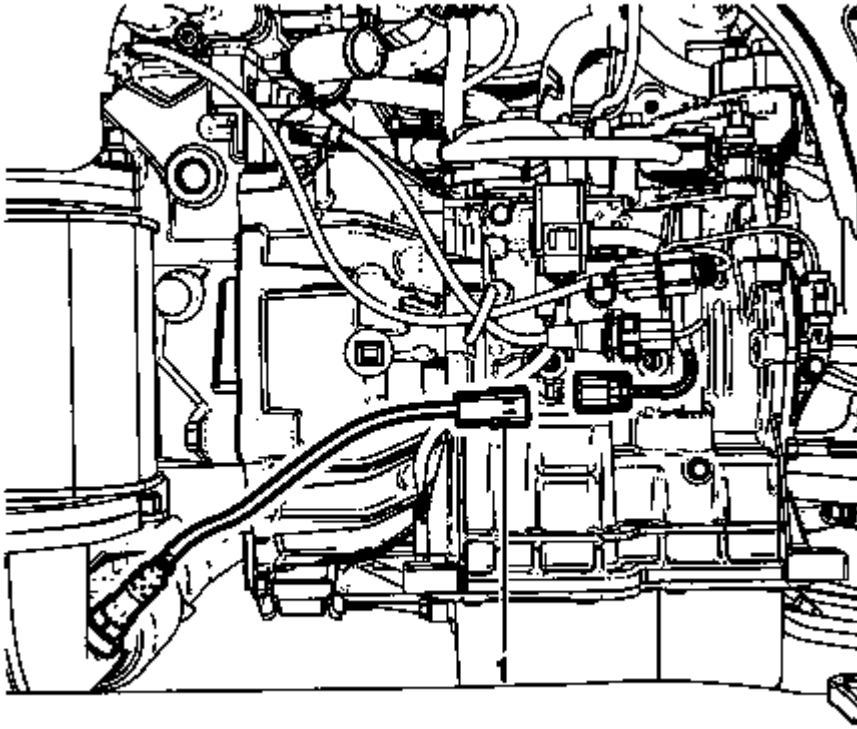


Fig. 182: Oxygen Sensor Connector
Courtesy of GENERAL MOTORS COMPANY

28. Connect the oxygen sensor connector.

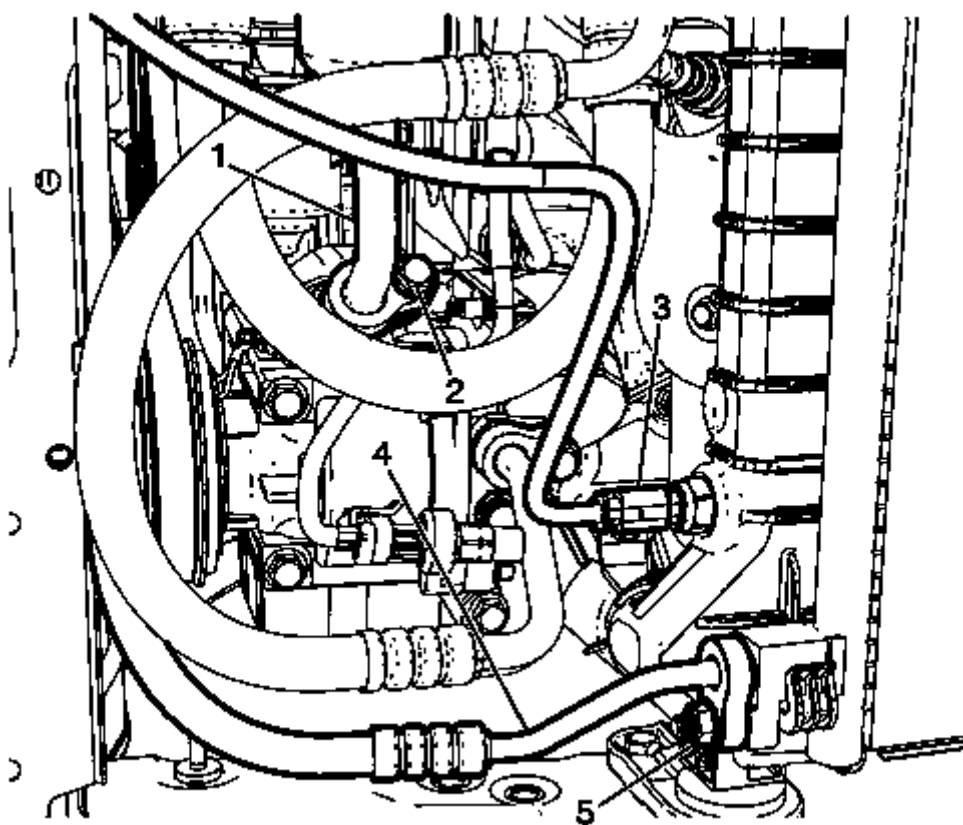


Fig. 183: Suction Pipe Bolt

Courtesy of GENERAL MOTORS COMPANY

29. Install the suction pipe (1) to the A/C compressor.
30. Install the suction pipe bolt (2) to the A/C compressor and tighten to 22 (16 lb ft).
31. Install the discharge pipe (4) to the A/C condenser.
32. Install the discharge pipe nut (5) to the A/C condenser and tighten to 10 (89 lb in).
33. Connect the coolant temperature sensor wiring connector (3) from the radiator.

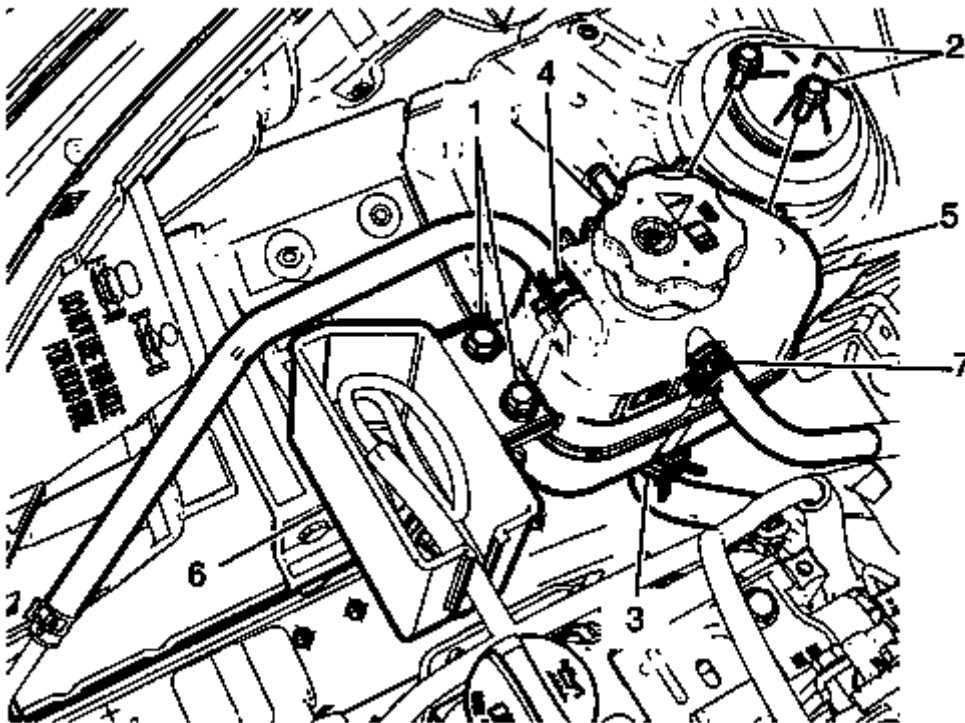


Fig. 184: Block Heater Connecting Plug Holder Bolt
Courtesy of GENERAL MOTORS COMPANY

34. Install the coolant surge tank (5) and coolant hoses with the coolant hose clips (3, 4, 7).
35. Install the coolant surge tank retaining bolts (2) and tighten to 8 (71 lb in).
36. Install the block heater cord container and tighten the block heater code container bolts (1) to 8 (71 lb in).

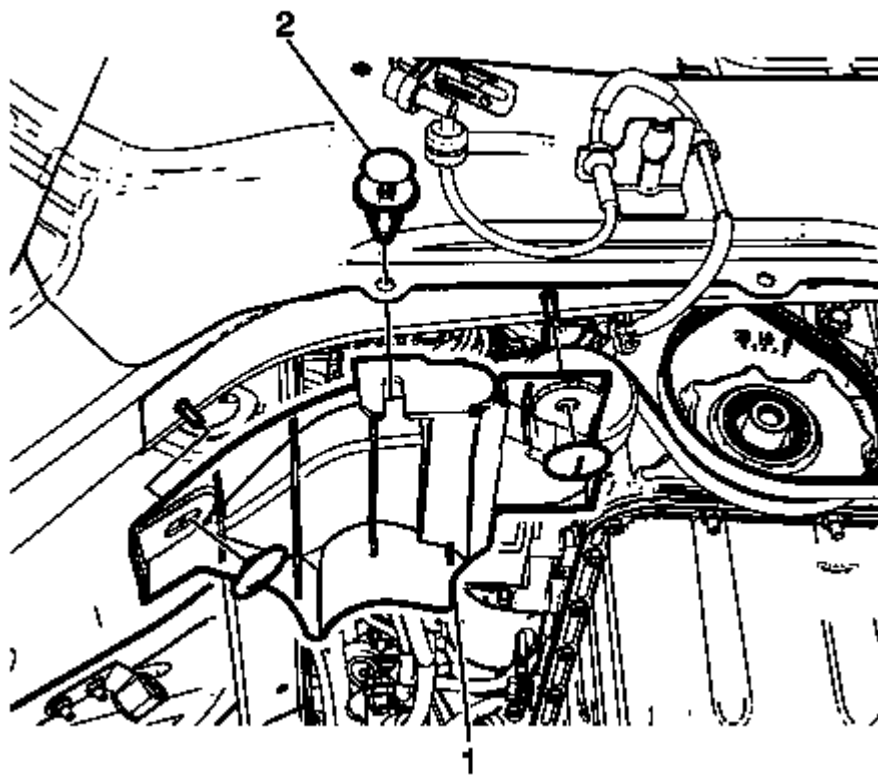


Fig. 185: Retainers And Water Deflector
Courtesy of GENERAL MOTORS COMPANY

37. Install the water deflector (1) with retainers (2).

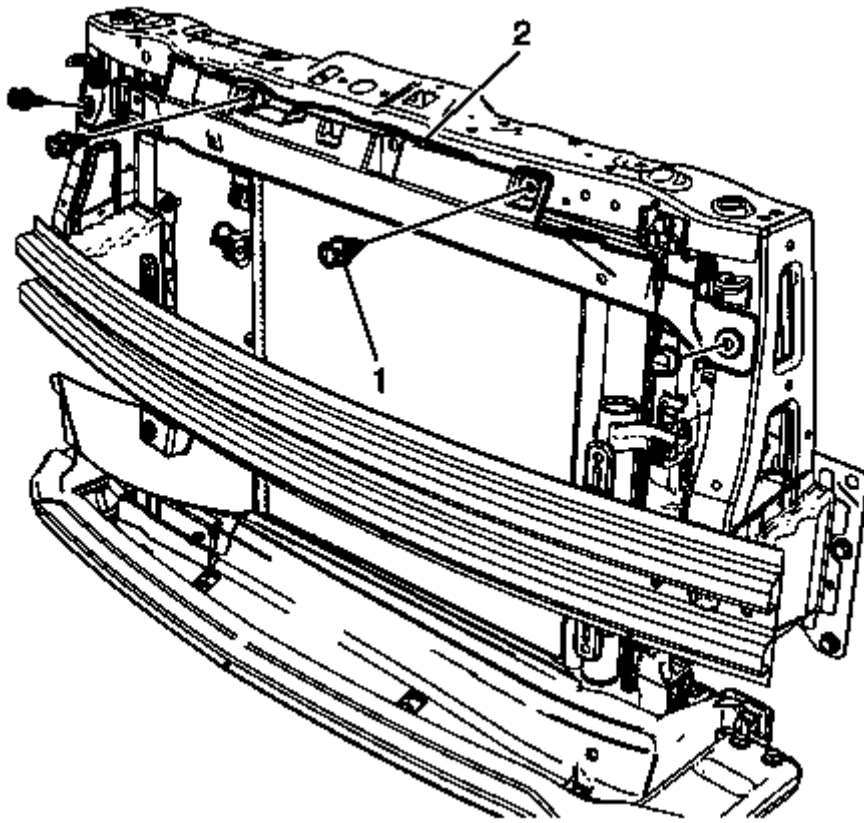


Fig. 186: Upper Air Guard Retainers
Courtesy of GENERAL MOTORS COMPANY

38. Install the upper air guard (2) and the upper air guard retainers (1).

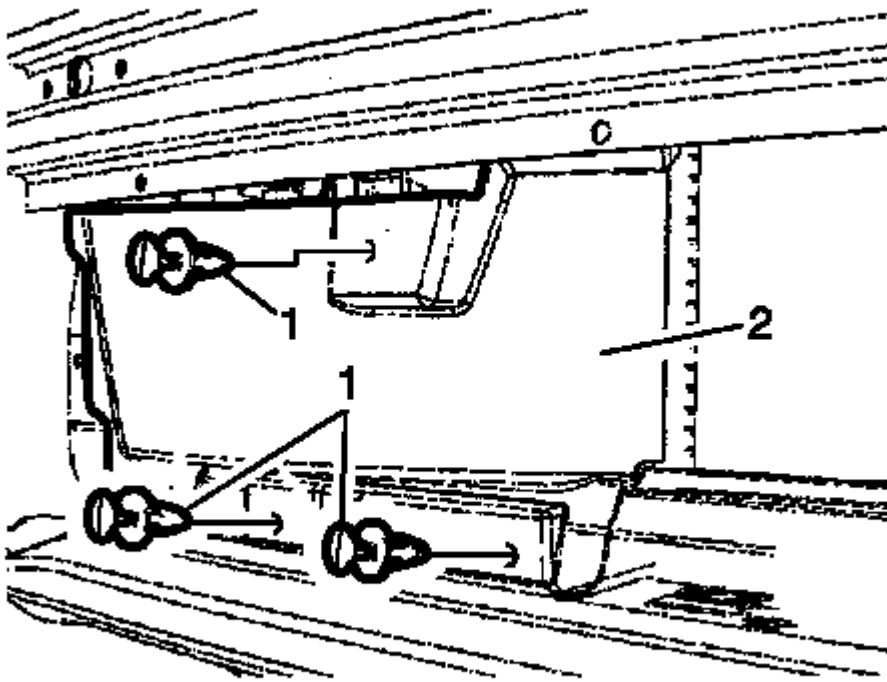


Fig. 187: Front Lower Air Baffle Retainers
Courtesy of GENERAL MOTORS COMPANY

39. Install the front lower air baffles (2) and the front lower air baffle retainers (1).

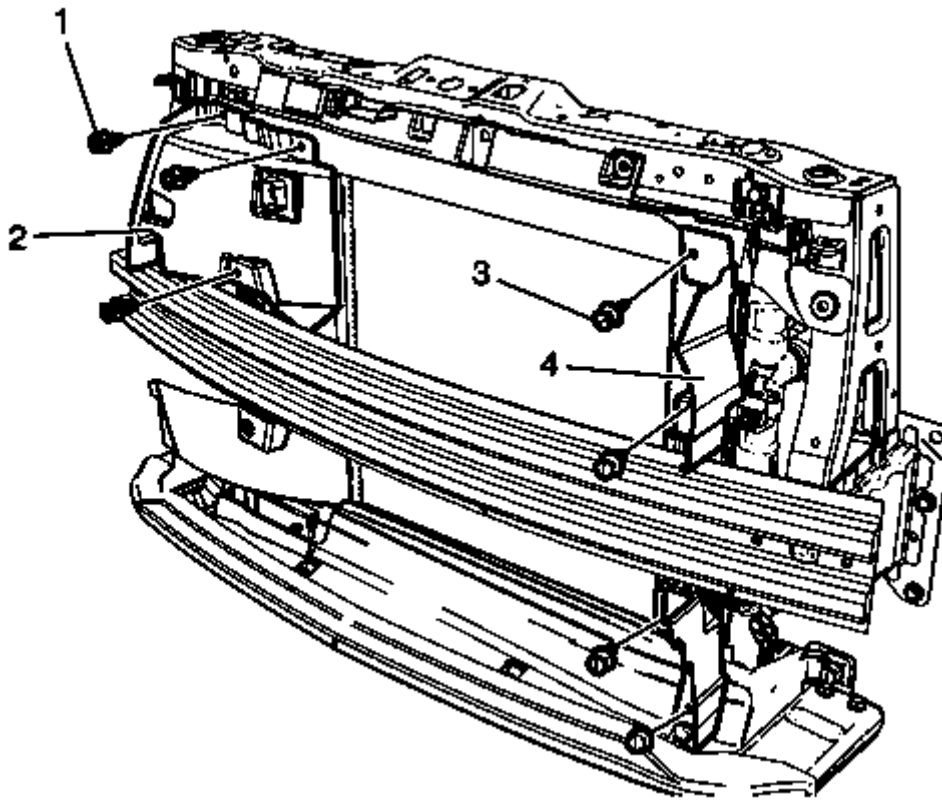


Fig. 188: Front Side Air Baffle Retainers
Courtesy of GENERAL MOTORS COMPANY

40. Install the front side air baffles (2, 4) and the front side air baffle retainers (1, 3).
41. Install the front bumper fascia. Refer to **Front Bumper Fascia Replacement** .

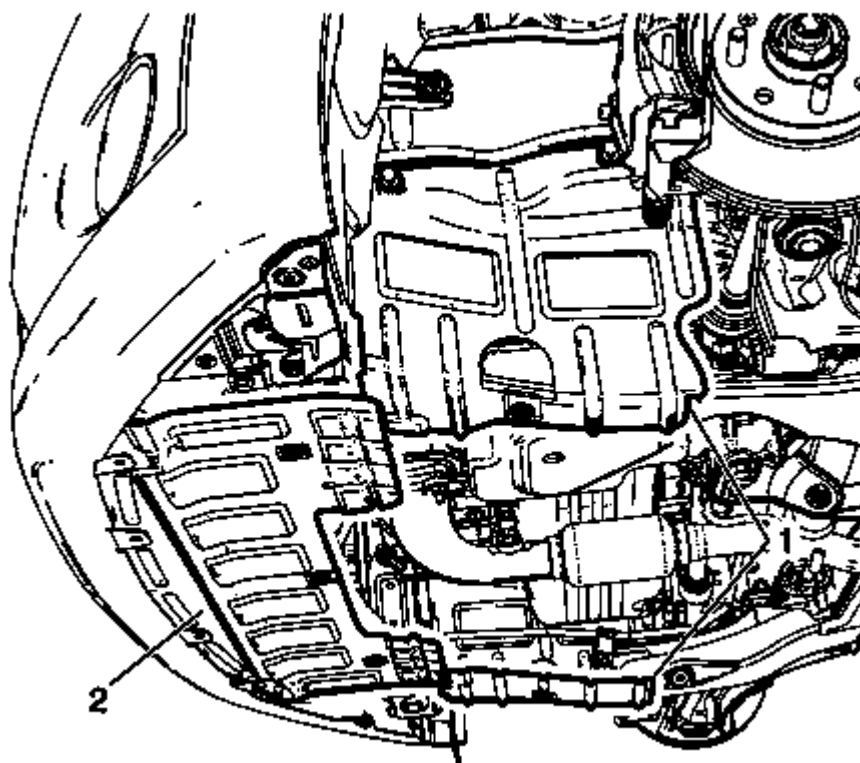


Fig. 189: Compartment Splash Shield
Courtesy of GENERAL MOTORS COMPANY

42. Install the compartment splash shield (1, 2). Refer to **Front Compartment Splash Shield Replacement** .

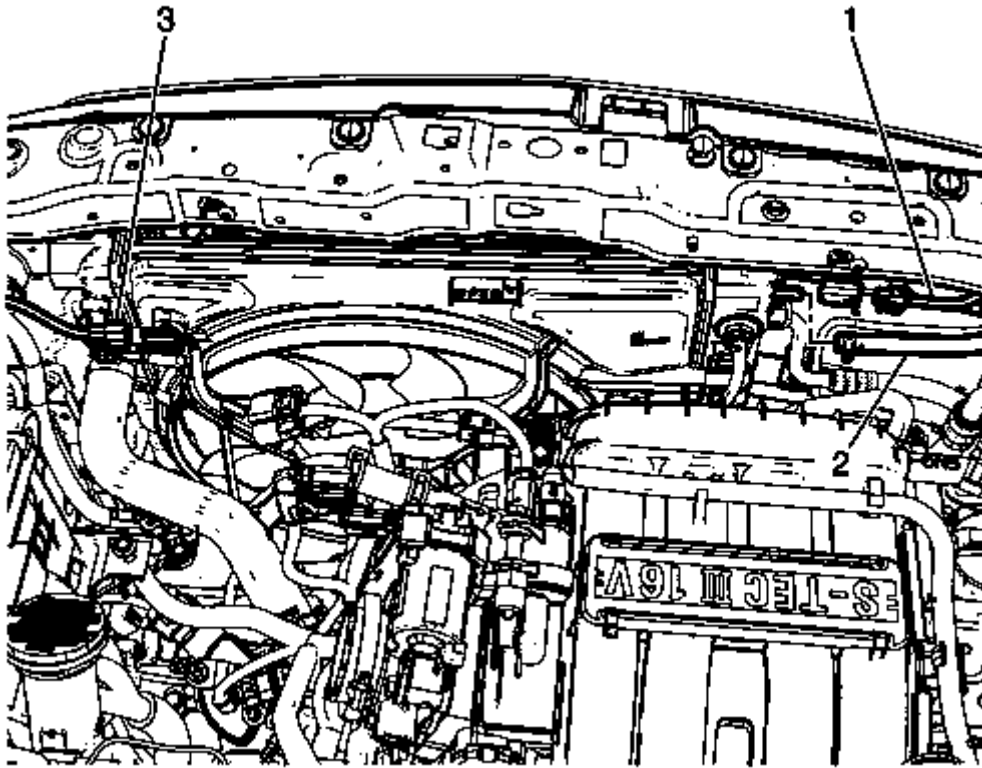


Fig. 190: Ambient Air Temperature Sensor Connector
Courtesy of GENERAL MOTORS COMPANY

43. Connect the coolant hose (2) to the radiator.
44. Connect the ambient air temperature sensor connector (1) to the ambient air temperature sensor if equipped.
45. Install the wiring harness connector (3) to the engine cooling fan harness connector.

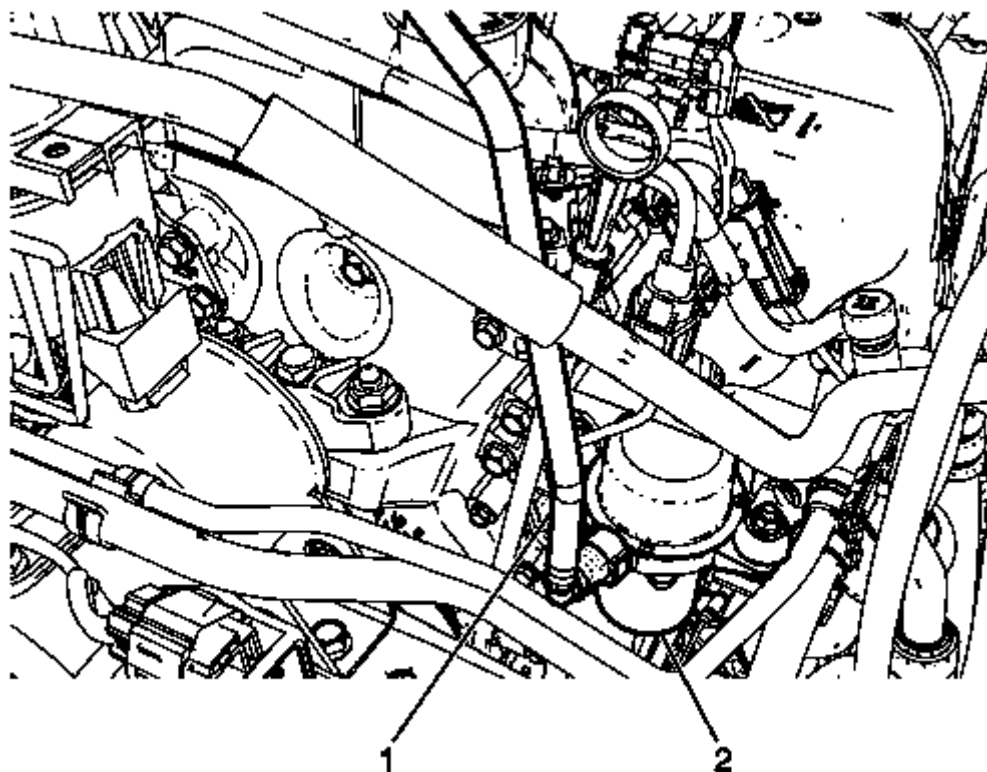


Fig. 191: Vacuum Pump Hose And Vacuum Pump
Courtesy of GENERAL MOTORS COMPANY

46. Install the vacuum pump hose (1) to the vacuum pump (2).

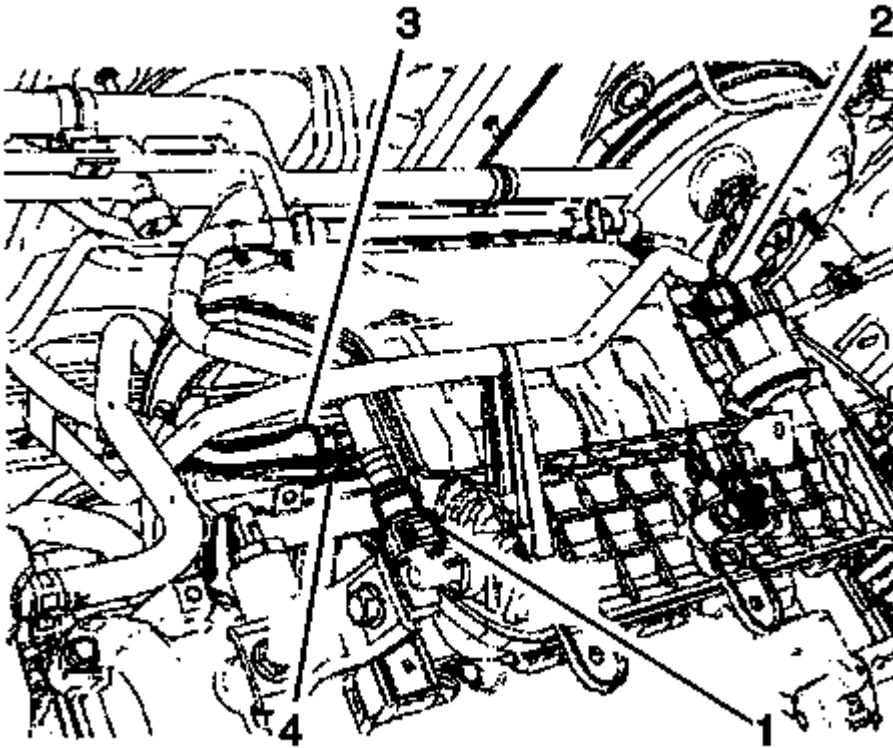


Fig. 192: Vacuum Hose

Courtesy of GENERAL MOTORS COMPANY

47. Connect the fuel feed hose (3) and install the fuel feed hose retaining clip (4). Refer to **Metal Collar Quick Connect Fitting Service** .
48. Connect the evaporative canister purge solenoid valve hose (2).
49. Connect the vacuum hose (1) to the intake manifold.

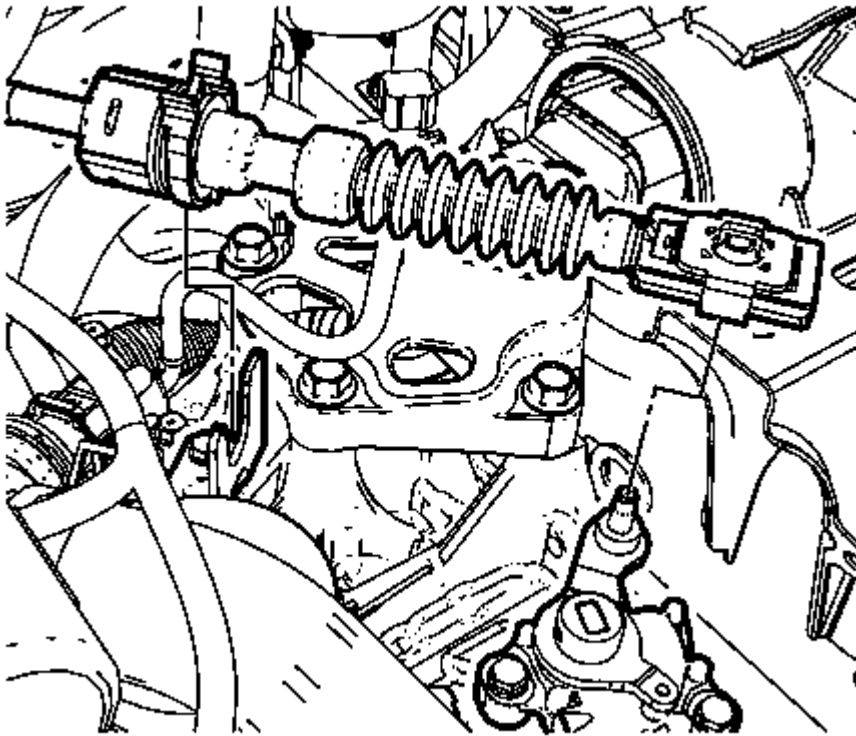


Fig. 193: Transmission Range Selector Lever Cable Terminal
Courtesy of GENERAL MOTORS COMPANY

50. Connect the transmission range selector lever cable terminal to the transmission lever pin. For manual transmission refer to **Manual Transmission Shift Lever and Selector Lever Cable Replacement (MX2, MFM)** .
51. Install the transmission range selector lever cable to the cable bracket.
52. Install the clutch actuator cylinder if equipped. Refer to **Clutch Actuator Cylinder Replacement** . (M/T)
53. Install the heater inlet hose. Refer to **Heater Inlet Hose Replacement (1.0L LMT, 1.19L LC5 and 1.2L LMU)** .
54. Install the heater outlet hose. Refer to **Heater Outlet Hose Replacement (1.0L LMT, 1.19L LC5 and 1.2L LMU)** .

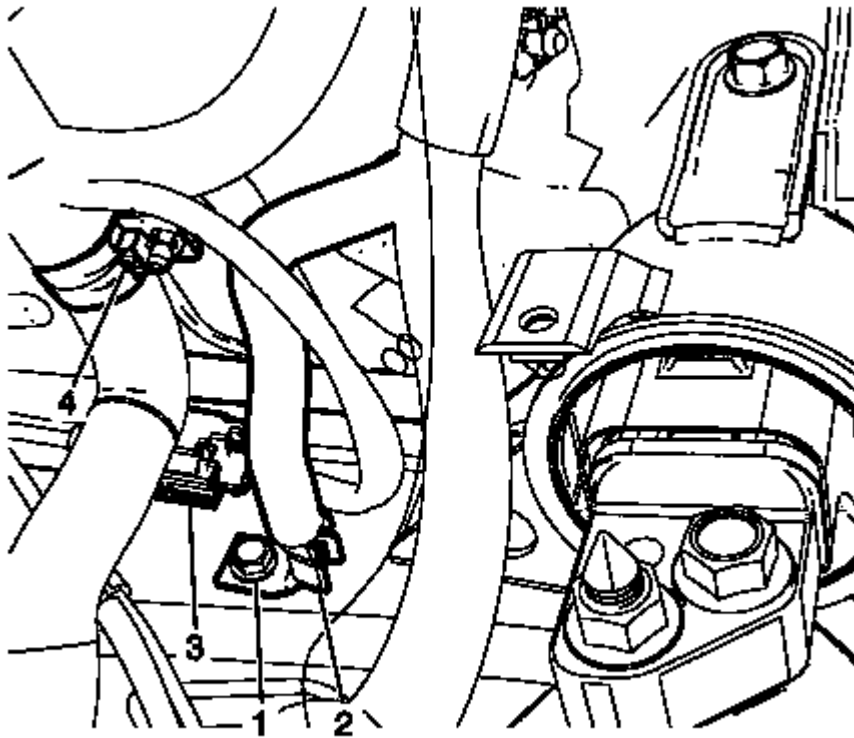


Fig. 194: Ground Bolt And Put Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

55. Install the wiring harness retainer (4).
56. Connect the wheel speed sensor connector (3).
57. Install the ground wiring harness and bolt (1) and tighten to 10 (89 lb in).

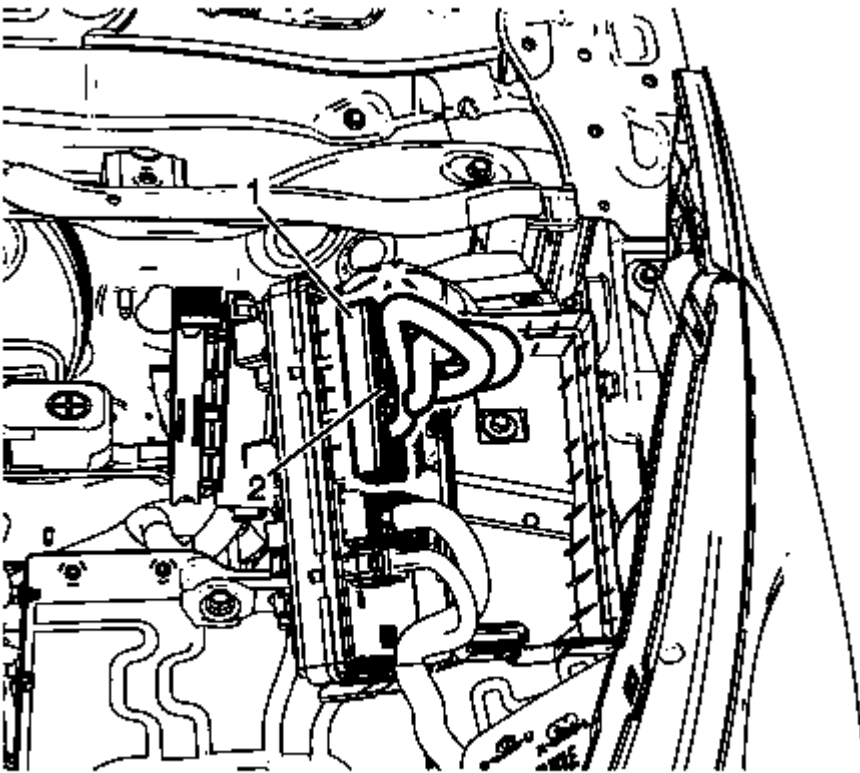


Fig. 195: Front Compartment Fuse Block
Courtesy of GENERAL MOTORS COMPANY

58. Connect the engine wiring harness connector (1) to the fuse block and tighten the wiring harness connector retaining bolt (2) to 6 (53 lb in). Repeat for remaining connector.
59. Connect the remaining wiring harness to the compartment fuse block.
60. Install the engine wiring harness fuse block to the lower plate.

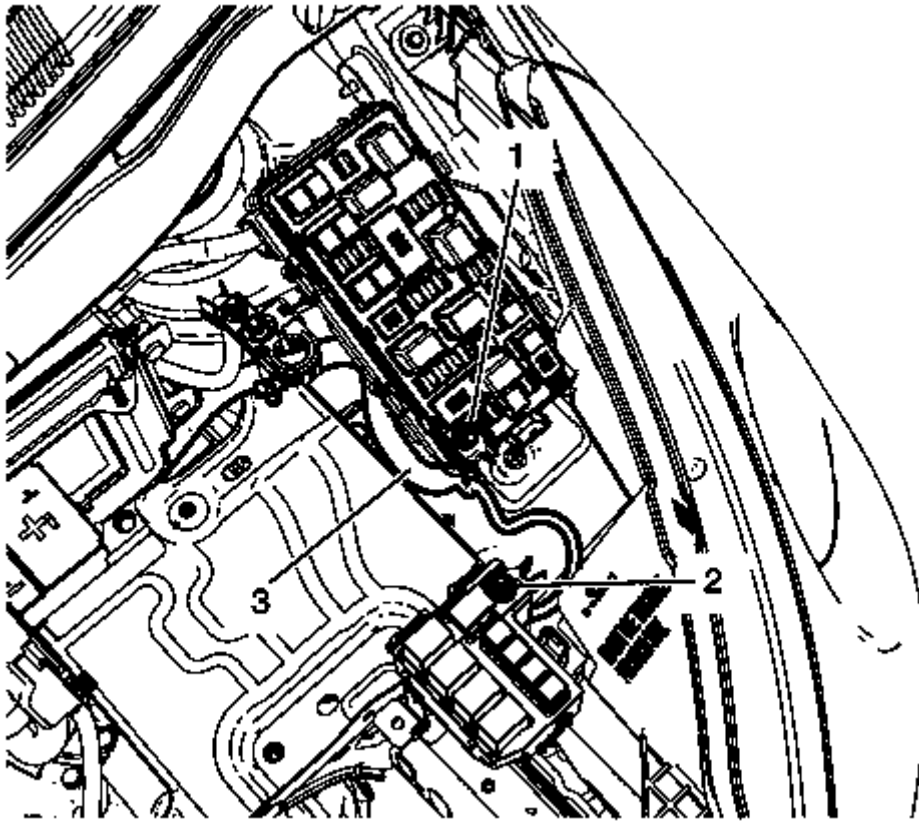


Fig. 196: Positive Battery Cable Nut

Courtesy of GENERAL MOTORS COMPANY

61. Install the positive cable (3) to the engine wiring harness fuse block and tighten the positive cable retaining nut (1, 2) to 10 (89 lb in).

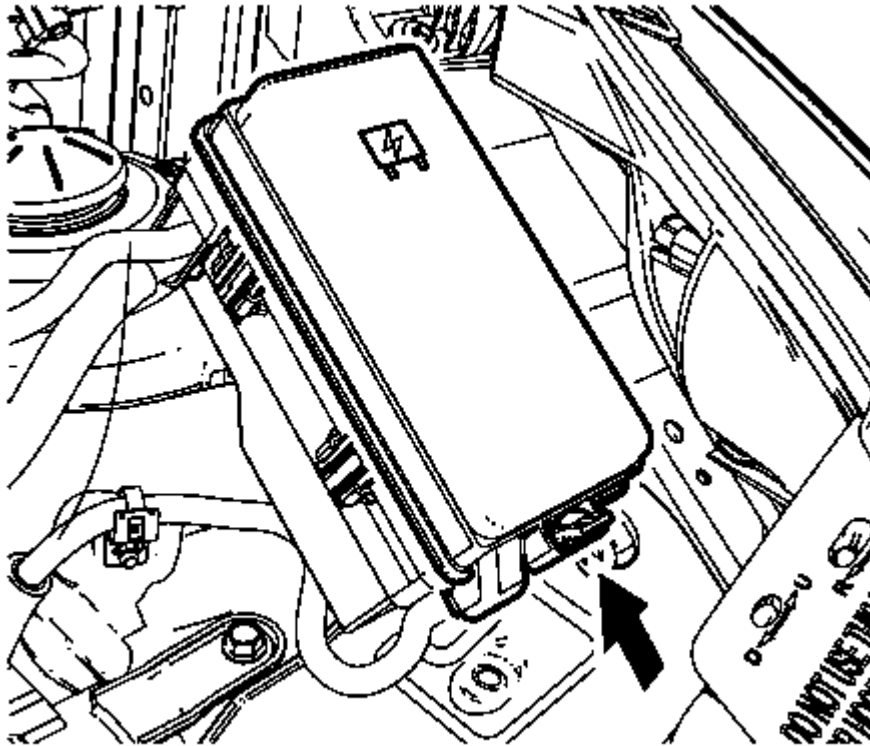


Fig. 197: Front Compartment Fuse Block Cover
Courtesy of GENERAL MOTORS COMPANY

62. Install the engine wiring harness fuse block cover.

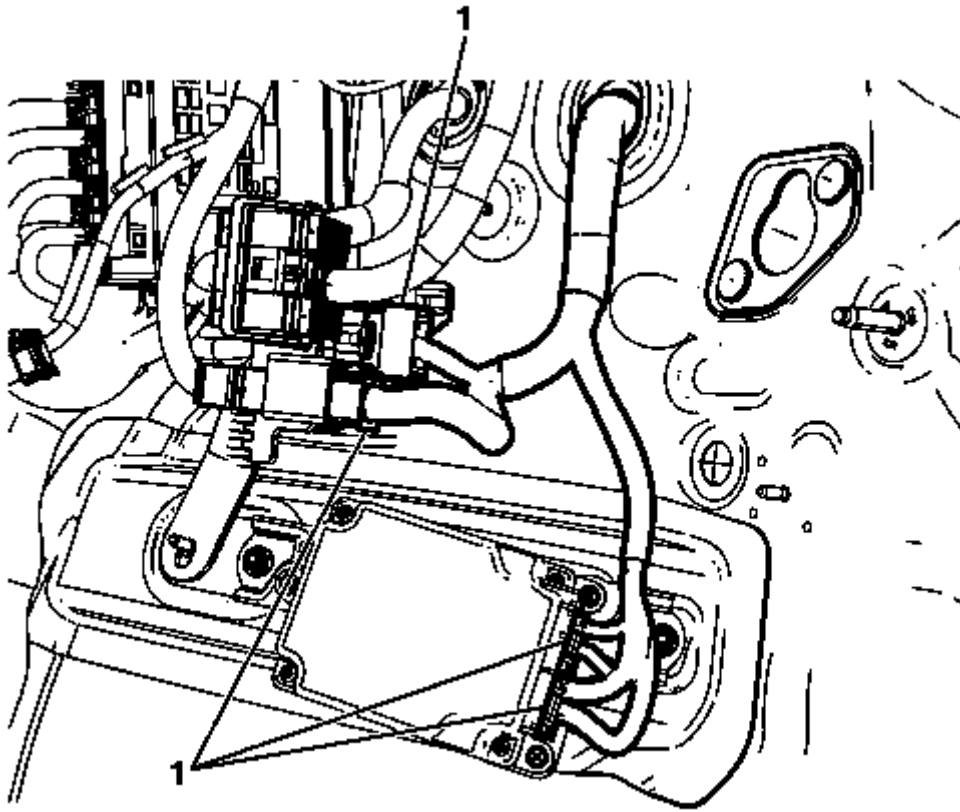


Fig. 198: Engine Wiring Harnesses Connectors
Courtesy of GENERAL MOTORS COMPANY

63. Install the engine wiring harness through the front of dash on the left of the steering shaft under the dash and connect the 4 engine wiring harnesses connectors (1).

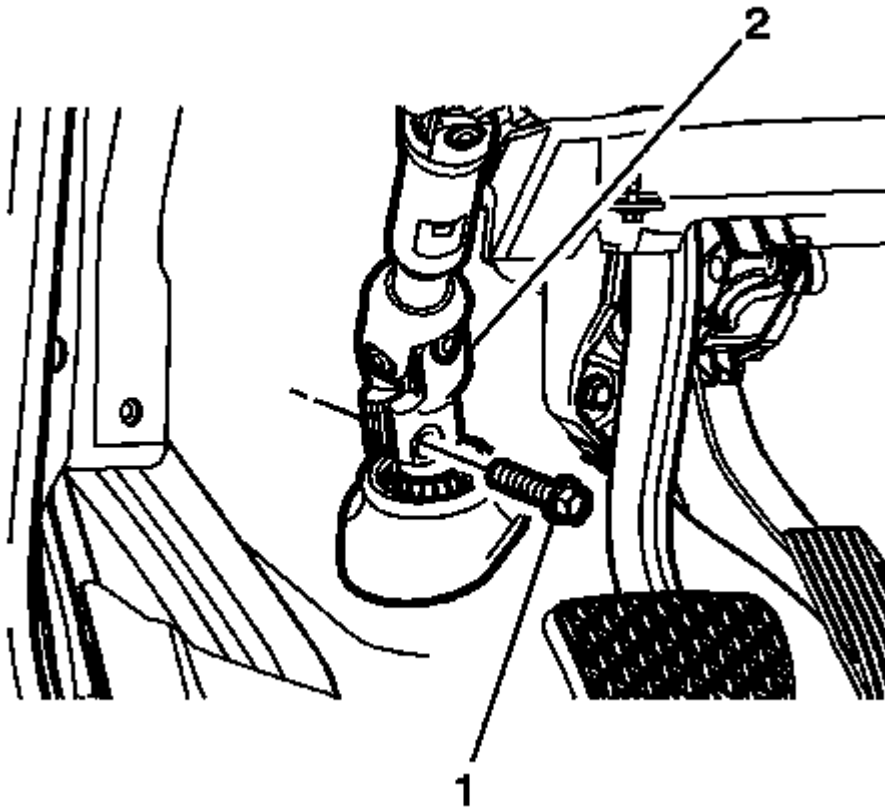


Fig. 199: Lower Intermediate Steering Shaft Bolt
Courtesy of GENERAL MOTORS COMPANY

64. Install the lower intermediate steering shaft (2) and tighten the lower Intermediate steering shaft bolt (1) to 27 (20 lb ft).
65. Install the battery tray. Refer to **Battery Tray Replacement** .
66. Install the engine control module. Refer to **Engine Control Module Replacement** .
67. Install the battery. Refer to **Battery Replacement** .
68. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
69. Install the front wheels and tires. Refer to **Tire and Wheel Removal and Installation** .
70. Recharge the refrigerant. Refer to **Refrigerant Recovery and Recharging** .
71. Refill the cooling system. Refer to **Cooling System Draining and Filling** .
72. Check the engine oil level and fill new engine oil up if necessary.
73. Connect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection** .
74. Close the hood.

ENGINE BLOCK HEATER REPLACEMENT (LL0)

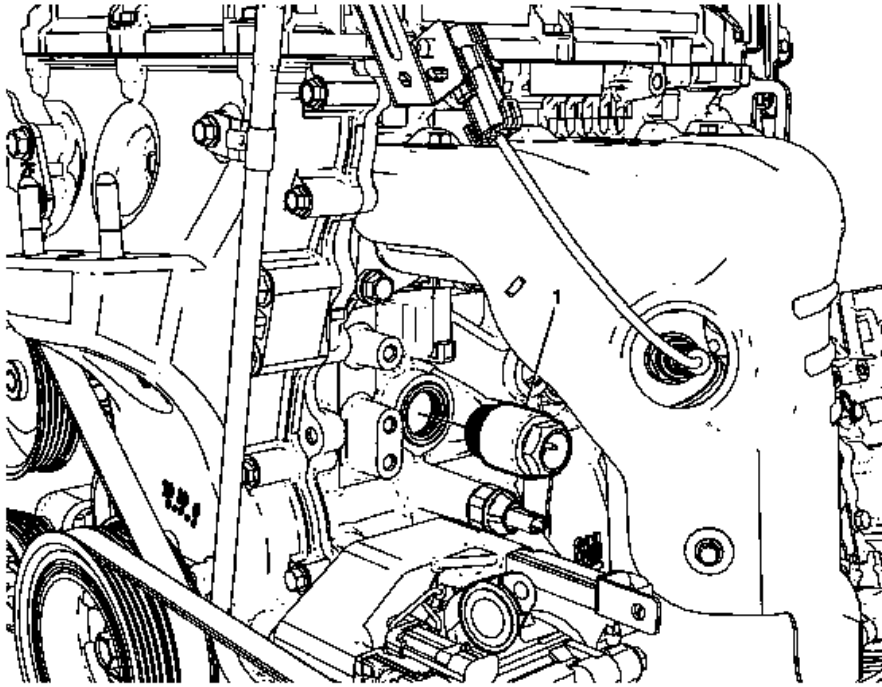


Fig. 200: Engine Block Heater
 Courtesy of GENERAL MOTORS COMPANY

Engine Block Heater Replacement (LL0)

Callout	Component Name
Preliminary Procedure 1. Drain the cooling system. Refer to <u>Cooling System Draining and Filling</u> . 2. Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> 3. Disconnect the engine block heater electrical connector.	
1	Engine Block Heater CAUTION: Refer to <u>Component Fastener Tightening Caution</u> . Procedure Remove the engine block heater. Tighten 60 (44 lb ft)

ENGINE OIL AND OIL FILTER REPLACEMENT

Removal Procedure

1. Turn the ignition OFF.
2. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .

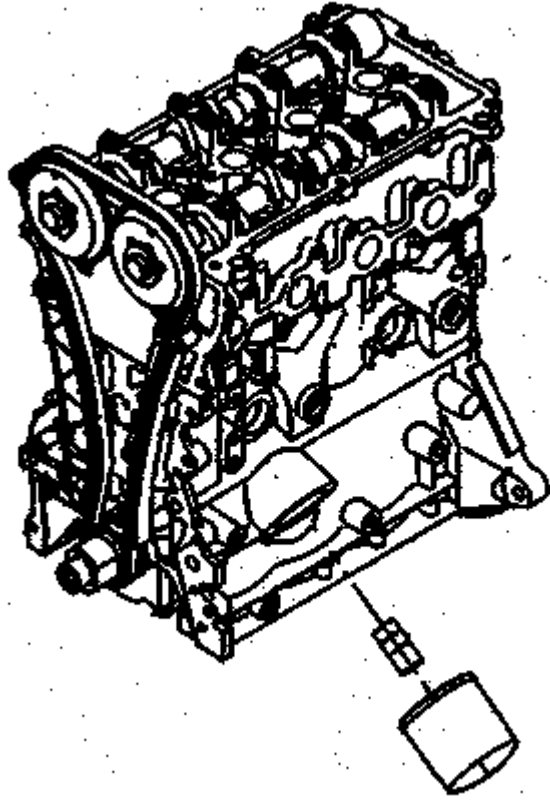


Fig. 201: Oil Filter

Courtesy of GENERAL MOTORS COMPANY

3. Remove the oil filter, using suitable tool.
4. Discard the oil filter.

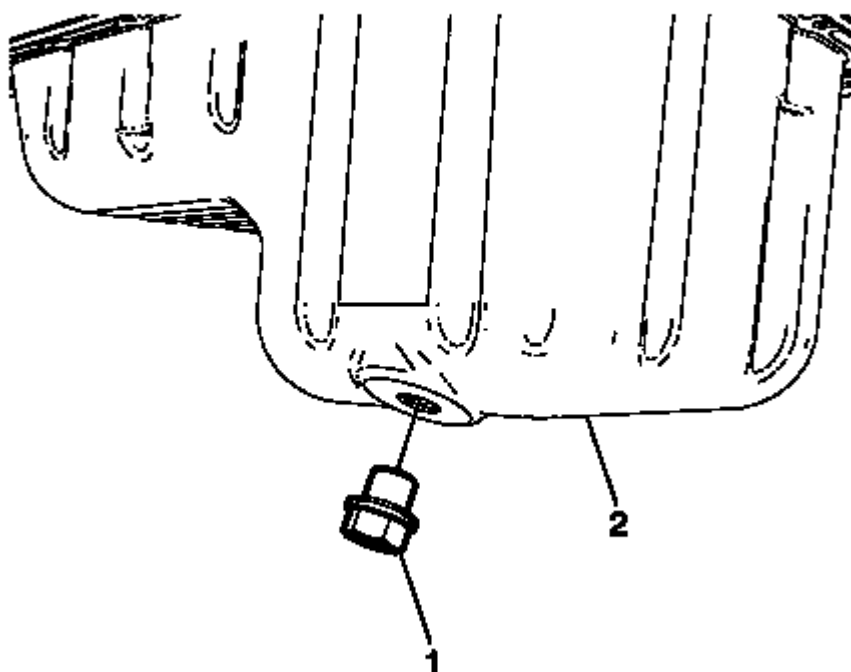


Fig. 202: Oil Pan Drain Plug

Courtesy of GENERAL MOTORS COMPANY

5. Place a suitable container below the oil pan drain plug (1).
6. Remove the oil pan drain plug (1) from the oil pan (2).
7. Allow the oil to drain completely.

Installation Procedure

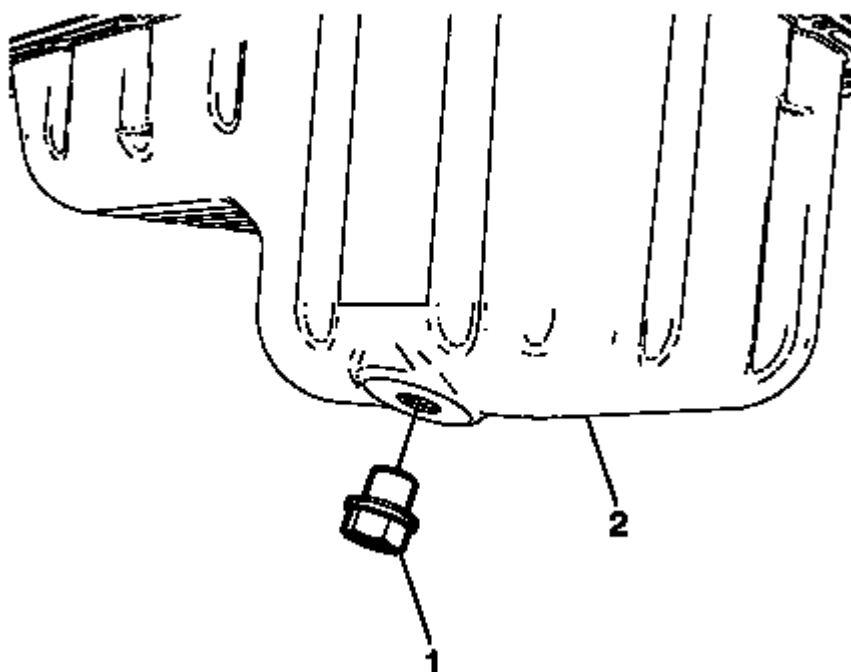


Fig. 203: Oil Pan Drain Plug

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

1. Install the oil pan drain plug (1) to the oil pan (2) and tighten the oil pan drain plug to 25 (18 lb ft).

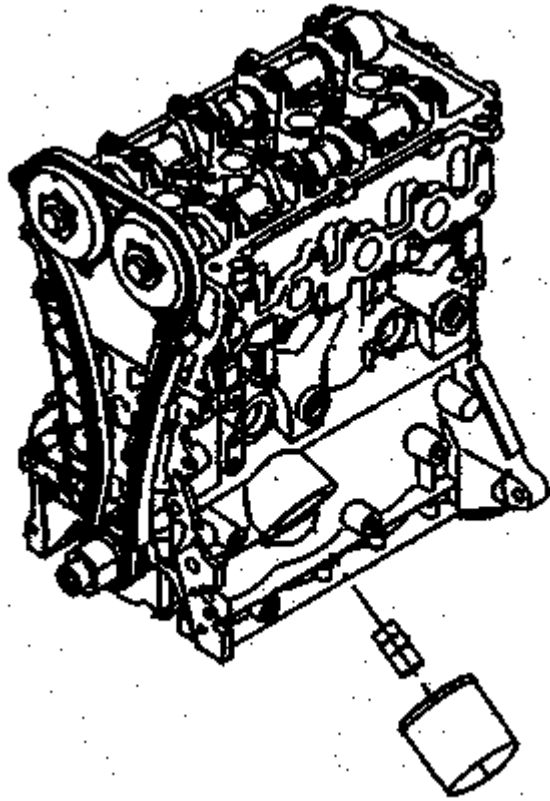


Fig. 204: Oil Filter

Courtesy of GENERAL MOTORS COMPANY

2. Install the NEW oil filter.
3. Install the oil filter using suitable tool.
4. Tighten the oil filter to 16 (12 lb ft).
5. Lower the vehicle.
6. Fill the engine with the appropriate oil type and quantity. Refer to **Fluid and Lubricant Recommendations** and **Approximate Fluid Capacities** .

PISTON, CONNECTING ROD AND BEARING REPLACEMENT

Special Tools

- **EN-50174** Piston Ring Compressor (1.0L only)
- **J-8037** Piston Ring Compressor

For equivalent regional tools, refer to **Special Tools**

Removal Procedure

1. Remove the cylinder head. Refer to **Cylinder Head Replacement (LL0)**, **Cylinder Head Replacement**

(LFM).

2. Remove the oil pan. Refer to **Oil Pan Replacement**
3. Raise the vehicle by its full height. Refer to **Lifting and Jacking the Vehicle** .
4. Install the crankshaft balancer bolt.
5. Set the pistons 1 and 4 to TDC in direction of engine rotation.

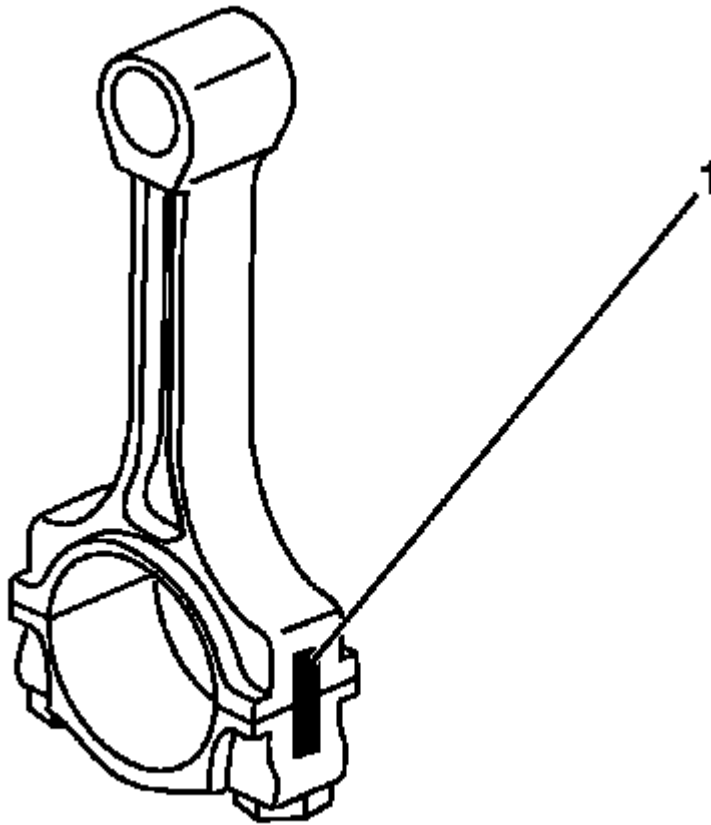


Fig. 205: View Of Con-Rod Bearing Caps
Courtesy of GENERAL MOTORS COMPANY

6. Mark the connecting rod with the connecting rod bearing cover (1).

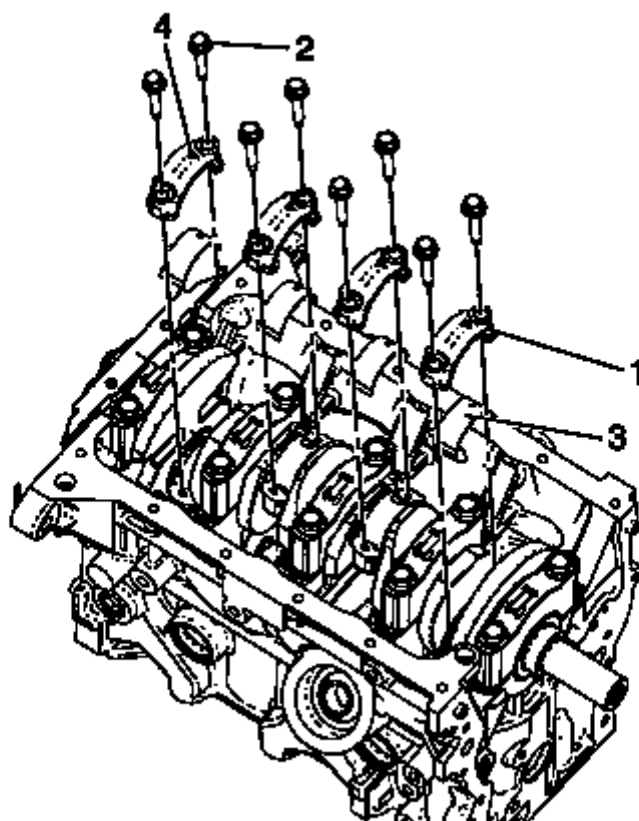


Fig. 206: Rod Bearing Caps Nuts

Courtesy of GENERAL MOTORS COMPANY

7. Remove the 4 connecting rod bearing caps nuts (2) of cylinder 1 and 4.
8. Remove the connecting rod bearing caps (1) and the connecting rod bearing (3).

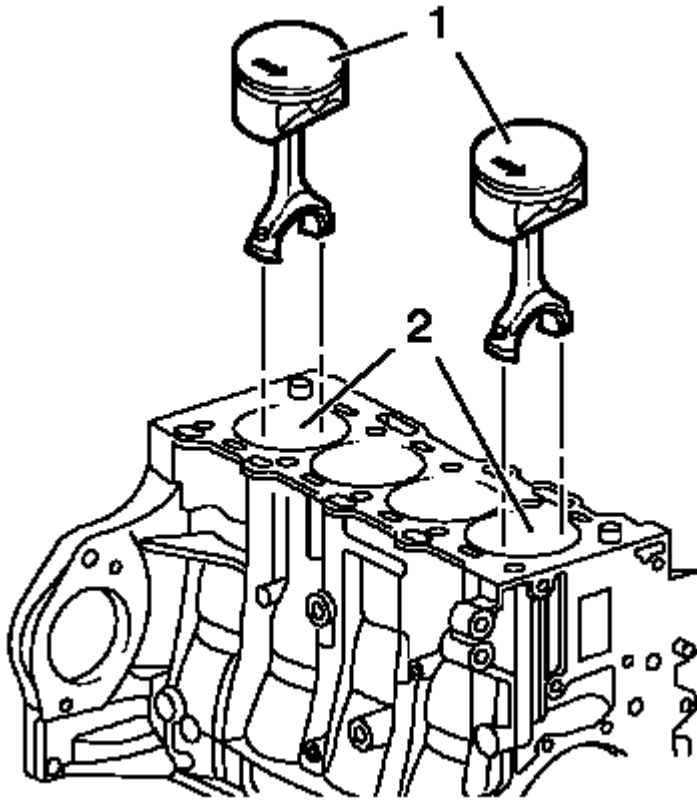


Fig. 207: Pistons 1, 4 And Cylinder Bore
Courtesy of GENERAL MOTORS COMPANY

9. Push the pistons 1 and 4 (1) out of the cylinder bore (2).
10. Lower the vehicle.

NOTE: The shear surfaces of the con-rod and the con-rod bearing cover form a unique fit and must not be swapped or damaged. Do not lay down on the shear surfaces.

11. Remove the pistons 1 and 4 (1).
12. Raise the vehicle by its full height.
13. Turn crankshaft on crankshaft balancer through 180 degrees in direction of rotation of engine.
14. Repeat for the piston 2 and 3.

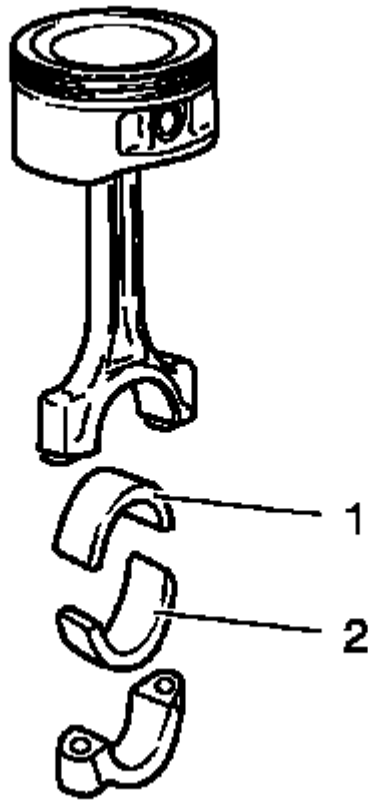


Fig. 208: Connecting Rod Bearing
Courtesy of GENERAL MOTORS COMPANY

NOTE: Observe correct fitting position, observe alignment.

15. Remove the connecting rod bearing (1, 2).
16. Check the components. Refer to **Piston, Connecting Rod and Bearing Cleaning and Inspection (LL0)**, **Piston, Connecting Rod and Bearing Cleaning and Inspection (LFM)**.

Installation Procedure

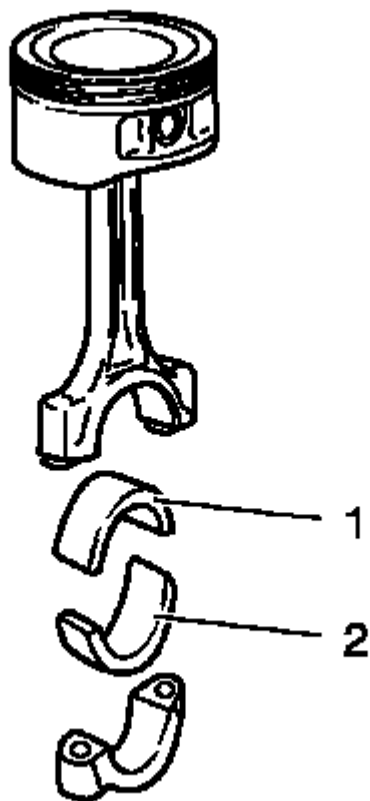


Fig. 209: Connecting Rod Bearing
Courtesy of GENERAL MOTORS COMPANY

NOTE: Lubricate the connection rod bearing with NEW engine oil.

1. Install the connecting rod bearing (1, 2).

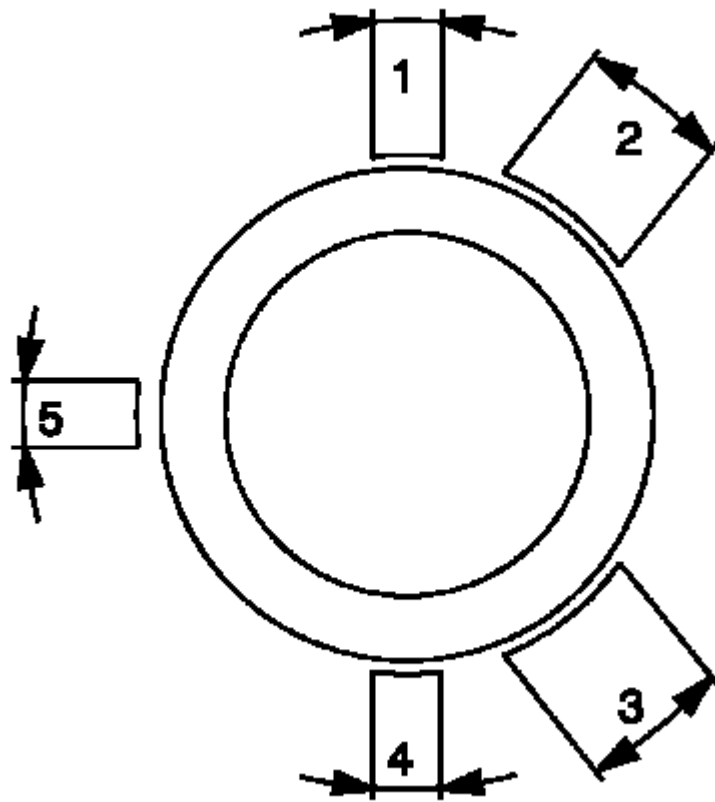


Fig. 210: View Of Piston Ring Joint Positions
Courtesy of GENERAL MOTORS COMPANY

2. Set piston ring joints.
 - Piston compression upper ring in position (1).
 - Piston compression lower ring in position (4).
 - Interim ring of the piston oil ring rail in position (5), steel band rings of the piston oil ring rail in position (2) and/or (3).

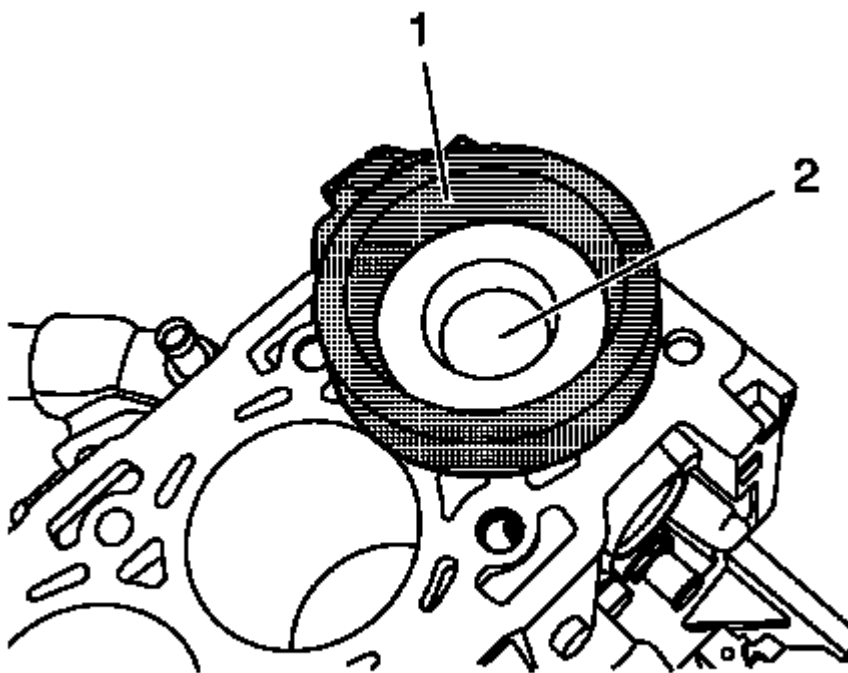


Fig. 211: Piston Rings, Piston And Cylinder Bore
Courtesy of GENERAL MOTORS COMPANY

3. Lubricate the piston rings, piston (1), inner cylinder bore surface and **EN-50174 (J-8037)** piston ring compressor (2) with clean engine oil.

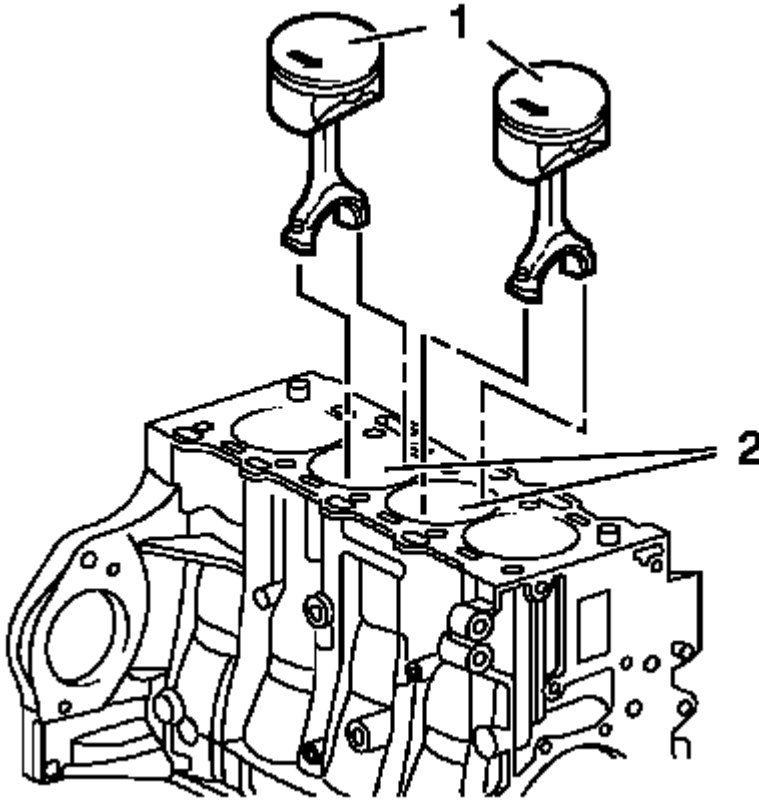


Fig. 212: Pistons 2, 3 And Cylinder Bore
Courtesy of GENERAL MOTORS COMPANY

NOTE: Arrow on piston head points to engine timing side, bead on connecting rod points to transmission side of engine.

4. Push the pistons 2 and 3 (1) into the cylinder bore (2).
5. Raise the vehicle by its full height.

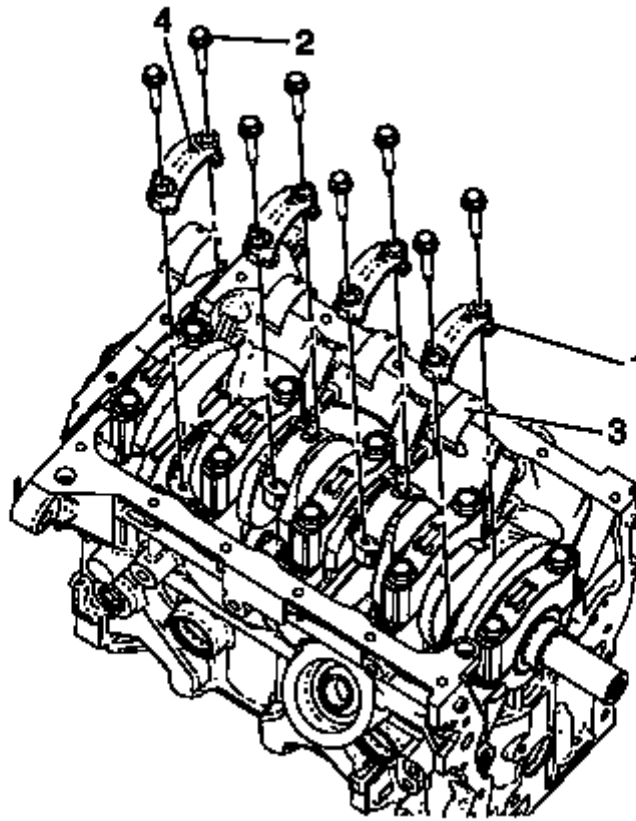


Fig. 213: Rod Bearing Caps Nuts

Courtesy of GENERAL MOTORS COMPANY

6. Install the connecting rod bearing caps (1) and the connecting rod bearing (3).

CAUTION: Refer to Fastener Caution .

7. Install 4 NEW connecting rod bearing caps bolts (2) of cylinder 2 and 3 and tighten to $20 + 90^\circ$ (15 lb ft + 90°).
8. Turn crankshaft on crankshaft balancer through 180 degrees in direction of rotation of engine.
9. Repeat for the piston 1 and 4.
10. Set the crankshaft in direction of engine rotation to 60 degrees before UDC.
11. Install the oil pan. Refer to Oil Pan Replacement.
12. Install the cylinder head. Refer to Cylinder Head Replacement (LL0), Cylinder Head Replacement (LFM).

CAMSHAFT COVER REPLACEMENT (LL0)

Removal Procedure

1. Open the hood.
2. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
3. Remove the intake manifold. Refer to **Intake Manifold Replacement**.
4. Remove the ignition coil cover. Refer to **Ignition Coil Cover Replacement (LL0)**, **Ignition Coil Cover Replacement (LFM)**.

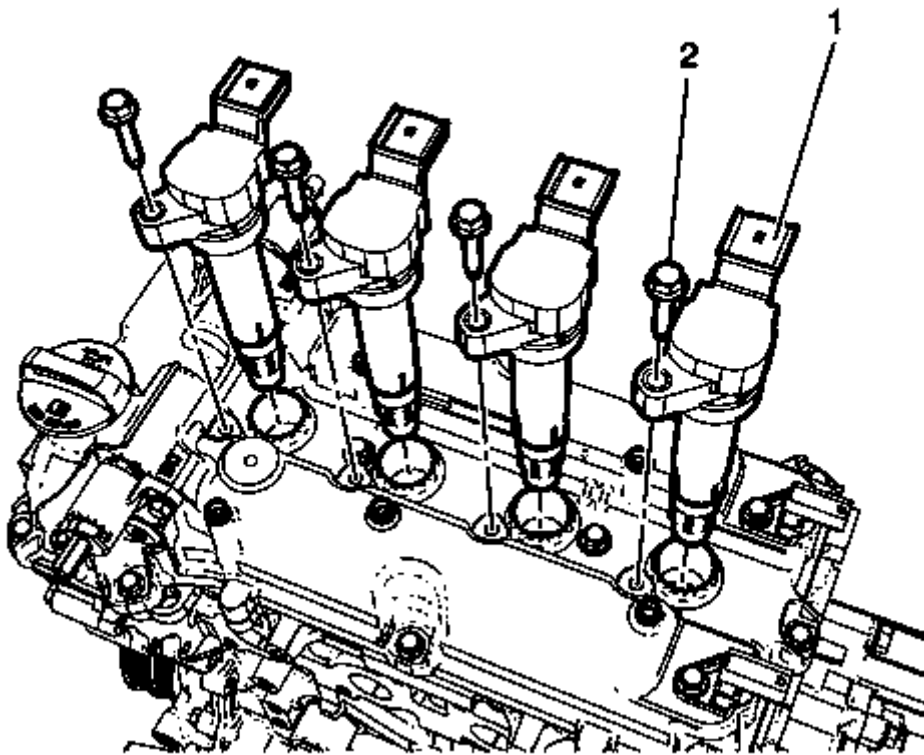


Fig. 214: Ignition Coil

Courtesy of GENERAL MOTORS COMPANY

5. Disconnect the fuel injector connectors. Refer to **Fuel Injection Fuel Rail Assembly Replacement (LFM)** , **Fuel Injection Fuel Rail Assembly Replacement (LL0)** .
6. Remove the ignition coil (1). Refer to **Ignition Coil Replacement (LL0)** , **Ignition Coil Replacement (LFM)** .
7. Remove the camshaft position sensor. Refer to **Camshaft Position Sensor Replacement (LFM)** , **Camshaft Position Sensor Replacement (LL0)** .
8. Remove the camshaft position actuator solenoid valve. Refer to **Camshaft Position Actuator Solenoid Valve Removal**.
9. Remove the oil filler cap.

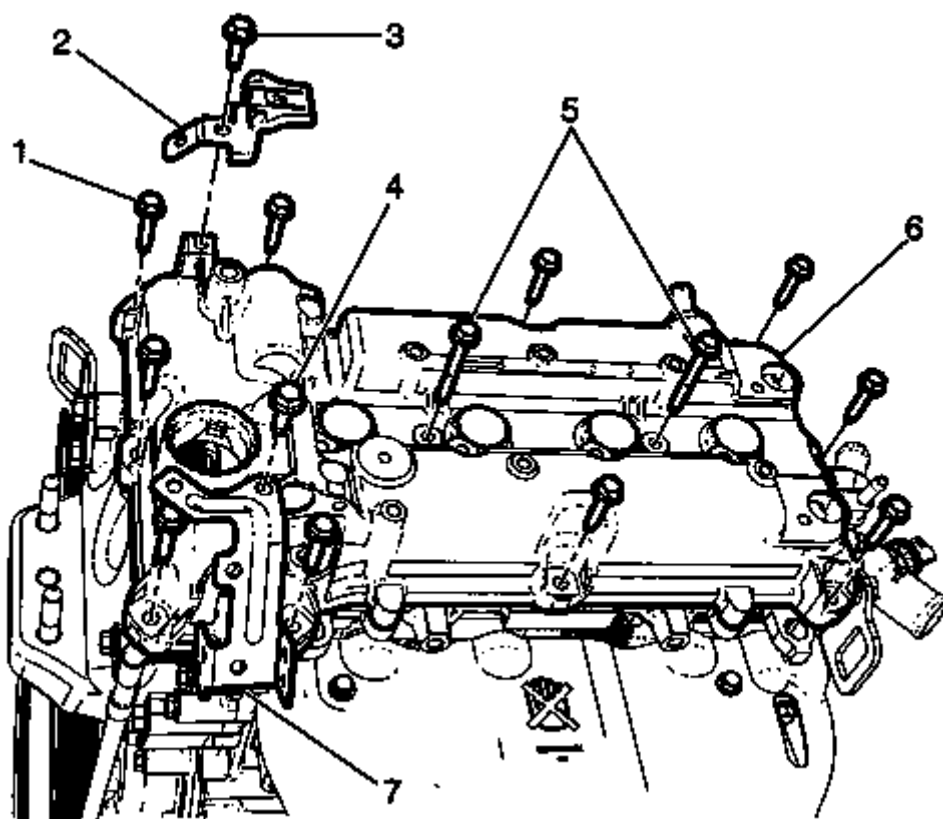


Fig. 215: Engine Injection And Ignition Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

10. Remove The 1 Engine Injection And Ignition Bracket Bolt (3).
11. Remove the engine injection and ignition bracket (2).
12. Remove the 1 camshaft cover front bracket bolt (4).
13. Remove the camshaft cover front bracket (7).
14. Remove the 2 camshaft cover bolts (5).
15. Remove the 10 camshaft cover bolts (1).
16. Remove the camshaft cover (6).

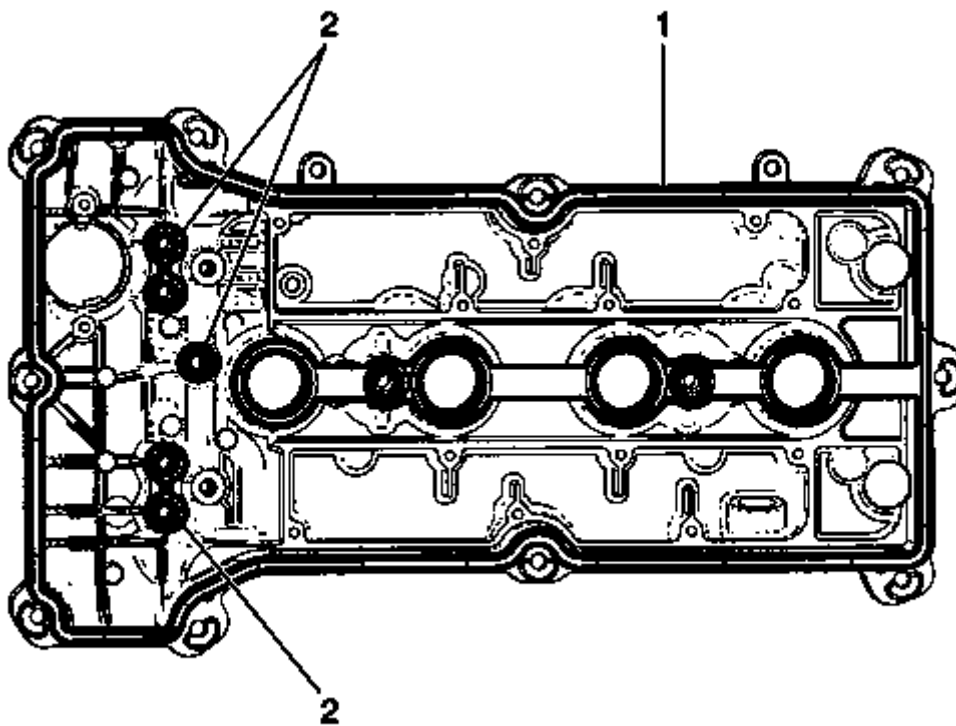


Fig. 216: Camshaft Cover Gasket

Courtesy of GENERAL MOTORS COMPANY

17. Remove the camshaft cover gasket (1).
18. Remove the camshaft cover seals (2).

Installation Procedure

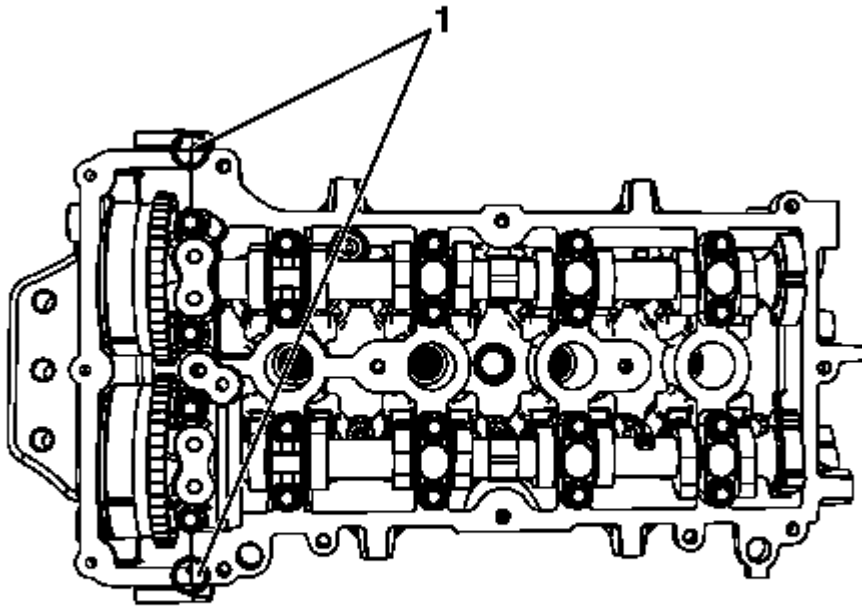


Fig. 217: Cured RTV Carefully

Courtesy of GENERAL MOTORS COMPANY

1. Remove the cured RTV carefully (1) and then clean the sealing surfaces.

NOTE: After RTV applying, the assembly completion time including torque check must be done within 8 minutes.

2. Apply RTV sealant to T-joint between cylinder head and front cover (1).

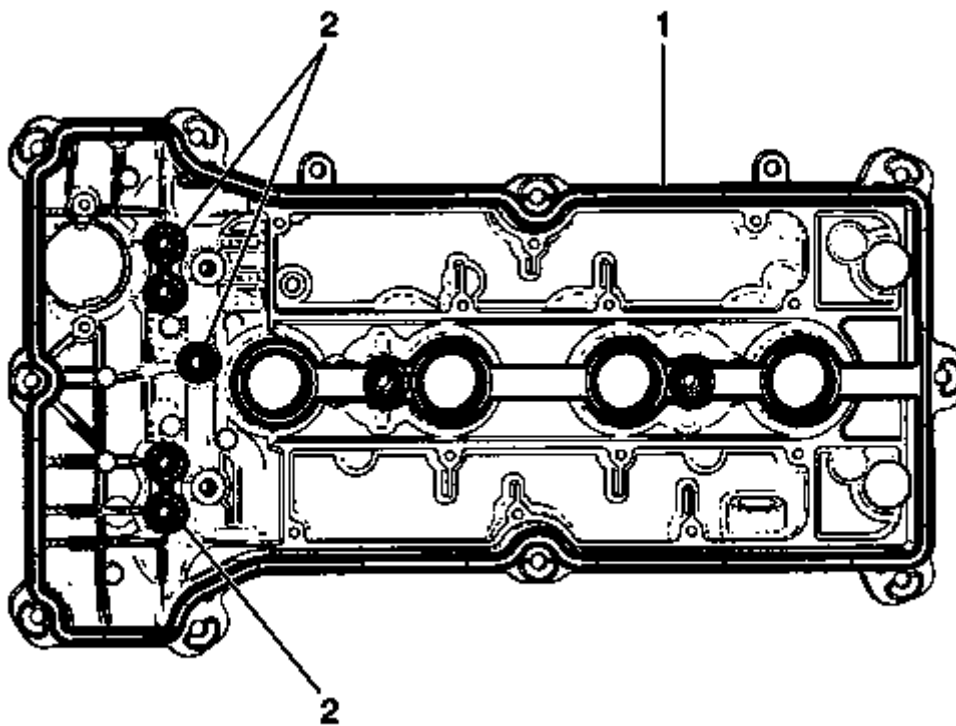


Fig. 218: Camshaft Cover Gasket

Courtesy of GENERAL MOTORS COMPANY

3. Install the camshaft cover seals (2) to the camshaft cover.
4. Install the camshaft cover gasket (1) to the camshaft cover.

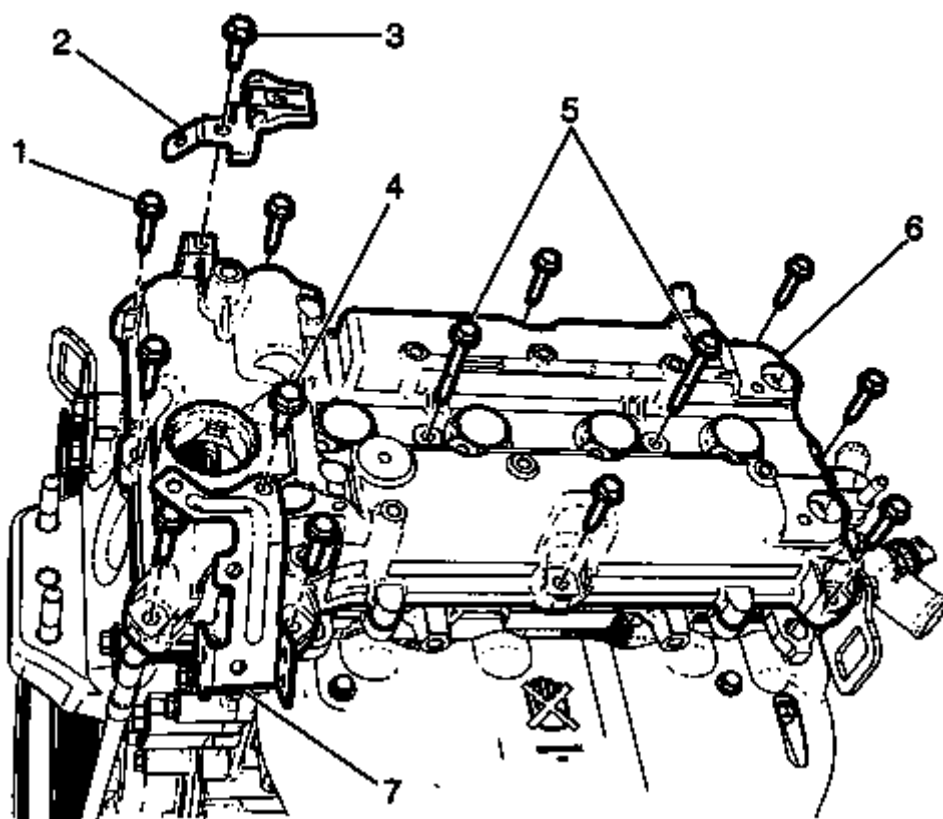


Fig. 219: Engine Injection And Ignition Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

5. Install the camshaft cover (6).

CAUTION: Refer to Fastener Caution .

6. Install the 2 camshaft cover bolts (5) and tighten to 10 (89 lb in).
7. Install the 10 camshaft cover bolts (1) and tighten to 10 (89 lb in).
8. Install the camshaft cover front bracket (7).
9. Install the 1 camshaft cover front bracket bolt (4) and tighten to 10 (89 lb in).
10. Install the engine injection and ignition bracket (2).
11. Install the 1 engine injection and ignition bracket bolt (3) and tighten to 10 (89 lb in).
12. Install the oil filler cap.

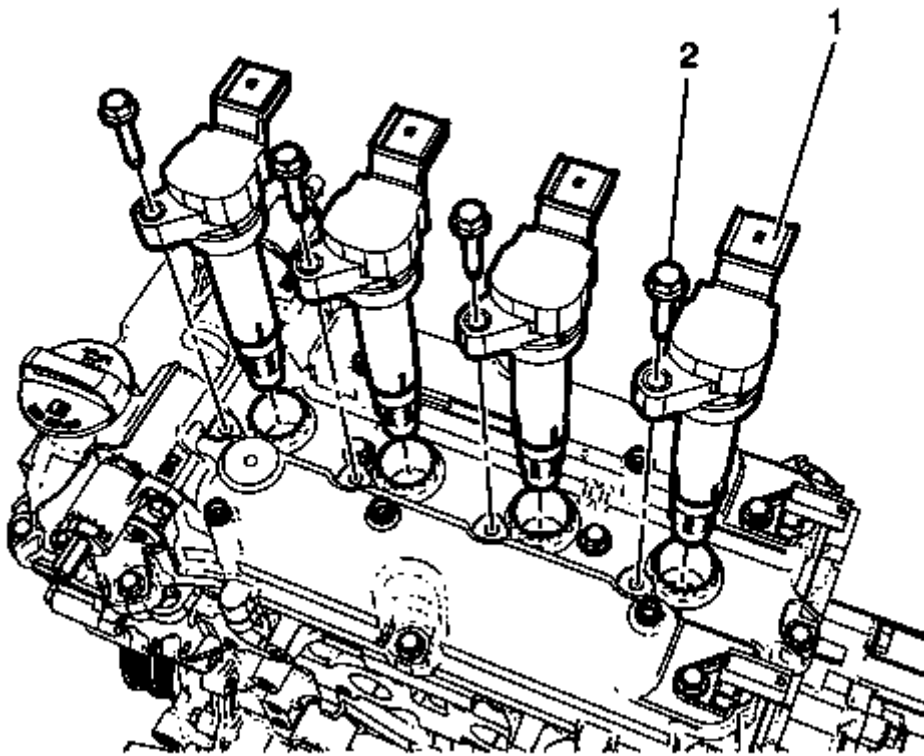


Fig. 220: Ignition Coil

Courtesy of GENERAL MOTORS COMPANY

13. Install the ignition coil (1). Refer to **Ignition Coil Replacement (LL0)** , **Ignition Coil Replacement (LFM)** .
14. Connect the fuel injector connectors. Refer to **Fuel Injection Fuel Rail Assembly Replacement (LFM)** , **Fuel Injection Fuel Rail Assembly Replacement (LL0)** .
15. Install the camshaft position sensor. Refer to **Camshaft Position Sensor Replacement (LFM)** , **Camshaft Position Sensor Replacement (LL0)** .
16. Install the camshaft position actuator solenoid valve. Refer **Camshaft Position Actuator Solenoid Valve Installation**.
17. Install the ignition coil cover. Refer to **Ignition Coil Cover Replacement (LL0)**, **Ignition Coil Cover Replacement (LFM)**.
18. Install the intake manifold. Refer to **Intake Manifold Replacement**.
19. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
20. Close the hood.

CAMSHAFT COVER REPLACEMENT (LFM)

Removal Procedure

1. Open the hood.
2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection .
3. Remove the upper intake manifold. Refer to Upper Intake Manifold Replacement (LFM).
4. Remove the positive crankcase ventilation tube. Refer to Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (LL0), Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (LFM).
5. Remove the ignition coil cover. Refer to Ignition Coil Cover Replacement (LL0), Ignition Coil Cover Replacement (LFM).

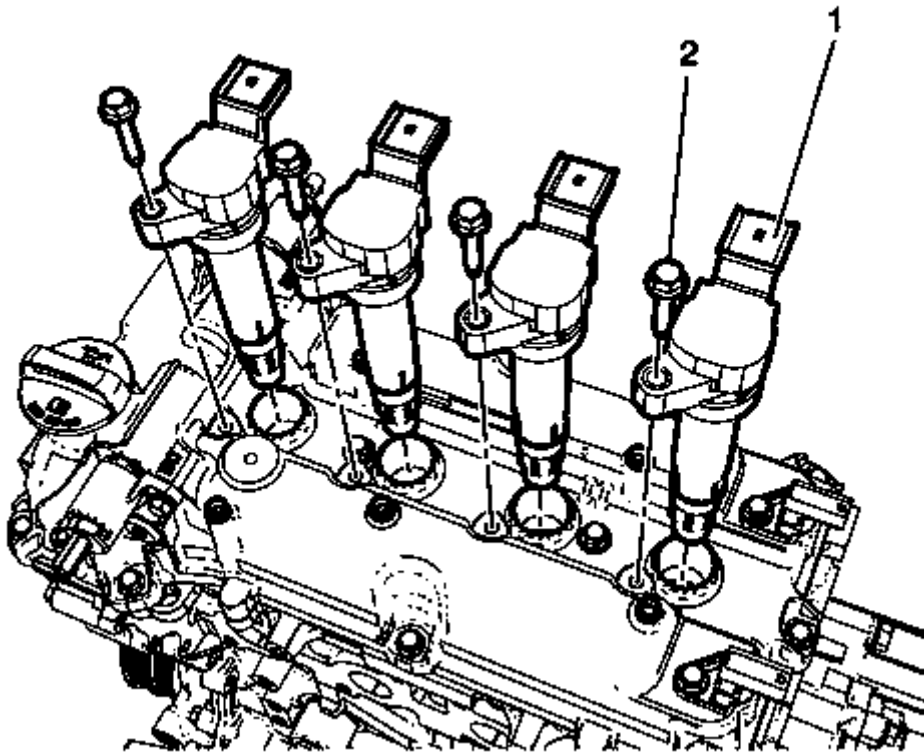


Fig. 221: Ignition Coil
Courtesy of GENERAL MOTORS COMPANY

6. Disconnect the fuel injector connectors. Refer to Fuel Injection Fuel Rail Assembly Replacement (LFM) , Fuel Injection Fuel Rail Assembly Replacement (LL0) .
7. Remove the ignition coil. Refer to Ignition Coil Replacement (LL0) , Ignition Coil Replacement (LFM) .
8. Remove the camshaft position sensor. Refer to Camshaft Position Sensor Replacement (LFM) , Camshaft Position Sensor Replacement (LL0) .
9. Remove the camshaft position actuator solenoid valve. Refer to Camshaft Position Actuator Solenoid Valve Removal.

10. Remove the oil filler cap.

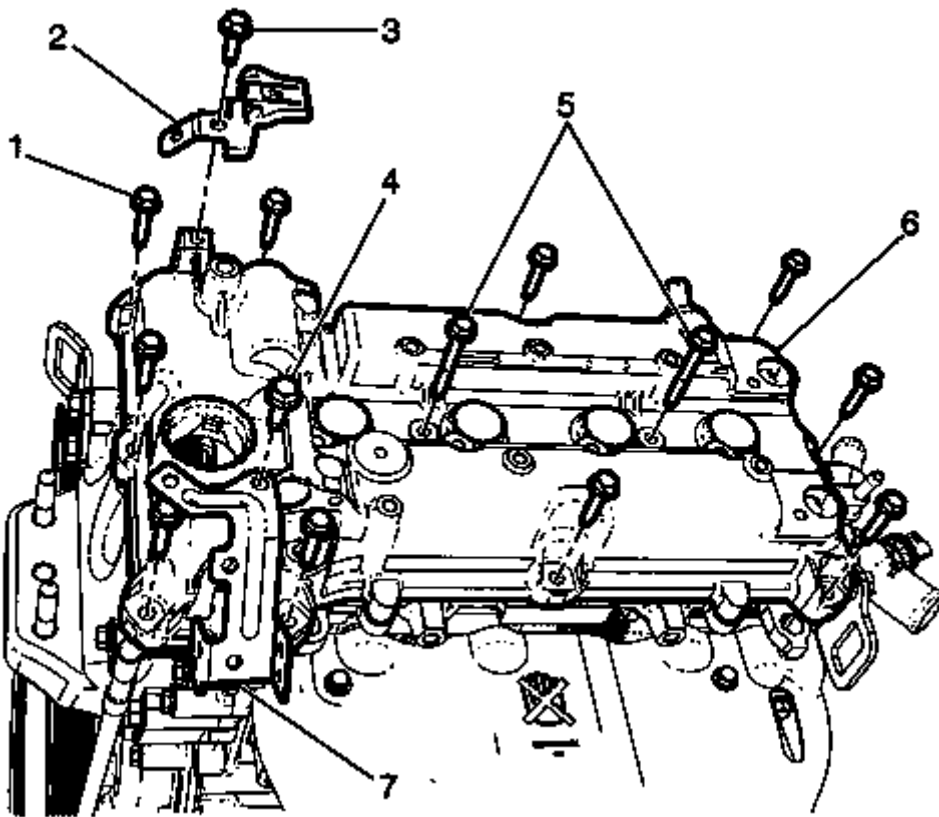


Fig. 222: Engine Injection And Ignition Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

11. Remove the 1 engine injection and ignition bracket bolt (3).
12. Remove the engine injection and ignition bracket (2).
13. Remove the 1 camshaft cover front bracket bolt (4).
14. Remove the camshaft cover front bracket (7).
15. Remove the 2 camshaft cover bolts (5).
16. Remove the 10 camshaft cover bolts (1).
17. Remove the camshaft cover (6).

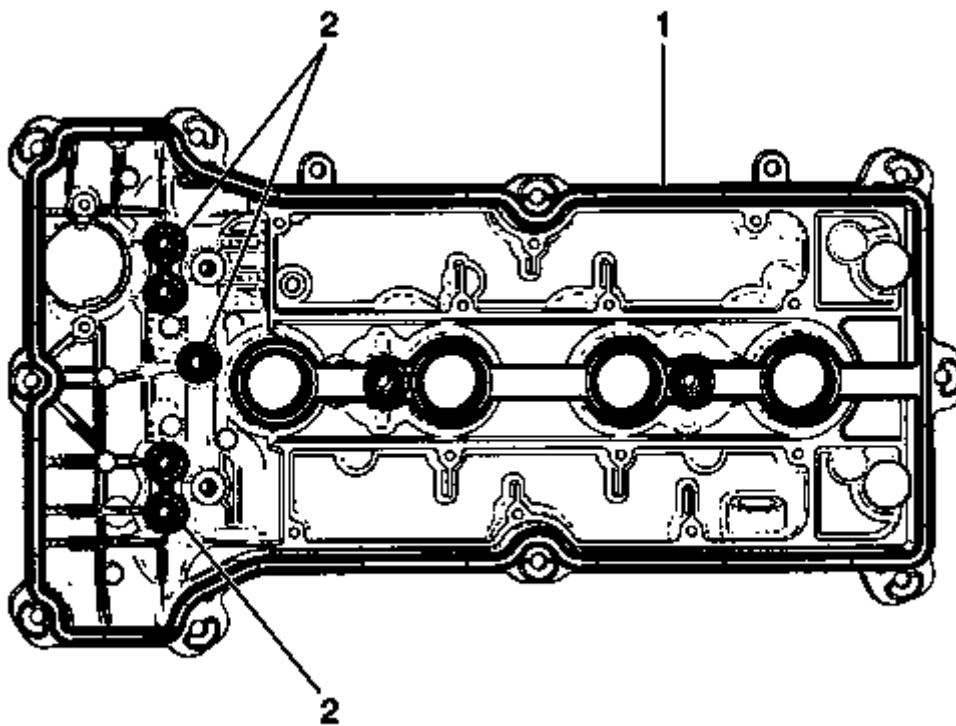


Fig. 223: Camshaft Cover Gasket

Courtesy of GENERAL MOTORS COMPANY

18. Remove the camshaft cover gasket (1).
19. Remove the camshaft cover seals (2).

Installation Procedure

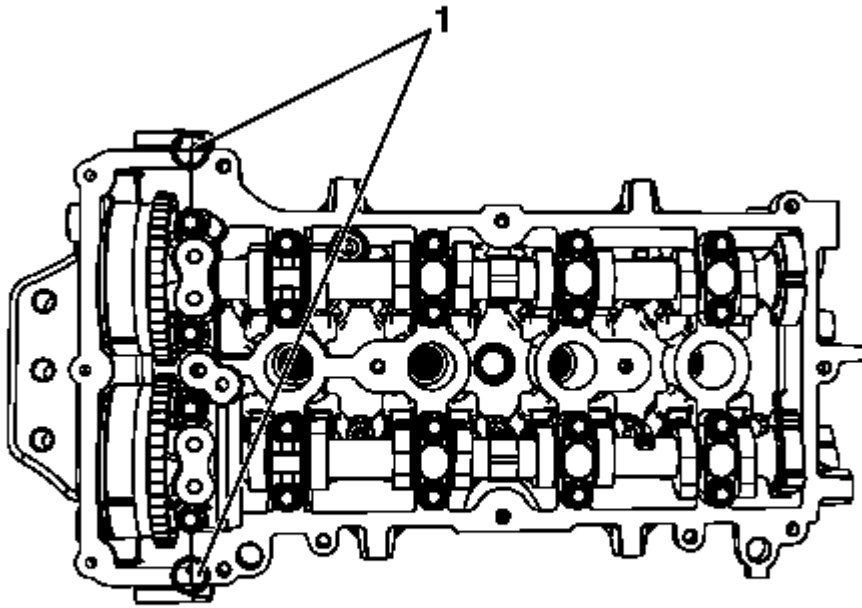


Fig. 224: Cured RTV Carefully

Courtesy of GENERAL MOTORS COMPANY

1. Remove the cured RTV carefully (1) and then clean the sealing surfaces.

NOTE: After RTV applying, the assembly completion time including torque check must be done within 8 minutes.

2. Apply RTV sealant to T-joint between cylinder head and front cover (1).

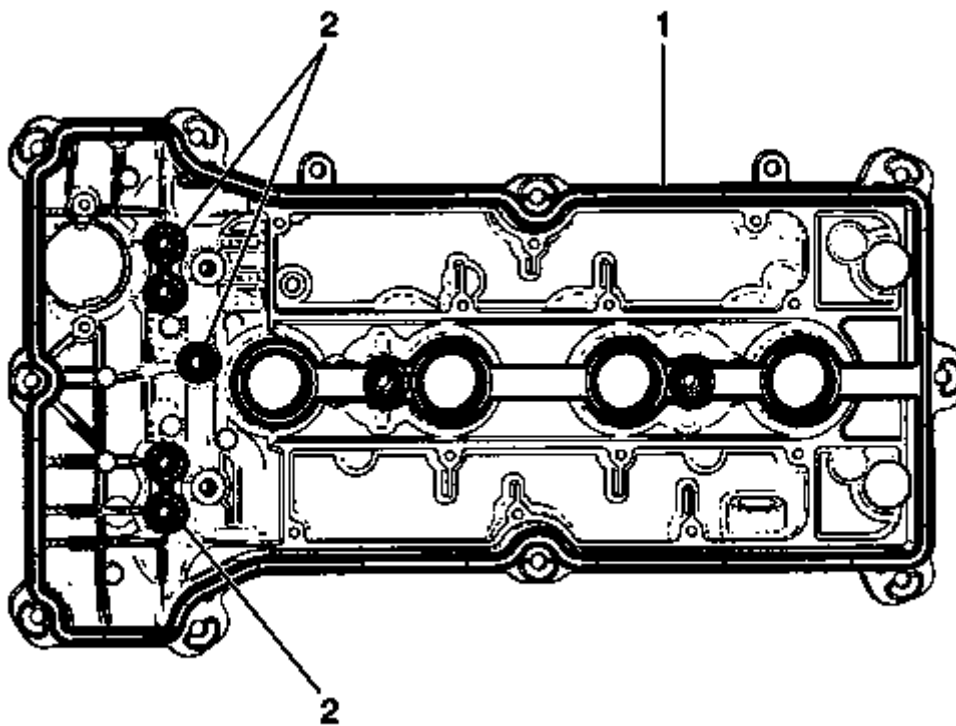


Fig. 225: Camshaft Cover Gasket

Courtesy of GENERAL MOTORS COMPANY

3. Install the camshaft cover seals (2) to the camshaft cover.
4. Install the camshaft cover gasket (1) to the camshaft cover.

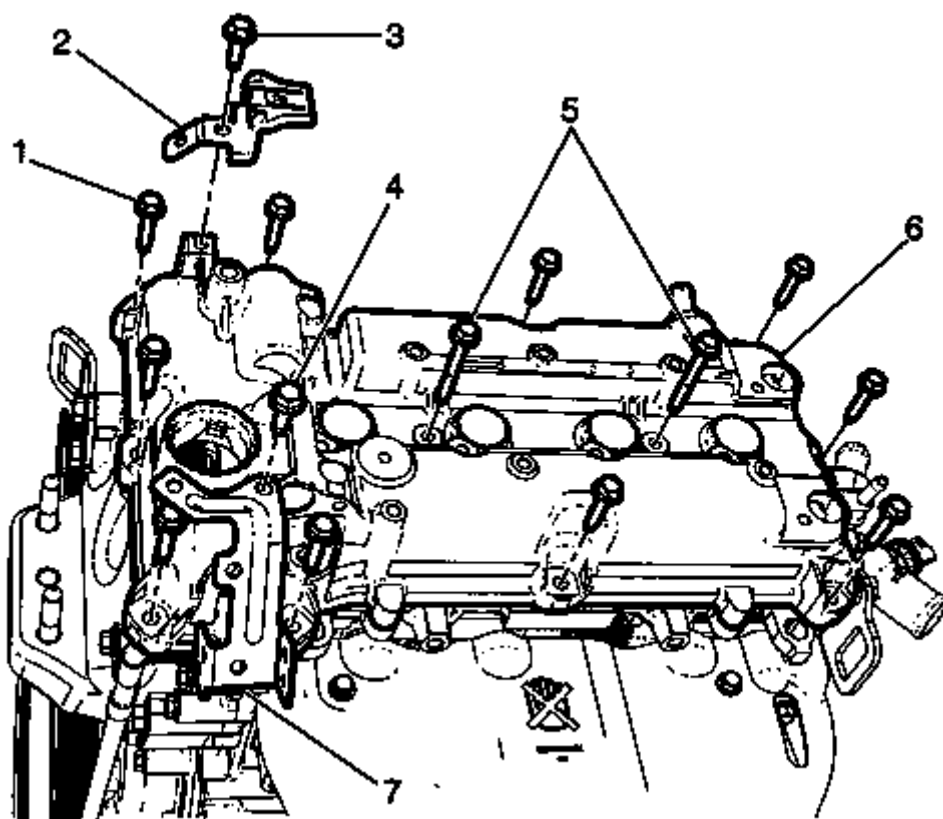


Fig. 226: Engine Injection And Ignition Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

5. Install the camshaft cover (3).

CAUTION: Refer to Fastener Caution .

6. Install the 2 camshaft cover bolts (5) and tighten to 10 (89 lb in).
7. Install the 10 camshaft cover bolts (1) and tighten to 10 (89 lb in).
8. Install the camshaft cover front bracket (7).
9. Install the 1 camshaft cover front bracket bolt (4) and tighten to 10 (89 lb in).
10. Install the engine injection and ignition bracket (2).
11. Install the 1 engine injection and ignition bracket bolt (3) and tighten to 10 (89 lb in).
12. Install the oil filler cap.

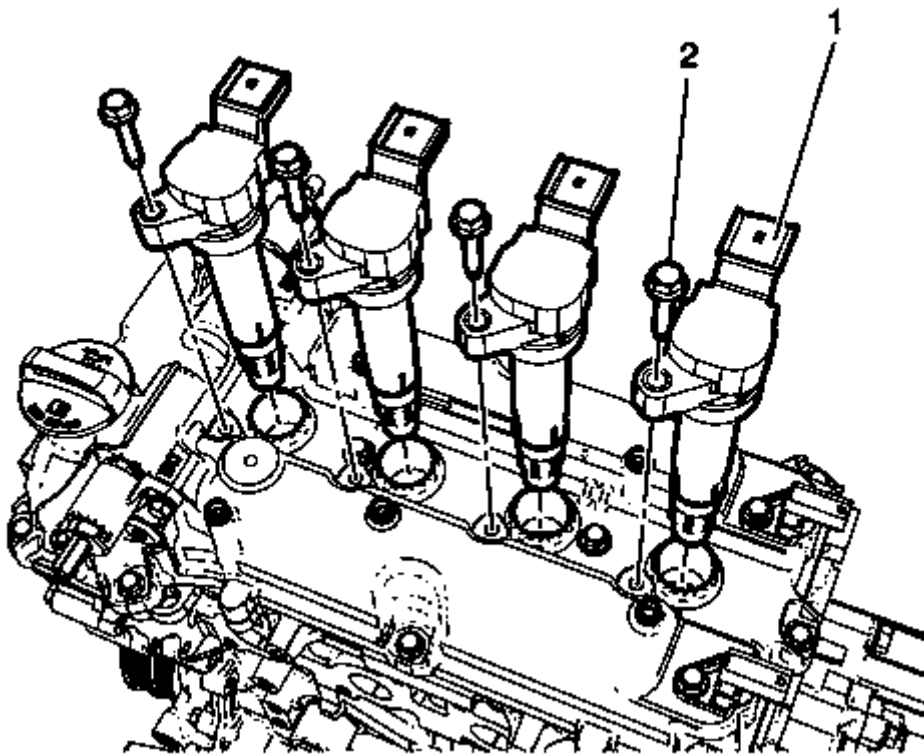


Fig. 227: Ignition Coil

Courtesy of GENERAL MOTORS COMPANY

13. Install the ignition coil (1). Refer to **Ignition Coil Replacement (LL0)** , **Ignition Coil Replacement (LFM)** .
14. Connect the fuel injector connectors. Refer to **Fuel Injection Fuel Rail Assembly Replacement (LFM)** , **Fuel Injection Fuel Rail Assembly Replacement (LL0)** .
15. Install the camshaft position sensor. Refer to **Camshaft Position Sensor Replacement (LFM)** , **Camshaft Position Sensor Replacement (LL0)** .
16. Install the camshaft position actuator solenoid valve. Refer **Camshaft Position Actuator Solenoid Valve Installation**.
17. Install the ignition coil cover. Refer to **Ignition Coil Cover Replacement (LL0)**, **Ignition Coil Cover Replacement (LFM)**.
18. Remove the positive crankcase ventilation tube. Refer to **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (LL0)**, **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (LFM)**.
19. Install the upper intake manifold. Refer to **Upper Intake Manifold Replacement (LFM)**.
20. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
21. Close the hood.

CAMSHAFT EXHAUST SPROCKET REPLACEMENT

Removal Procedure

1. Remove the engine front cover. Refer to Engine Front Cover with Oil Pump Replacement.
2. Remove the timing chain. Refer to Camshaft Timing Chain Replacement and Adjustment.

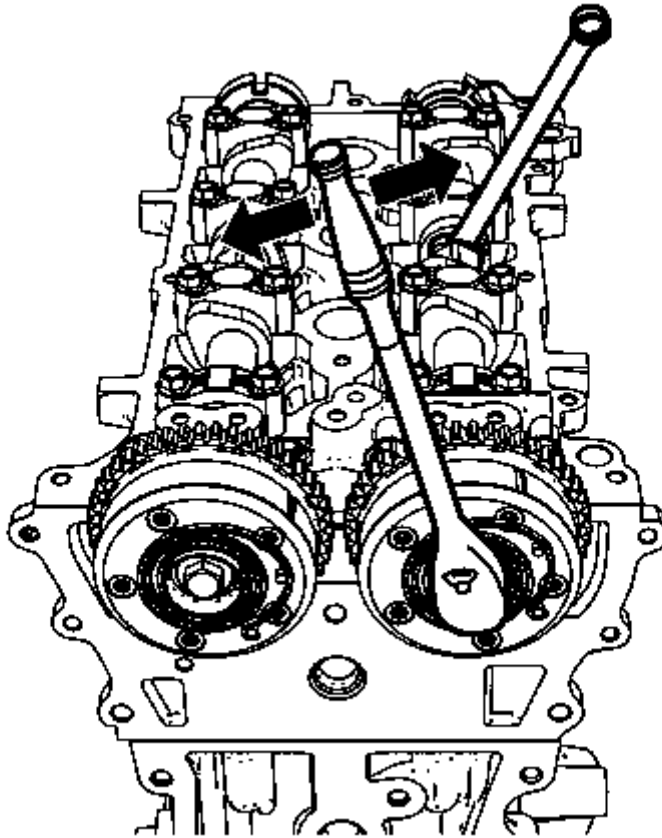


Fig. 228: Intake And Exhaust Camshaft
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Use extreme care when installing the camshaft not to nick, scratch or damage the camshaft lobes or bearing surfaces.

3. While holding the intake camshaft firmly in place, loosen the intake camshaft sprocket bolt.
4. While holding the exhaust camshaft firmly in place, loosen the exhaust camshaft sprocket bolt.

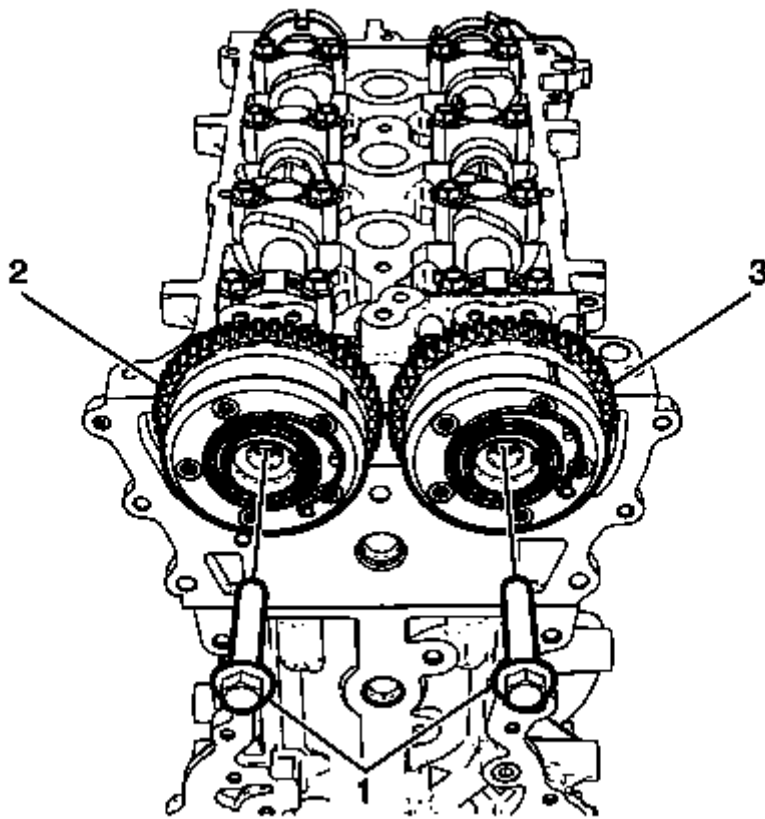


Fig. 229: Intake And Exhaust Camshaft Sprocket Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the intake and exhaust camshaft sprocket bolts (1).
6. Remove the intake camshaft sprocket (2).
7. Remove the exhaust camshaft sprocket (3).

Installation Procedure

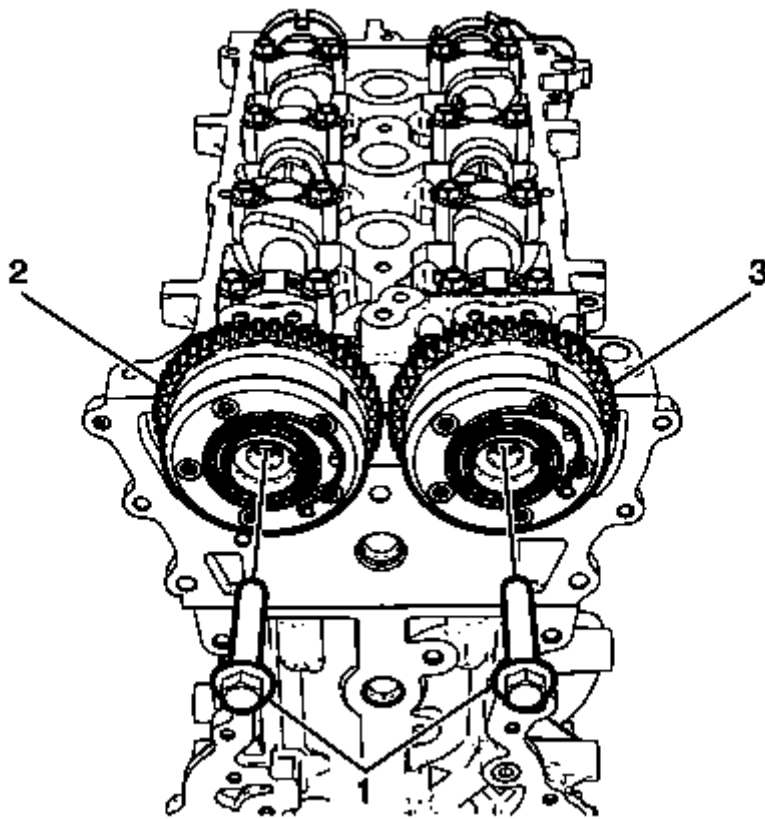


Fig. 230: Intake And Exhaust Camshaft Sprocket Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the exhaust camshaft sprocket (3).
2. Install the intake camshaft sprocket (2).

CAUTION: Refer to Fastener Caution .

3. Install the intake and exhaust camshaft sprocket bolts (1).

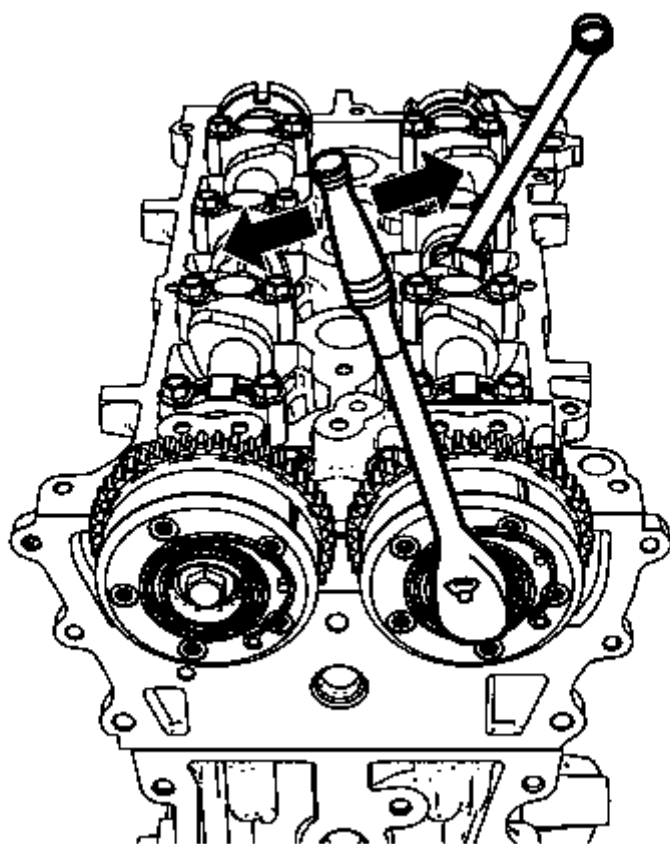


Fig. 231: Intake And Exhaust Camshaft
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Use extreme care when installing the camshaft not to nick, scratch or damage the camshaft lobes or bearing surfaces.

4. While holding the intake camshaft firmly in place, install the intake camshaft sprocket bolt and tighten to $32 + 50^\circ$ (24 lb ft + 50°).
5. While holding the exhaust camshaft firmly in place, tighten the exhaust camshaft sprocket bolt to $32 + 50^\circ$ (24 lb ft + 50°).
6. Install the timing chain. Refer to **Camshaft Timing Chain Replacement and Adjustment.**
7. Install the engine front cover. Refer to **Engine Front Cover with Oil Pump Replacement.**

ENGINE OIL PRESSURE INDICATOR SWITCH REPLACEMENT

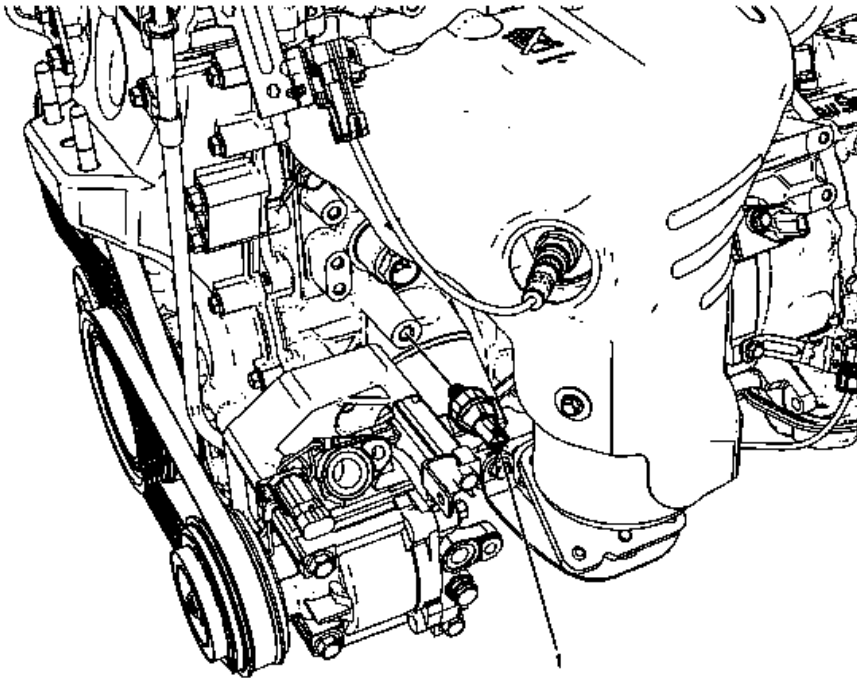


Fig. 232: Engine Oil Pressure Indicator Switch
 Courtesy of GENERAL MOTORS COMPANY

Engine Oil Pressure Indicator Switch Replacement

Callout	Component Name
Preliminary Procedure Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> .	
1	Oil Pressure Indicator Switch CAUTION: Refer to <u>Fastener Caution</u> . Procedure Disconnect the oil pressure indicator switch electrical wiring harness connector and remove the oil pressure indicator switch. Tighten 35 (26 lb ft)

CAMSHAFT REPLACEMENT (LL0)

Removal Procedure

1. Remove the camshaft sprocket. Refer to **Camshaft Exhaust Sprocket Replacement**.

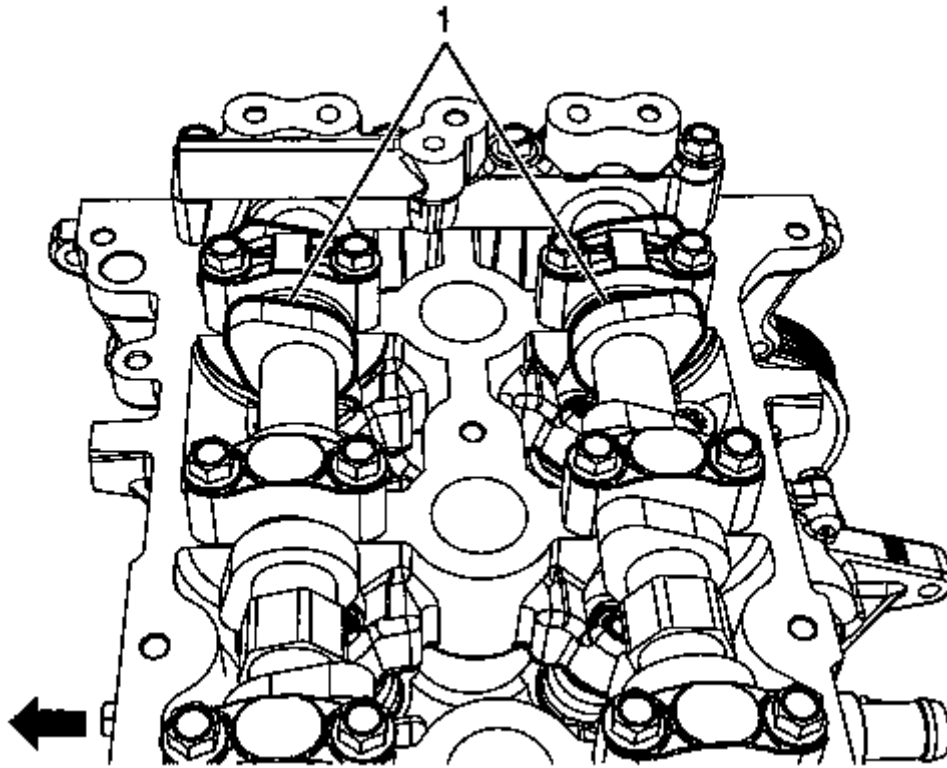


Fig. 233: Camshaft Lobes

Courtesy of GENERAL MOTORS COMPANY

2. Position the camshaft lobes (1) in a neutral position.

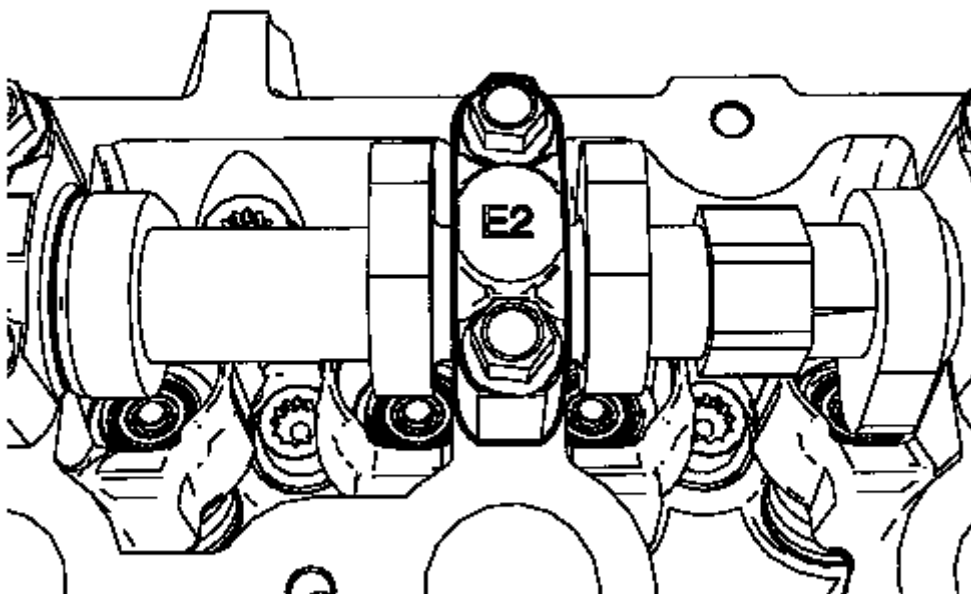


Fig. 234: View Of Markings On Bearing Caps
Courtesy of GENERAL MOTORS COMPANY

3. Observe the markings on the bearing caps. Each bearing cap is marked in order to identify its location. The markings have the following meanings:
 - The raised feature must always be oriented toward the center of the cylinder head.
 - The I indicates the intake camshaft.
 - The E indicates the exhaust camshaft.
 - The number indicates the journal position from the front of the cylinder block.

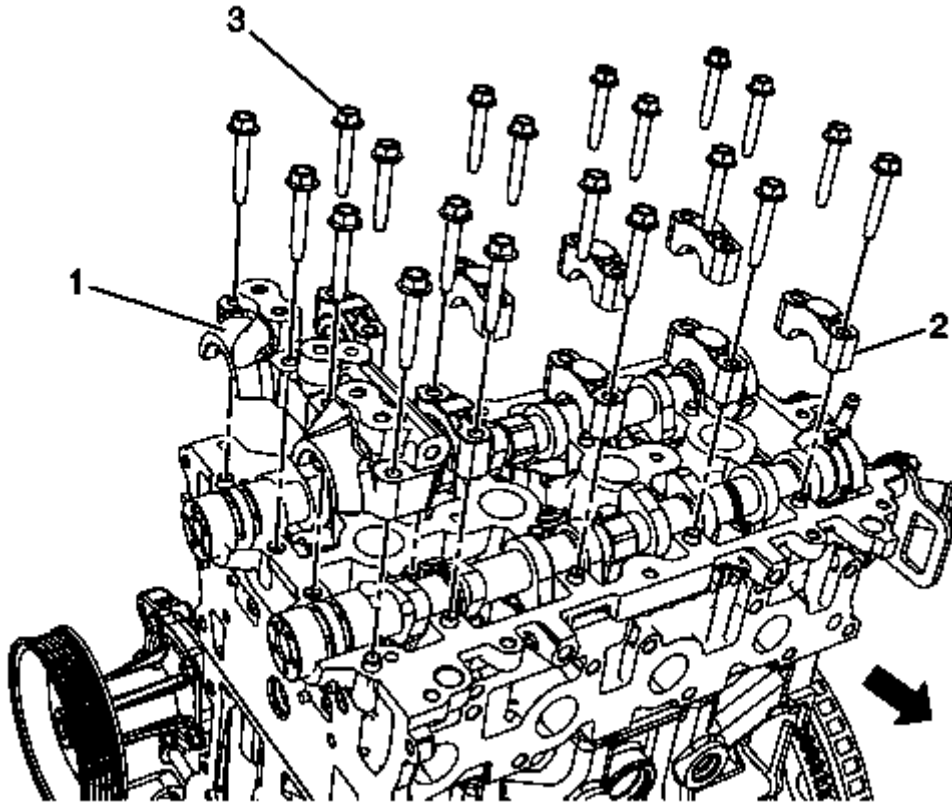


Fig. 235: Camshaft Bearing Cap Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Loosen the 20 camshaft bearing cap bolts (3) working from outside to inside in a spiral in steps of 1/2 up to 1 turn.
5. Remove the 20 camshaft bearing cap bolts (3).

NOTE: Mark camshaft bearing caps before removal.

6. Remove the camshaft bearing caps (1, 2) from the cylinder head.

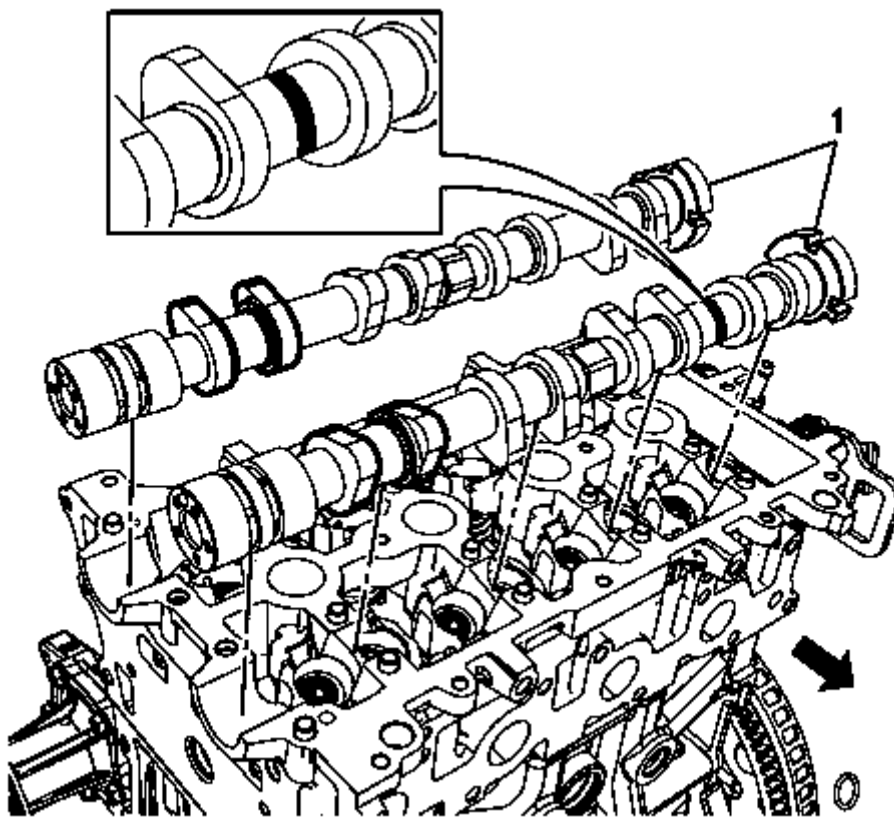


Fig. 236: Camshafts

Courtesy of GENERAL MOTORS COMPANY

NOTE: The exhaust camshaft has a groove between the No. 3 journal and No. 4 journal. The intake camshaft has no groove.

7. Remove the camshafts (1).

Installation Procedure

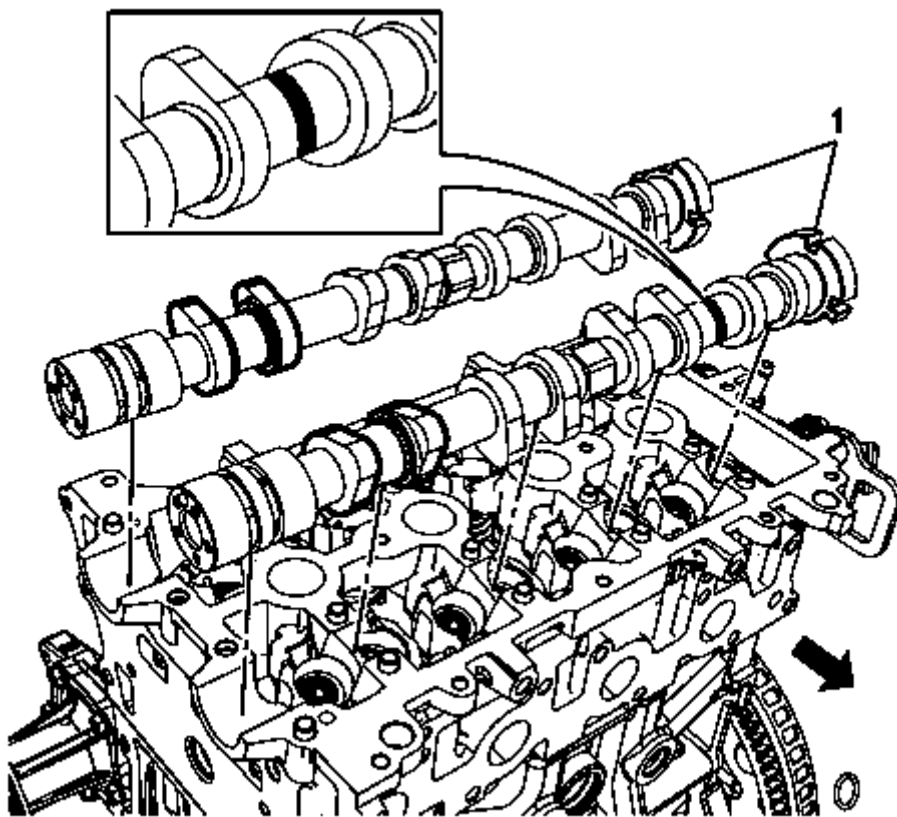


Fig. 237: Camshafts

Courtesy of GENERAL MOTORS COMPANY

NOTE: The exhaust camshaft has a groove between the No. 3 journal and No. 4 journal. The intake camshaft has no groove.

1. Install the camshafts (1).

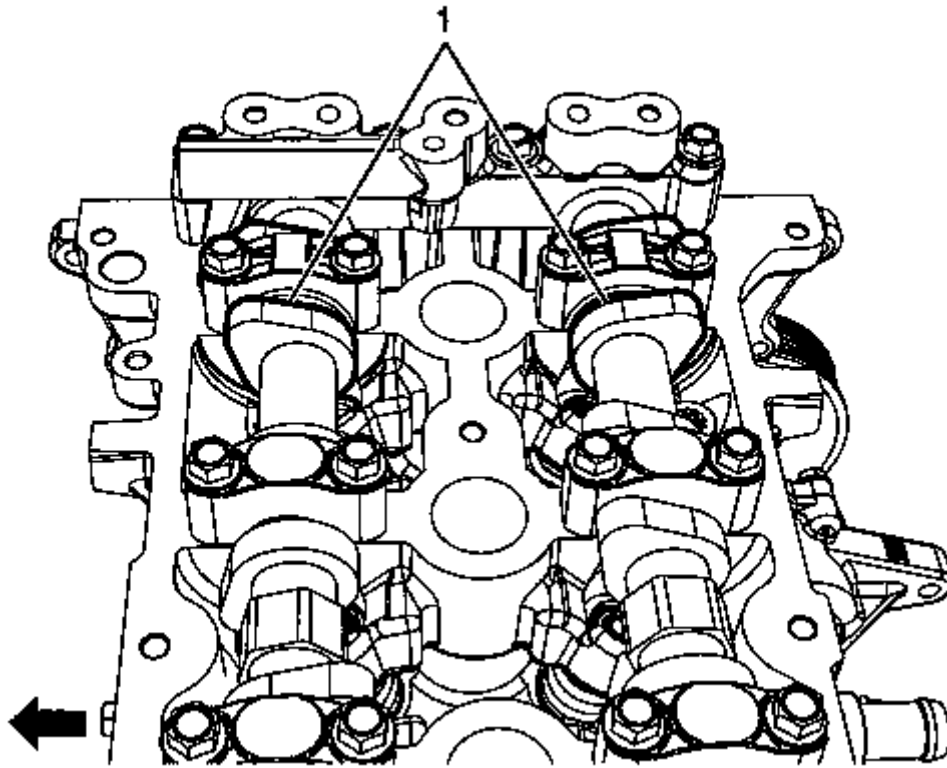


Fig. 238: Camshaft Lobes

Courtesy of GENERAL MOTORS COMPANY

2. Check the camshaft lobes (1) are in a neutral position.

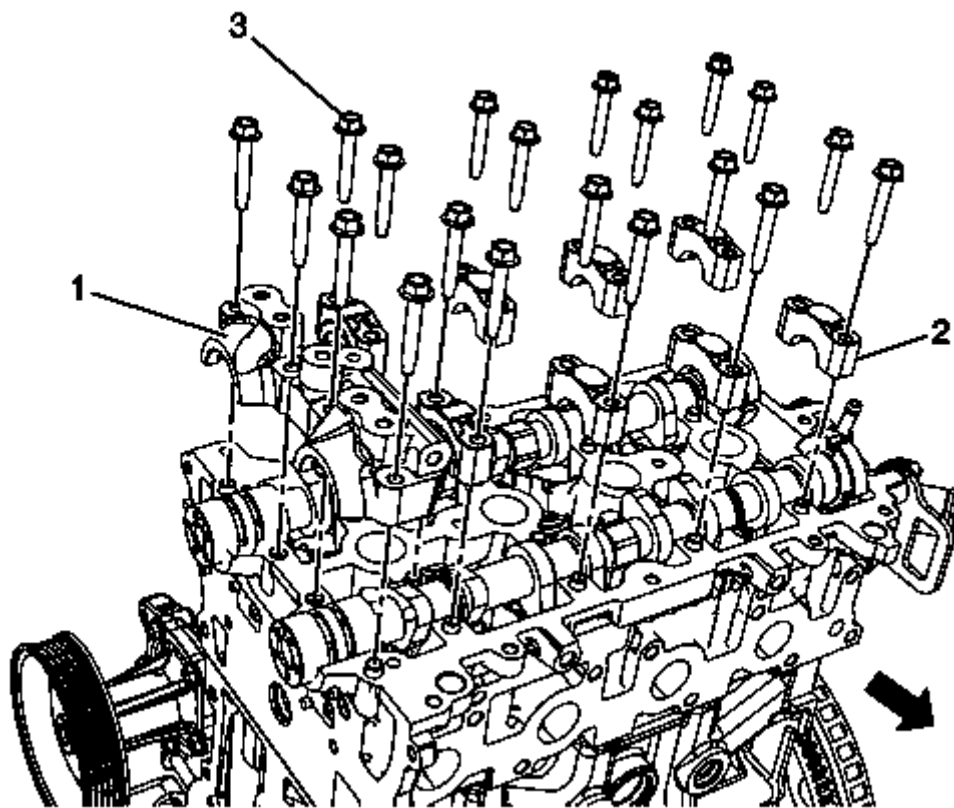


Fig. 239: Camshaft Bearing Cap Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Install the camshaft bearing thrust cap (1) in the first journal of the right cylinder head.
4. Install the remaining bearing caps (2) with their orientation mark toward the center of the cylinder head.
5. Hand start to tighten the all cylinder head retaining bolts (3).
6. Tighten the 20 camshaft bearing cap bolts (3) working from inside to outside in a spiral.
7. Tighten the 20 camshaft bearing cap bolts to 10 (89 lb in).

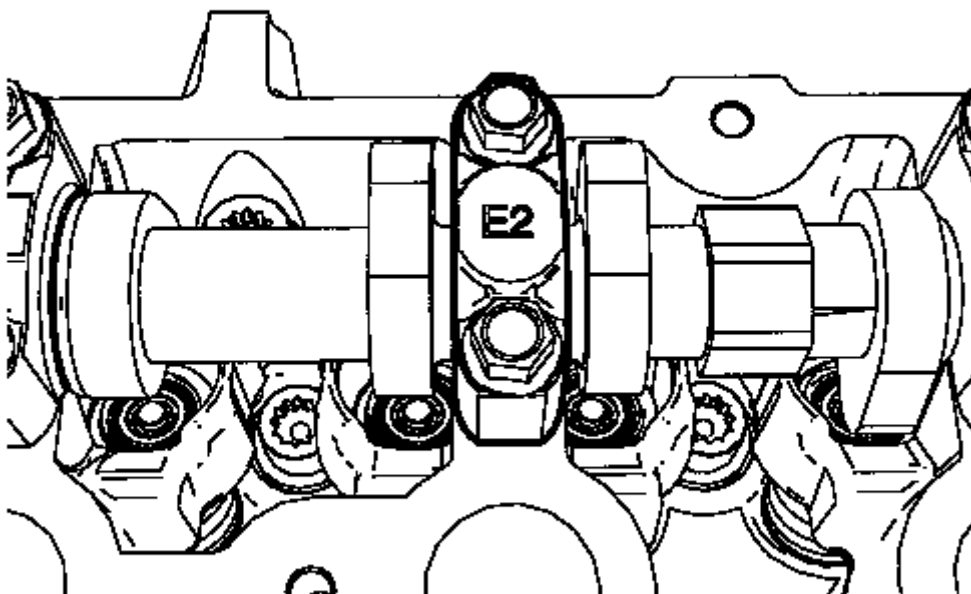


Fig. 240: View Of Markings On Bearing Caps
Courtesy of GENERAL MOTORS COMPANY

8. Observe the markings on the bearing caps. Each bearing cap is marked in order to identify its location. The markings have the following meanings:
 - The raised feature must always be oriented toward the center of the cylinder head.
 - The I indicates the intake camshaft.
 - The E indicates the exhaust camshaft.
 - The number indicates the journal position from the front of the cylinder block.
9. Install the camshaft sprocket. Refer to **Camshaft Exhaust Sprocket Replacement**.

CAMSHAFT REPLACEMENT (LFM)

Removal Procedure

1. Remove the camshaft sprocket. Refer to **Camshaft Exhaust Sprocket Replacement**.

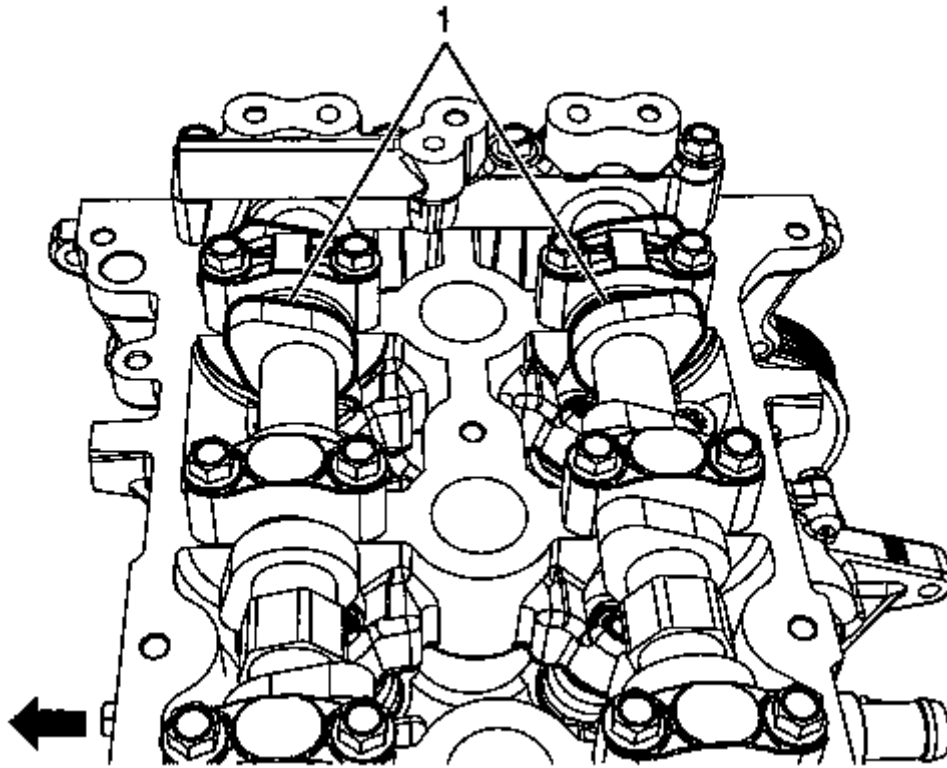


Fig. 241: Camshaft Lobes

Courtesy of GENERAL MOTORS COMPANY

2. Position the camshaft lobes (1) in a neutral position.

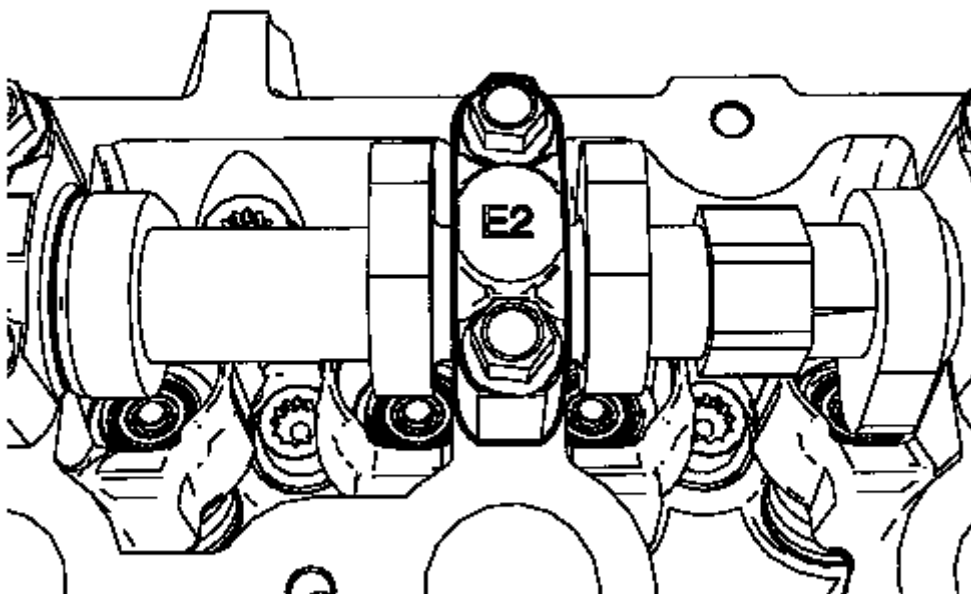


Fig. 242: View Of Markings On Bearing Caps
Courtesy of GENERAL MOTORS COMPANY

3. Observe the markings on the bearing caps. Each bearing cap is marked in order to identify its location. The markings have the following meanings:
 - The raised feature must always be oriented toward the center of the cylinder head.
 - The I indicates the intake camshaft.
 - The E indicates the exhaust camshaft.
 - The number indicates the journal position from the front of the cylinder block.

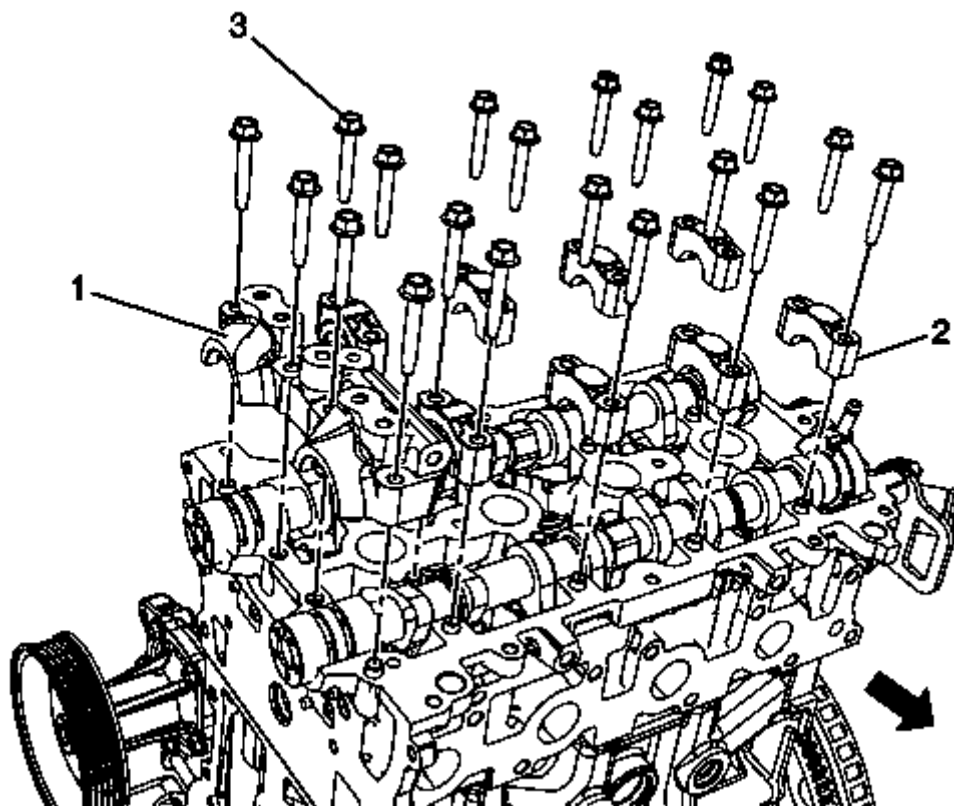


Fig. 243: Camshaft Bearing Cap Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Loosen the 20 camshaft bearing cap bolts (3) working from outside to inside in a spiral in steps of 1/2 up to 1 turn.
5. Remove the 20 camshaft bearing cap bolts (3).

NOTE: Mark camshaft bearing caps before removal.

6. Remove the camshaft bearing caps (1, 2) from the cylinder head.

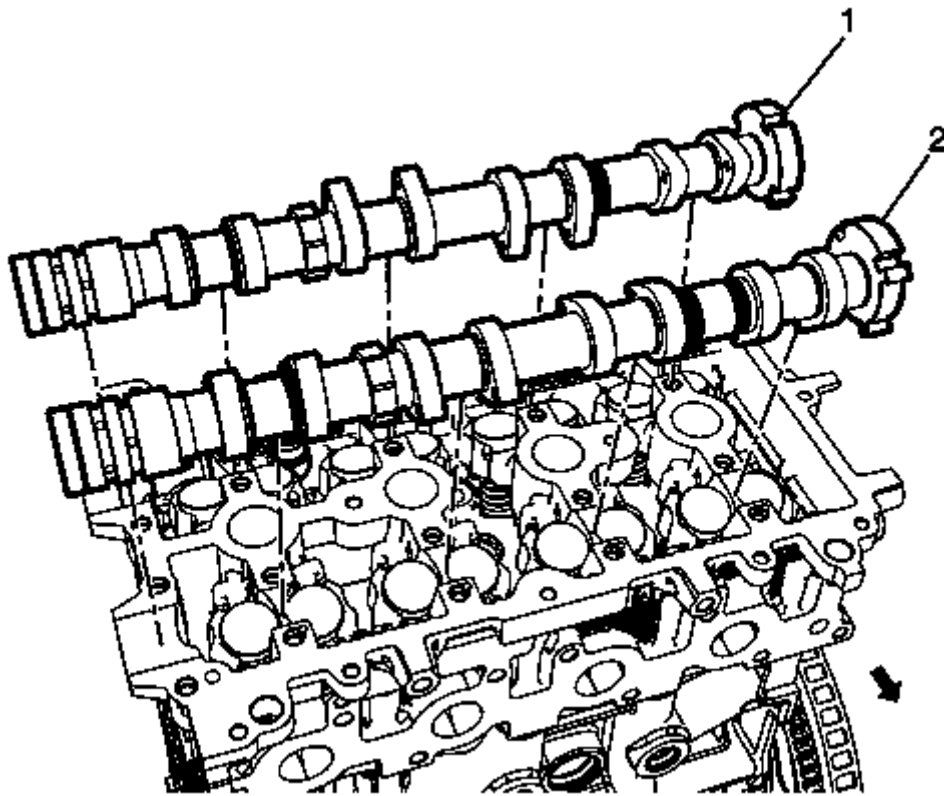


Fig. 244: Intake Camshaft

Courtesy of GENERAL MOTORS COMPANY

NOTE: The exhaust camshaft has 2 grooves between the No. 3 journal and No. 4 journal. The intake camshaft has 1 groove.

7. Remove the intake camshaft (1) and exhaust camshaft (2).

Installation Procedure

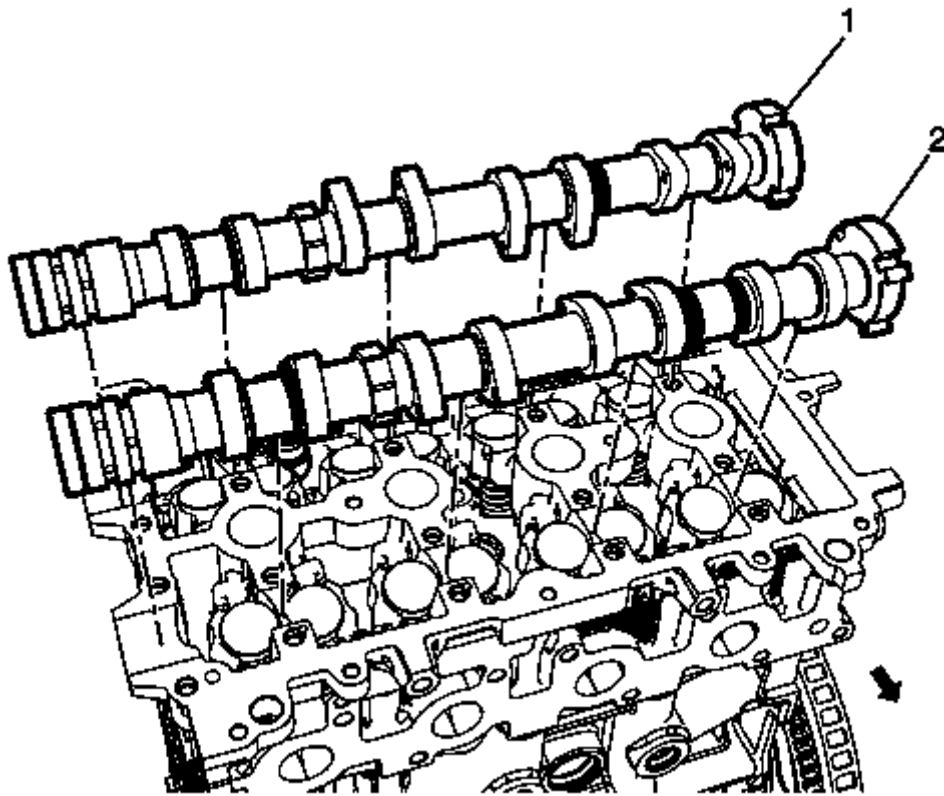


Fig. 245: Intake Camshaft

Courtesy of GENERAL MOTORS COMPANY

NOTE: The exhaust camshaft has 2 grooves between the No. 3 journal and No. 4 journal. The intake camshaft has 1 groove.

1. Install the intake camshaft (1) and exhaust camshaft (2).

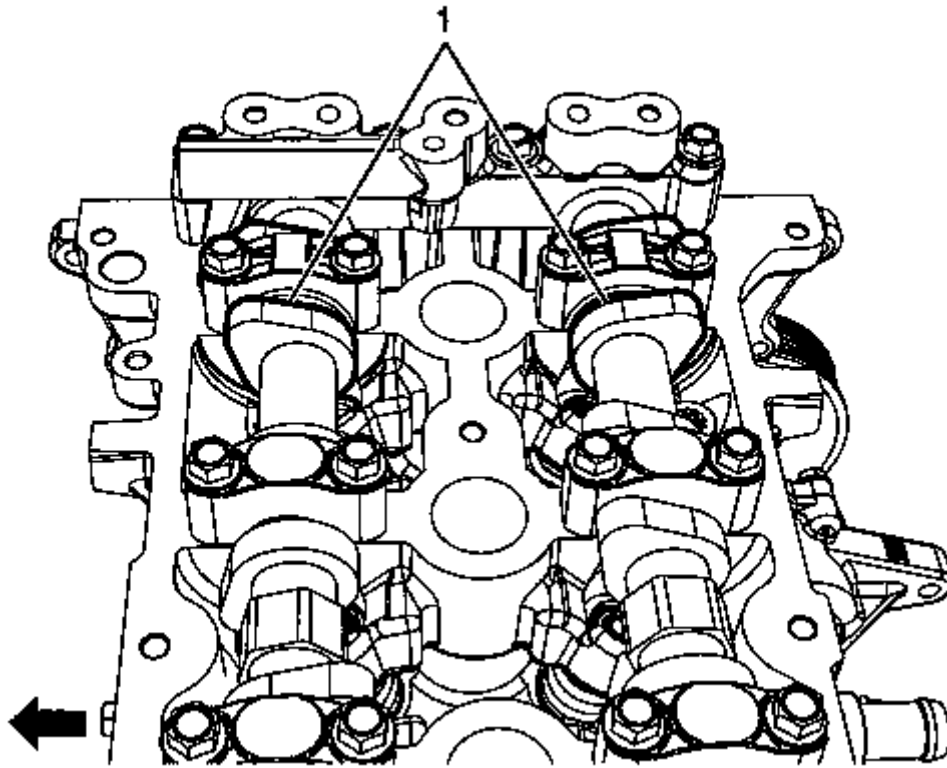


Fig. 246: Camshaft Lobes

Courtesy of GENERAL MOTORS COMPANY

2. Check the camshaft lobes (1) are in a neutral position.

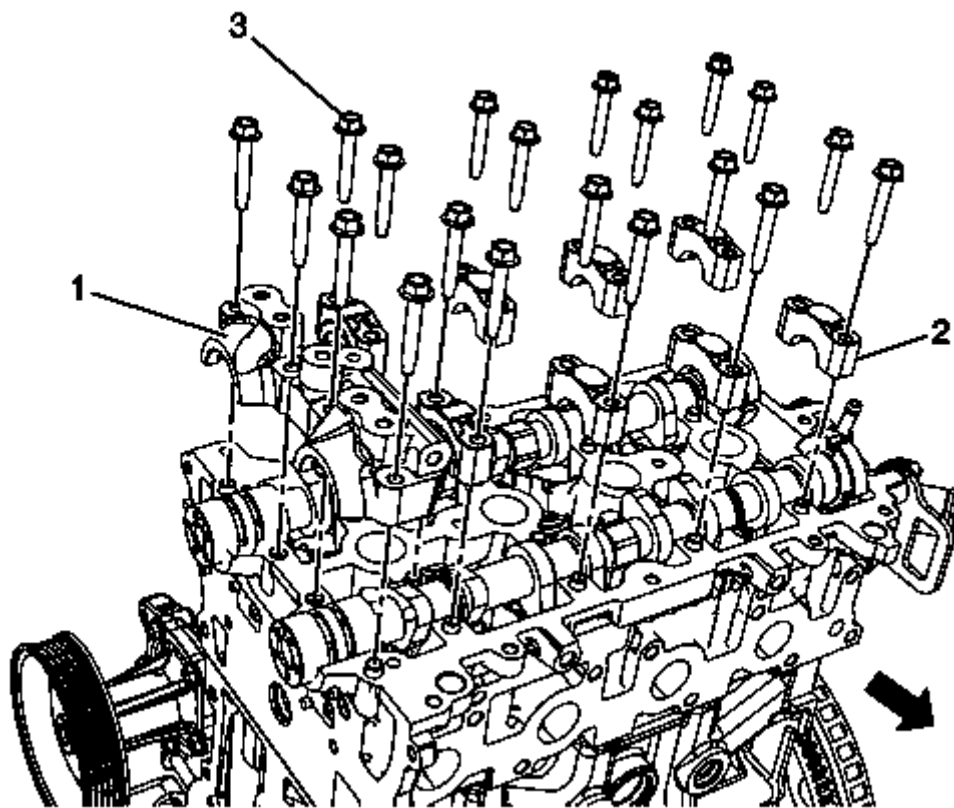


Fig. 247: Camshaft Bearing Cap Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Install the camshaft bearing thrust cap (1) in the first journal of the right cylinder head.
4. Install the remaining bearing caps (2) with their orientation mark toward the center of the cylinder head.
5. Hand start to tighten all cylinder head retaining bolts (3).
6. Tighten the 20 camshaft bearing cap bolts (3) working from inside to outside in a spiral.
7. Tighten the 20 camshaft bearing cap bolts to 10 (89 lb in).

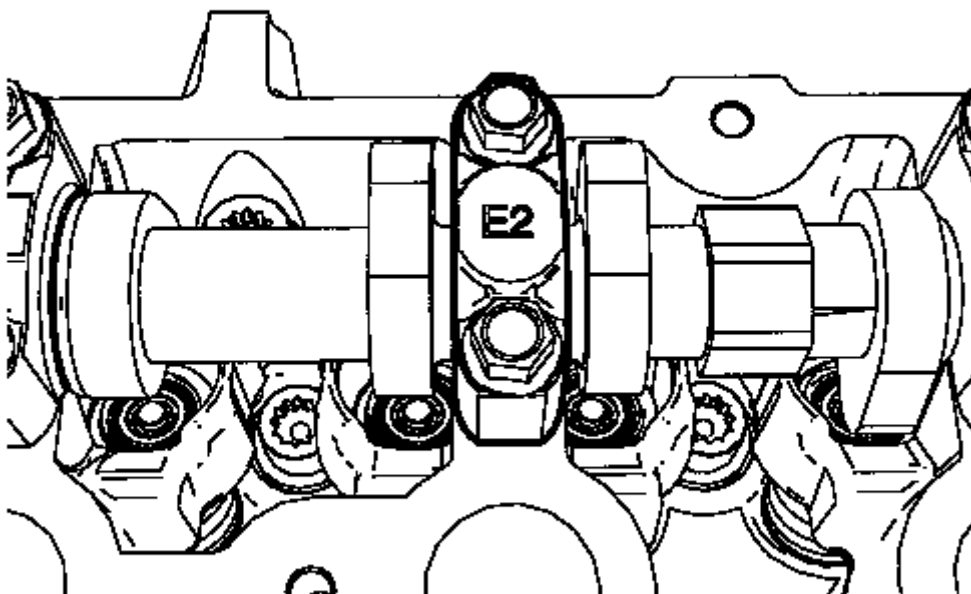


Fig. 248: View Of Markings On Bearing Caps
Courtesy of GENERAL MOTORS COMPANY

8. Observe the markings on the bearing caps. Each bearing cap is marked in order to identify its location. The markings have the following meanings:
 - The raised feature must always be oriented toward the center of the cylinder head.
 - The I indicates the intake camshaft.
 - The E indicates the exhaust camshaft.
 - The number indicates the journal position from the front of the cylinder block.
9. Install the camshaft sprocket. Refer to **Camshaft Exhaust Sprocket Replacement**.

ENGINE SUPPORT FIXTURE

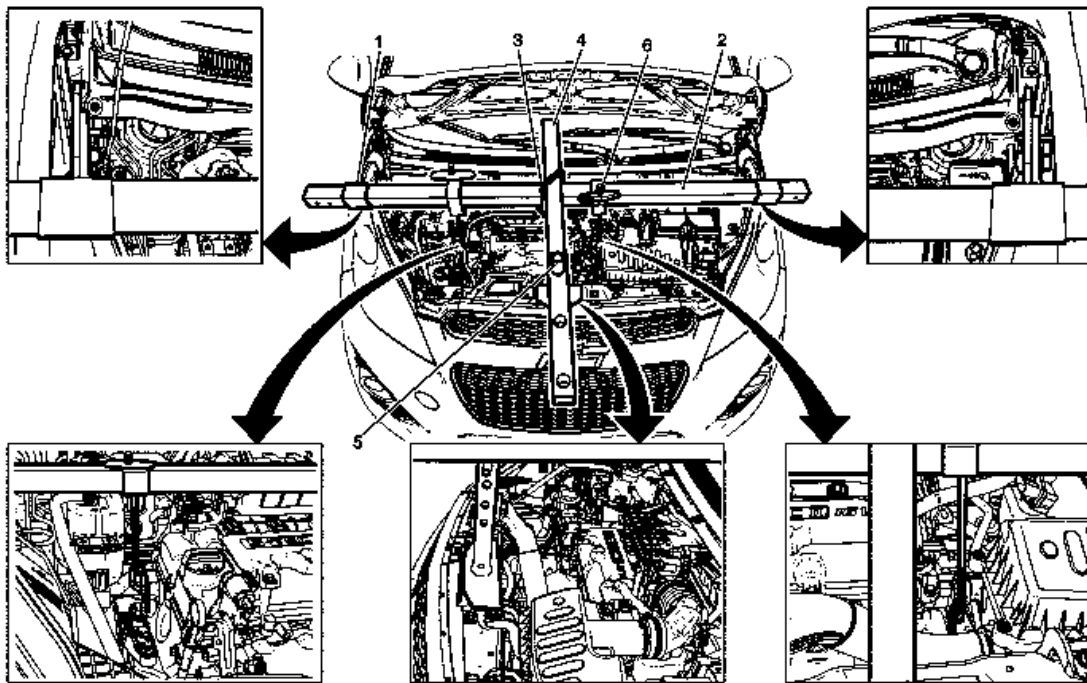


Fig. 249: Engine Support Fixture
 Courtesy of GENERAL MOTORS COMPANY

Engine Support Fixture

Callout	Component Name
Preliminary Procedure 1. Open the hood. 2. Disconnect the 2 hood muckets from the fender frame. • EN-28467-300 Engine Support Fixture Adapter • J-28467-518 Main Support Beam • J-28467-1A Cross Bracket • J-28467-5A Strut Tower Support Assembly • J-28467-2A Radiator Tube Shelf Assembly • J-28467-8A Hook Assembly • J-36857 Engine Lift Bracket	
For equivalent regional tools, refer to Special Tools .	
1	Engine Support Fixture Adapter Leg (Qty: 2) Procedure Install the bracket to fender frame. Do not install on top of fender lip.
2	Main Support Beam
3	Cross Bracket
	Strut Tower Support Assembly

4	Procedure Adjust the length of the strut tower support assembly.
5	Radiator Tube Shelf Assembly
6	Hook Assembly (Qty: 2) Procedure Use a grade 10.9 bolt to install the engine lift bracket. NOTE: If the engine is not equipped with engine lift bracket, install J-36857 in place.

VALVE STEM OIL SEAL AND VALVE SPRING REPLACEMENT

Special Tools

- **EN 46116** Valve Stem Seal Remover/Installer
- **EN-49075** Valve Spring Compressor Adapter
- **EN-49076** Cylinder Pressure Adapter
- **EN-50173** Universal Valve Spring Compressor
- **KM-845** Tappet Suction Device

For equivalent regional tools, refer to **Special Tools**.

Removal Procedure

1. Remove the camshaft. Refer to **Camshaft Replacement (LL0)**, **Camshaft Replacement (LFM)**.

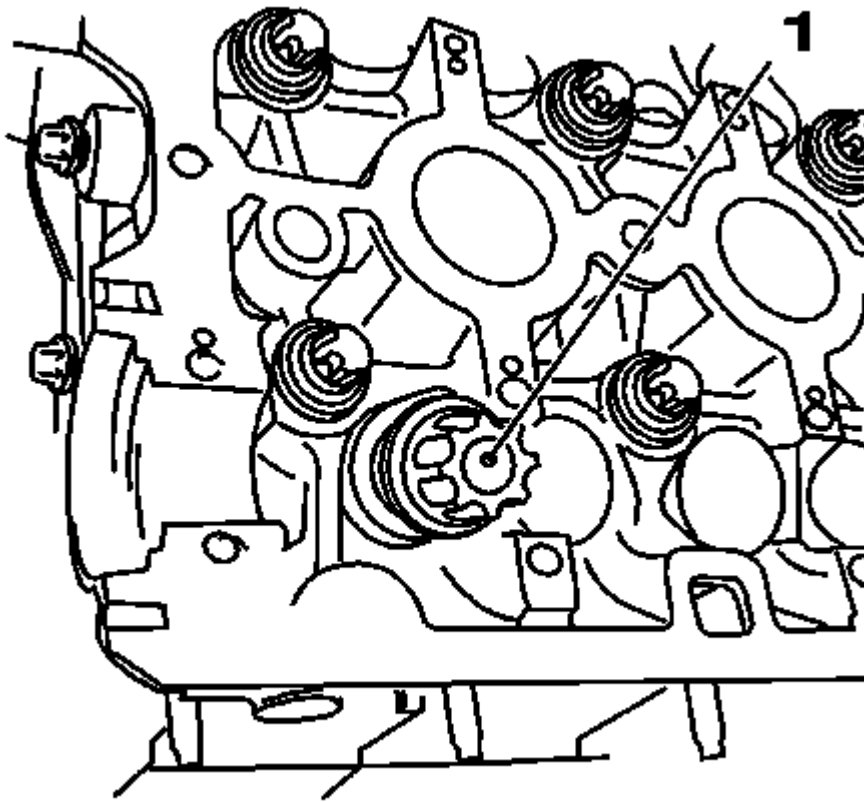


Fig. 250: View Of Camshaft Bearing Cap
Courtesy of GENERAL MOTORS COMPANY

2. Remove the valve tappet (1) using **KM-845** tappet suction device.

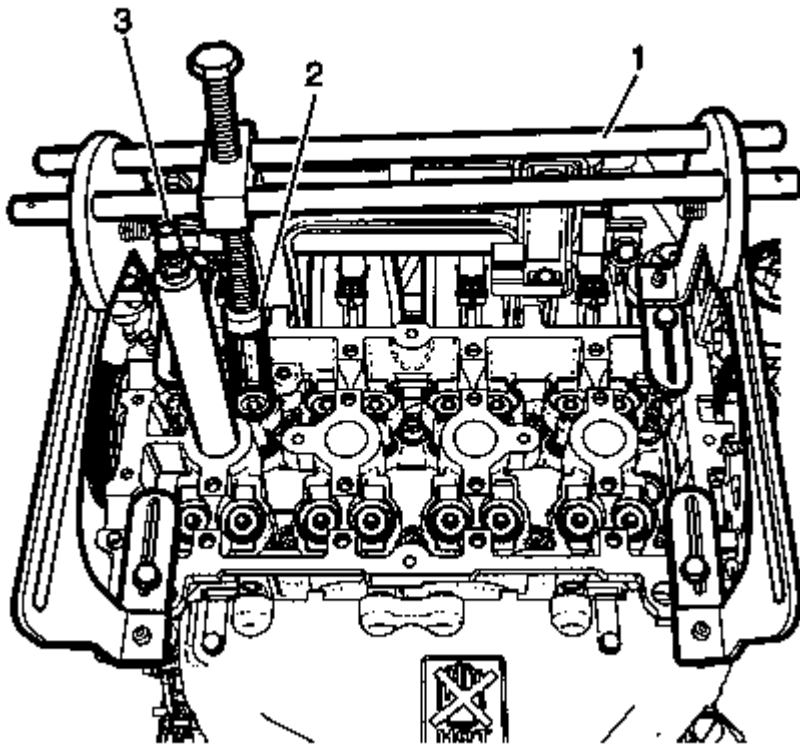


Fig. 251: Universal Valve Spring Compressor
Courtesy of GENERAL MOTORS COMPANY

3. Install the **EN-50173** universal valve spring compressor (1) and **EN-49075** valve spring compressor adapter (2).
4. Remove the spark plug and install the **EN-49076** cylinder pressure adapter.
5. Connect the compressed air hose to **EN-49076** cylinder pressure adapter. It keeps the valve not slip into the cylinder by blowing compressed air into the cylinder.
6. Use the magnet in order to remove the valve collet.

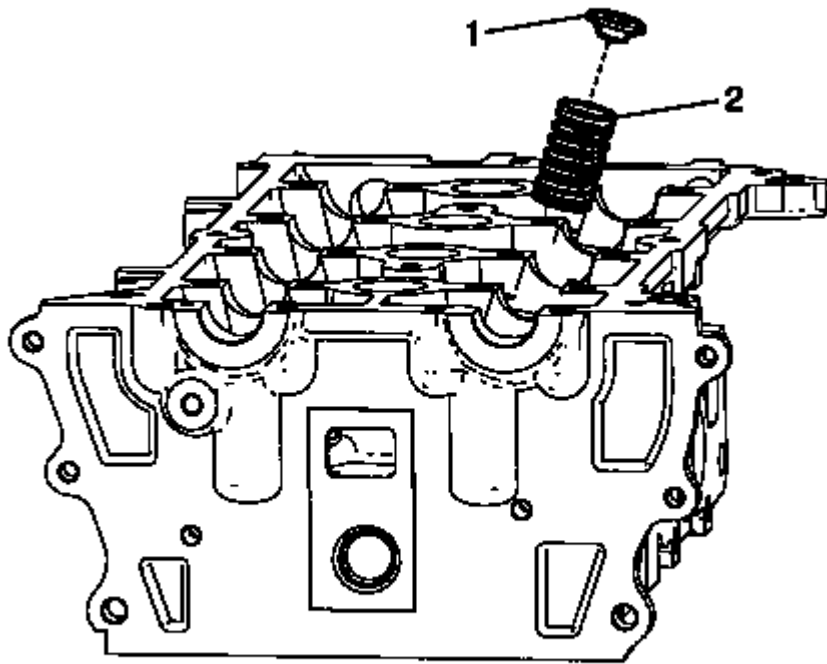


Fig. 252: Retainer And Valve Spring
Courtesy of GENERAL MOTORS COMPANY

7. Remove the retainer (1) and valve spring (2).

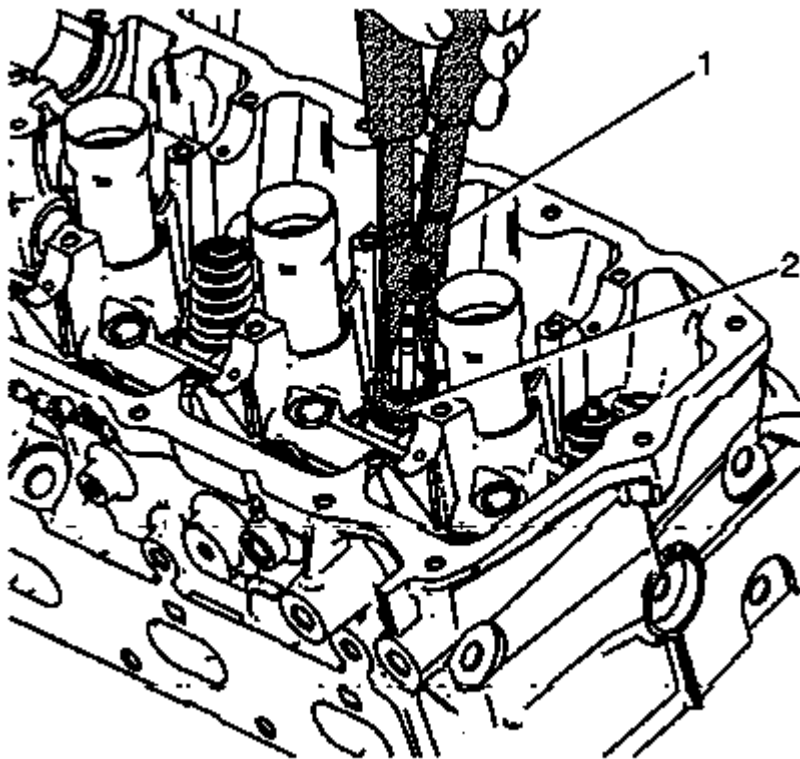


Fig. 253: View Of EN 46116 & Valve Stem Seal
Courtesy of GENERAL MOTORS COMPANY

8. Remove the valve stem seal (2) using EN 46116 valve stem seal remover/installer (1).

Installation Procedure

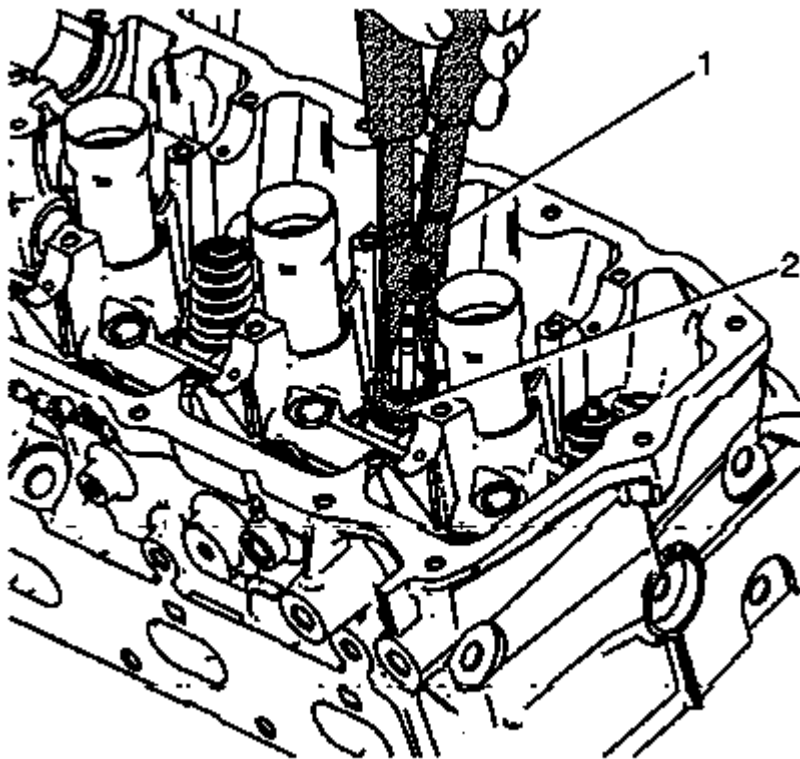


Fig. 254: View Of EN 46116 & Valve Stem Seal
Courtesy of GENERAL MOTORS COMPANY

1. Remove the valve stem seal (2) using EN 46116 valve stem seal remover/installer (1).

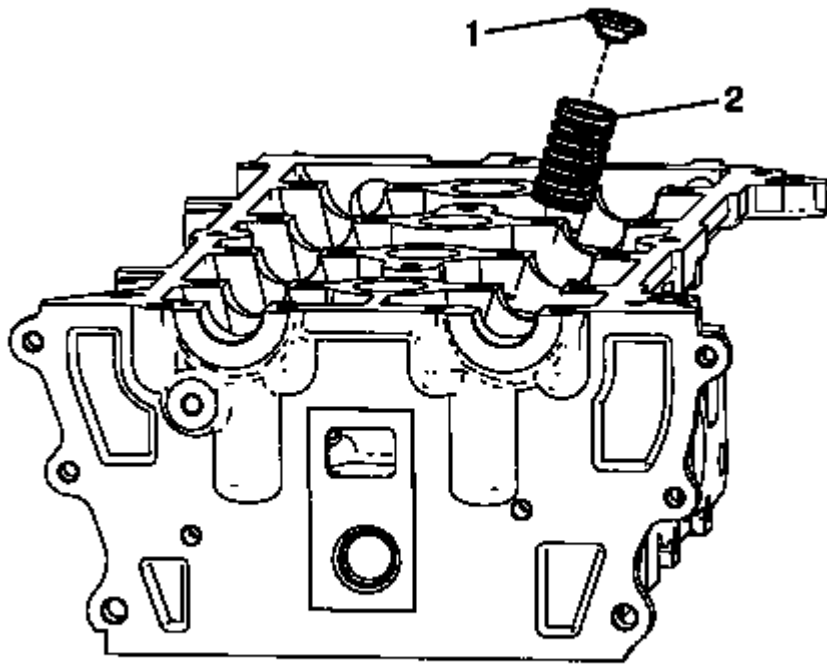


Fig. 255: Retainer And Valve Spring
Courtesy of GENERAL MOTORS COMPANY

2. Install the valve spring (2), retainer (1) and seal.

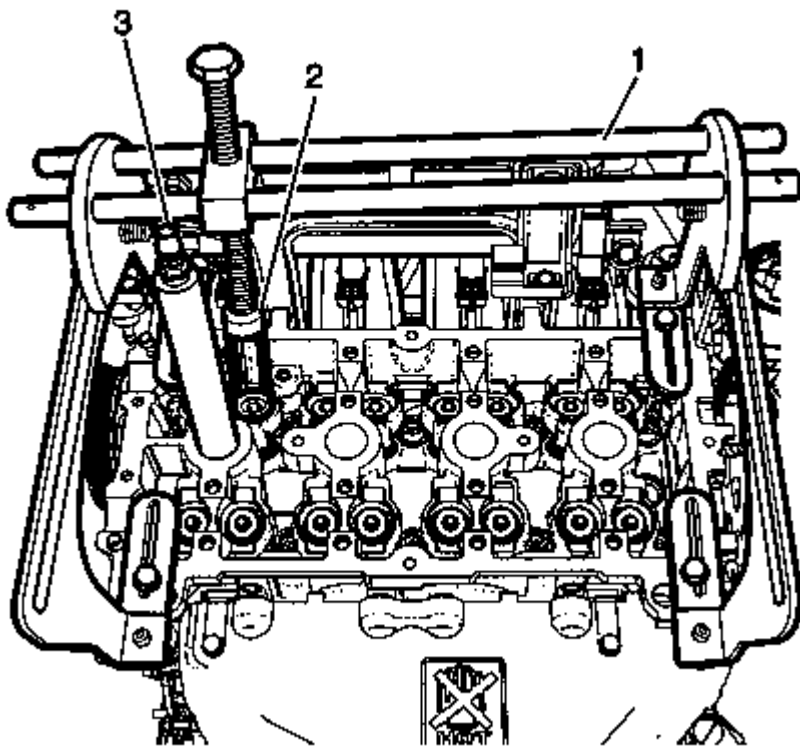


Fig. 256: Universal Valve Spring Compressor
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the compressed air hose from EN 49076 cylinder pressure adapter.

CAUTION: Refer to Fastener Caution .

4. Remove the EN 49076 cylinder pressure adapter (3), install the spark plug and tighten the spark plug to 20 (15 lb ft).
5. Remove the EN-50173 universal valve spring compressor (1) and EN-49075 valve spring compressor adapter (2).

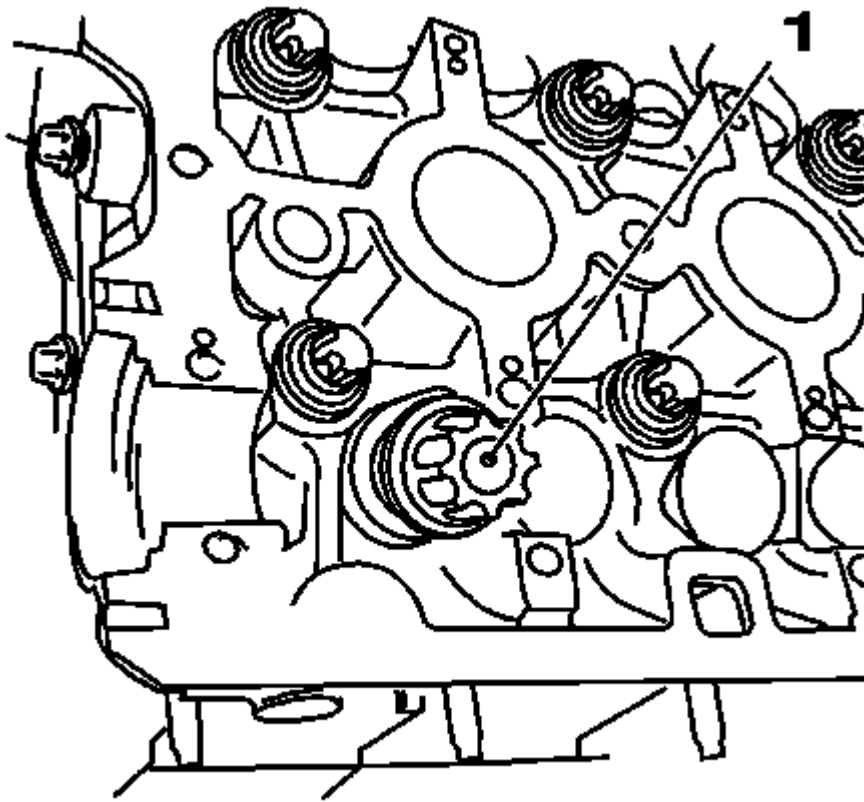


Fig. 257: View Of Camshaft Bearing Cap
Courtesy of GENERAL MOTORS COMPANY

6. Install the valve tappet (1).
7. Install the camshaft. Refer to Camshaft Replacement (LL0), Camshaft Replacement (LFM).

VALVE CLEARANCE ADJUSTMENT (LFM)

Measurement

1. Remove the camshaft cover. Refer to Camshaft Cover Replacement (LL0), Camshaft Cover Replacement (LFM).

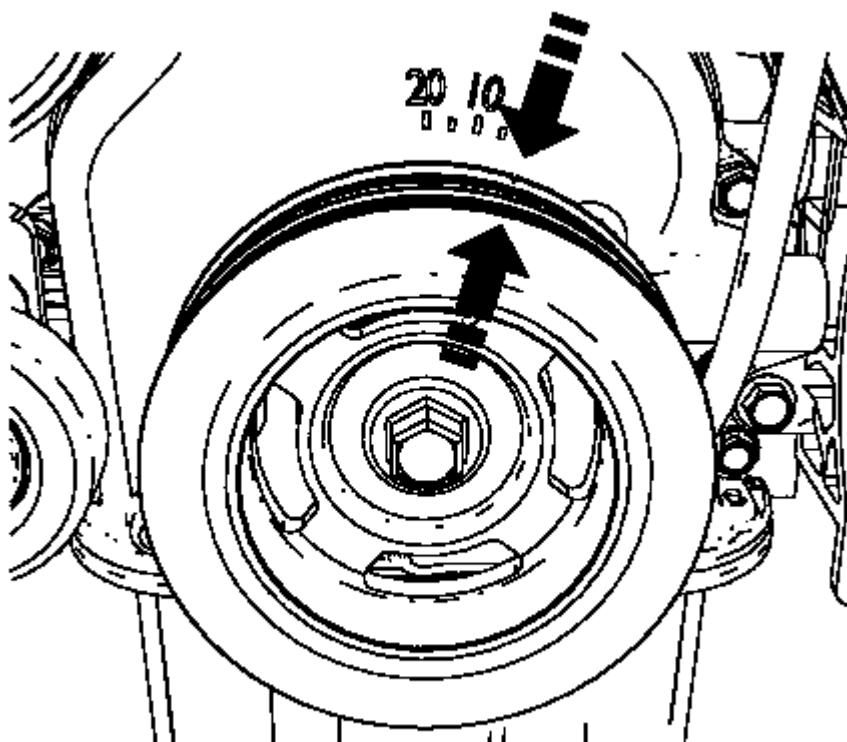


Fig. 258: Crankshaft Pulley

Courtesy of GENERAL MOTORS COMPANY

2. Rotate the crankshaft pulley in direction of engine rotation, aligning the pulley groove with the 0 point on the cover, in order to set engine to TDC.

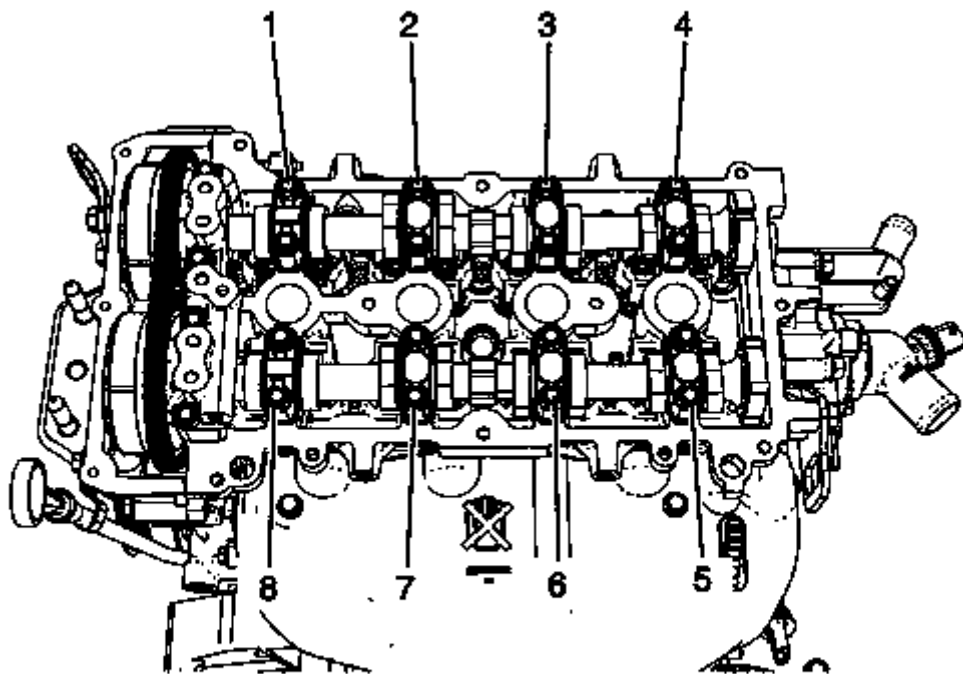


Fig. 259: Measuring valve clearance At positions (1), (2), (6) and (8)
Courtesy of GENERAL MOTORS COMPANY

3. Measure the valve clearance at positions (1), (2), (6) and (8).
4. Rotate the crankshaft pulley 360 degrees in direction of engine rotation.
5. Measure the valve clearance at positions (3), (4), (5) and (7).
6. If the measured values are not within specifications, replace the valve tappets.

Specifications

- Intake Side: 0.075-0.125 mm
- Exhaust Side: 0.245-0.295 mm

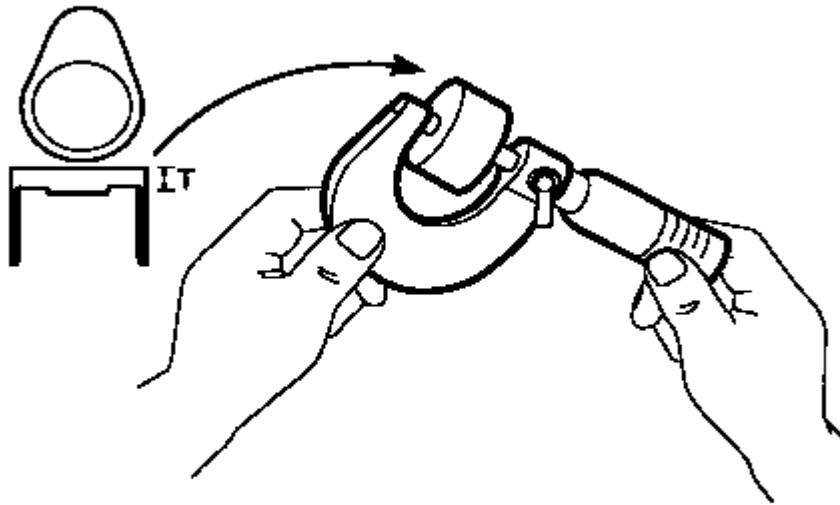


Fig. 260: Measuring Old Tappet
 Courtesy of GENERAL MOTORS COMPANY

7. Determine the tappet size. Refer to determining replacement tappet size.
 1. Remove the old tappet. Refer to Valve Stem Oil Seal and Valve Spring Replacement.
 2. Measure the old tappet.
 3. Perform the following calculation to determine the replacement tappet size:

Specifications

- Intake: value of removed tappet + measured clearance - 0.1 mm = new tappet size
- Exhaust: value of removed tappet + measured clearance - 0.27 mm = new tappet size

Example:

- Old tappet = 3.20 mm, clearance was 0.30 mm, Intake clearance value is 0.1 mm
- $3.20 \text{ mm} + 0.30 \text{ mm} - 0.1 \text{ mm} = 3.40 \text{ mm}$
- 3.40 mm = 96449615 (part number)

Tappet Selection

Part Number	ID Number	Value (mm)
-------------	-----------	------------

96449601	312	3.12 ± 0.01
96449602	314	3.14 ± 0.01
96449603	316	3.16 ± 0.01
96449604	318	3.18 ± 0.01
96449605	320	3.20 ± 0.01
96449606	322	3.22 ± 0.01
96449607	324	3.24 ± 0.01
96449608	326	3.26 ± 0.01
96449609	328	3.28 ± 0.01
96449610	330	3.30 ± 0.01
96449611	332	3.32 ± 0.01
96449612	334	3.34 ± 0.01
96449613	336	3.36 ± 0.01
96449614	338	3.38 ± 0.01
96449615	340	3.40 ± 0.01
96449616	342	3.42 ± 0.01
96449617	344	3.44 ± 0.01
96449618	346	3.46 ± 0.01
96449619	348	3.48 ± 0.01
96449620	350	3.50 ± 0.01
96449621	352	3.52 ± 0.01
96449622	354	3.54 ± 0.01
96449623	356	3.56 ± 0.01
96449624	358	3.58 ± 0.01
96449625	360	3.60 ± 0.01
96449626	362	3.62 ± 0.01
96449627	364	3.64 ± 0.01
96449628	366	3.66 ± 0.01
96449629	368	3.68 ± 0.01
96449630	370	3.70 ± 0.01
96449631	372	3.72 ± 0.01
96449632	374	3.74 ± 0.01
96449633	376	3.76 ± 0.01
96449634	378	3.78 ± 0.01
96449635	380	3.80 ± 0.01
96449636	382	3.82 ± 0.01
96449637	384	3.84 ± 0.01
96449638	386	3.86 ± 0.01
96449639	388	3.88 ± 0.01
96449640	390	3.90 ± 0.01

VALVE STEM AND VALVE GUIDE CLEARANCE INSPECTION

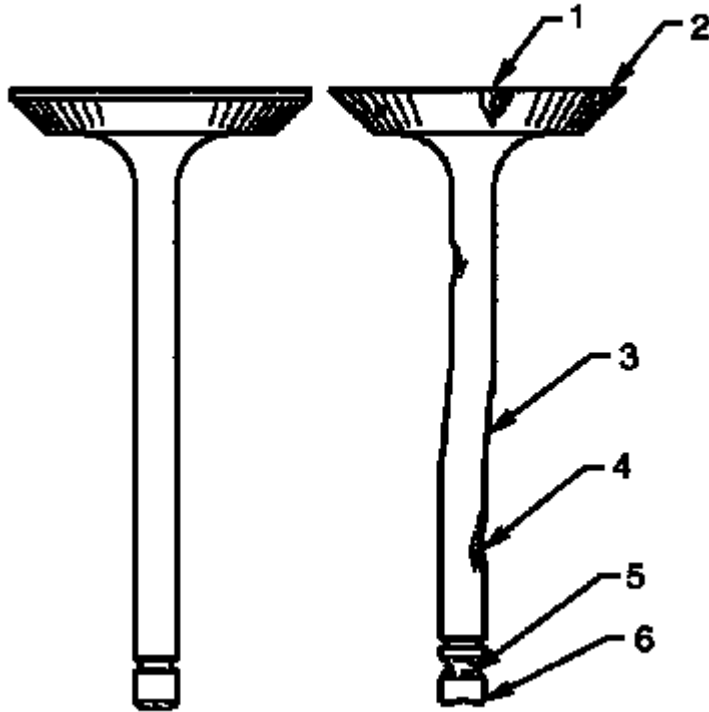


Fig. 261: Valve Stem and Valve Guide Clearance Inspection

Courtesy of GENERAL MOTORS COMPANY

1. Inspect the valve for damage from the head to tip for the following conditions:
 - Pitting in the valve seat area (1)
 - Lack of valve margin (2)
 - Bending in the valve stem (3)
 - Pitting or excessive wear in the stem (4)
 - Worn valve key grooves (5)
 - Worn valve tip (6)
2. Replace the valve if any of these conditions exist.

NOTE: **Valve guide is not removable. Replace the cylinder head if it is out of specification.**

3. Measure the valve stem diameter (1) and valve guide inside diameter. If it is out of specification, replace it. Refer to **Engine Mechanical Specifications (LL0)**, **Engine Mechanical Specifications (LFM)**.

CRANKSHAFT REAR OIL SEAL AND HOUSING REPLACEMENT

Special Tools

J 45507 Crankshaft Rear Oil Seal Installer

For equivalent regional tools, refer to Special Tools.

Removal Procedure

1. If equipped with a manual transmission remove the flywheel. Refer to Engine Flywheel Replacement.
2. If equipped with an automatic transmission, remove the automatic transmission flex plate. Refer to Automatic Transmission Flex Plate Replacement.
3. Place a collecting container under the vehicle.
4. Remove the oil pan. Refer to Oil Pan Replacement.

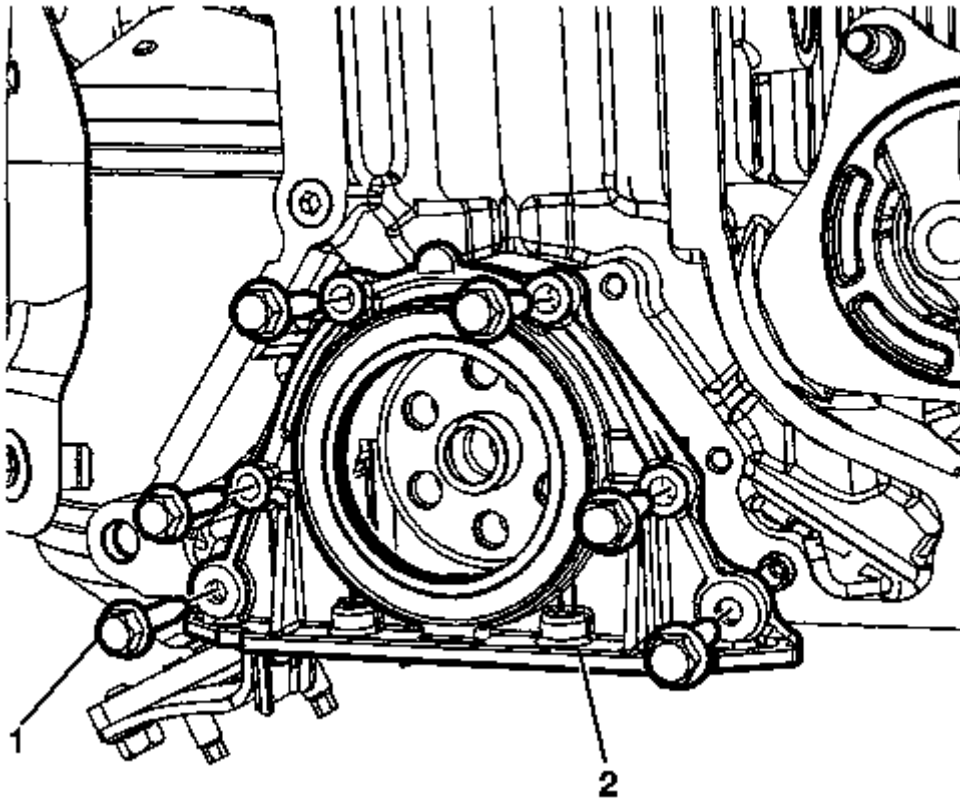


Fig. 262: Fasteners, Oil Seal And Housing
Courtesy of GENERAL MOTORS COMPANY

5. Remove the 6 fasteners (1) from the oil seal and housing (2).
6. Clean the threads of the 6 fasteners (1).

NOTE: Take care when removing the oil seal and housing to avoid damage to the crankshaft and oil pan.

7. Remove the oil seal and housing using a suitable tool.

Installation Procedure

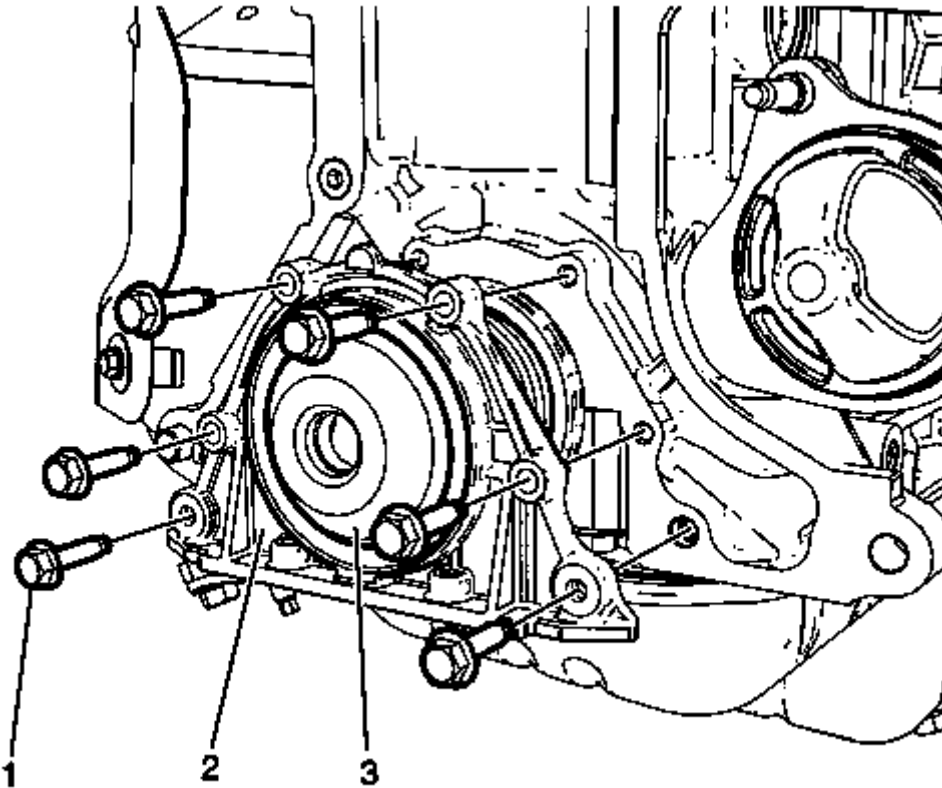


Fig. 263: Crankshaft Rear Oil Seal And Housing
Courtesy of GENERAL MOTORS COMPANY

1. Apply sealant to the crankshaft rear oil seal and housing. Refer to **Adhesives, Fluids, Lubricants and Sealers**.
2. Install the J 45507 Crankshaft Rear Oil Seal Installer (3) to the crankshaft rear oil seal and housing (2).
3. Push the crankshaft rear oil seal and housing (2) until the crankshaft rear oil seal and housing is flush and sits evenly in the cylinder block.
4. Remove the J 45507 Crankshaft Rear Oil Seal Installer (3) from the crankshaft.
5. Apply thread locker to the threads of the 6 fasteners (1). Refer to **Adhesives, Fluids, Lubricants and Sealers**.

CAUTION: Refer to Fastener Caution .

6. Install the 6 fasteners (1) and tighten to 10 (89 lb in).
7. Install the oil pan. Refer to **Oil Pan Replacement**.

8. If equipped with a manual transmission, install the flywheel. Refer to **Engine Flywheel Replacement**.
9. If equipped with an automatic transmission, install the automatic transmission flex plate. Refer to **Automatic Transmission Flex Plate Replacement**.

IGNITION COIL COVER REPLACEMENT (LL0)

Removal Procedure

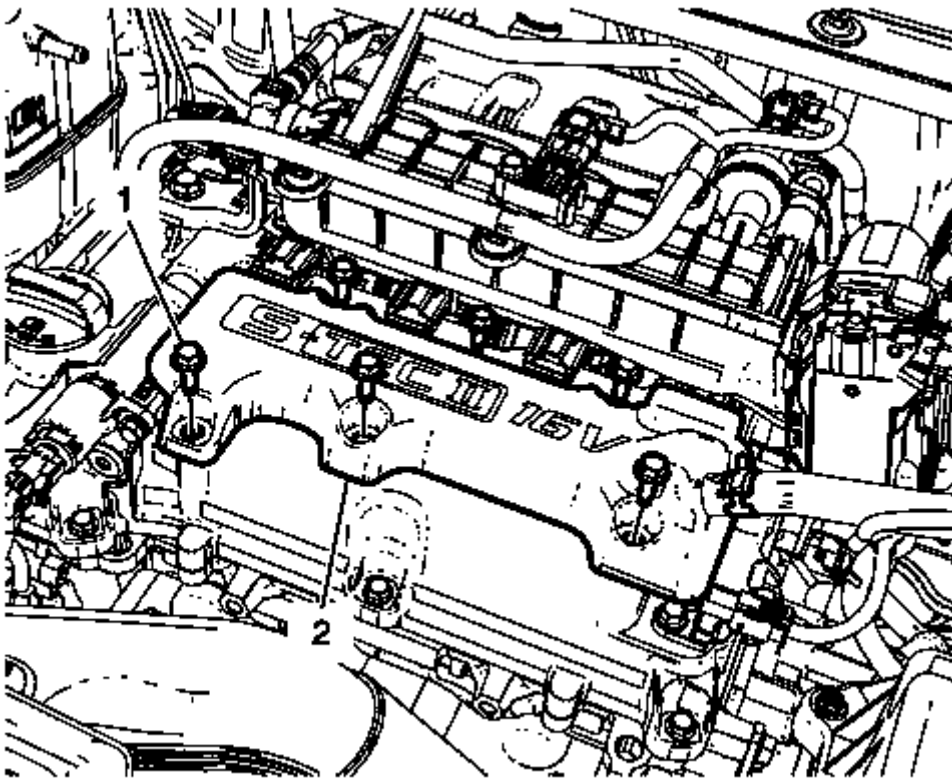


Fig. 264: Engine Compression Test Tool
Courtesy of GENERAL MOTORS COMPANY

1. Open the hood.
2. Disconnect the breather hose and clamp from the ignition coil cover.
3. Remove the 6 ignition coil cover bolts (1).
4. Remove the ignition coil cover (2).

Installation Procedure

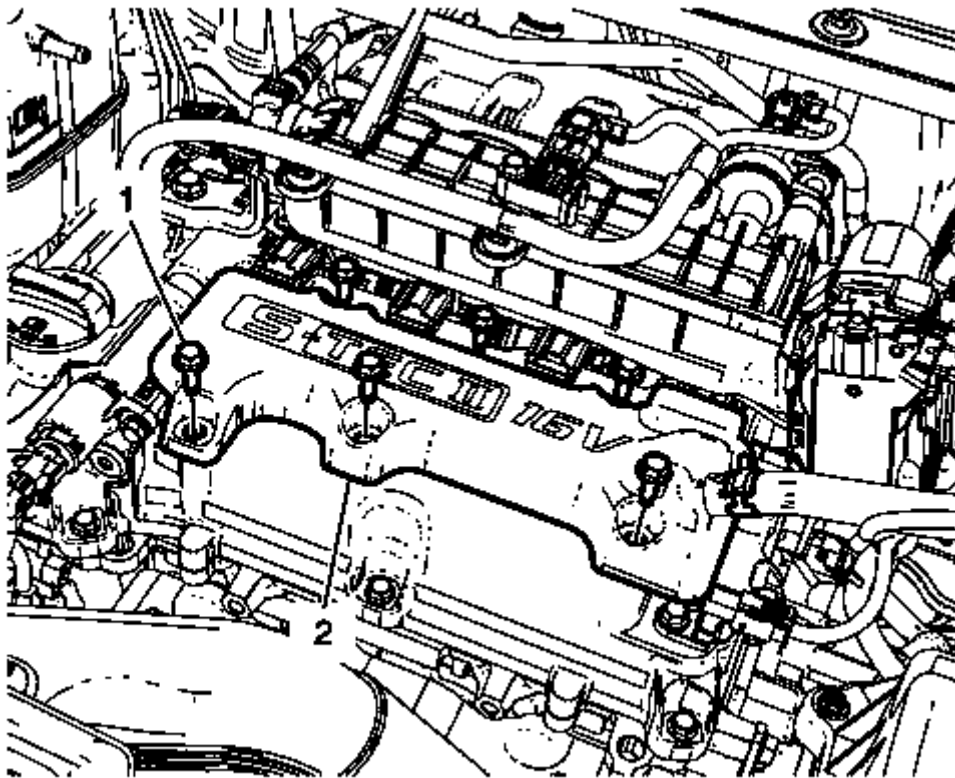


Fig. 265: Engine Compression Test Tool
Courtesy of GENERAL MOTORS COMPANY

1. Install the ignition coil cover (2).
2. Install the 6 ignition coil cover bolts (1) and tighten to 10 (80 lb in).
3. Connect the breather hose and clamp to the ignition coil cover.
4. Close the hood.

IGNITION COIL COVER REPLACEMENT (LFM)

Removal Procedure

1. Open the hood.
2. Remove the upper intake manifold. Refer to **Upper Intake Manifold Replacement (LFM)**.

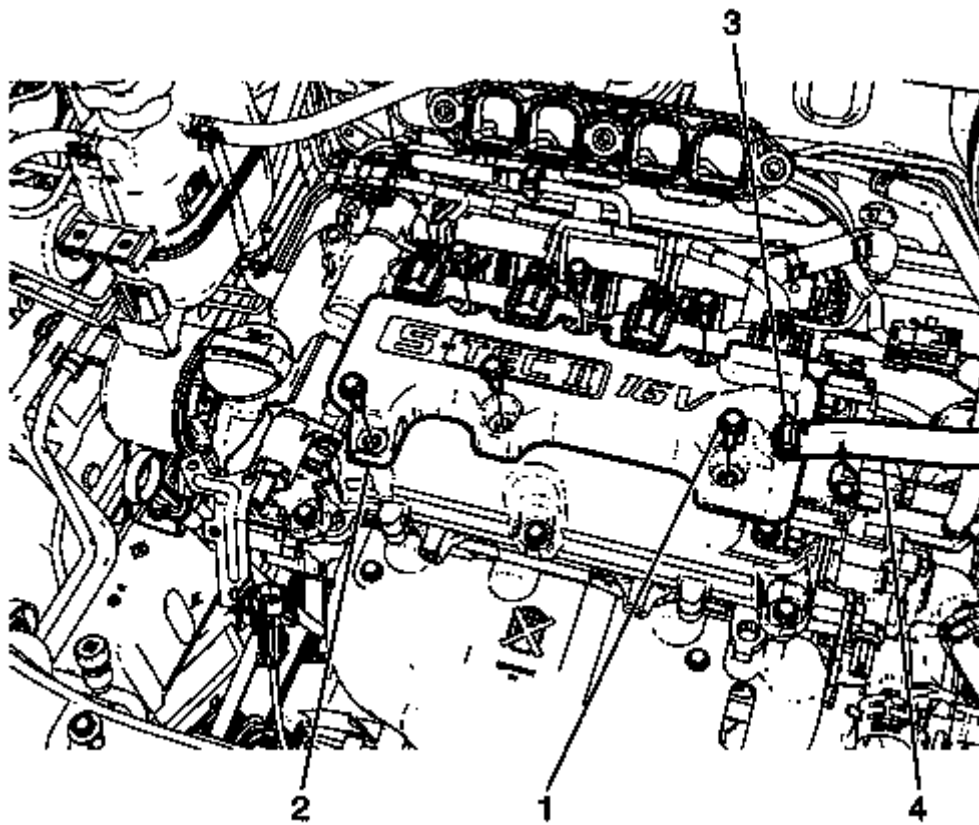


Fig. 266: Breather Hose

Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the breather hose (4) and clamp (3) from the ignition coil cover.
4. Remove the 6 ignition coil cover bolts (1).
5. Remove the ignition coil cover (2).

Installation Procedure

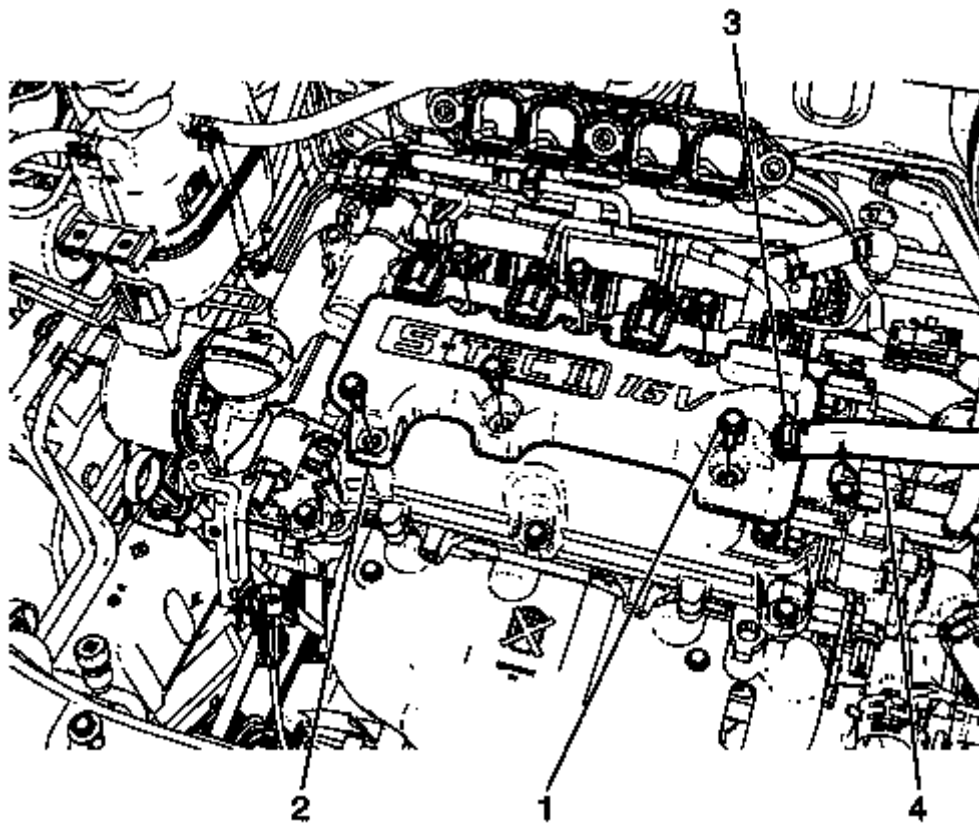


Fig. 267: Breather Hose

Courtesy of GENERAL MOTORS COMPANY

1. Install the ignition coil cover (2).
2. Install the 6 ignition coil cover bolts (1) and tighten to 10 (80 lb in).
3. Connect the breather hose (4) and clamp (3) to the ignition coil cover.
4. Install the upper intake manifold housing. Refer to Upper Intake Manifold Replacement (LFM).
5. Close the hood.

REPAIR INSTRUCTIONS - OFF VEHICLE

CAMSHAFT CLEANING AND INSPECTION

1. Clean the camshaft in solvent.

WARNING: Refer to Safety Glasses Warning .

2. Dry the camshaft with compressed air.

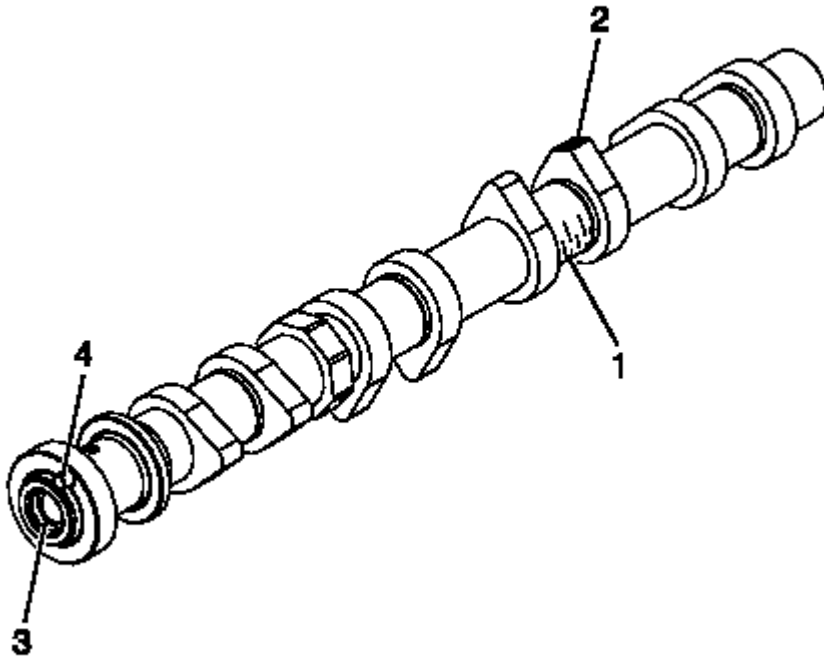


Fig. 268: Bearing Journals

Courtesy of GENERAL MOTORS COMPANY

3. Inspect the camshaft for the following conditions:
 - Camshaft bearing journals (1) that are:
 - Worn
 - Scored
 - Damaged
 - Worn camshaft lobes (2)
 - Damaged sprocket bolt threads (3)
 - Damaged sprocket pin

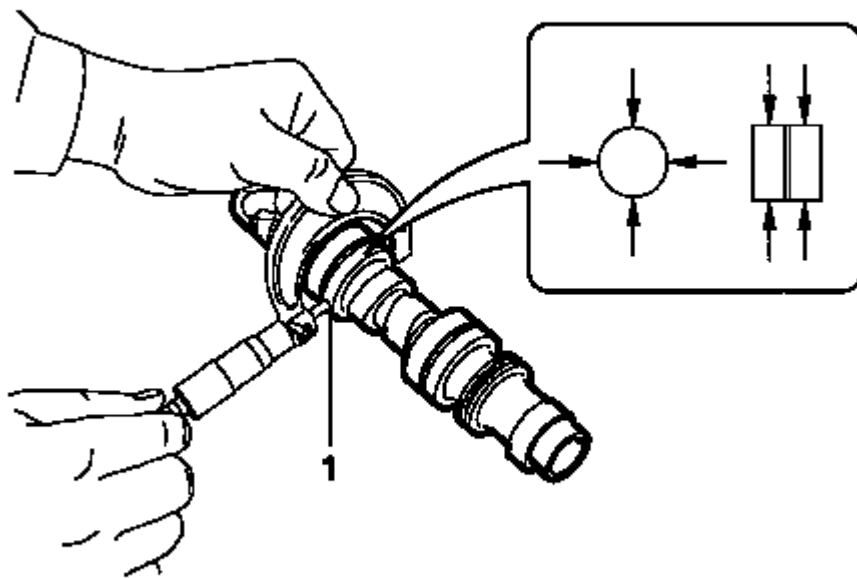


Fig. 269: Measuring Outer Diameter Of Each Journal
Courtesy of GENERAL MOTORS COMPANY

4. Measure the outer diameter of each journal (1) at the 4 different places.
5. Replace the camshaft if the measured value is not as specified.

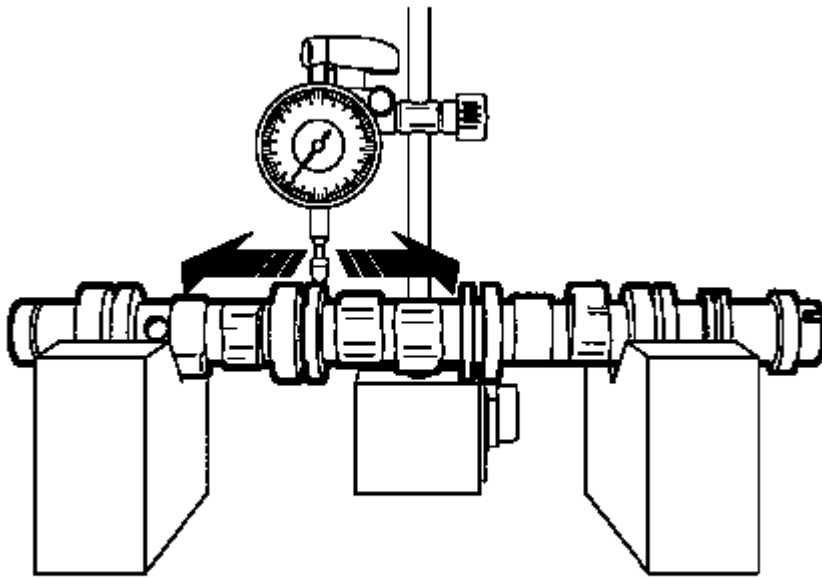


Fig. 270: Measuring Excessive Camshaft Runout Using Indicator
Courtesy of GENERAL MOTORS COMPANY

6. Measure for excessive camshaft runout, using the indicator.
 1. Mount the camshaft in a suitable fixture.
 2. Use the indicator in order to measure for a bent camshaft. Refer to **Engine Mechanical Specifications (LL0)**, **Engine Mechanical Specifications (LFM)**.
7. Replace the camshaft if runout exceeds specifications.

CAMSHAFT POSITION ACTUATOR SOLENOID VALVE REMOVAL

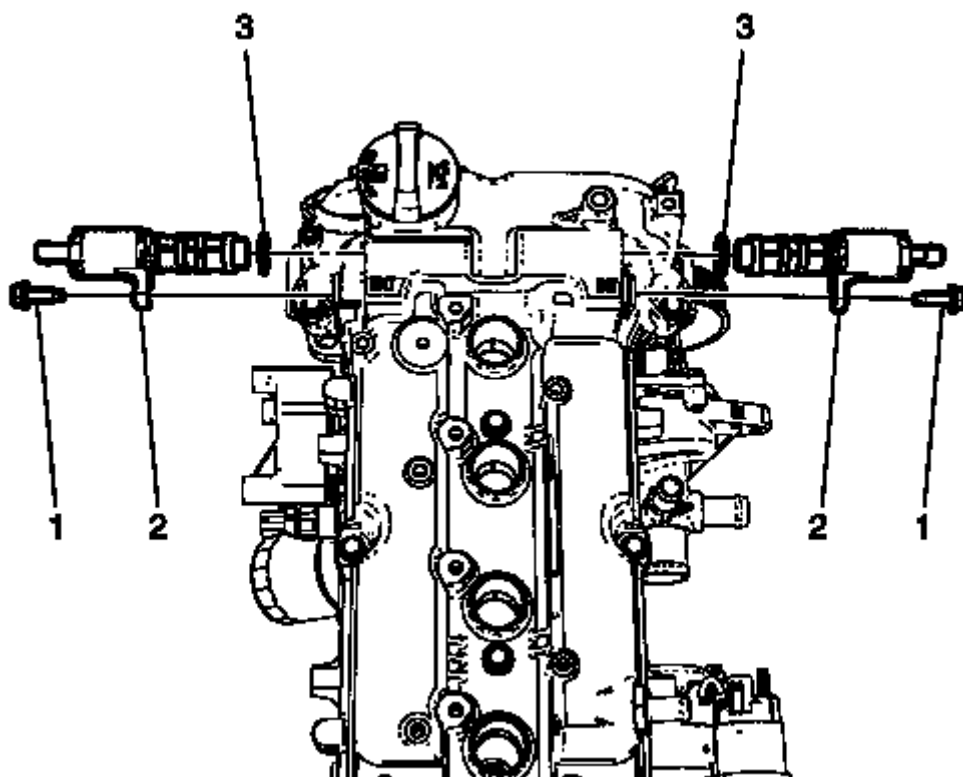


Fig. 271: Camshaft Position Actuator Solenoid Valve Bolts And Valves
Courtesy of GENERAL MOTORS COMPANY

1. Remove the camshaft position actuator solenoid valve bolts (1).
2. Remove the camshaft position actuator solenoid valves (2).
3. Remove the camshaft position actuator solenoid valve seals (3).

GENERATOR BRACKET REMOVAL

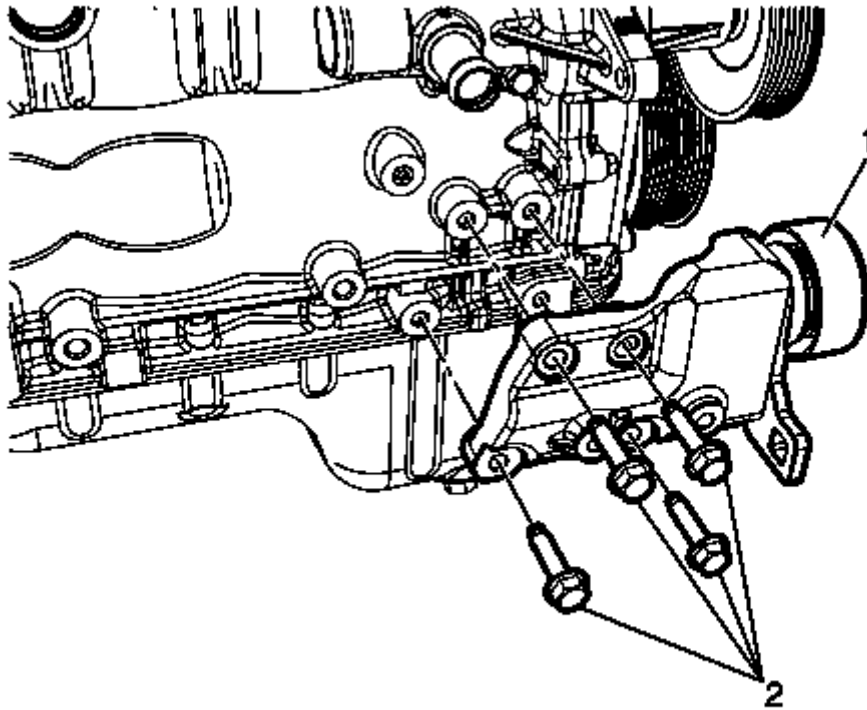


Fig. 272: Generator Bracket Retaining Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Remove the generator bracket retaining bolts (2).
2. Remove the generator bracket (1).

AIR CONDITIONING COMPRESSOR BRACKET REMOVAL

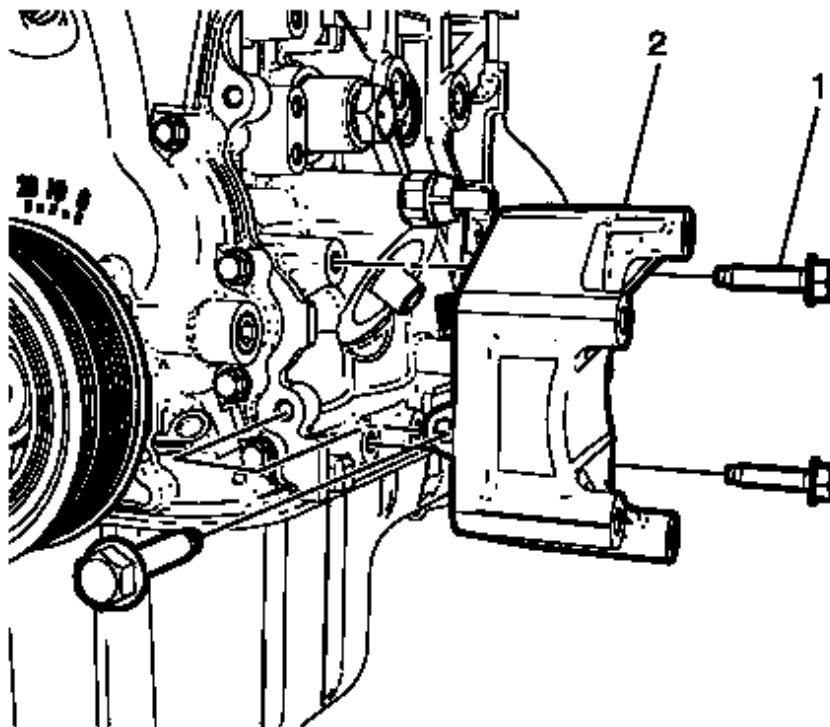


Fig. 273: Air Conditioning Compressor Bolts And Bracket
Courtesy of GENERAL MOTORS COMPANY

1. Remove the 3 air conditioning compressor bolts (1).
2. Remove the air conditioning compressor bracket (2).

CRANKSHAFT BALANCER REMOVAL

Special Tools

- **EN 50175** Crankshaft Locking Device
- **J-22888-20A** Crankshaft Balancer Puller

For equivalent regional tools, refer to **Special Tools**.

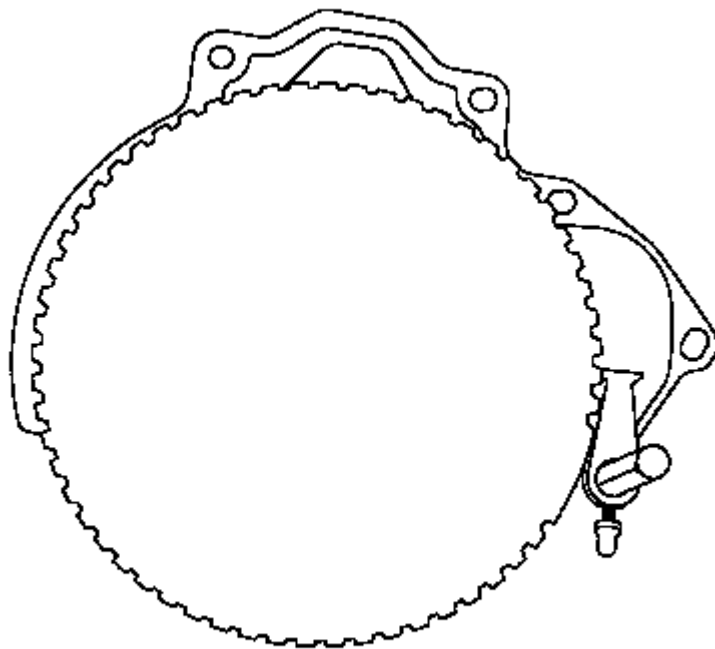


Fig. 274: EN 50050 Crankshaft Locking Device
Courtesy of GENERAL MOTORS COMPANY

1. Install the **EN 50050** crankshaft locking device. Lock the flywheel via the starter ring gear.

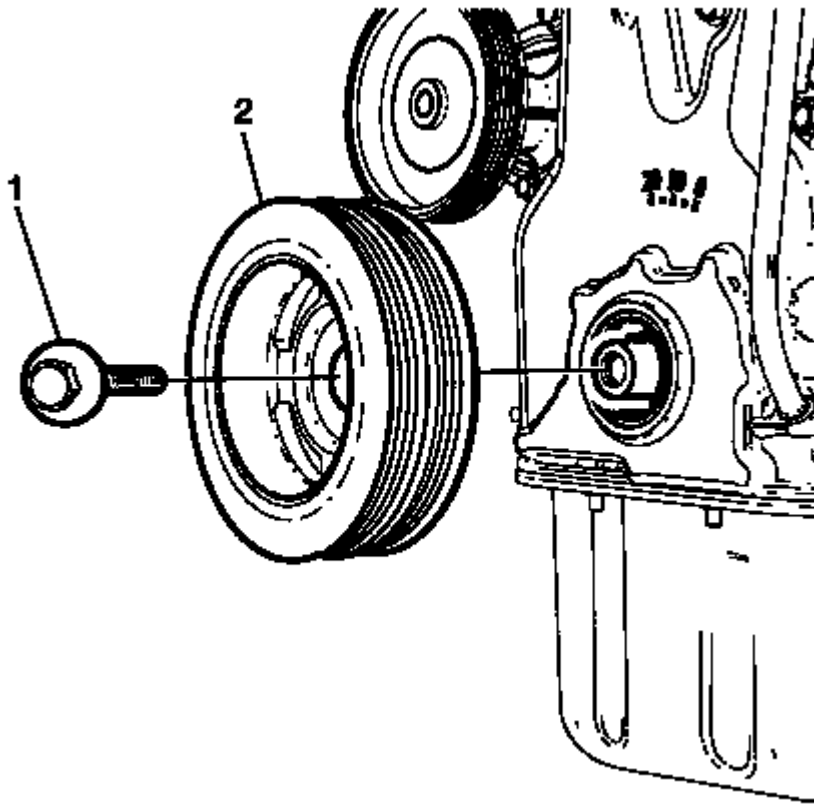


Fig. 275: Crankshaft Balancer Bolt
Courtesy of GENERAL MOTORS COMPANY

2. Remove the bolt (1).
3. Install **J-22888-20A** crankshaft balancer puller to the crankshaft balancer (2).
4. Remove the crankshaft balancer (2).
5. Remove the **EN 50050** crankshaft locking device.

CRANKSHAFT SPROCKET REMOVAL

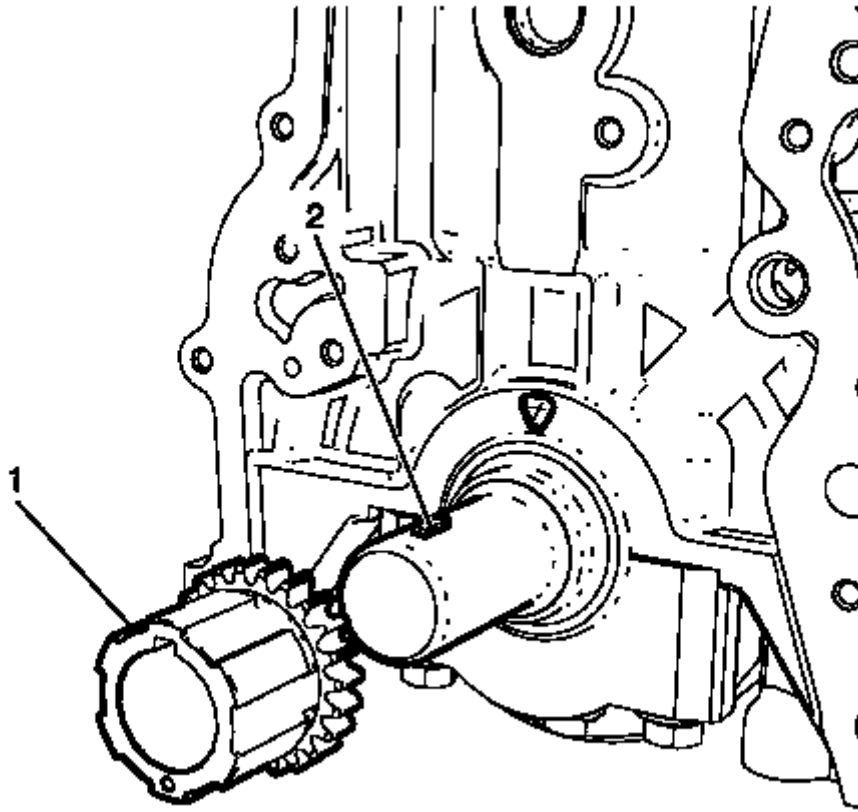


Fig. 276: Crankshaft Sprocket
Courtesy of GENERAL MOTORS COMPANY

Remove the crankshaft sprocket (1).

ENGINE FLYWHEEL REMOVAL

Special Tools

EN-50050 Crankshaft Locking Device

For equivalent regional tools, refer to **Special Tools**.

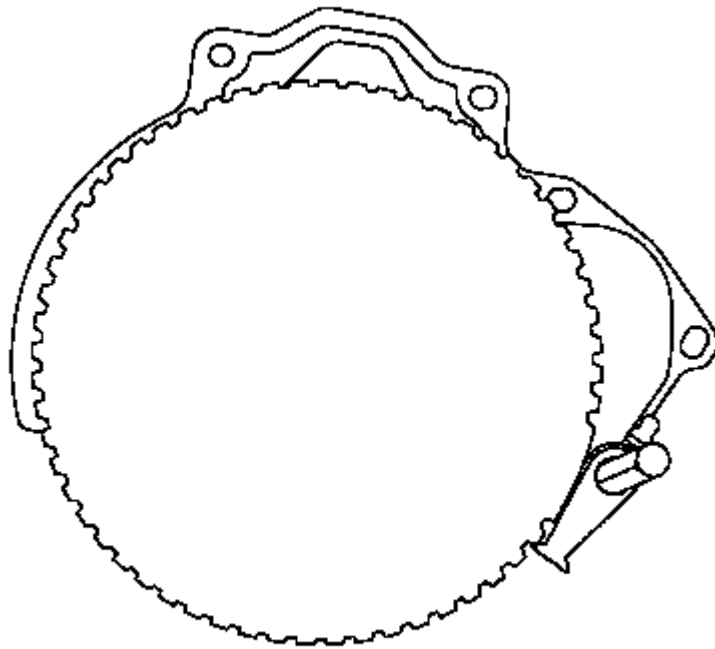


Fig. 277: EN-50050 Crankshaft Locking Device
Courtesy of GENERAL MOTORS COMPANY

1. Install the **EN-50050** crankshaft locking device, lock the flywheel via the starter ring gear.
2. Loosen the flywheel bolts.
3. Remove the **EN-50050** crankshaft locking device.

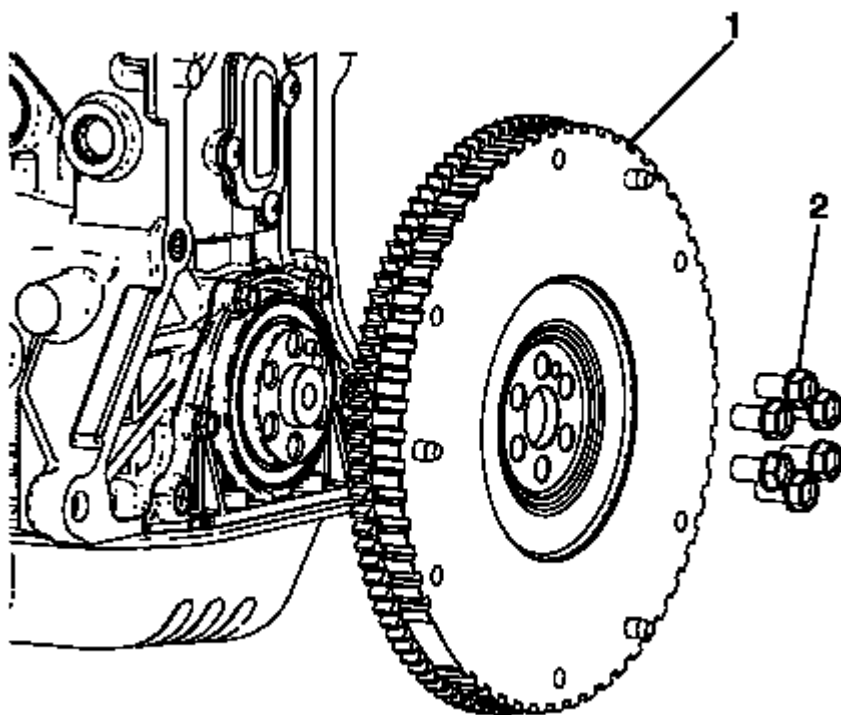


Fig. 278: Flywheel And Bolts

Courtesy of GENERAL MOTORS COMPANY

4. Remove the 6 flywheel bolts (2).
5. Remove the flywheel.

AUTOMATIC TRANSMISSION FLEX PLATE REMOVAL

Special Tools

EN 50050 Crankshaft Locking Device

For equivalent regional tools, refer to **Special Tools**.

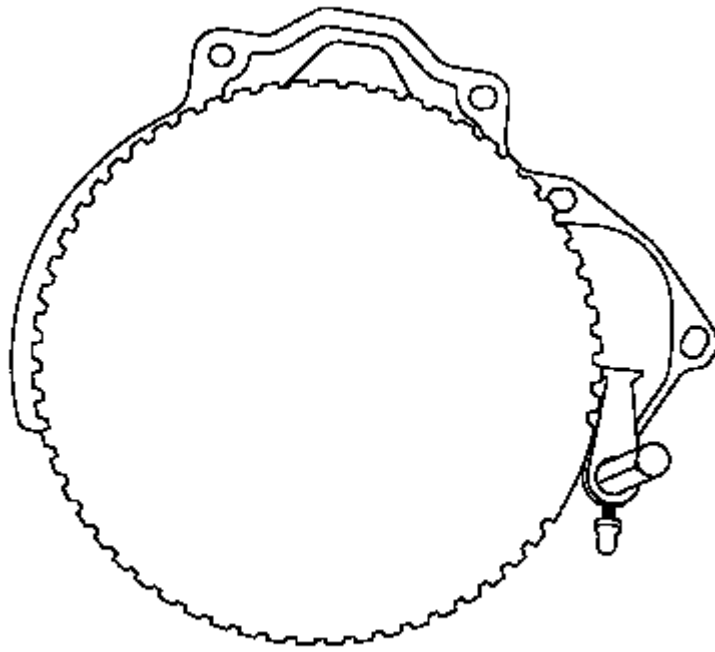


Fig. 279: EN 50050 Crankshaft Locking Device
Courtesy of GENERAL MOTORS COMPANY

1. Install the **EN 50050** crankshaft locking device, lock the automatic transmission flex plate via the starter ring gear.
2. Loosen the 6 automatic transmission flex plate bolts.
3. Remove the **EN 50050** crankshaft locking device.

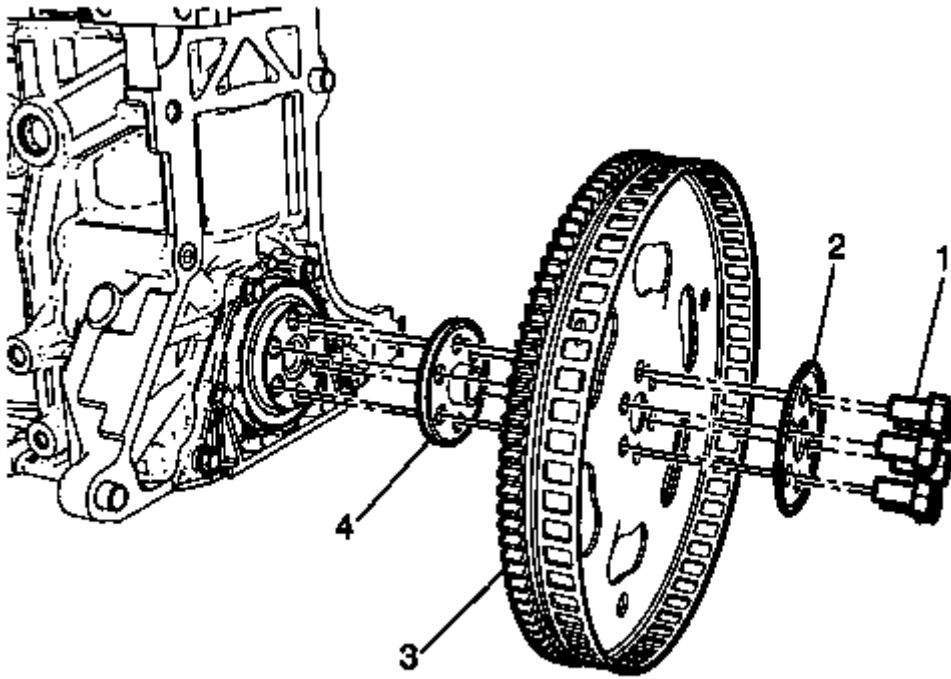


Fig. 280: Automatic Transmission Flex Plate Bolts And Automatic Transmission Flex Plate Retainer

Courtesy of GENERAL MOTORS COMPANY

4. Remove the 6 automatic transmission flex plate bolts (1).
5. Remove the automatic transmission flex plate retainer (2).
6. Remove the automatic transmission flex plate (3).
7. Remove the automatic transmission flex plate spacer (4).

OIL LEVEL INDICATOR AND TUBE REMOVAL

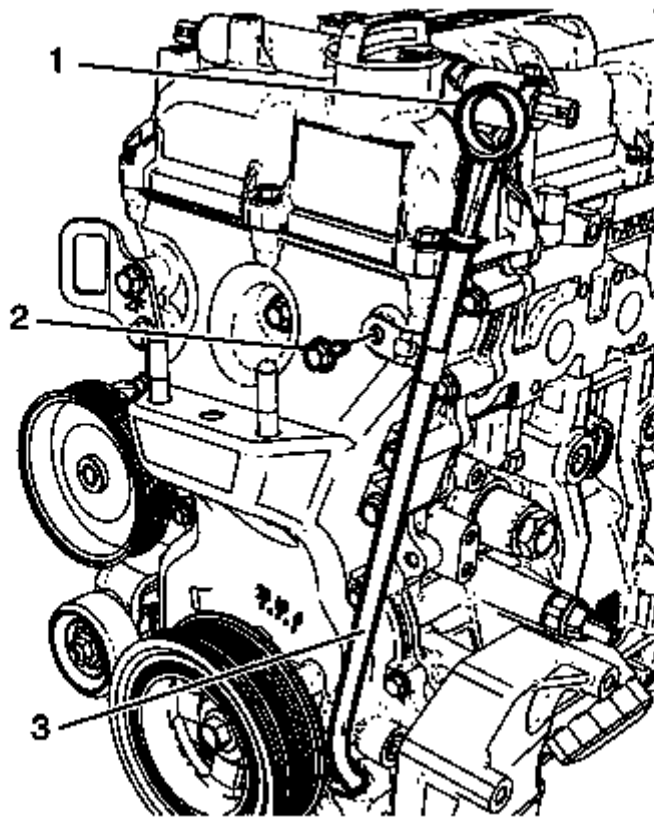


Fig. 281: Oil Dipstick And Oil Level Indicator Tube Bolt
Courtesy of GENERAL MOTORS COMPANY

1. Remove the oil dipstick (1).
2. Remove the oil level indicator tube bolt (2).

NOTE: **If the engine oil level is at maximum, oil may emerge while removing the oil dipstick guide tube.**

3. Remove the oil level indicator tube (3) and oil level indicator seal.

ENGINE COOLANT THERMOSTAT REMOVAL

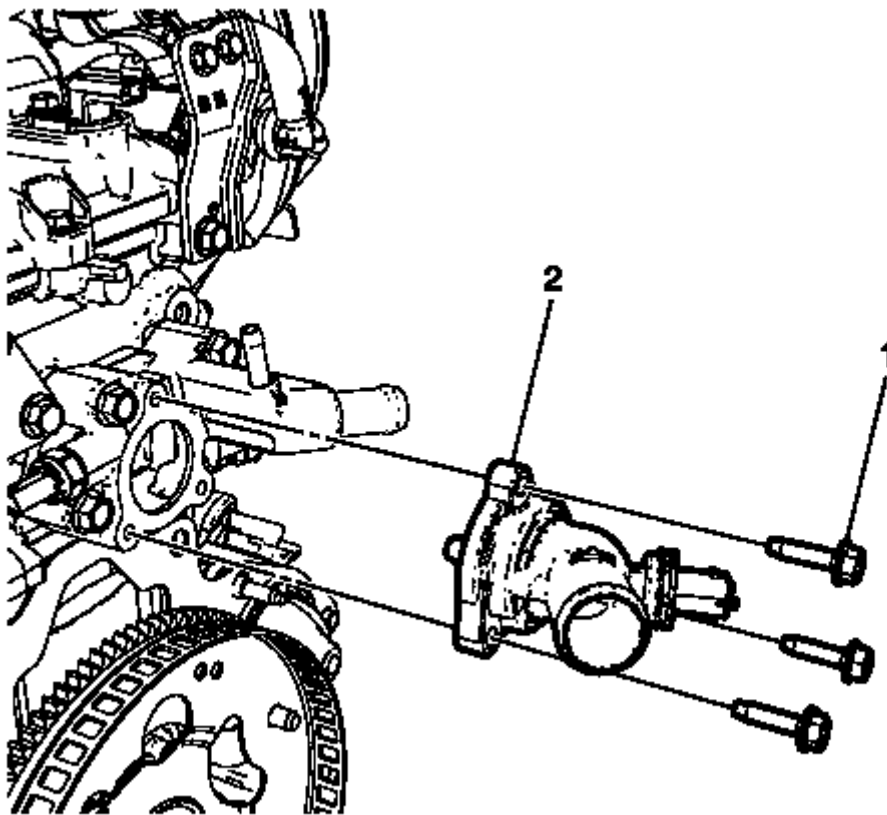


Fig. 282: Engine Coolant Thermostat Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Remove the 3 engine coolant thermostat bolts (1).
2. Remove the engine coolant thermostat assembly (2).

ENGINE WATER OUTLET ADAPTER REMOVAL

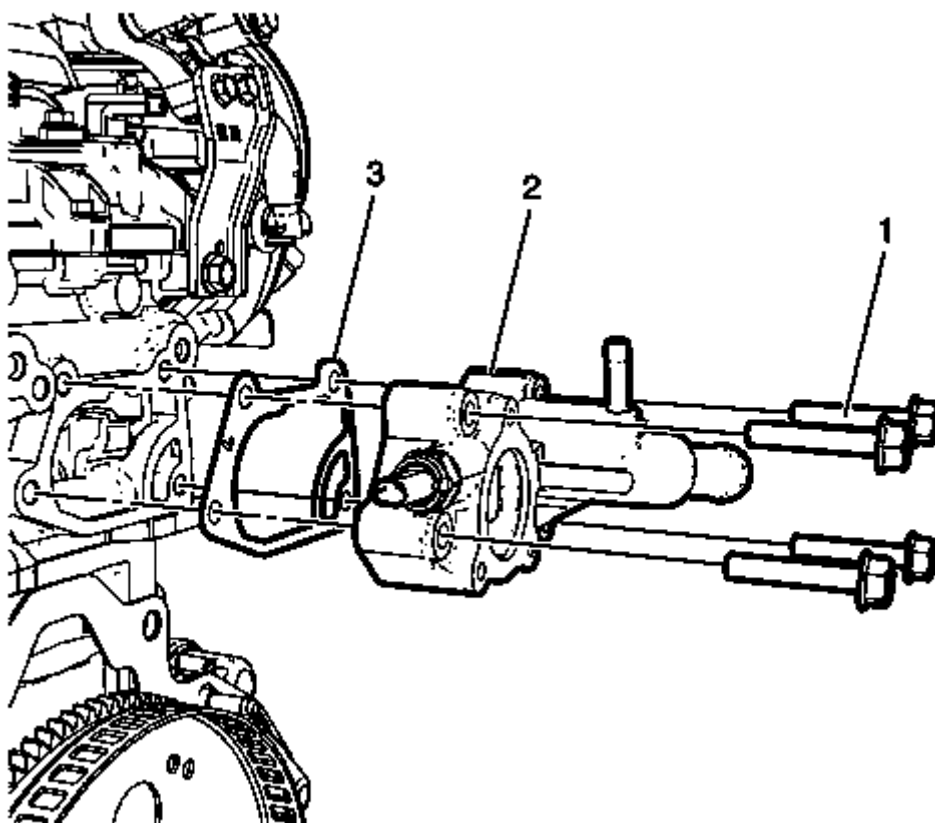


Fig. 283: Engine Water Outlet Adapter Housing Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Remove the 4 engine water outlet adapter housing bolts (1).

NOTE: Replace the engine water outlet housing if it is porous or cracked.

2. Remove the engine water outlet adapter housing (2).
3. Inspect the engine water outlet adapter gasket (3).

THROTTLE BODY ASSEMBLY REMOVAL

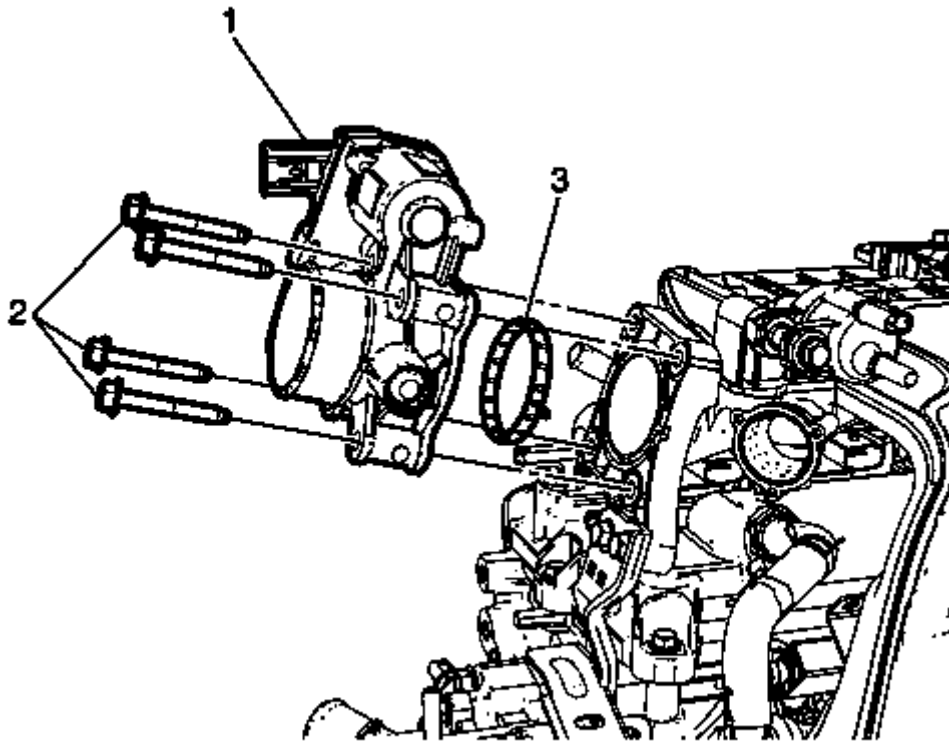


Fig. 284: Throttle Body Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Remove the 4 throttle body bolts (2).
2. Remove the throttle body (1).
3. Remove the throttle body seal (3).

INTAKE MANIFOLD REMOVAL (LL0)

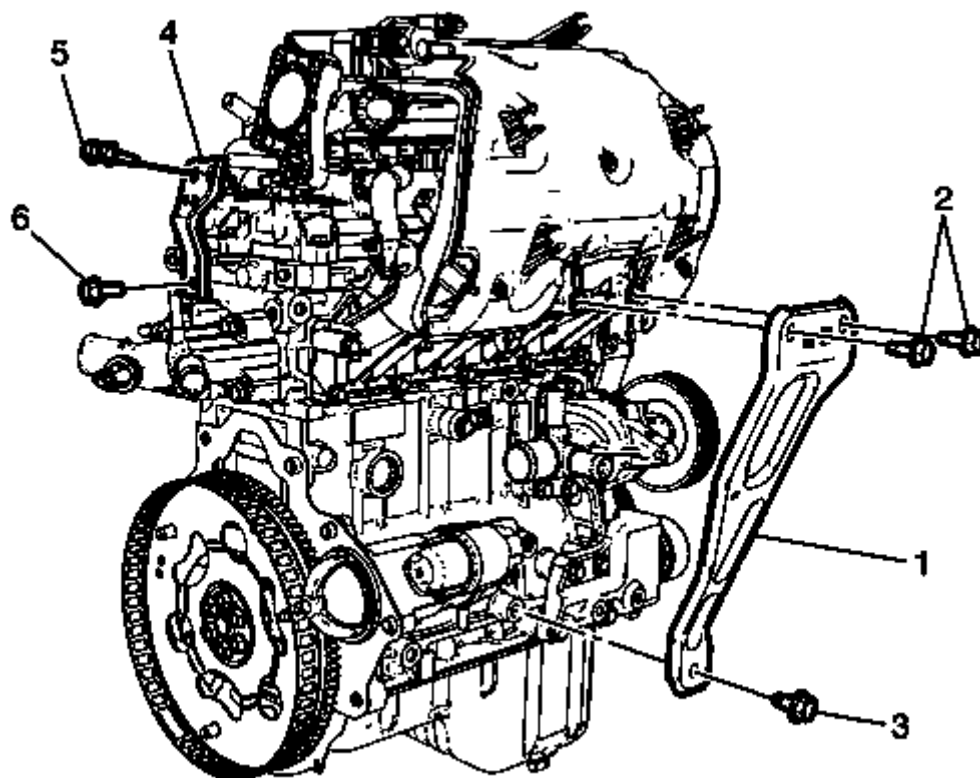


Fig. 285: Intake Manifold Upper Bracket
Courtesy of GENERAL MOTORS COMPANY

1. Remove the intake manifold rear bracket (1) and bolts (2, 3).
2. Remove the upper intake manifold side bracket (4) and bolts (5, 6).

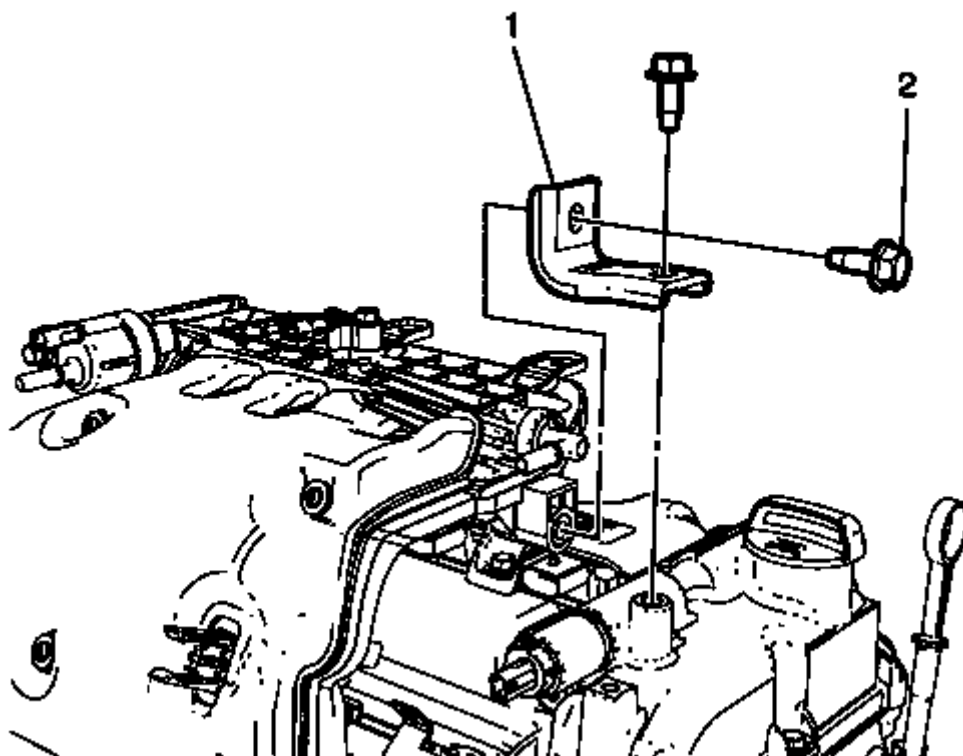


Fig. 286: Intake Manifold Upper Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Remove the intake manifold upper bracket bolts (2).
4. Remove the intake manifold upper bracket (1).

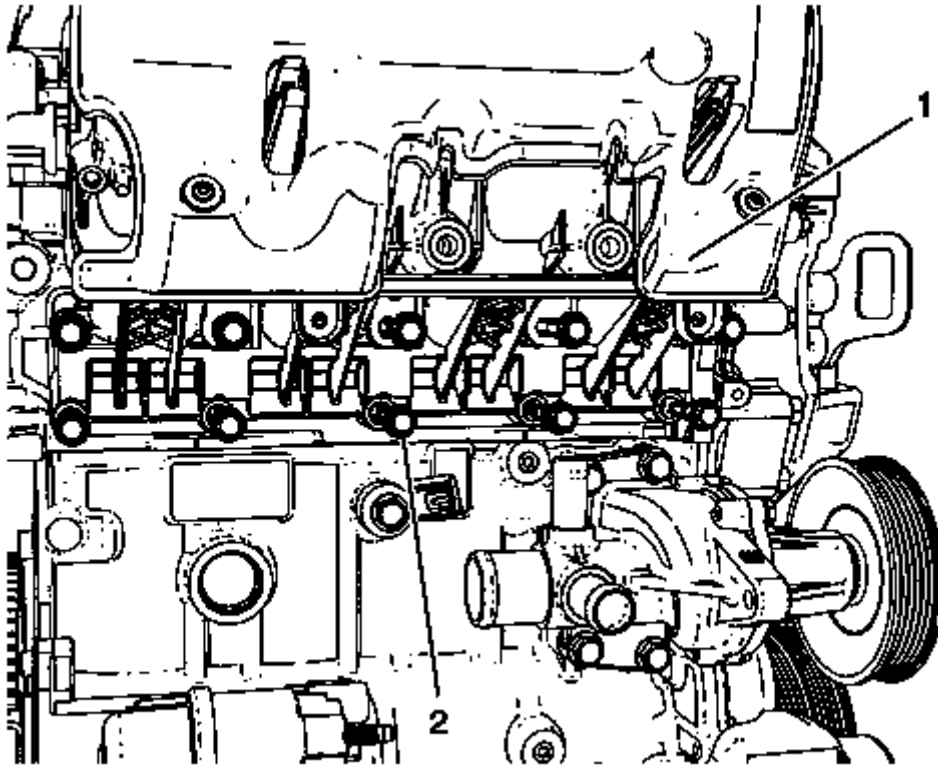


Fig. 287: Intake Manifold 10 Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the lower intake manifold 10 bolts (2).
6. Remove the intake manifold (1).

INTAKE MANIFOLD REMOVAL (LFM)

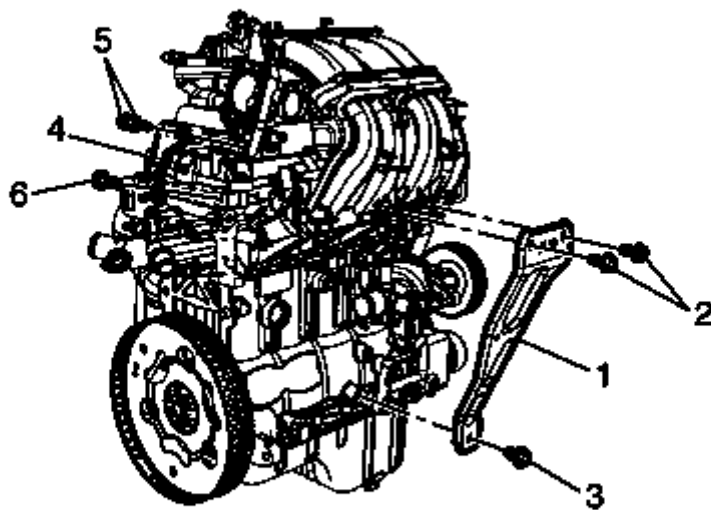


Fig. 288: Intake Manifold Rear Bracket

Courtesy of GENERAL MOTORS COMPANY

1. Remove the intake manifold rear bracket (1) and bolts (2, 3).
2. Remove the upper intake manifold side bracket (4) and bolts (5, 6).

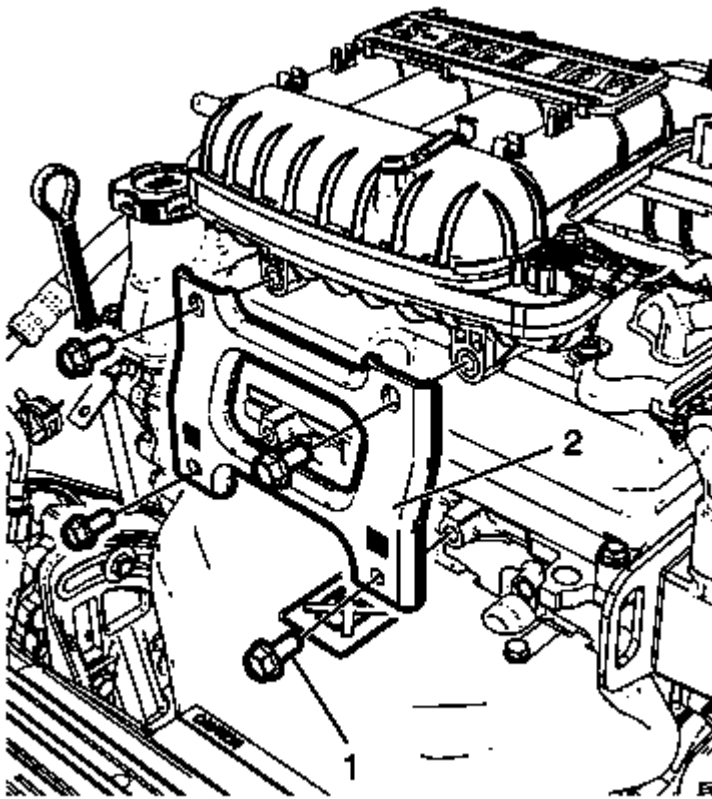


Fig. 289: Upper Intake Manifold Front Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Remove the upper intake manifold front bracket bolts (1).
4. Remove the upper intake manifold front bracket (2).

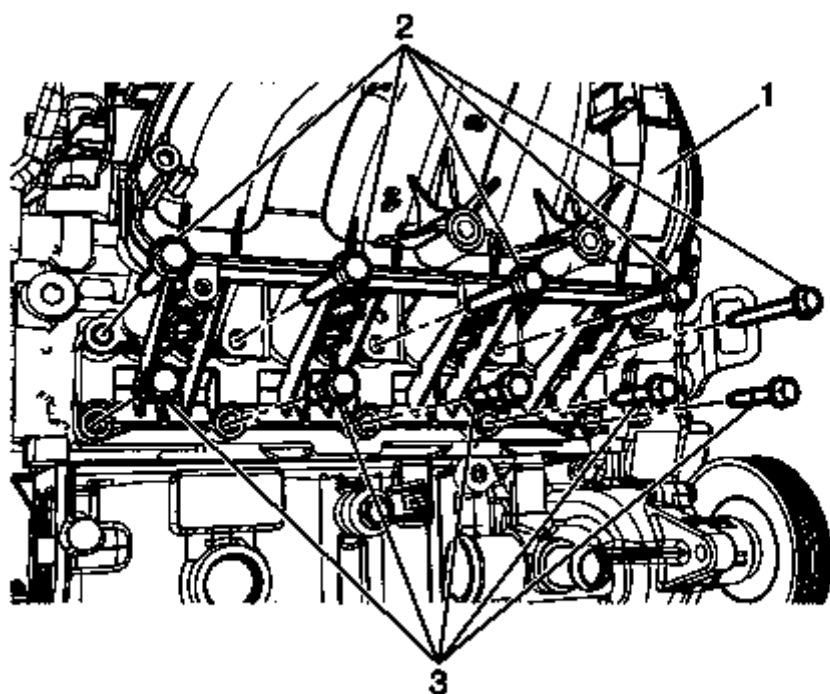


Fig. 290: Lower Intake Manifold And Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the lower intake manifold 10 bolts (2, 3).
6. Remove the lower intake manifold (1).

IGNITION COIL REMOVAL

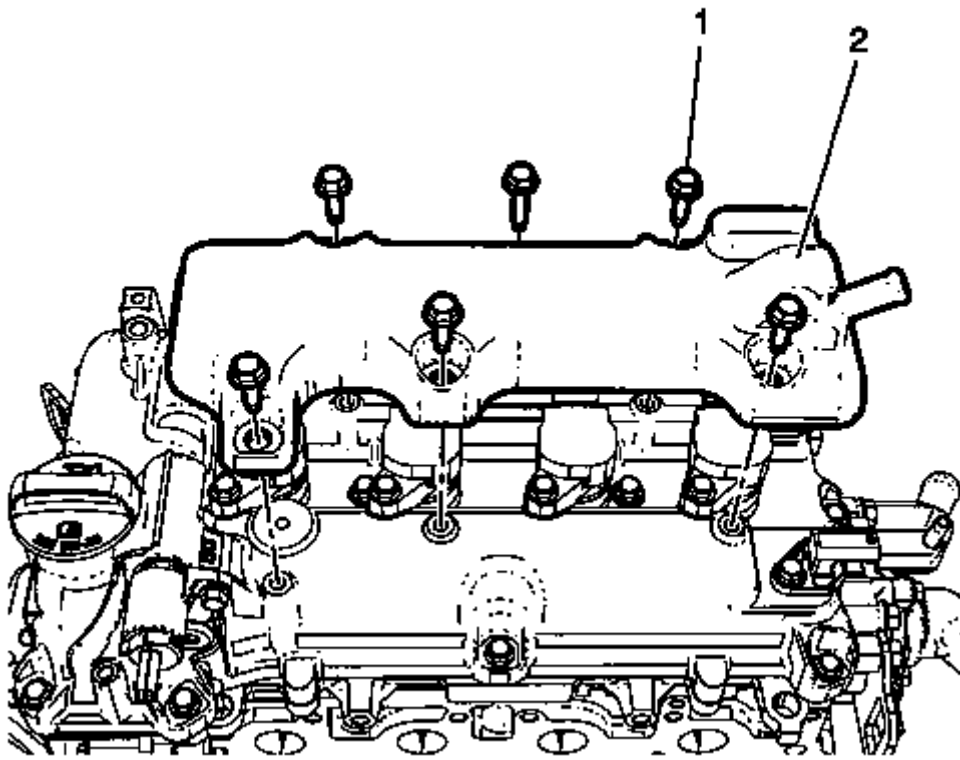


Fig. 291: Ignition Coil Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Remove the ignition coil cover bolts (1).
2. Remove the ignition coil cover (2).

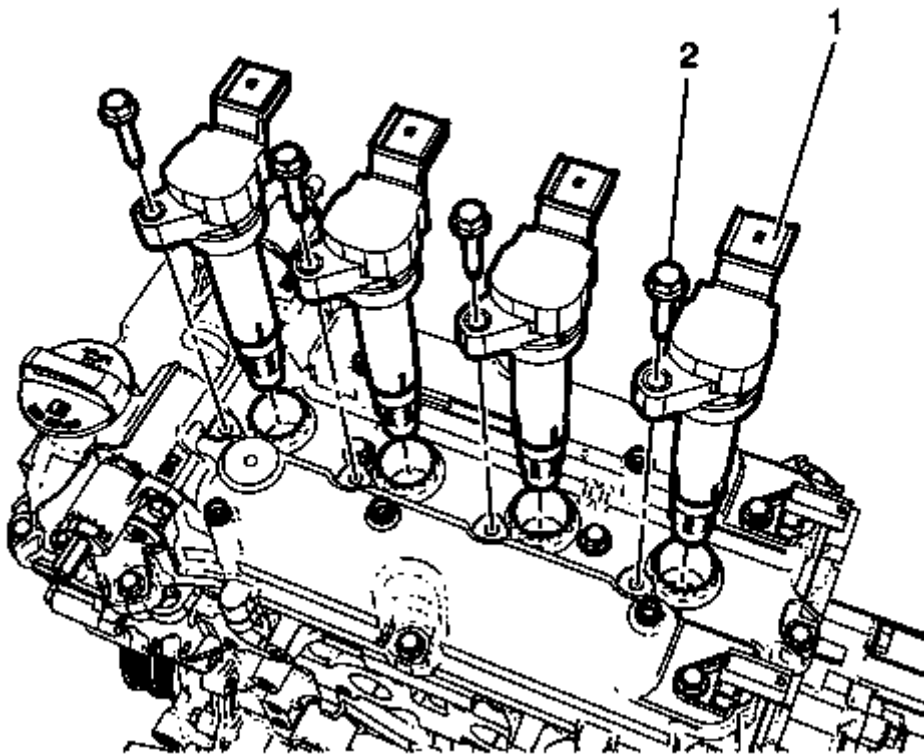


Fig. 292: Ignition Coil
Courtesy of GENERAL MOTORS COMPANY

3. Remove the ignition coil bolts (2).
4. Remove the ignition coil (1).

CAMSHAFT COVER REMOVAL

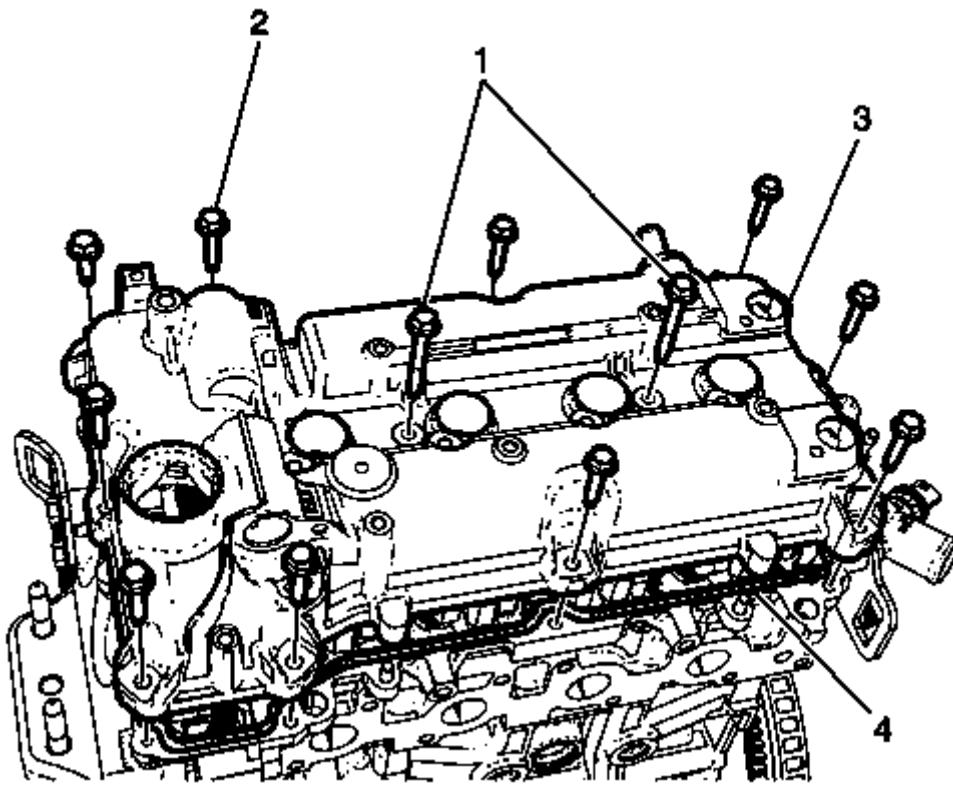


Fig. 293: Camshaft Cover Bolts

Courtesy of GENERAL MOTORS COMPANY

1. Remove the camshaft cover bolts (1, 2).
2. Remove the camshaft cover (3).
3. Remove the camshaft cover gasket (4).

WATER PUMP REMOVAL

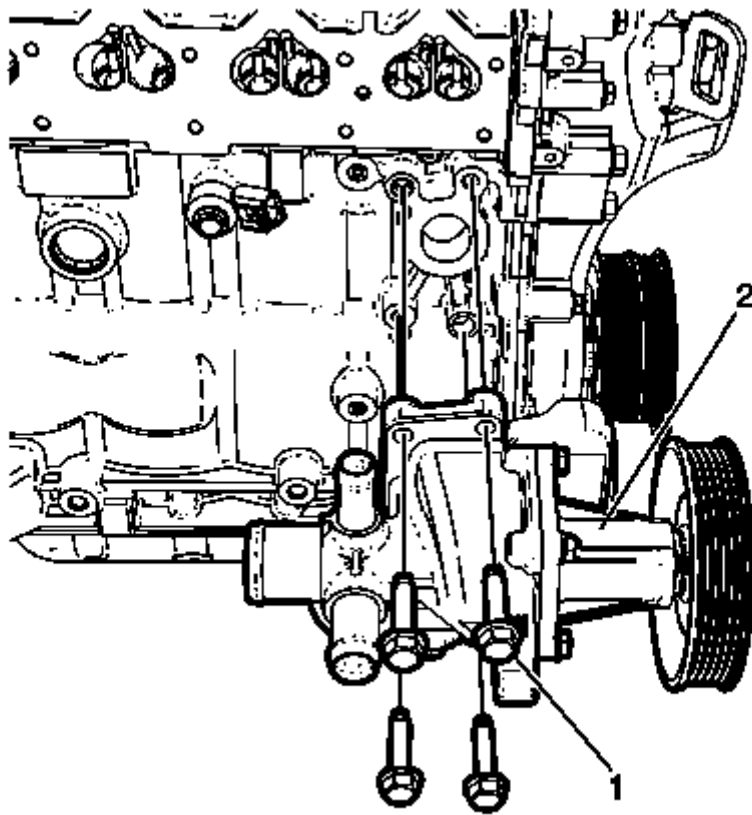


Fig. 294: Water Pump Bolts

Courtesy of GENERAL MOTORS COMPANY

1. Remove the 4 water pump bolts (1).
2. Remove the water pump (2).

ENGINE FRONT COVER AND OIL PUMP REMOVAL

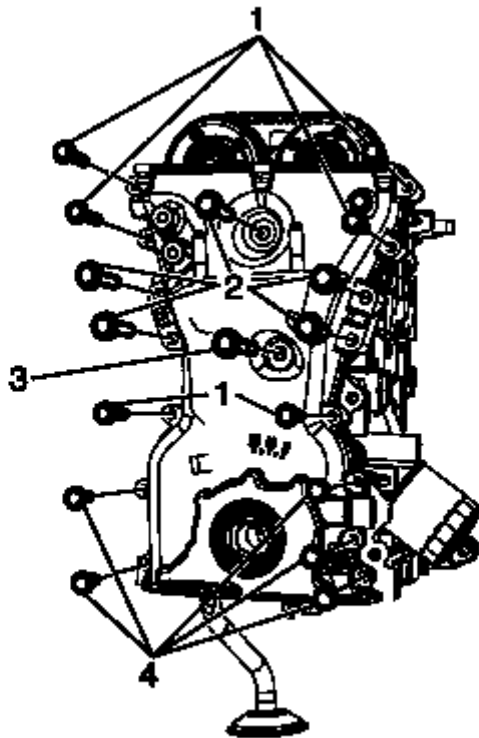


Fig. 295: Engine Front Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: Note the different screw lengths.

1. Remove the bolts (1, 2, 3, 4).

NOTE: Do not damage the sealing surfaces.

2. Remove the engine front cover with the included oil pump.

NOTE: There are no serviceable components within the oil pump. Disassemble the pump only to diagnose an oiling concern. A disassembled oil pump must not be reused. A disassembled oil pump must be replaced.

3. Clean the sealing surface.

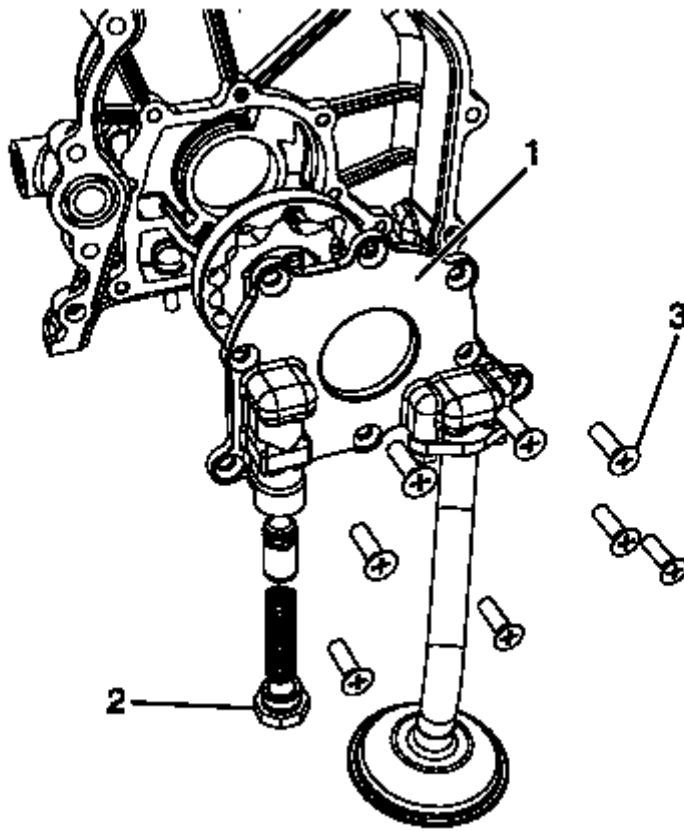


Fig. 296: Oil Pump Screws

Courtesy of GENERAL MOTORS COMPANY

4. Remove the oil pump screws (3).
5. Remove the oil pump (1).
6. Remove the plug, holding the plug for the oil relief valve components.
7. Remove the plug, spring and plunger (2), from the oil pump housing (1).

CAMSHAFT TIMING CHAIN REMOVAL

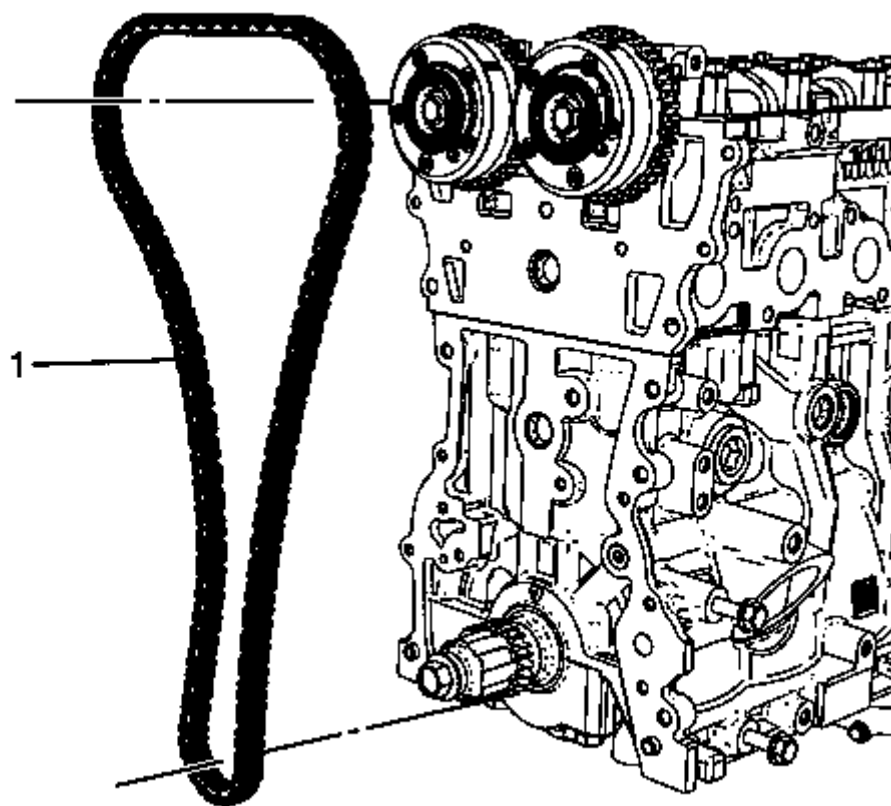


Fig. 297: Timing Chain

Courtesy of GENERAL MOTORS COMPANY

Remove the timing chain (1).

TIMING CHAIN TENSIONER REMOVAL

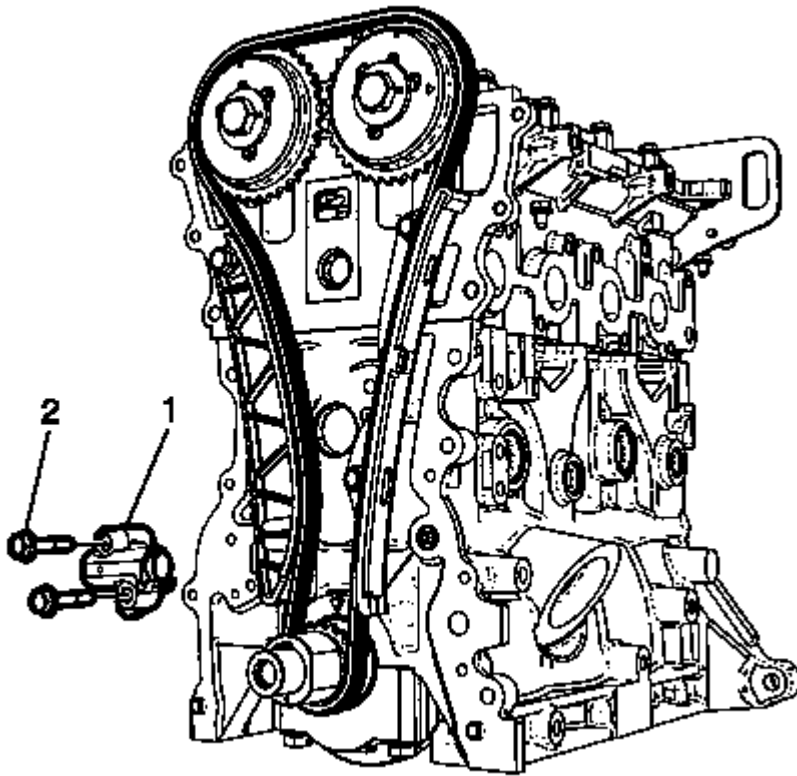


Fig. 298: Timing Chain Tensioner Retaining Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Remove the timing chain tensioner retaining bolts (2).
2. Remove the timing chain tensioner (1).
3. Inspect the timing chain tensioner mounting surface on the cylinder head for burrs or any defects that may degrade the sealing.

TIMING CHAIN GUIDE REMOVAL

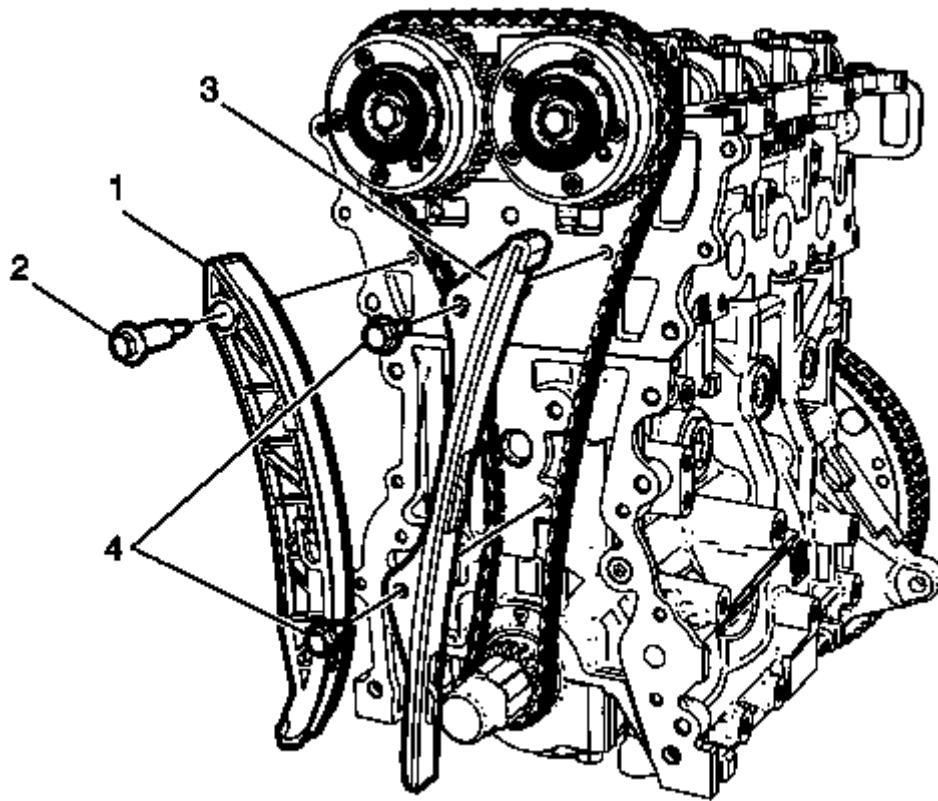


Fig. 299: Left Timing Chain Shoe Retaining Bolt
Courtesy of GENERAL MOTORS COMPANY

1. Remove the timing chain guide retaining bolts (4).
2. Remove the timing chain guide (3).
3. Remove the timing chain shoe retaining bolt (2).
4. Remove the timing chain shoe (1).

ENGINE LIFT FRONT BRACKET REMOVAL

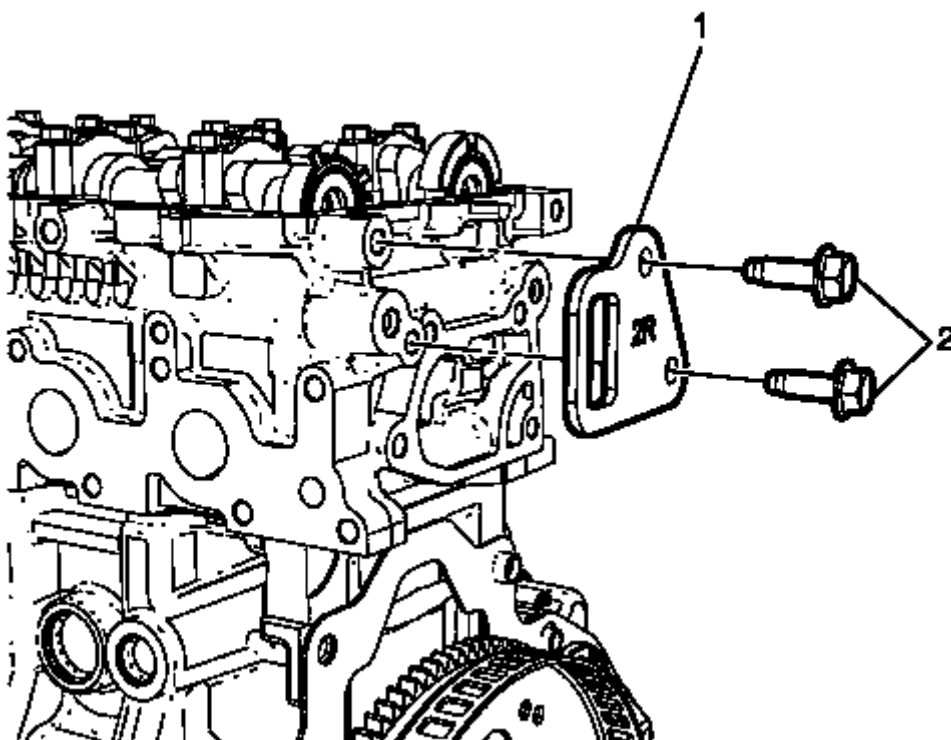


Fig. 300: Engine Lift Front Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Remove the engine lift front bracket bolts (2) from the cylinder head.
2. Remove the engine lift front bracket (1).

ENGINE LIFT REAR BRACKET REMOVAL

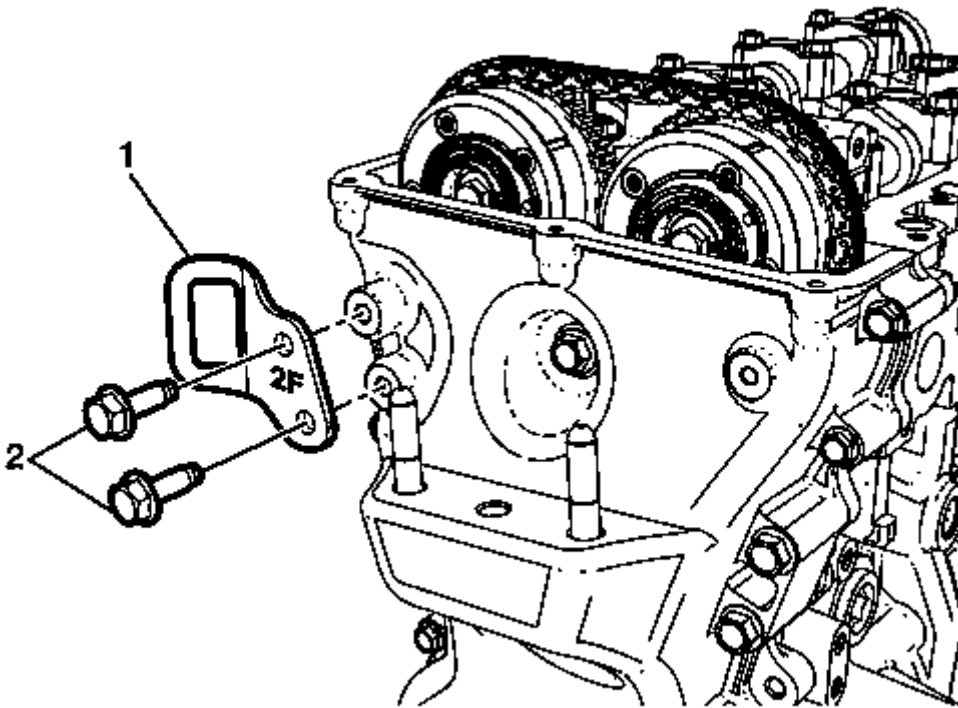


Fig. 301: Engine Lift Rear Bracket And Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Remove the engine lift rear bracket bolts (2) from the timing chain cover.
2. Remove the engine lift rear bracket (1).

CAMSHAFT REMOVAL (LL0)

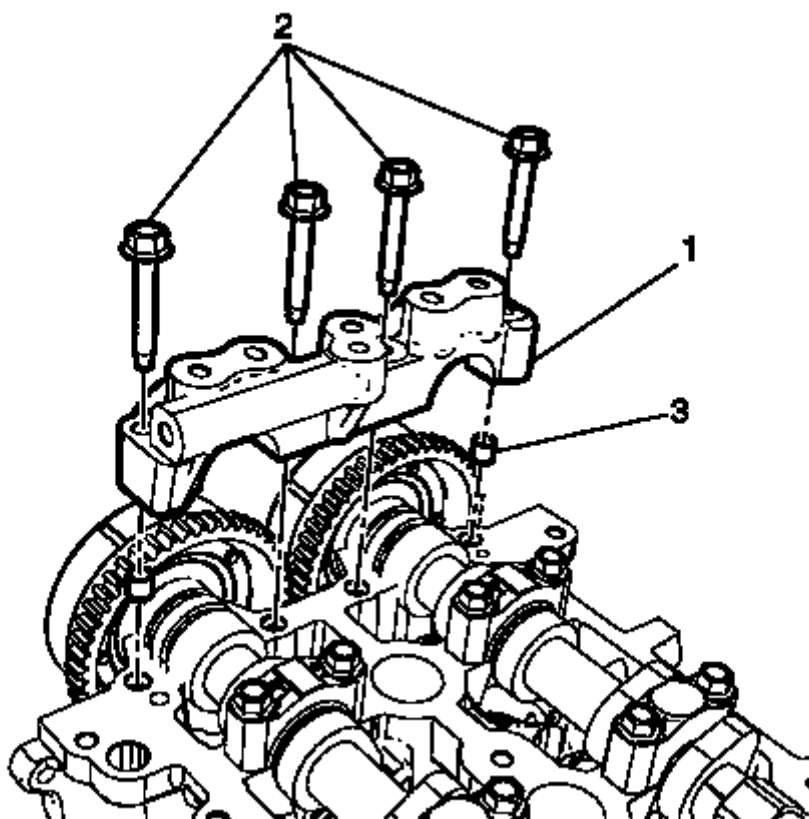


Fig. 302: First Camshaft Bearing Cap Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Remove the first camshaft bearing cap bolts (2).
2. Remove the first camshaft bearing cap (1) and dowel pin (3).

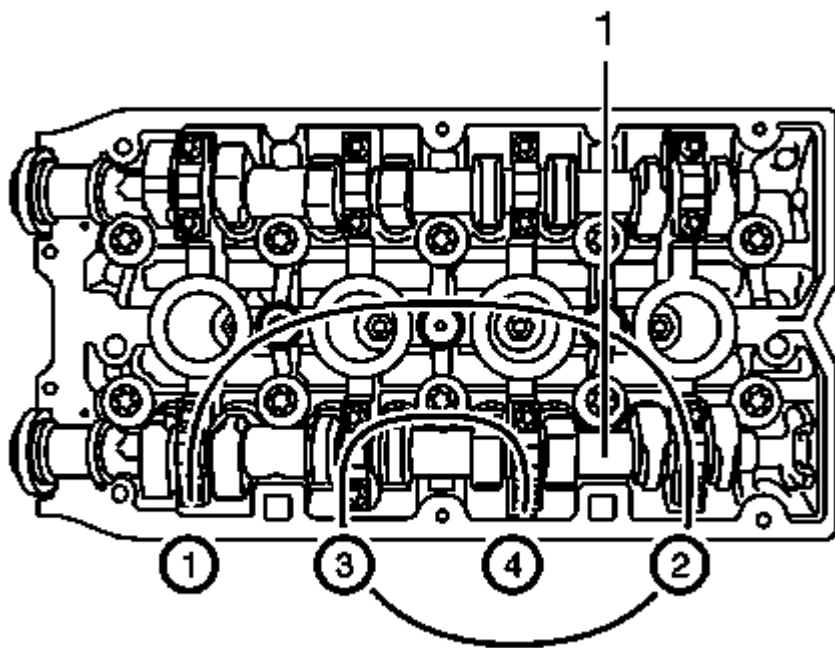


Fig. 303: Exhaust Camshaft Bearing Cap Bolts Loosening Sequence
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Note removal sequence 1-4.**

3. Loosen the 8 exhaust camshaft bearing cap bolts working from outside to inside in a spiral in steps of 1/2 up to 1 turn.

NOTE: **Mark camshaft bearing caps before removal.**

4. Remove the 8 exhaust camshaft bearing cap bolts.
5. Remove the 4 exhaust camshaft bearing caps numbers 6-9 from the cylinder head.
6. Remove the exhaust camshaft.

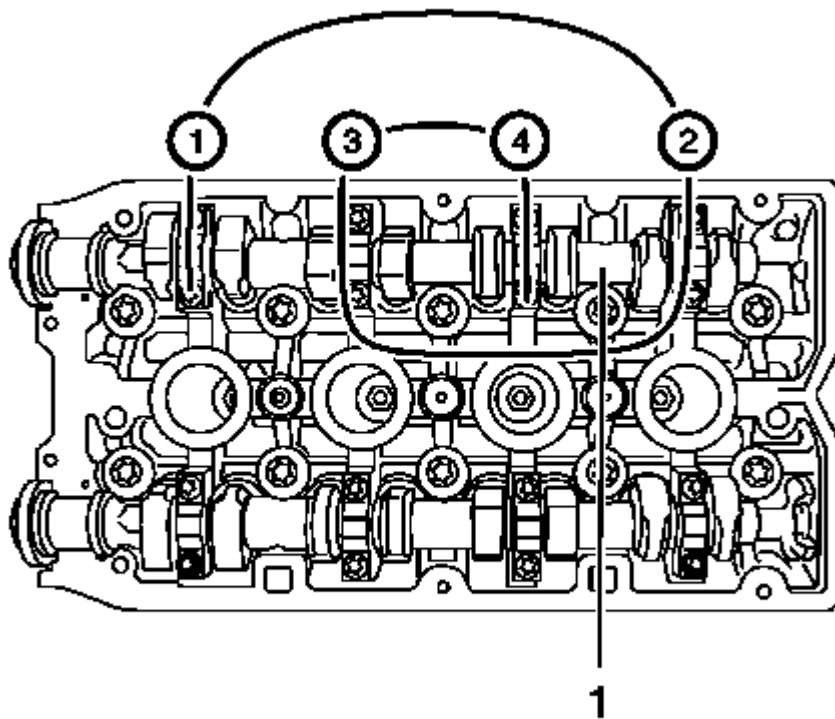


Fig. 304: Intake Camshaft Bearing Cap Bolts Loosening Sequence
Courtesy of GENERAL MOTORS COMPANY

NOTE: Note removal sequence 1-4.

7. Loosen the 8 intake camshaft bearing cap bolts working from outside to inside in a spiral in steps of 1/2 up to 1 turn.
8. Remove the 8 intake camshaft bearing cap bolts.

NOTE: Mark camshaft bearing caps before removal.

9. Remove the 4 intake camshaft bearing caps numbers 2-5 from the cylinder head.

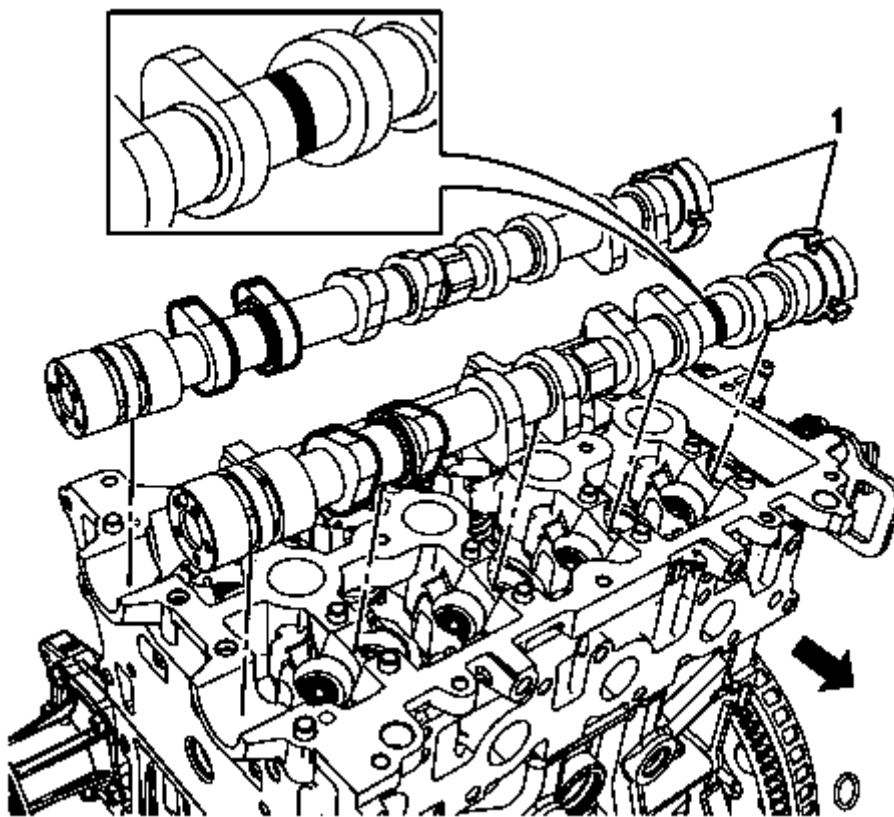


Fig. 305: Camshafts

Courtesy of GENERAL MOTORS COMPANY

NOTE: The exhaust camshaft has a groove between the No. 3 journal and No. 4 journal. The intake camshaft has no groove.

10. Remove the intake camshaft and the exhaust camshaft (1).

CAMSHAFT REMOVAL (LFM)

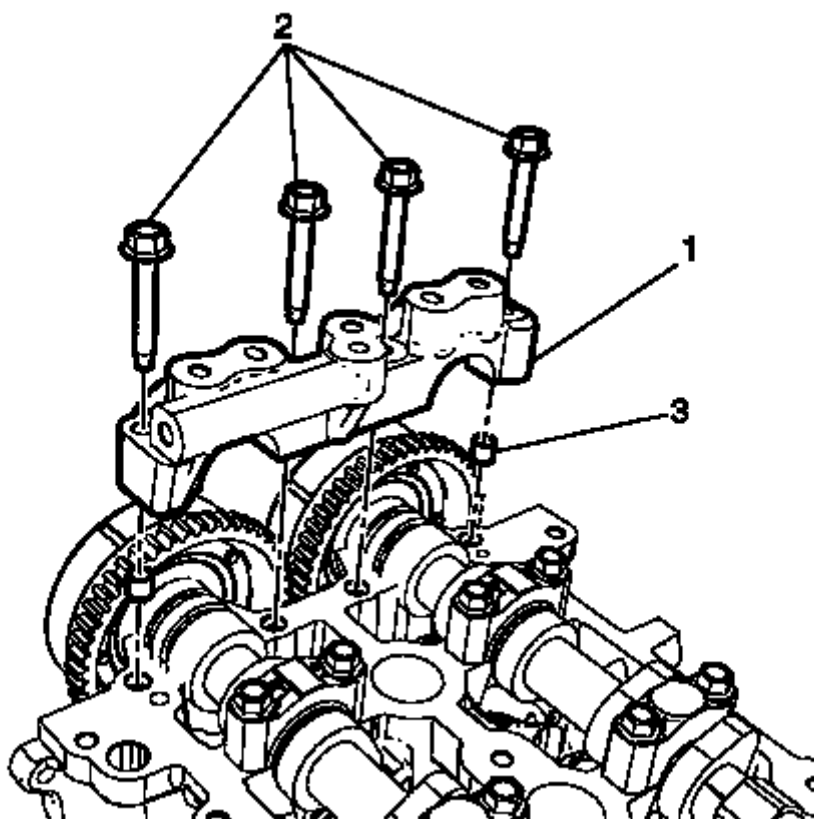


Fig. 306: First Camshaft Bearing Cap Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Remove the first camshaft bearing cap bolts (2).
2. Remove the first camshaft bearing cap (1) and dowel pin (3).

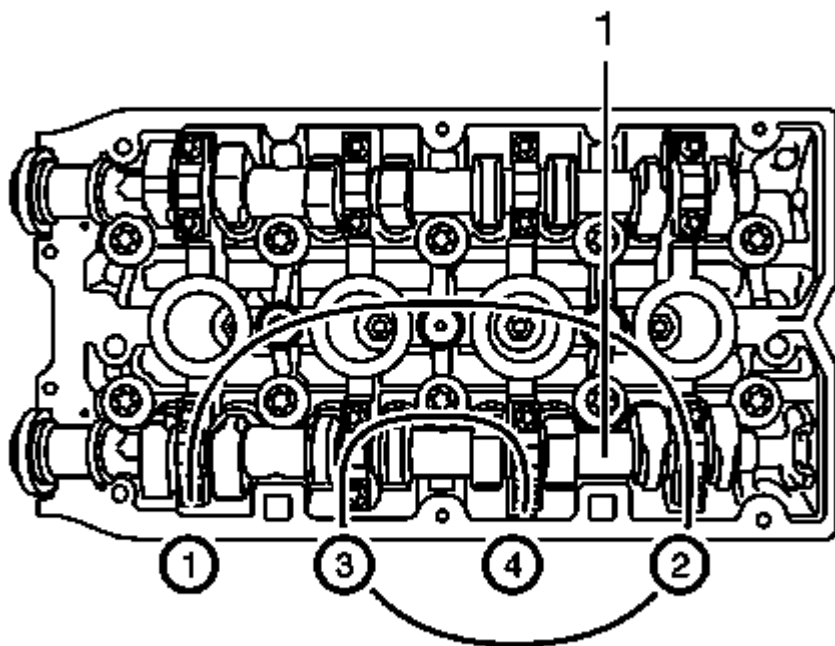


Fig. 307: Exhaust Camshaft Bearing Cap Bolts Loosening Sequence
Courtesy of GENERAL MOTORS COMPANY

NOTE: Note removal sequence 1-4.

3. Loosen the 8 exhaust camshaft bearing cap bolts working from outside to inside in a spiral in steps of 1/2 up to 1 turn.

NOTE: Mark camshaft bearing caps before removal.

4. Remove the 8 exhaust camshaft bearing cap bolts.
5. Remove the 4 exhaust camshaft bearing caps numbers 6-9 from the cylinder head.
6. Remove the exhaust camshaft.

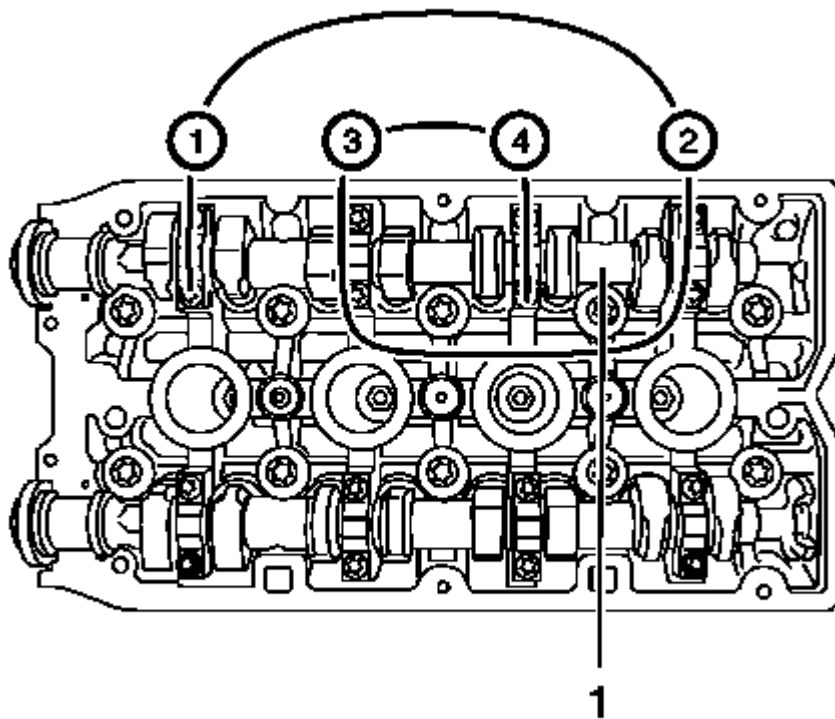


Fig. 308: Intake Camshaft Bearing Cap Bolts Loosening Sequence
Courtesy of GENERAL MOTORS COMPANY

NOTE: Note removal sequence 1-4.

7. Loosen the 8 intake camshaft bearing cap bolts working from outside to inside in a spiral in steps of 1/2 up to 1 turn.
8. Remove the 8 intake camshaft bearing cap bolts.

NOTE: Mark camshaft bearing caps before removal.

9. Remove the 4 intake camshaft bearing caps numbers 2-5 from the cylinder head.

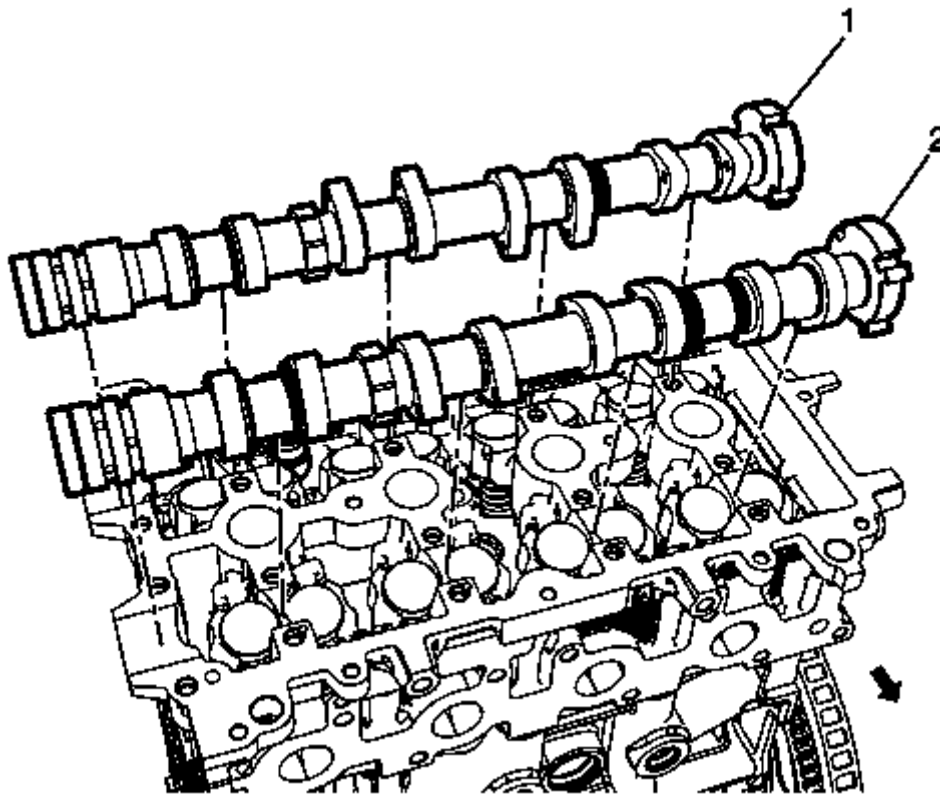


Fig. 309: Intake Camshaft

Courtesy of GENERAL MOTORS COMPANY

NOTE: The exhaust camshaft has 2 grooves between the No. 3 journal and No. 4 journal. The intake camshaft has 1 groove.

10. Remove the intake camshaft (1) and the exhaust camshaft (2).

CYLINDER HEAD AND GASKET REMOVAL

Special Tools

GE-42072 Cylinder Head Bolt Remover/Installer

For equivalent regional tools, refer to **Special Tools**.

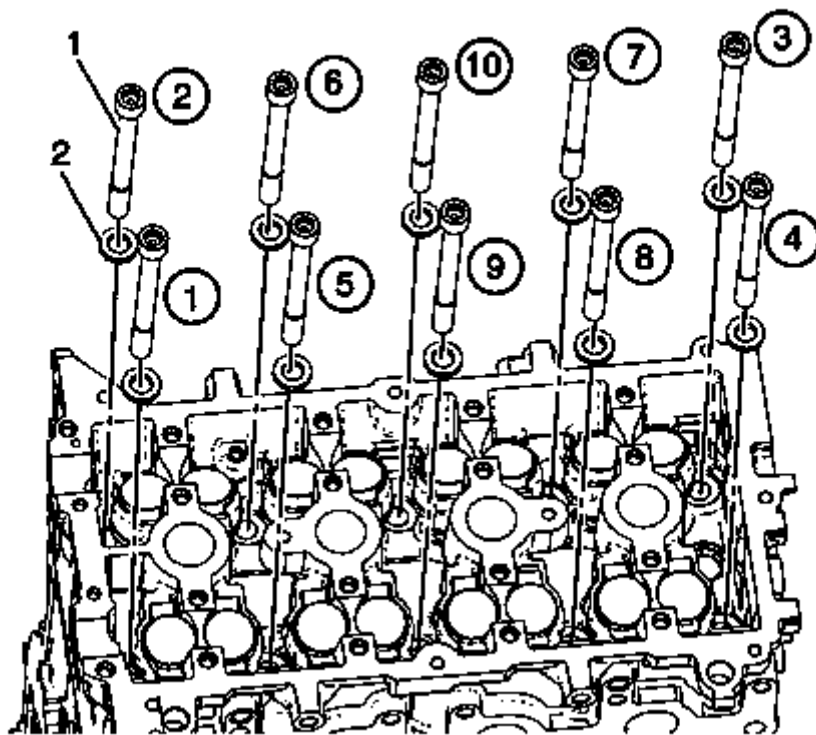


Fig. 310: Identifying Cylinder Head Bolts With GE-42072 Cylinder Head Bolt Remover/Installer In Sequence

Courtesy of GENERAL MOTORS COMPANY

NOTE: The cylinder head bolts require a 10 mm 12 point triple square tool for proper servicing. Use GE-42072 Cylinder Head Bolt Remover/Installer or equivalent when servicing head bolts.

1. Remove the 10 cylinder head bolts with the **GE-42072** cylinder head bolt remover/installer (1) in sequence as shown
 1. Loosen the 10 bolts 90°.
 2. Loosen the 10 bolts 180°.
2. Remove the cylinder head and place on a suitable base.
3. Remove the cylinder head gasket.

OIL PUMP DISASSEMBLE

NOTE: There are no serviceable components within the oil pump. Disassemble the pump only to diagnose an oiling concern. A disassembled oil pump must not be reused. A disassembled oil pump must be replaced.

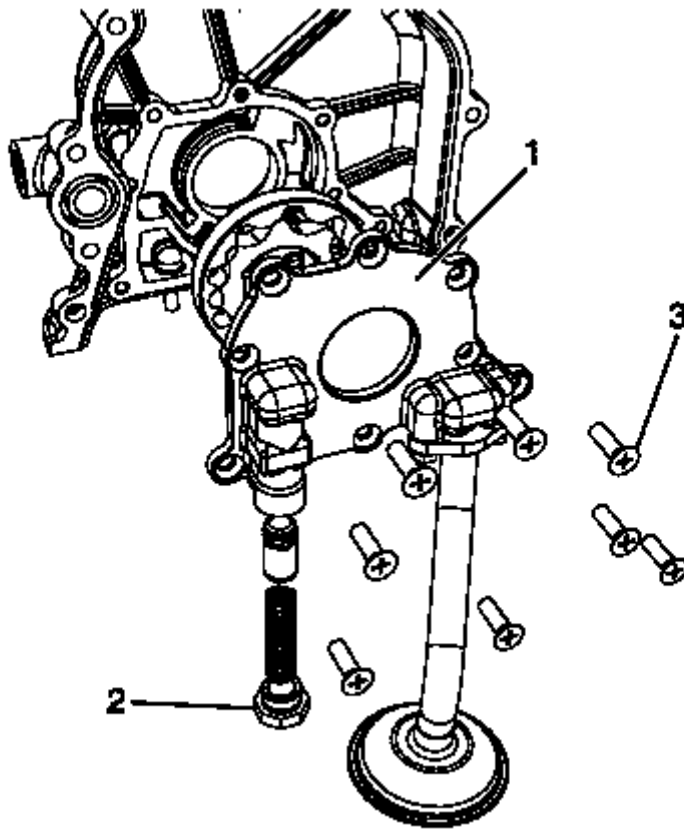


Fig. 311: Oil Pump Screws

Courtesy of GENERAL MOTORS COMPANY

1. Remove the oil pump housing retaining bolts (3).
2. Remove the oil pump housing (1).
3. Remove the inner oil pump drive gear.
4. Remove the outer oil pump driven gear.
5. Remove the plug (2), holding the plug, for the oil relief valve components.
6. Remove the plug, spring and plunger from the oil pump housing (1).

OIL PUMP ASSEMBLE

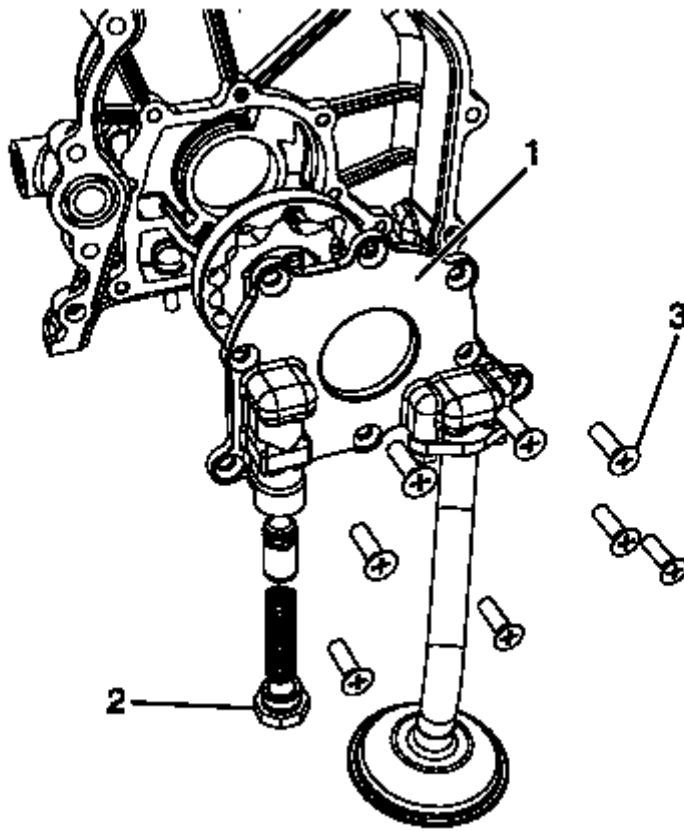


Fig. 312: Oil Pump Screws

Courtesy of GENERAL MOTORS COMPANY

1. Install the oil relief components to oil pump housing (1).
2. Install the plug (2).

NOTE: The dimpled surface must be face-up in the pump body.

3. Install the inner oil pump drive gear and the outer oil pump driven gear in the engine front cover in the same orientation as removed.
4. Install the oil pump housing (1) to the engine front cover.

CAUTION: Refer to Fastener Caution .

5. Install the oil pump housing retaining bolts (3) and tighten to 10 (89 lb in).

OIL PAN REMOVAL

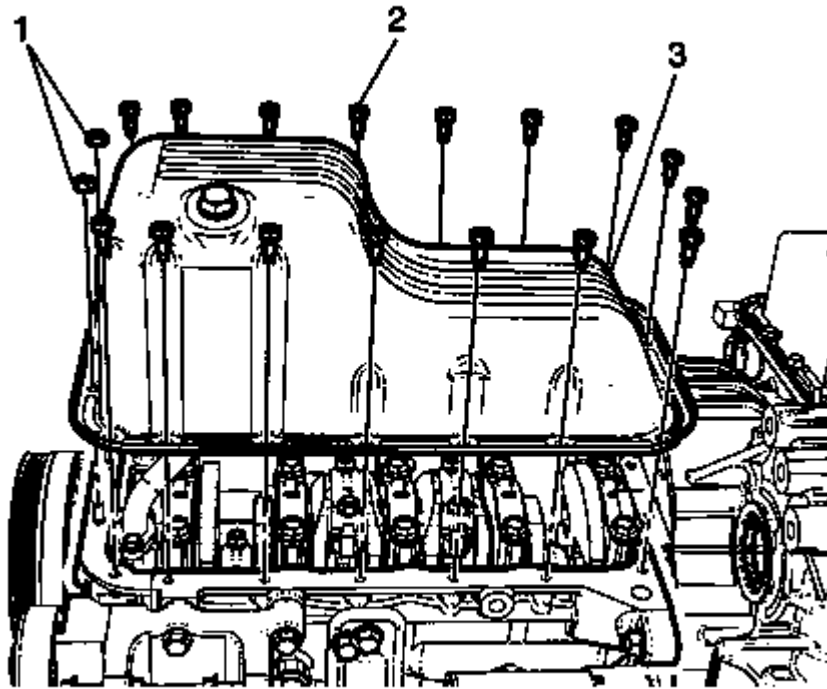


Fig. 313: Oil Pan Bolts And Nuts

Courtesy of GENERAL MOTORS COMPANY

1. Remove the 16 oil pan bolts (2) and 2 nuts (1) from the engine block.
2. Use a suitable tool to remove the oil pan (3) evenly all the way around.
3. Discard the oil pan.

PISTON, CONNECTING ROD AND BEARING REMOVAL

1. Install the crankshaft balancer bolt.
2. Set the pistons 1 and 4 to BDC in direction of engine rotation.

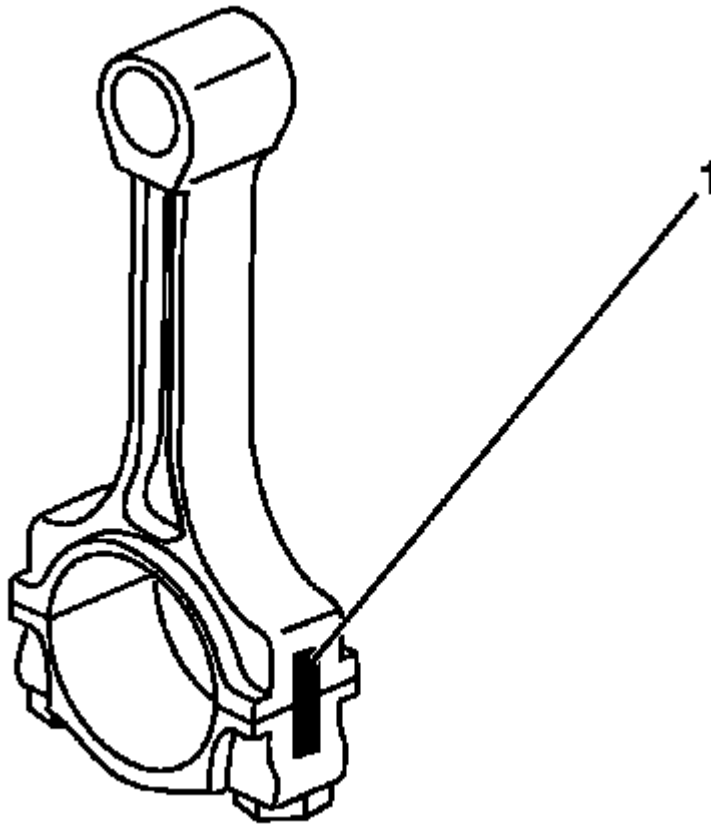


Fig. 314: View Of Con-Rod Bearing Caps
Courtesy of GENERAL MOTORS COMPANY

3. Mark the connecting rod with the connecting rod bearing cover (1).

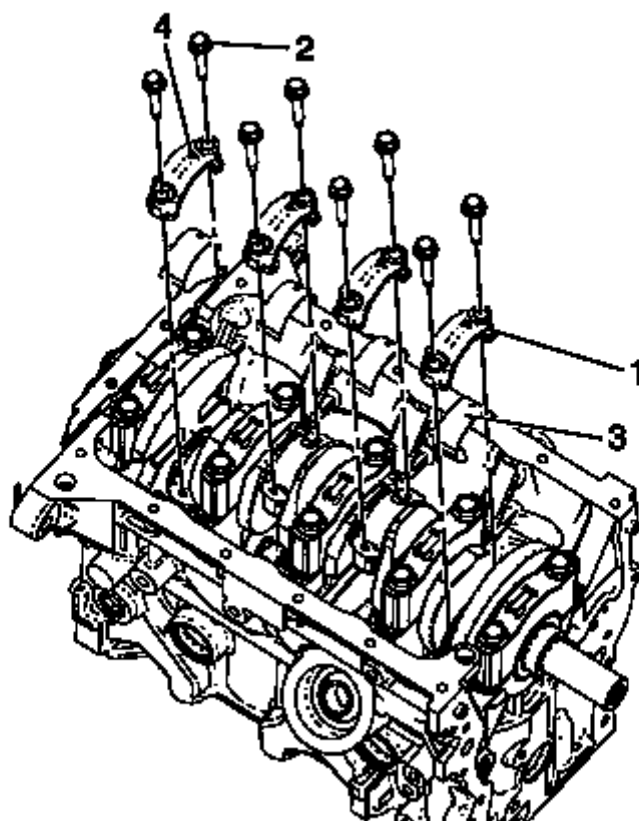


Fig. 315: Rod Bearing Caps Nuts

Courtesy of GENERAL MOTORS COMPANY

4. Remove the 4 connecting rod bearing caps bolts (2) of cylinder 1 and 4.
5. Remove the connecting rod bearing caps (1) and the connecting rod bearing (3).

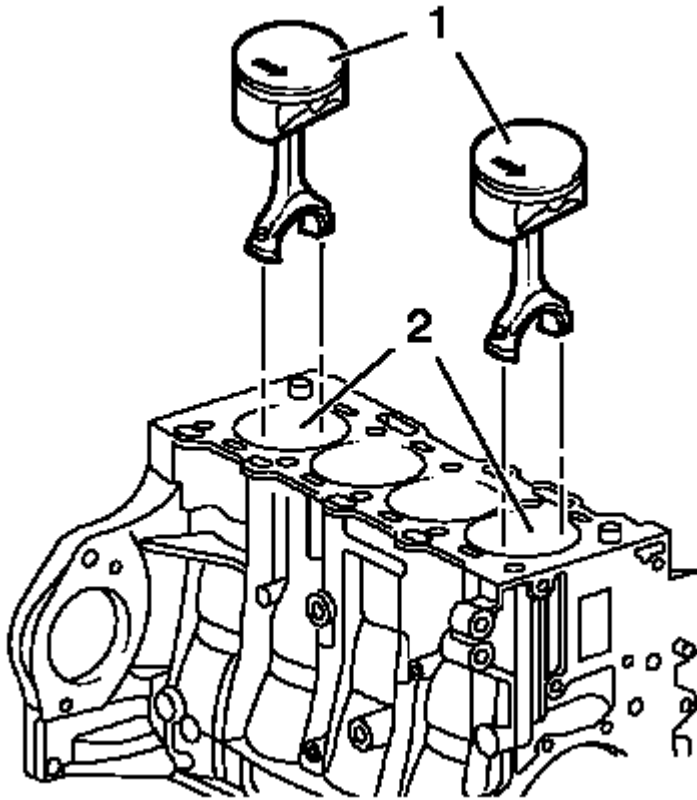


Fig. 316: Pistons 1, 4 And Cylinder Bore
Courtesy of GENERAL MOTORS COMPANY

6. Push the pistons 1 and 4 (1) out of the cylinder bore (2).
7. Remove the pistons 1 and 4 (1).
8. Turn crankshaft on crankshaft balancer through 180 degrees in direction of rotation of engine.
9. Repeat for the piston 2 and 3.

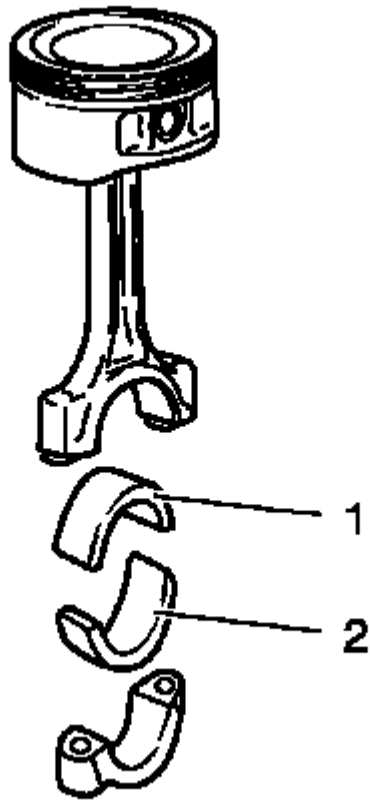


Fig. 317: Connecting Rod Bearing
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Observe correct fitting position, observe alignment.**

10. Remove the connecting rod bearing (1, 2).

CRANKSHAFT FRONT OIL SEAL REMOVAL

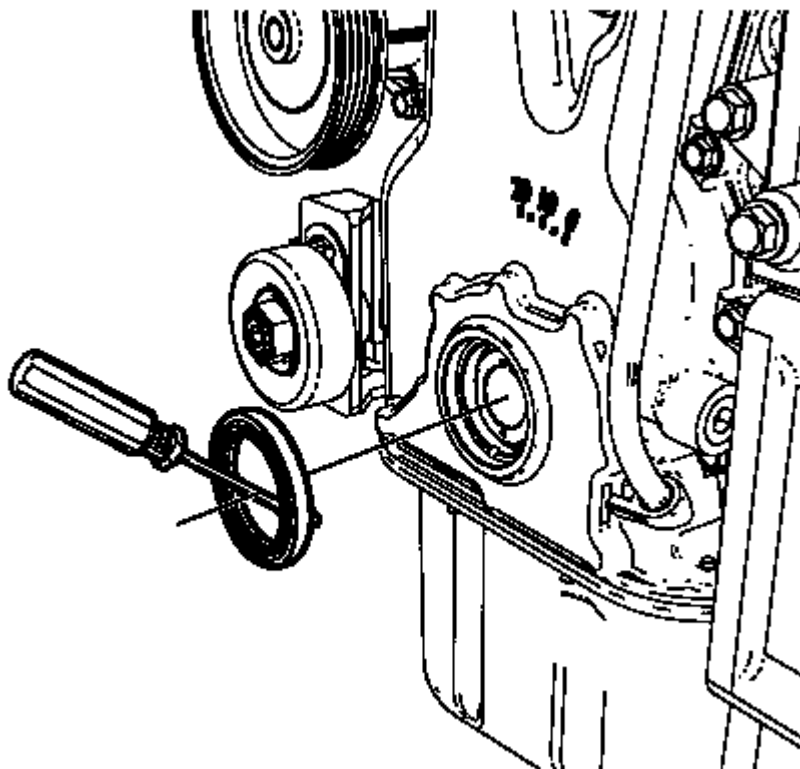


Fig. 318: Using Flat-Bladed Tool To Remove Seal From Front Cover
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Clean the crankshaft sealing surface with a clean, lint-free towel. Inspect lead-in edge of crankshaft for burrs/sharp edges that could damage the rear main oil seal. Remove burrs/sharp edges with crocus cloth before proceeding.

Using the suitable tool, remove the crankshaft front oil seal from the crankshaft.

CRANKSHAFT REAR OIL SEAL AND HOUSING REMOVAL

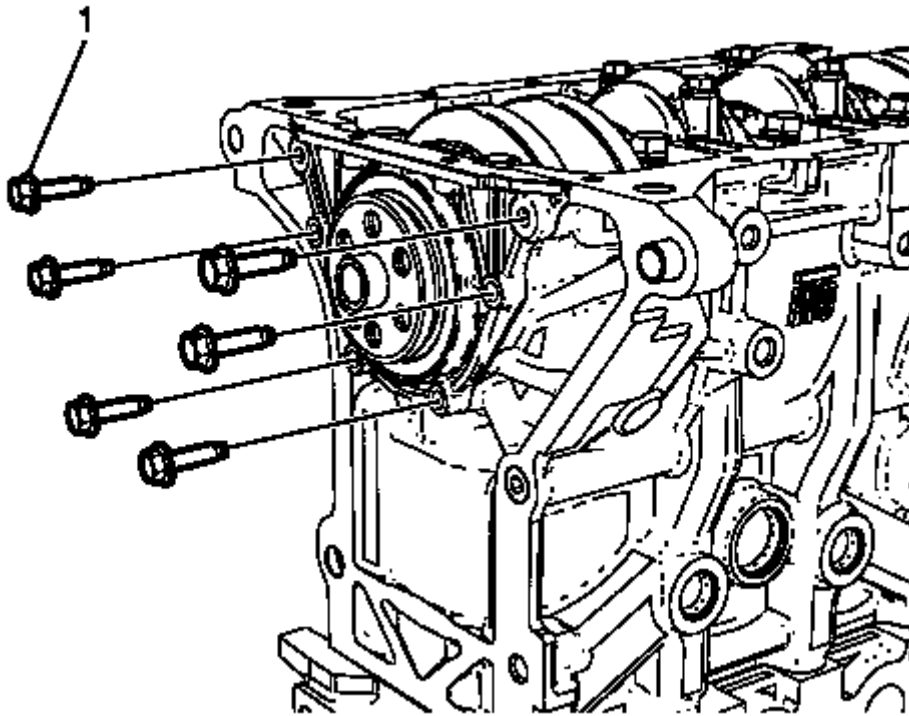


Fig. 319: Crankshaft Rear Oil Seal Housing Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Remove the crankshaft rear oil seal housing bolts (1).

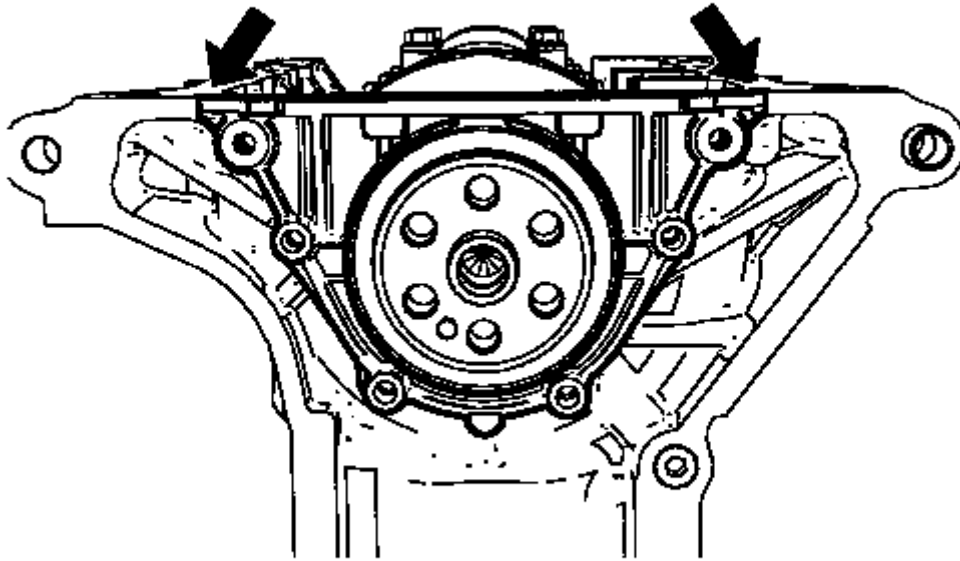


Fig. 320: Edge Of Crankshaft Rear Oil Seal Housing
Courtesy of GENERAL MOTORS COMPANY

2. Use the pry points located at the edge of the crankshaft rear oil seal housing to separate the RTV sealant.

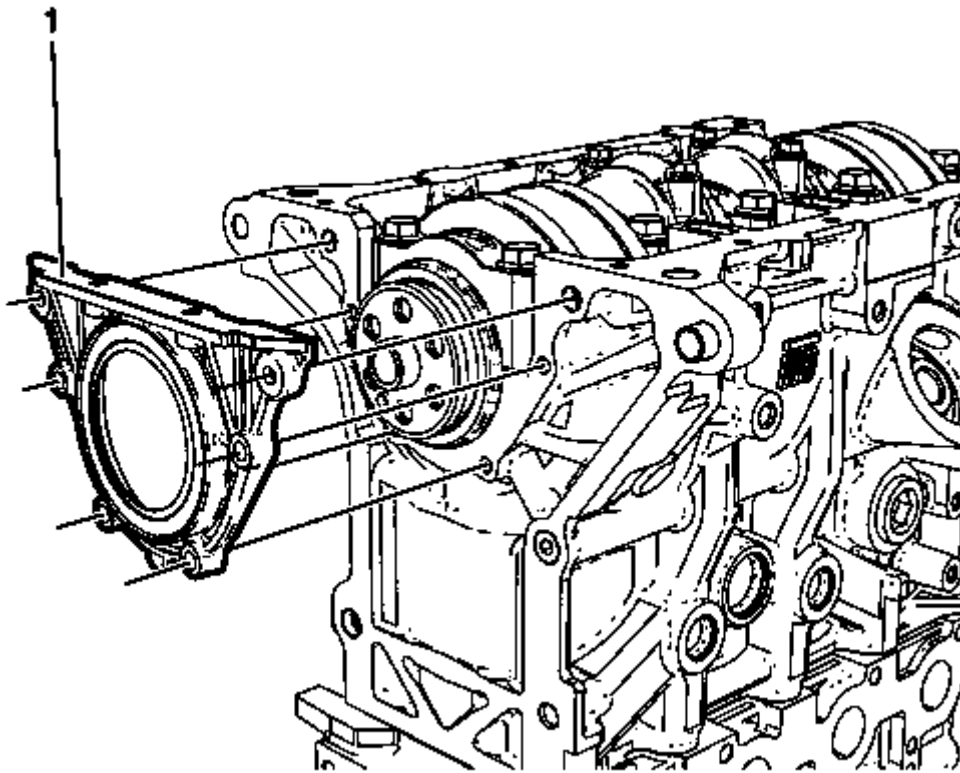


Fig. 321: Crankshaft Rear Oil Seal And Housing
Courtesy of GENERAL MOTORS COMPANY

3. Remove and discard the crankshaft rear oil seal and housing (1).

CRANKSHAFT AND BEARING REMOVAL

NOTE: Take extreme care to prevent any scratches, nicks or damage to the inner side of the cylinder and bearings.

NOTE: Check and confirm the sequence of the crankshaft caps and bearings.

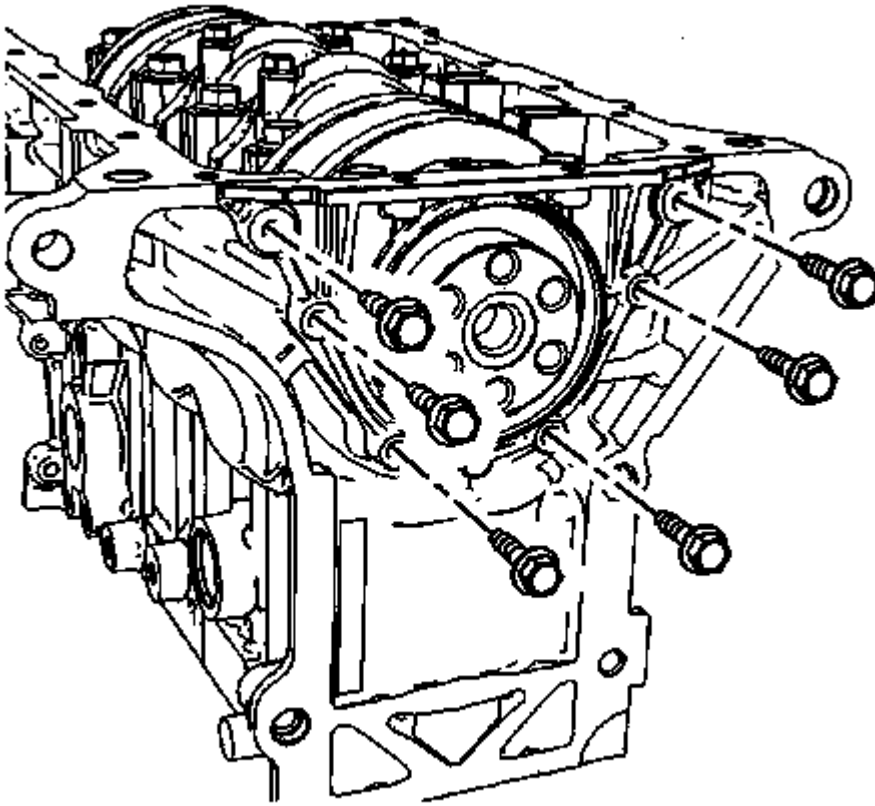


Fig. 322: Crankshaft Rear Oil Seal With Housing
Courtesy of GENERAL MOTORS COMPANY

1. Remove the crankshaft rear oil seal with housing.

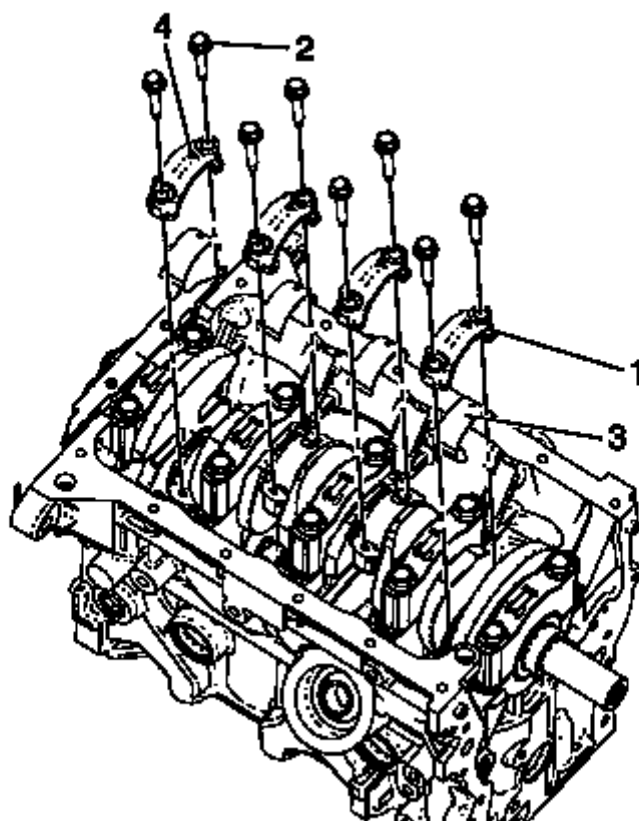


Fig. 323: Rod Bearing Caps Nuts

Courtesy of GENERAL MOTORS COMPANY

2. Remove the connecting rod bearing cap bolts (2).
3. Remove the connecting rod bearing caps (1) and bearing (3).

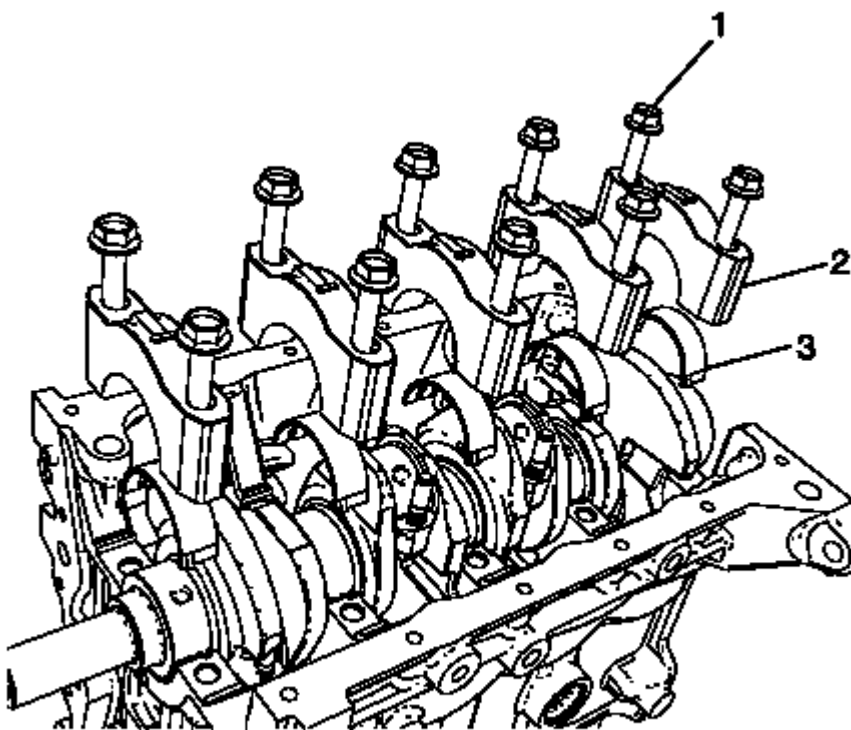


Fig. 324: Crankshaft Bearing Caps
Courtesy of GENERAL MOTORS COMPANY

4. Identify the crankshaft bearing caps.
5. Remove the 10 bolts (1).
6. Remove the crankshaft bearing caps (2).
7. Remove the crankshaft bearing cap bearing (3).
8. Remove the crankshaft.

ENGINE BLOCK DISASSEMBLE (LL0)

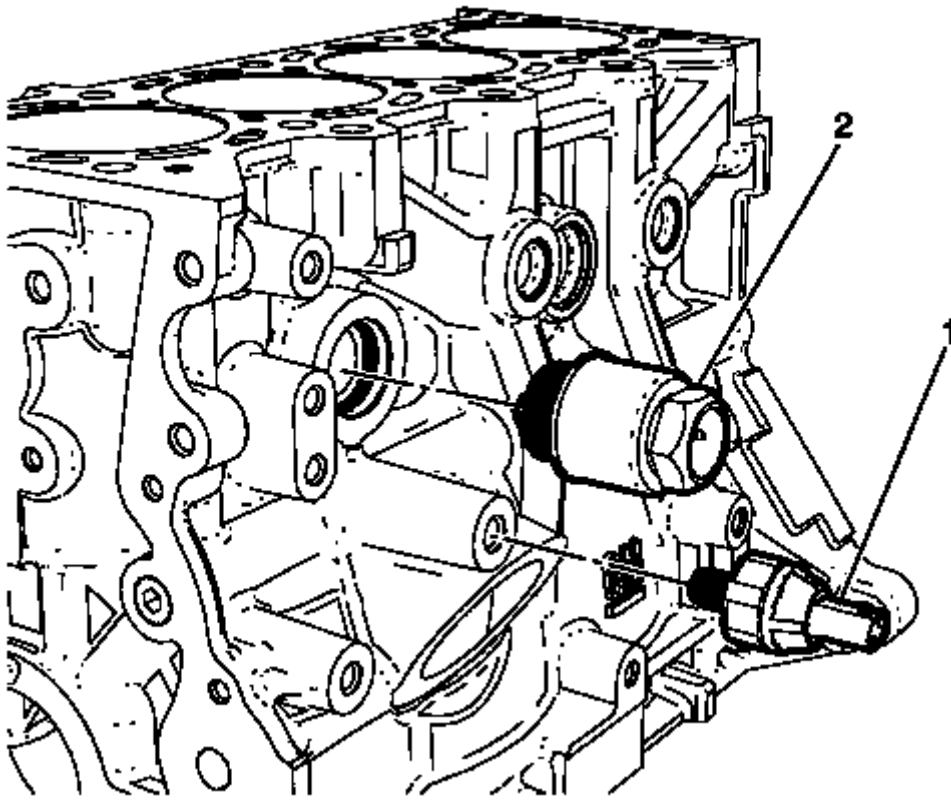


Fig. 325: Oil Pressure Switch And Block Heater
Courtesy of GENERAL MOTORS COMPANY

1. Remove the oil pressure switch (1) and block heater (2).

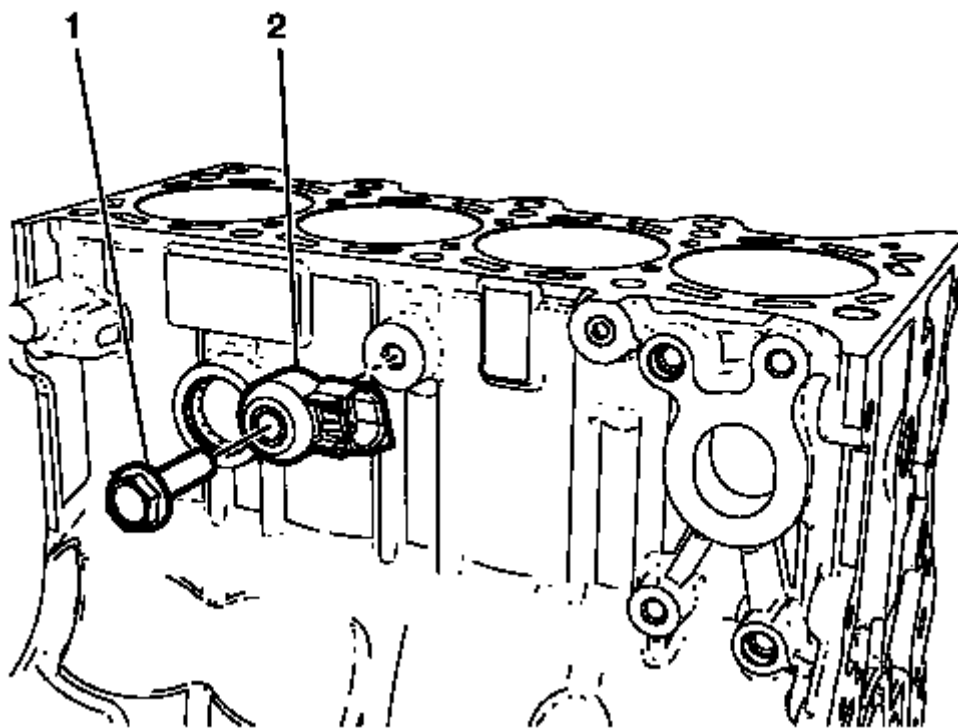


Fig. 326: Knock Sensor Bolt And Knock Sensor
Courtesy of GENERAL MOTORS COMPANY

2. Remove the knock sensor bolt (1) and the knock sensor (2).
3. Clean the thread.

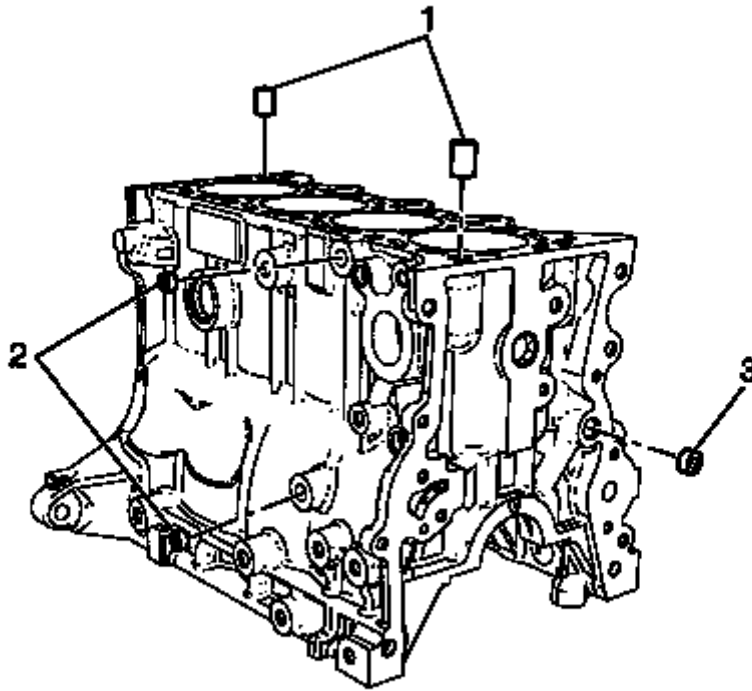


Fig. 327: Cylinder Head Locating

Courtesy of GENERAL MOTORS COMPANY

4. Remove the cylinder head locating (1).
5. Remove the engine block oil gallery plugs (2, 3).

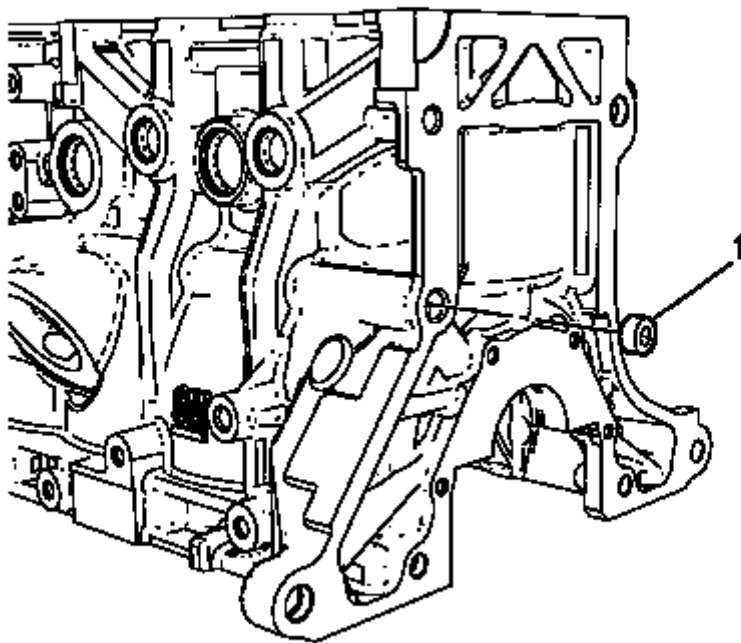


Fig. 328: Engine Block Oil Gallery Plug
Courtesy of GENERAL MOTORS COMPANY

6. Remove the engine block oil gallery plug (1).

ENGINE BLOCK DISASSEMBLE (LFM)

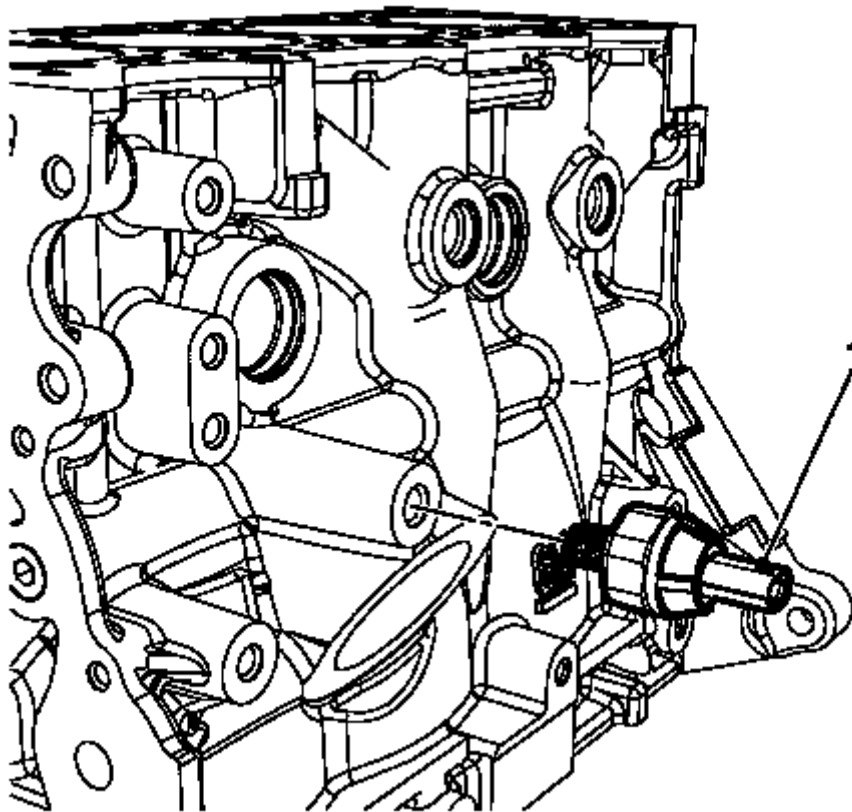


Fig. 329: Oil Pressure Switch

Courtesy of GENERAL MOTORS COMPANY

1. Remove the oil pressure switch (1).

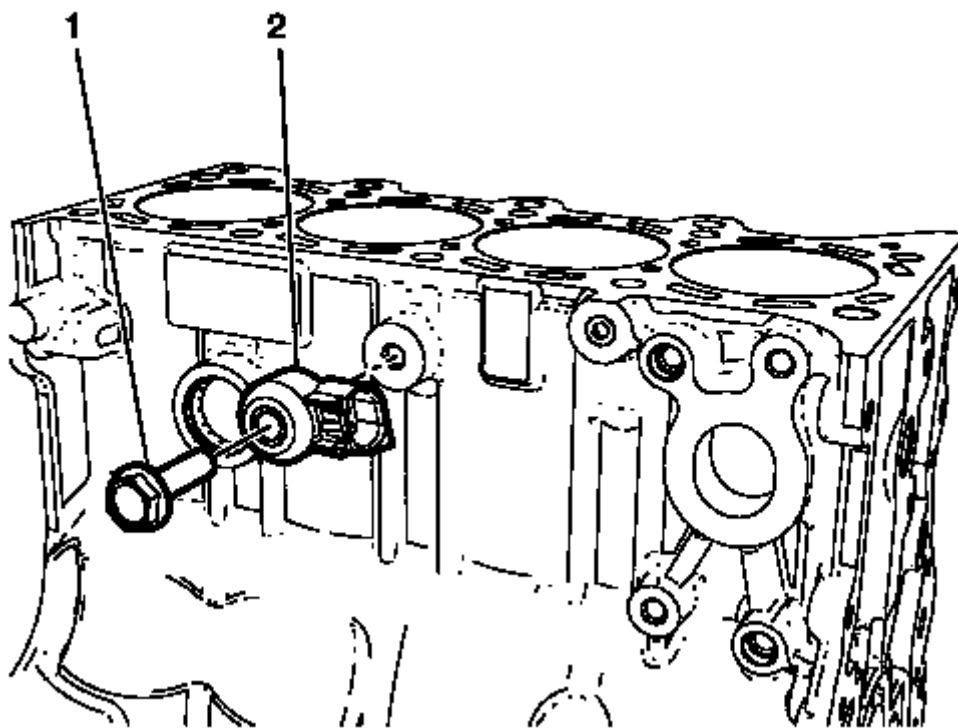


Fig. 330: Knock Sensor Bolt And Knock Sensor
Courtesy of GENERAL MOTORS COMPANY

2. Remove the knock sensor bolt (1) and the knock sensor (2).
3. Clean the thread.

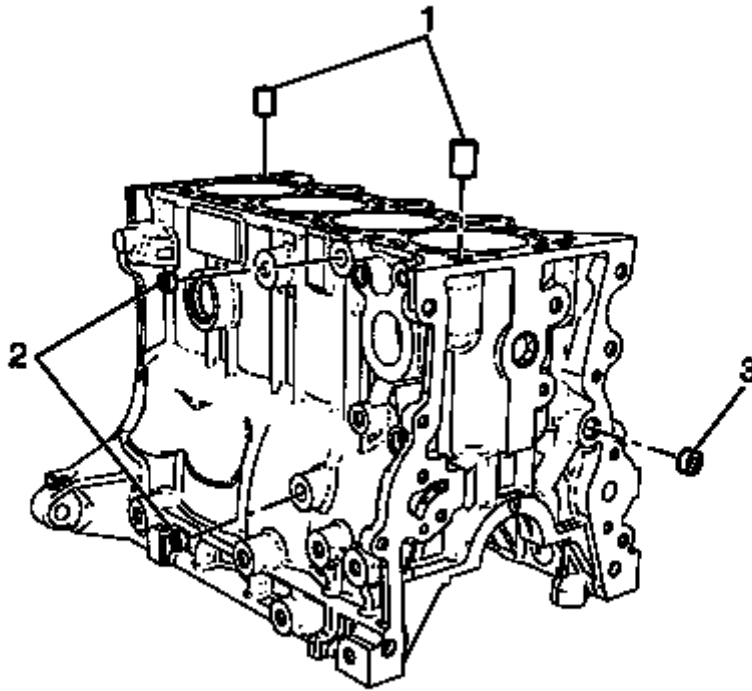


Fig. 331: Cylinder Head Locating

Courtesy of GENERAL MOTORS COMPANY

4. Remove the cylinder head locating (1).
5. Remove the engine block oil gallery plugs (2, 3).

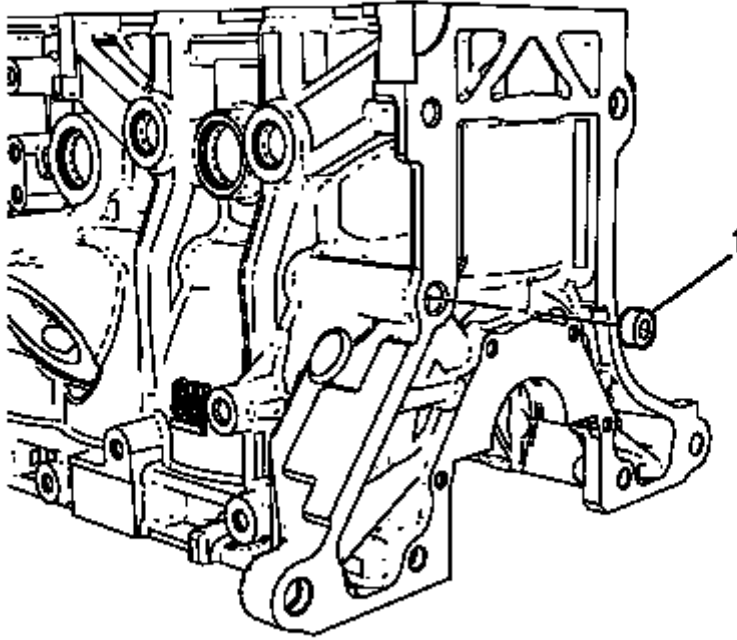


Fig. 332: Engine Block Oil Gallery Plug
Courtesy of GENERAL MOTORS COMPANY

6. Remove the engine block oil gallery plug (1).

PISTON, CONNECTING ROD AND BEARING CLEANING AND INSPECTION (LL0)

Cleaning Procedure

NOTE: **DO NOT use a wire brush any part of the piston.**

1. Clean the piston skirts and the pins with a cleaning solvent.
2. Clean the piston ring grooves with a groove cleaner. Ensure that the oil ring holes and slots are clean.

WARNING: Refer to Safety Glasses and Compressed Air Warning .

3. Dry the piston with compressed air.

Piston Inspection Procedure

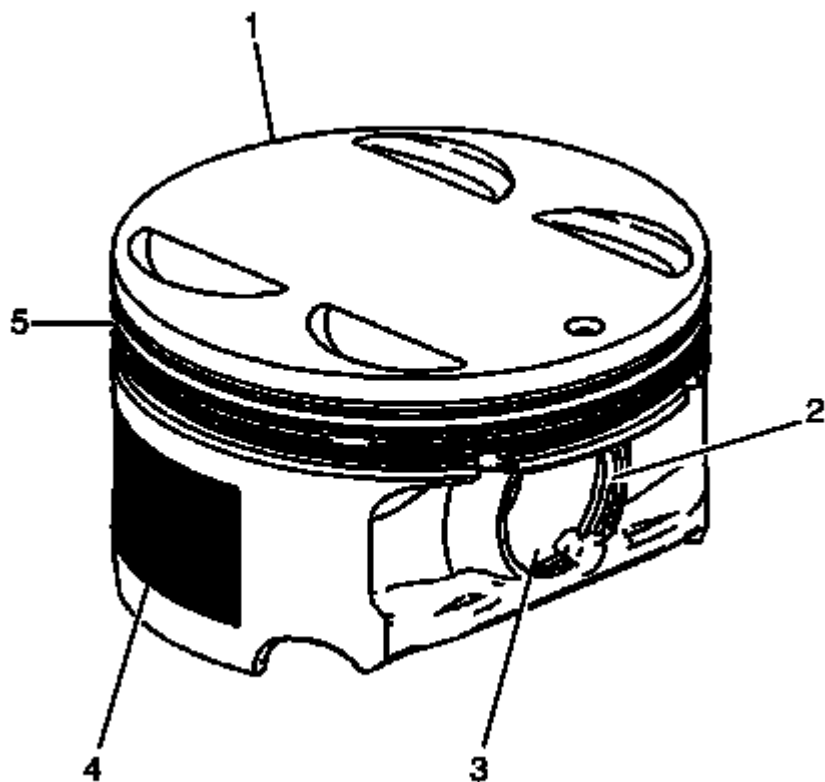


Fig. 333: Identifying Piston

Courtesy of GENERAL MOTORS COMPANY

1. Inspect the pistons for the following conditions:
 - Ring grooves for nicks, burrs that may cause binding (5)
 - Warped or worn ring lands (5)
 - Piston pin retainer grooves for burrs (2)
 - Eroded areas at the top of the piston (1)
 - Scuffed or damaged skirt coating (4)
 - Worn piston pin bores or worn piston pins (3)
2. Replace pistons that show any signs of damage or wear above acceptable tolerances.

Piston Measurement Procedure

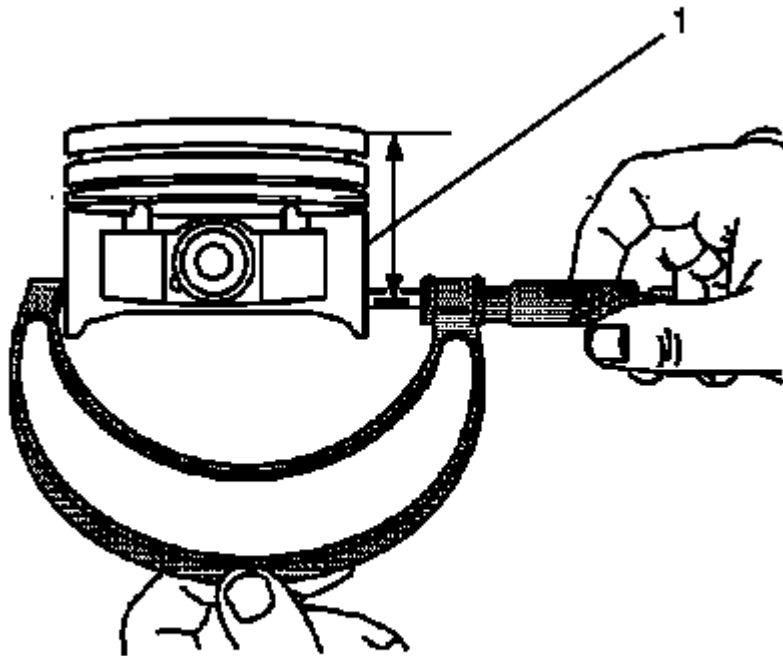


Fig. 334: View Of Piston Measurement
Courtesy of GENERAL MOTORS COMPANY

1. Measure piston width using the following procedure:
 1. Using an outside micrometer, measure the width of the piston at 8.5 mm (0.335 in) from the skirt bottom end (1), at the thrust surfaces of the piston, perpendicular to the piston pin centerline.
 2. Compare your results with the engine mechanical specifications. Refer to **Engine Mechanical Specifications (LL0)**, **Engine Mechanical Specifications (LFM)**.
 3. If the clearance obtained through measurement is greater than the provided specifications and the cylinder bores are within specification, replace the piston.

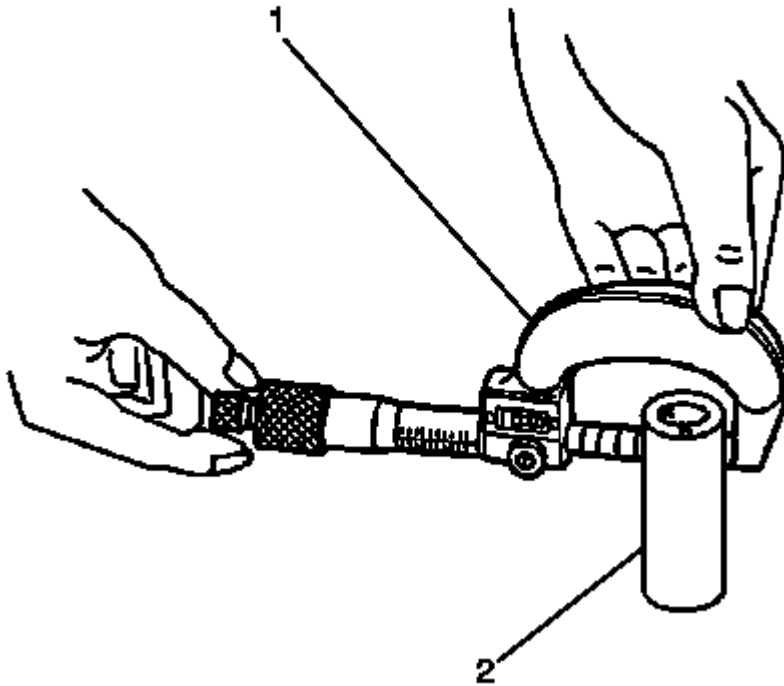


Fig. 335: Identifying Piston Pin Bore To Piston Pin Measurement From Outside Micrometer
Courtesy of GENERAL MOTORS COMPANY

2. Measure the piston pin bore to piston pin (2) clearances using the following procedure:
 1. Piston pin bores and pins must be free of varnish or scuffing.
 2. Use an outside micrometer (1) to measure the piston pin in the piston contact areas.

Piston Ring Measurement Procedure

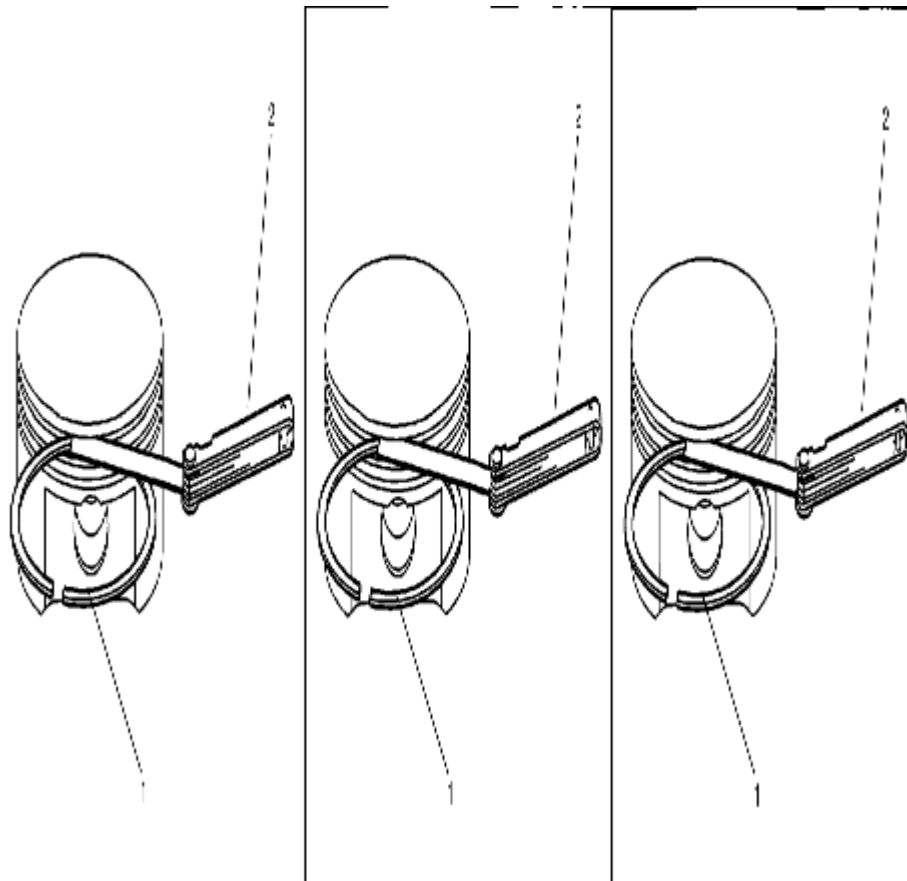


Fig. 336: Piston Ring

Courtesy of GENERAL MOTORS COMPANY

1. Measure the piston ring (1) side clearance using the following procedure:
 1. Roll the piston ring (1) entirely around the piston ring groove. If any binding is caused by the ring groove, dress the groove with a fine file. If any binding is caused by a distorted piston ring (1), replace the piston ring (1).
 2. With the piston ring (1) on the piston, use feeler gauges (2) to check clearance at multiple locations.
 3. Compare the measurements with piston ring side clearance listed in the.
 4. If the clearance is greater than specifications, replace the piston ring (1).

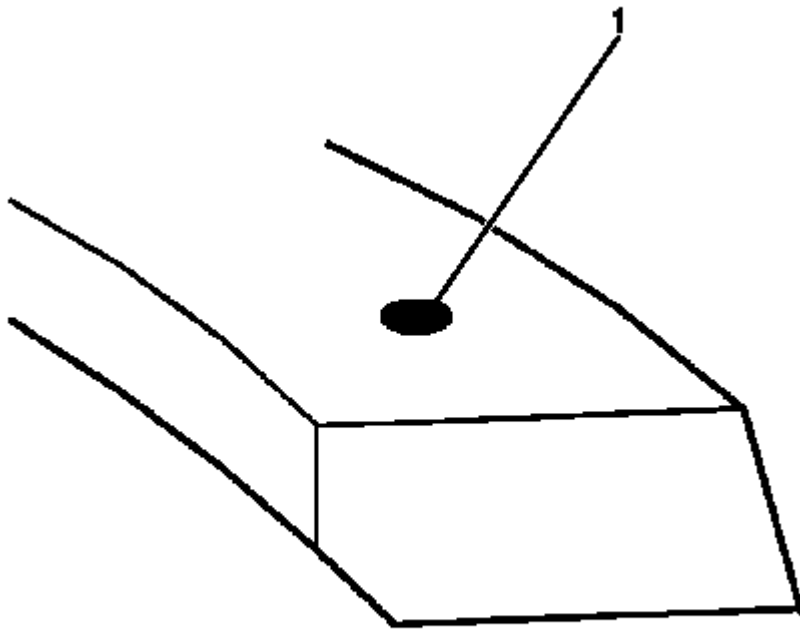


Fig. 337: Identifying Locating Dimple
Courtesy of GENERAL MOTORS COMPANY

2. There is a locating marking 'R' (1) on the compression rings near the end for identification. Install the compression rings with the dimple facing up.
3. If the new ring does not reduce the clearance to the correct specification, install a new piston.
4. If the new piston does not meet clearance specifications, the cylinder block may need to be oversized to 0.25 mm (0.010 in). There is only one size of oversized pistons and rings available for service.

Connecting Rod Cleaning Procedure

1. Clean the connecting rods in solvent.

WARNING: Refer to Safety Glasses and Compressed Air Warning .

2. Dry the connecting rod using compressed air.

Connecting Rod Visual Inspection Procedure

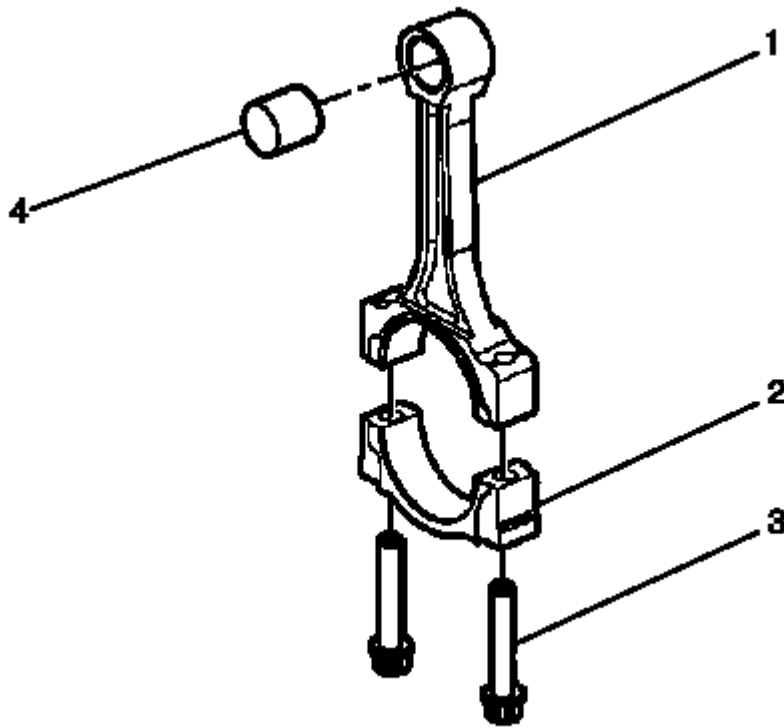


Fig. 338: Identifying Piston Pin Bushing, Connecting Rod Beam, Rod Cap & Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Inspect the piston pin bushing (4) for scoring or damage.
2. Inspect the connecting rod beam (1) for twisting or bending.
3. Inspect the rod cap (2) for any nicks or damage caused by possible interference.
4. Inspect for scratches or abrasion on the rod bearing seating surface.

NOTE: DO NOT scrape the rod or rod cap.

5. If the connecting rod bores contain minor scratches or abrasions, clean the bores in a circular direction with a light emery paper.
6. Inspect the connecting rod bolts (3) for damage or stretching.

Connecting Rod Measurement Procedure

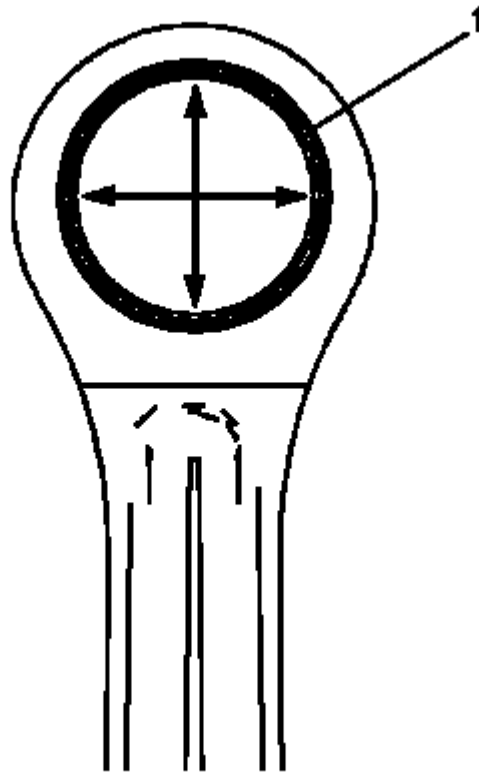


Fig. 339: Identifying Connecting Rod Piston Pin Bore
Courtesy of GENERAL MOTORS COMPANY

1. Using an inside micrometer, measure the connecting rod piston pin bore (1).
2. Subtract the piston pin diameter from the piston pin bore (1).
3. Compare the clearance measurements with the.
4. If the clearance is above acceptable tolerances, replace the piston pin. If a new pin does not resolve the clearance condition, replace the connecting rod.

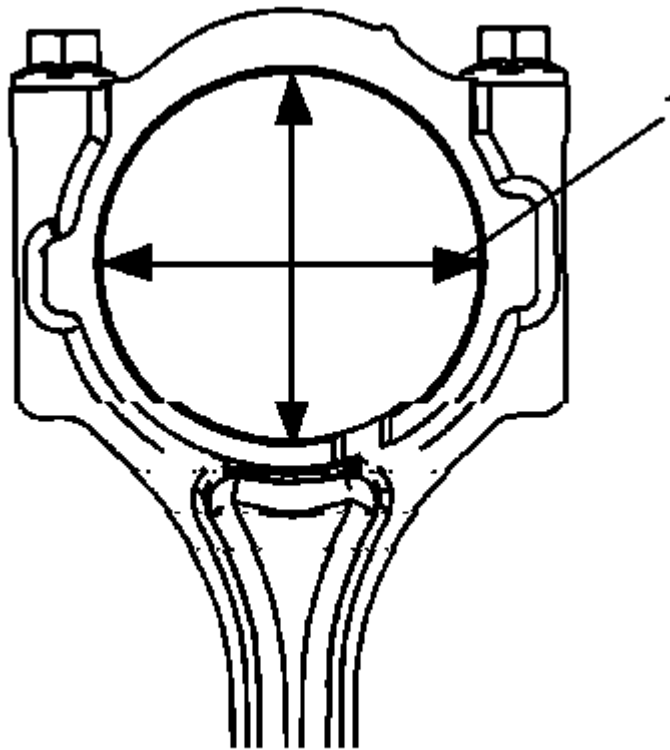


Fig. 340: Identifying Connecting Rod Crankshaft Bearing Bore Measurement From Inside Micrometer

Courtesy of GENERAL MOTORS COMPANY

5. Using an inside micrometer, measure the connecting rod crankshaft bearing bore (1).
6. Compare the bore measurements with the.
7. Replace the connecting rod if the connecting rod crankshaft bearing bore (1) is out of specifications. DO NOT recondition the connecting rod.

Connecting Rod Bearing Clearance Measurement Procedure - Using Plastic Gaging

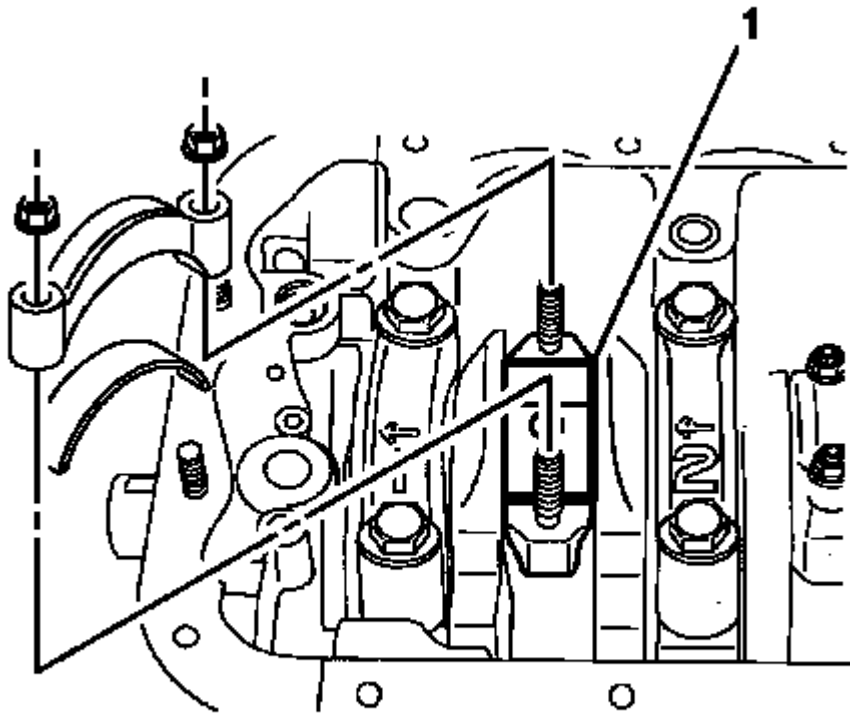


Fig. 341: Plastic Gauge

Courtesy of GENERAL MOTORS COMPANY

1. Cut the plastic gauge (1) the same length as the bearing width and put it on the crankshaft bearing. It should be parallel with the crankshaft.

CAUTION: Refer to Fastener Caution .

2. Install the connecting rod bearing and caps, tighten to 20 + 90° (15 lb ft + 90°).
3. Remove the connecting rod cap and bearing.

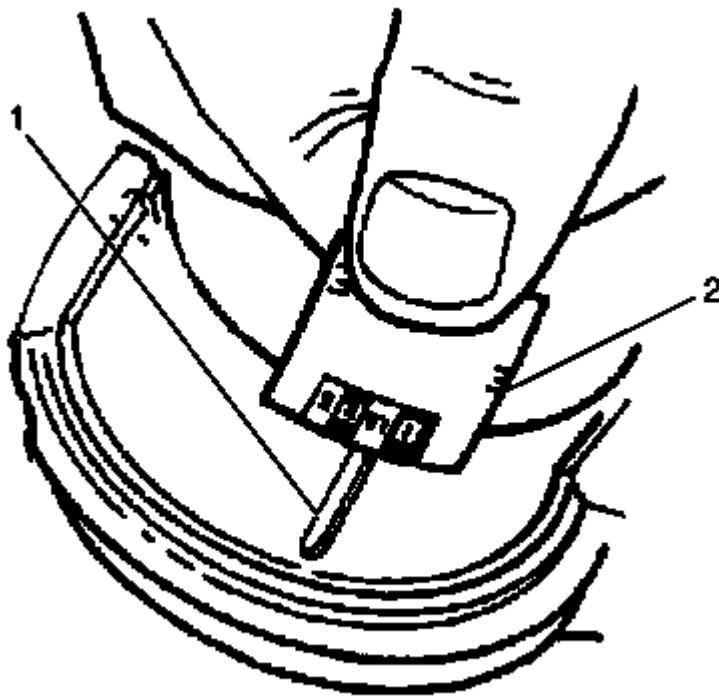


Fig. 342: View Of Crankshaft Bearing Clearance
Courtesy of GENERAL MOTORS COMPANY

4. Determine the connecting rod bearing clearance by comparing the width of the flattened plastic gauging material (1) at its widest point with the graduation on the gauging material container (2).
5. Compare your measurements with the engine mechanical specifications. Refer to **Engine Mechanical Specifications (LL0)**, **Engine Mechanical Specifications (LFM)**. If the new bearings DO NOT provide the proper crankshaft to connecting rod bearing clearance, inspect the following: **Engine Mechanical Specifications (LL0)**, **Engine Mechanical Specifications (LFM)**.
6. Clean the plastic gaging material from the connecting rod bearing journals using a soft lint-free cloth.

PISTON, CONNECTING ROD AND BEARING CLEANING AND INSPECTION (LFM)

Cleaning Procedure

NOTE: **DO NOT use a wire brush any part of the piston.**

1. Clean the piston skirts and the pins with a cleaning solvent.
2. Clean the piston ring grooves with a groove cleaner. Ensure that the oil ring holes and slots are clean.

WARNING: Refer to **Safety Glasses and Compressed Air Warning** .

3. Dry the piston with compressed air.

Piston Inspection Procedure

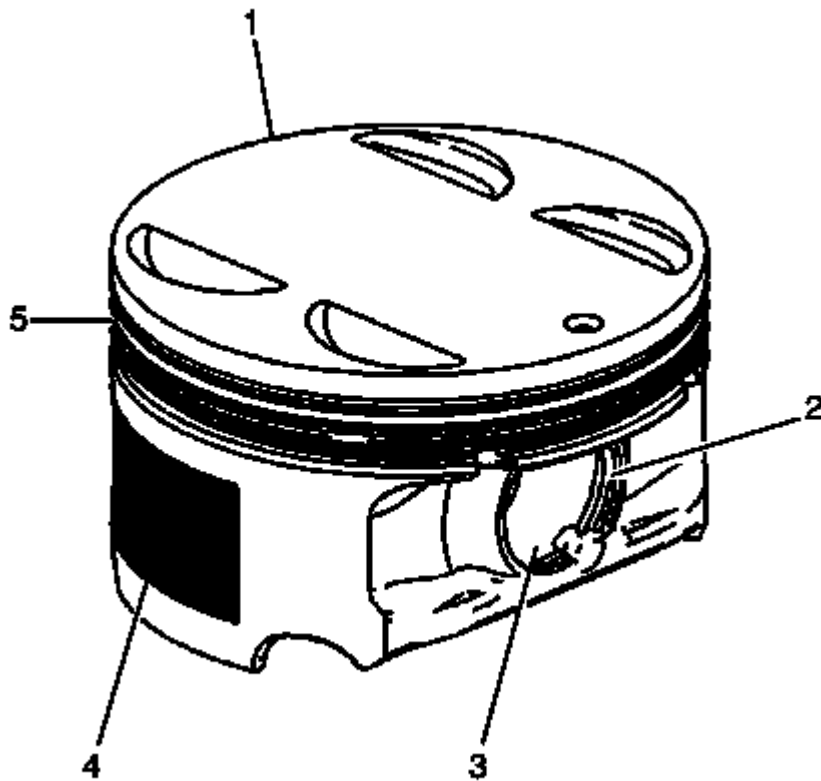


Fig. 343: Identifying Piston

Courtesy of GENERAL MOTORS COMPANY

1. Inspect the pistons for the following conditions:
 - Ring grooves for nicks, burrs that may cause binding (5)
 - Warped or worn ring lands (5)
 - Piston pin retainer grooves for burrs (2)
 - Eroded areas at the top of the piston (1)
 - Scuffed or damaged skirt coating (4)
 - Worn piston pin bores or worn piston pins (3)
2. Replace pistons that show any signs of damage or wear above acceptable tolerances.

Piston Measurement Procedure

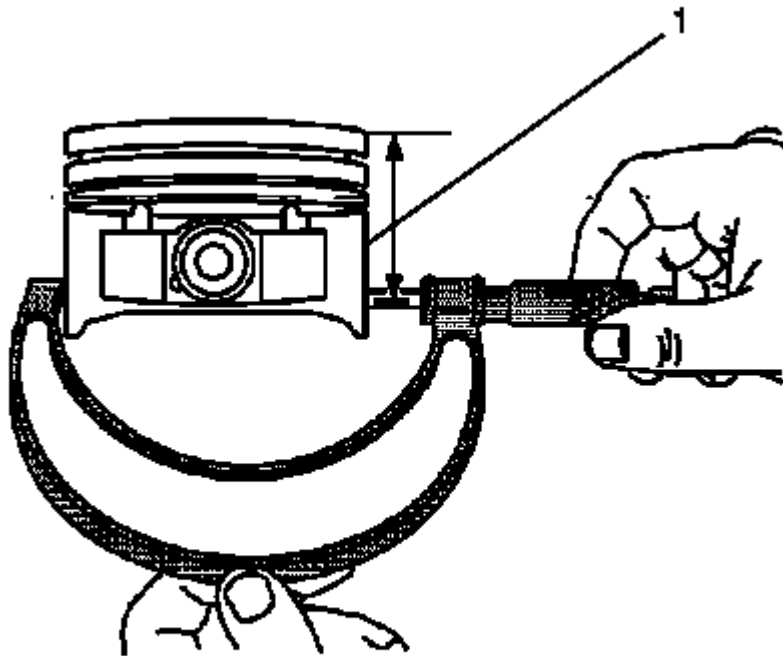


Fig. 344: View Of Piston Measurement
Courtesy of GENERAL MOTORS COMPANY

1. Measure piston width using the following procedure:
 1. Using an outside micrometer, measure the width of the piston at 7.5 mm (0.295 in) from the skirt bottom end (1), at the thrust surfaces of the piston, perpendicular to the piston pin centerline.
 2. Compare your results with the engine mechanical specifications. Refer to **Engine Mechanical Specifications (LL0)**, **Engine Mechanical Specifications (LFM)**.
 3. If the piston clearance to bore obtained through measurement is greater than the provided specifications (0.023-0.053 mm) and the cylinder bores are within specification (68.502-68.518), replace the piston.

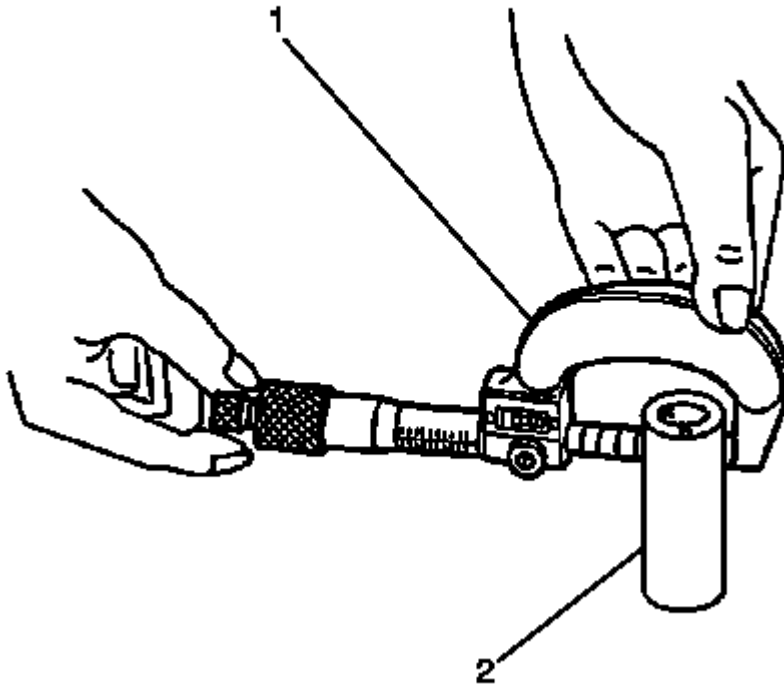


Fig. 345: Identifying Piston Pin Bore To Piston Pin Measurement From Outside Micrometer
Courtesy of GENERAL MOTORS COMPANY

2. Measure the piston pin bore to piston pin (2) clearances using the following procedure:
 1. Piston pin bores and pins must be free of varnish or scuffing.
 2. Use an outside micrometer (1) to measure the piston pin in the piston contact areas.
 3. If the result is out of specification (17.996-18.0), replace the pin.

Piston Ring Measurement Procedure

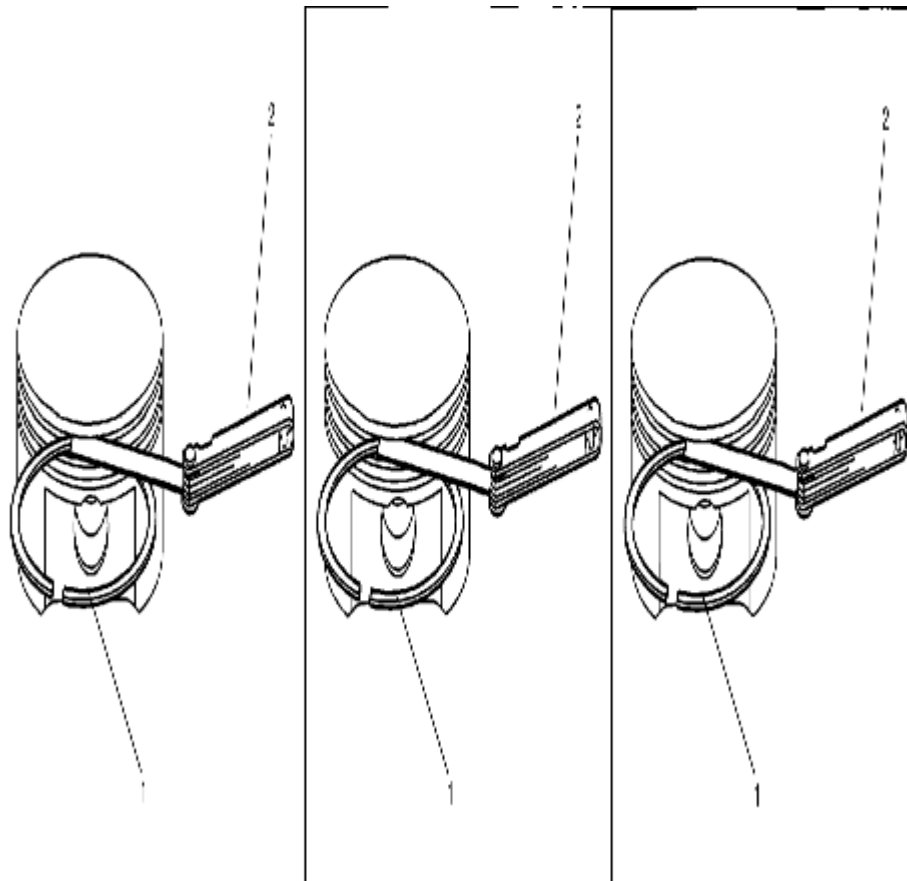


Fig. 346: Piston Ring

Courtesy of GENERAL MOTORS COMPANY

1. Measure the piston ring (1) side clearance using the following procedure:
 1. Roll the piston ring (1) entirely around the piston ring groove. If any binding is caused by the ring groove, dress the groove with a fine file. If any binding is caused by a distorted piston ring (1), replace the piston ring (1).
 2. With the piston ring (1) on the piston, use feeler gauges (2) to check clearance at multiple locations.
 3. Compare the measurements with piston ring side clearance listed in the.
 4. If the clearance is greater than the following specifications, replace the piston ring (1).
 - Top and 2nd: 0.03-0.07
 - Oil: 0.04-0.12

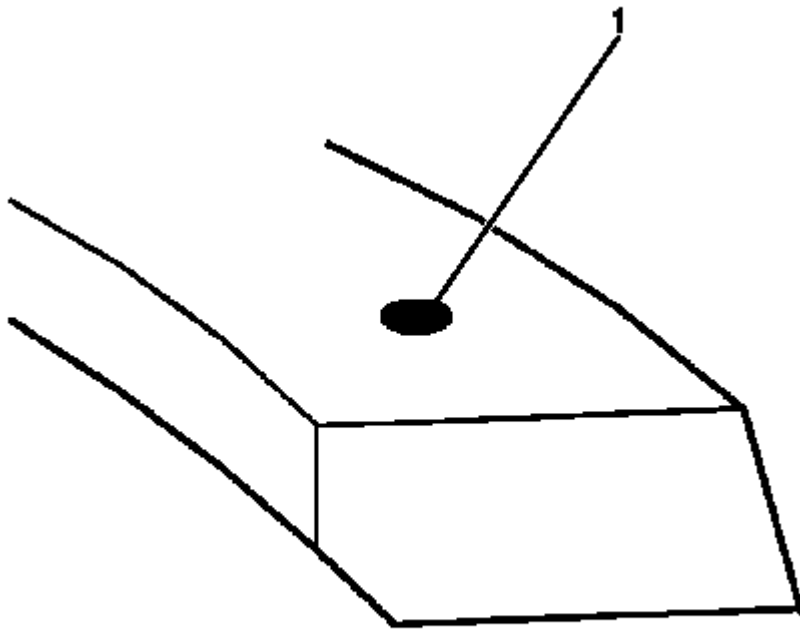


Fig. 347: Identifying Locating Dimple
Courtesy of GENERAL MOTORS COMPANY

2. There is a locating marking 'R' (1) on the compression rings near the end for identification. Install the compression rings with the dimple facing up.
3. If the new ring does not reduce the clearance to the correct specification, install a new piston.
4. If the new piston does not meet clearance specifications, the cylinder block may need to be oversized to 0.25 mm (0.010 in). There is only one size of oversized pistons and rings available for service.

Connecting Rod Cleaning Procedure

1. Clean the connecting rods in solvent.

WARNING: Refer to Safety Glasses and Compressed Air Warning .

2. Dry the connecting rod using compressed air.

Connecting Rod Visual Inspection Procedure

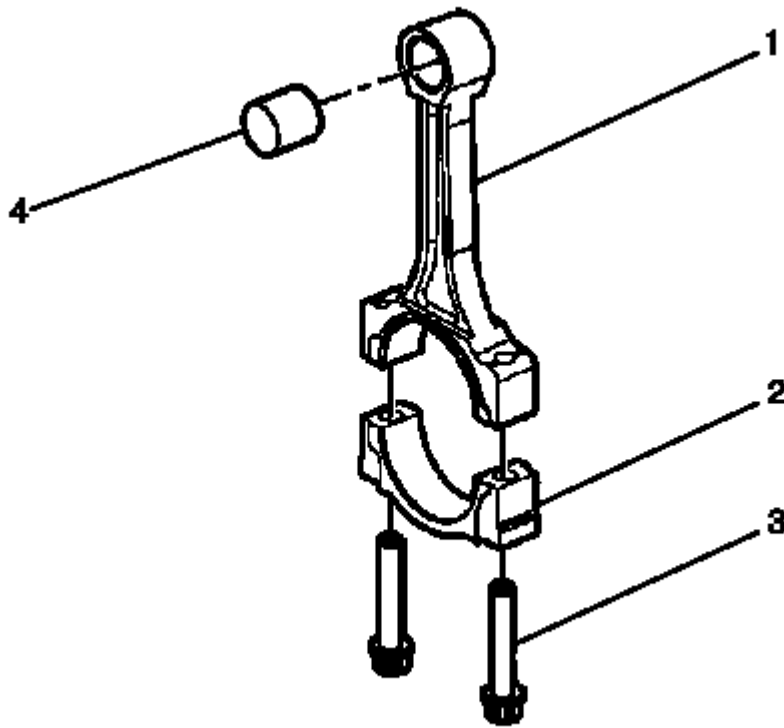


Fig. 348: Identifying Piston Pin Bushing, Connecting Rod Beam, Rod Cap & Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Inspect the piston pin bushing (4) for scoring or damage.
2. Inspect the connecting rod beam (1) for twisting or bending.
3. Inspect the rod cap (2) for any nicks or damage caused by possible interference.
4. Inspect for scratches or abrasion on the rod bearing seating surface.

NOTE: DO NOT scrape the rod or rod cap.

5. If the connecting rod bores contain minor scratches or abrasions, clean the bores in a circular direction with a light emery paper.
6. Inspect the connecting rod bolts (3) for damage or stretching.

Connecting Rod Measurement Procedure

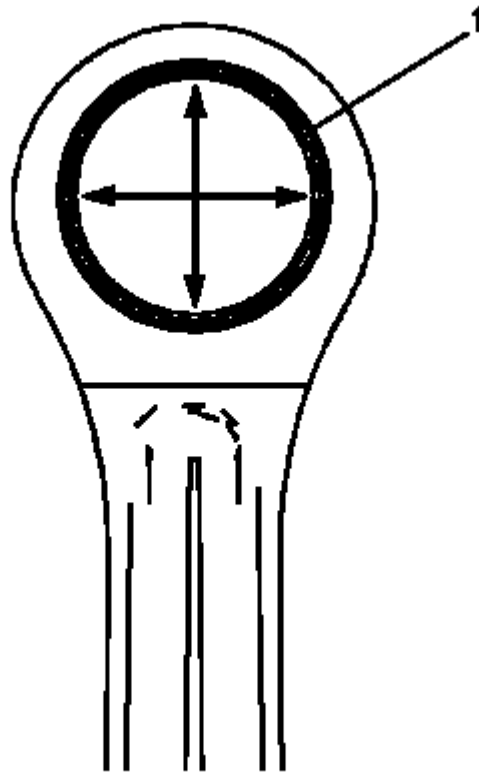


Fig. 349: Identifying Connecting Rod Piston Pin Bore
Courtesy of GENERAL MOTORS COMPANY

1. Using an inside micrometer, measure the connecting rod piston pin bore (1).
2. Subtract the piston pin diameter from the piston pin bore (1).
3. Compare the clearance measurements with the.
4. If the clearance is above acceptable tolerances (0.006-0.018), replace the piston pin. If a new pin does not resolve the clearance condition, replace the connecting rod.

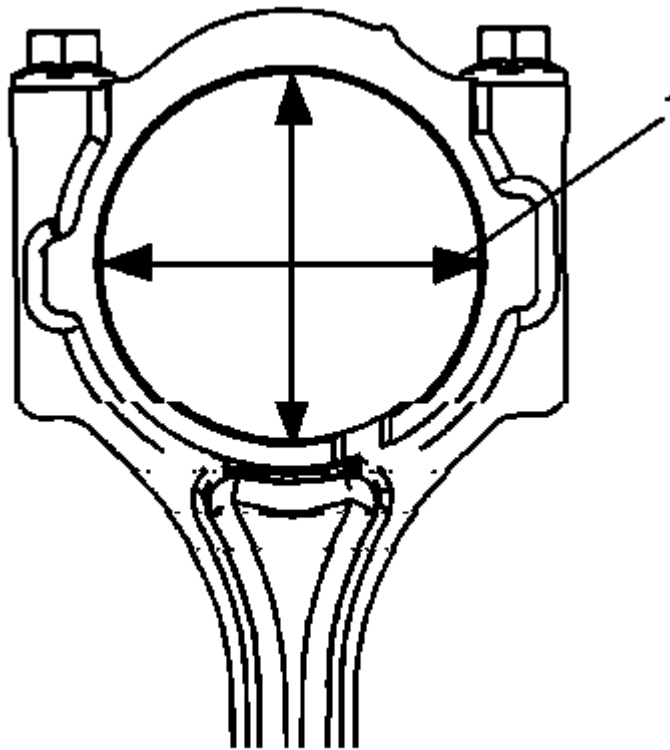


Fig. 350: Identifying Connecting Rod Crankshaft Bearing Bore Measurement From Inside Micrometer

Courtesy of GENERAL MOTORS COMPANY

5. Using an inside micrometer, measure the connecting rod crankshaft bearing bore (1).
6. Compare the bore measurements with the.
7. Replace the connecting rod if the connecting rod crankshaft bearing bore (1) is out of specifications. DO NOT recondition the connecting rod.

Connecting Rod Bearing Clearance Measurement Procedure - Using Plastic Gaging

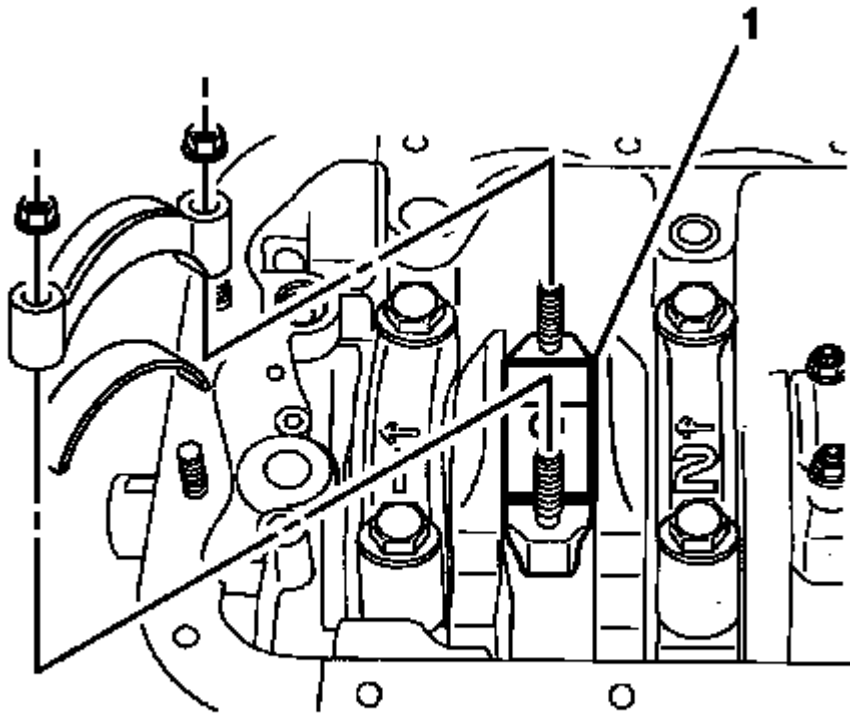


Fig. 351: Plastic Gauge

Courtesy of GENERAL MOTORS COMPANY

1. Cut the plastic gauge (1) the same length as the bearing width and put it on the crankshaft bearing. It should be parallel with the crankshaft.

CAUTION: Refer to Fastener Caution .

2. Install the connecting rod bearing and caps, tighten the connecting rod bearing cap bolts to $20 + 90^\circ$ (15 lb ft + 90°).
3. Remove the connecting rod cap and bearing.

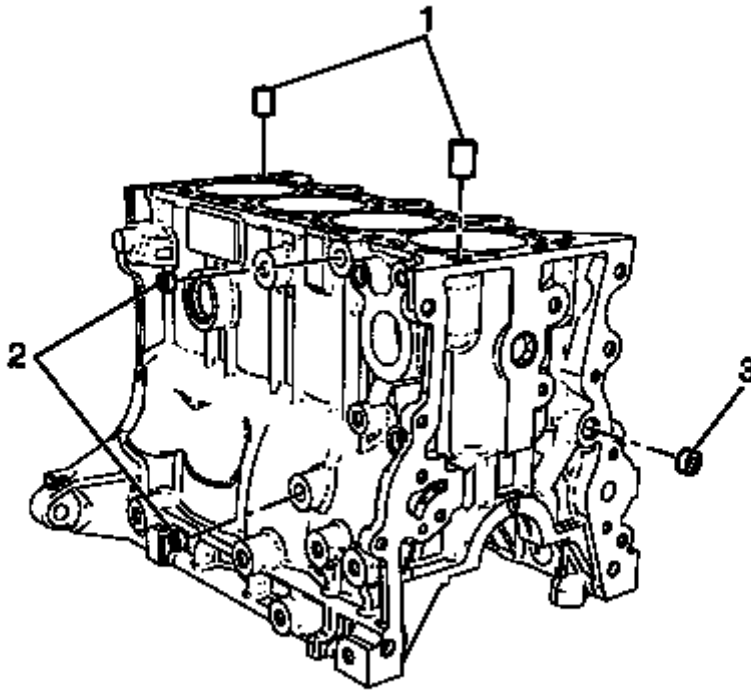


Fig. 353: Cylinder Head Locating
Courtesy of GENERAL MOTORS COMPANY

NOTE: Use a new engine block oil gallery plug.

1. Install the cylinder head locating (1).
2. Clean the thread of engine block and apply sealant to all plugs prior to installation. Refer to **Adhesives, Fluids, Lubricants and Sealers**.

CAUTION: Refer to **Fastener Caution** .

3. Install the new engine block oil gallery plugs (2, 3) and tighten to 12.5 (9 lb ft).

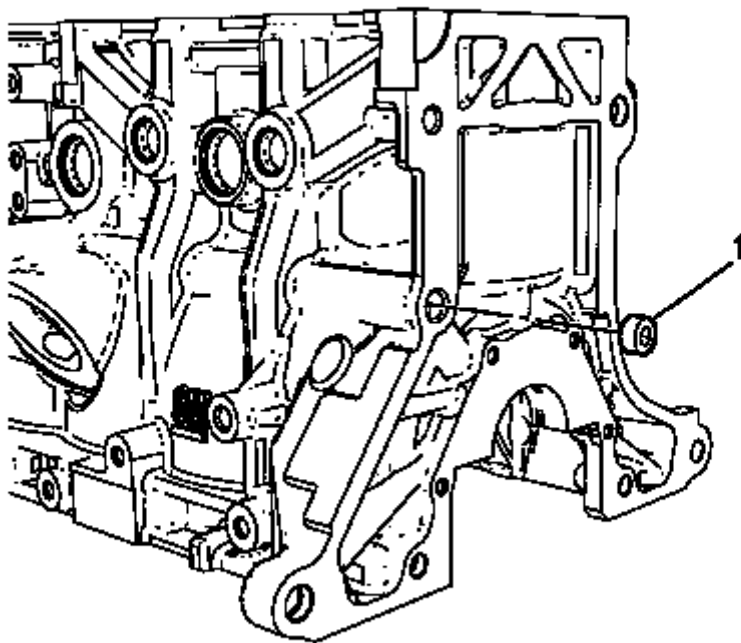


Fig. 354: Engine Block Oil Gallery Plug
Courtesy of GENERAL MOTORS COMPANY

NOTE: Use a new engine block oil gallery plug.

4. Install the new engine block oil gallery plug (1) and tighten to 12.5 (9 lb ft).

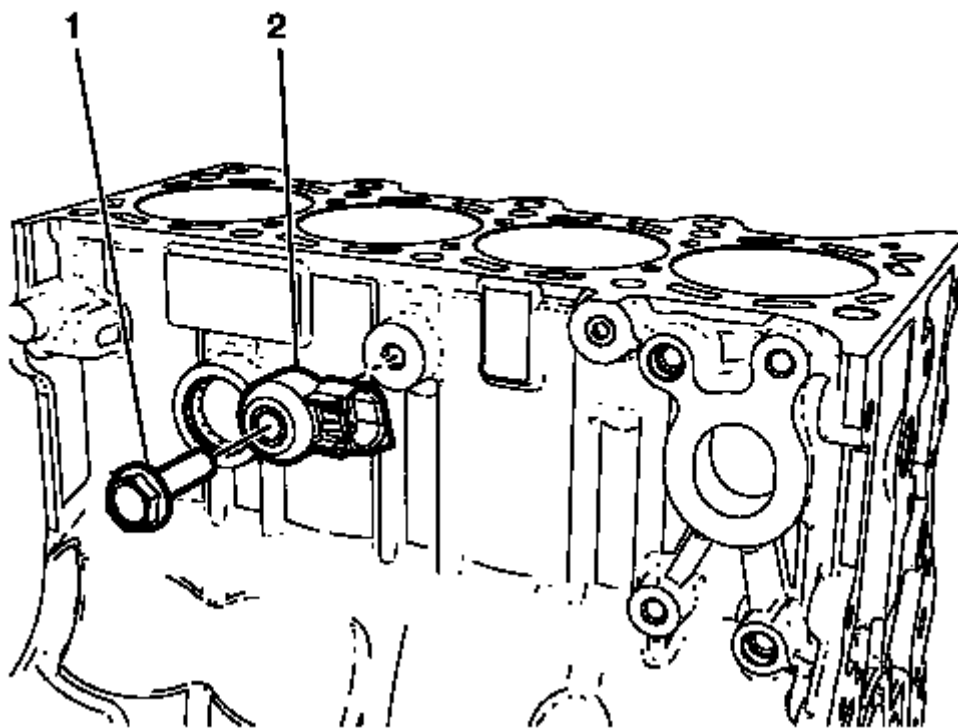


Fig. 355: Knock Sensor Bolt And Knock Sensor
Courtesy of GENERAL MOTORS COMPANY

5. Install the knock sensor (2) and the knock sensor bolt (1) and tighten to 25 (18 lb ft).

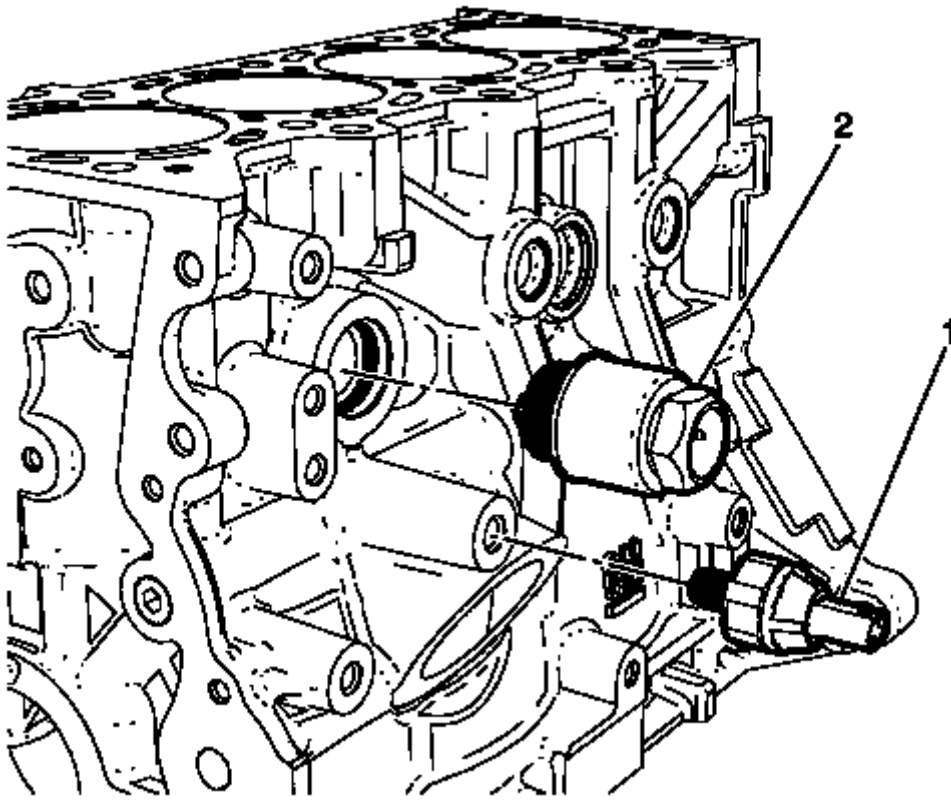


Fig. 356: Oil Pressure Switch And Block Heater
Courtesy of GENERAL MOTORS COMPANY

6. Install the oil pressure switch (1) and tighten to 35 (26 lb ft).
7. Install the block heater (2) and tighten to 60 (44 lb ft).

ENGINE BLOCK ASSEMBLE (LFM)

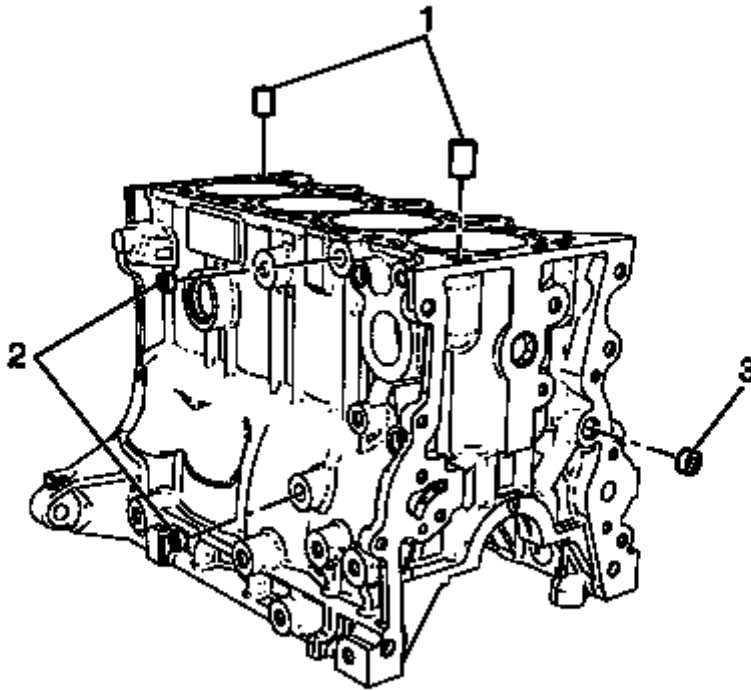


Fig. 357: Cylinder Head Locating
Courtesy of GENERAL MOTORS COMPANY

NOTE: Use a new engine block oil gallery plug.

1. Install the cylinder head locating (1).
2. Clean the thread of engine block and apply sealant to all plugs prior to installation. Refer to **Adhesives, Fluids, Lubricants and Sealers**.

CAUTION: Refer to **Fastener Caution** .

3. Install the new engine block oil gallery plugs (2, 3) and tighten to 12.5 (9 lb ft).

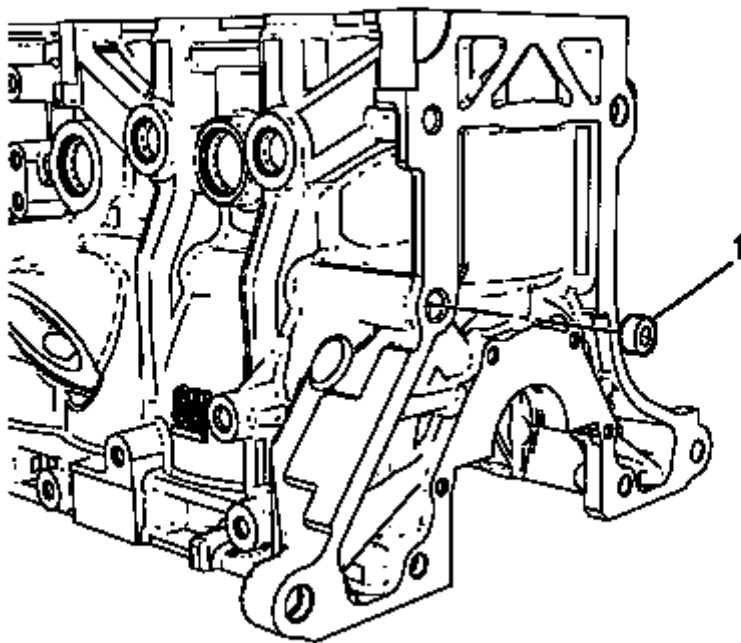


Fig. 358: Engine Block Oil Gallery Plug
Courtesy of GENERAL MOTORS COMPANY

NOTE: Use a new engine block oil gallery plug.

4. Install the new engine block oil gallery plug (1) and tighten to 12.5 (9 lb ft).

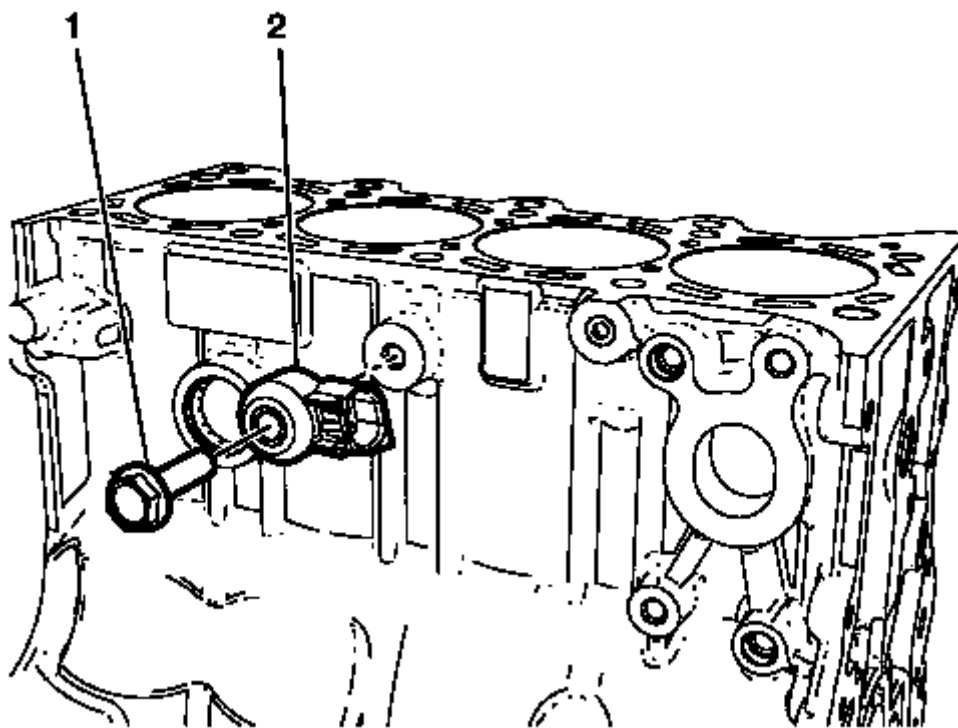


Fig. 359: Knock Sensor Bolt And Knock Sensor
Courtesy of GENERAL MOTORS COMPANY

5. Install the knock sensor (2) and the knock sensor bolt (1) and tighten to 25 (18 lb ft).

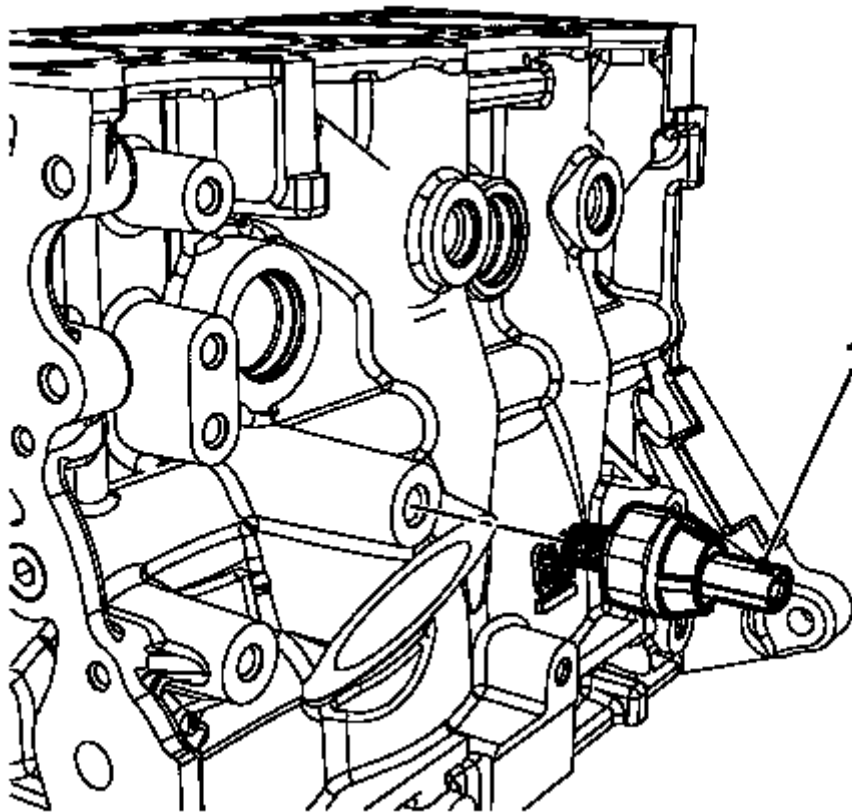


Fig. 360: Oil Pressure Switch

Courtesy of GENERAL MOTORS COMPANY

6. Install the oil pressure switch (1) and tighten to 35 (26 lb ft).

CRANKSHAFT AND BEARING INSTALLATION

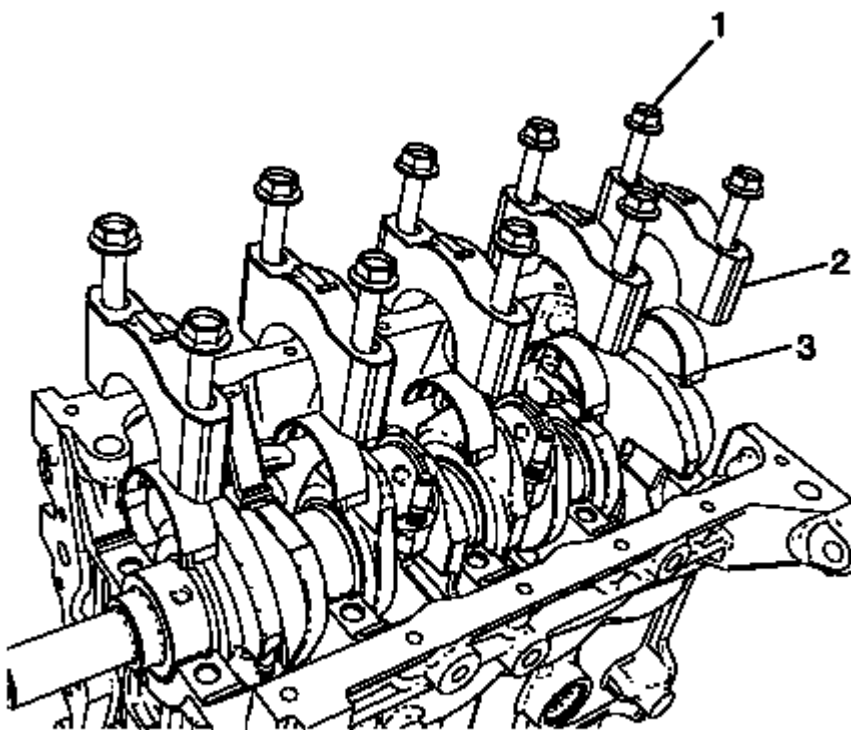


Fig. 361: Crankshaft Bearing Caps
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Inspect the installation position.**

1. Install the crankshaft.

NOTE: **Inspect the installation position.**

2. Install the crankshaft bearing (3).

NOTE: **Inspect the installation position.**

3. Install the crankshaft bearing cap (2).

CAUTION: Refer to Fastener Caution .

4. Install the crankshaft bearing cap bolts (1) and tighten to 30 + 30° (22 lb ft + 30°).

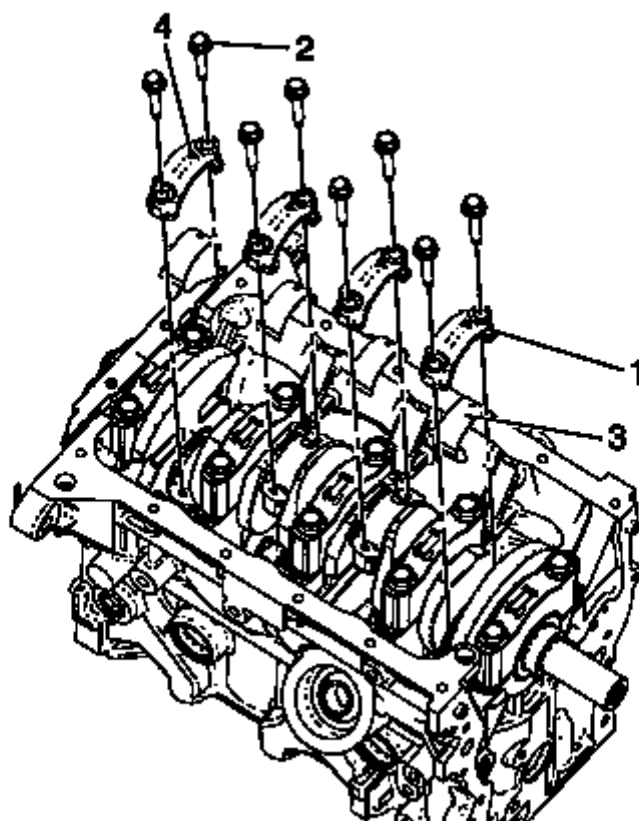


Fig. 362: Connecting Rod Bearing
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Inspect the installation position.**

5. Install the connecting rod bearing (3) and connecting rod bearing caps (1) and tighten the 8 connecting rod bearing cap bolts to 20 + 90° (15 lb ft + 90°).

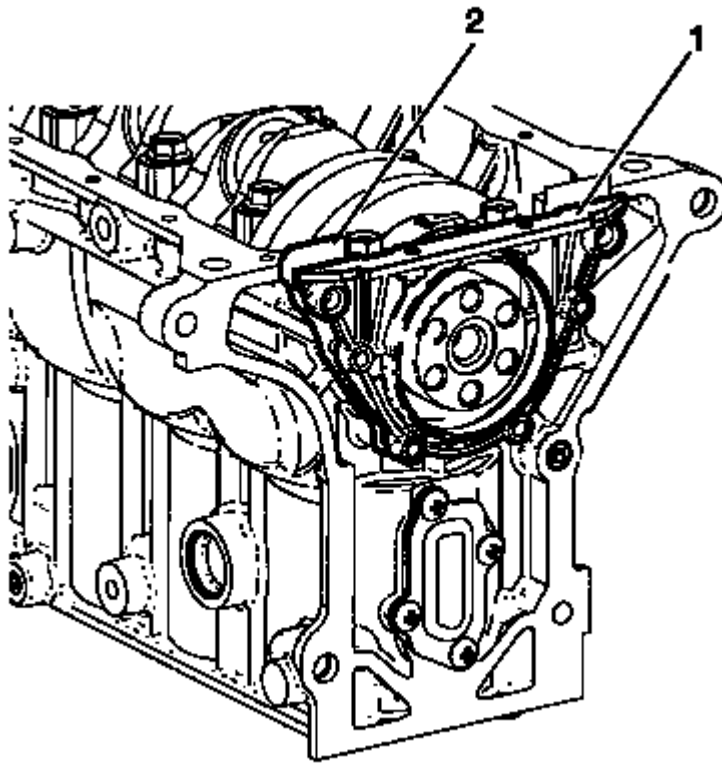


Fig. 363: Crankshaft Rear Oil Seal Housing
Courtesy of GENERAL MOTORS COMPANY

6. Install the crankshaft rear oil seal housing (1) with the new gasket (2) and tighten to 10 (89 lb in).

CRANKSHAFT REAR OIL SEAL AND HOUSING INSTALLATION

Special Tools

J 45507 Crankshaft Rear Oil Seal Installer

For equivalent regional tools, refer to **Special Tools**.

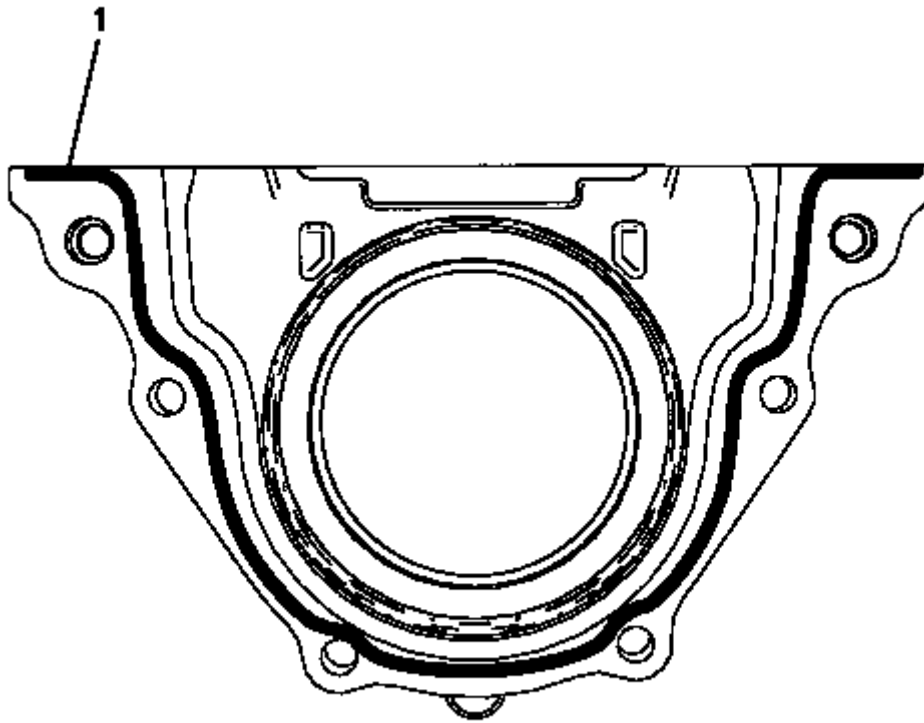


Fig. 364: Crankshaft Rear Oil Seal Housing
Courtesy of GENERAL MOTORS COMPANY

1. Place a 3 mm (0.118 in) bead of RTV sealant to the NEW crankshaft rear oil seal housing as shown (1). Refer to **Adhesives, Fluids, Lubricants and Sealers** for recommended sealant.

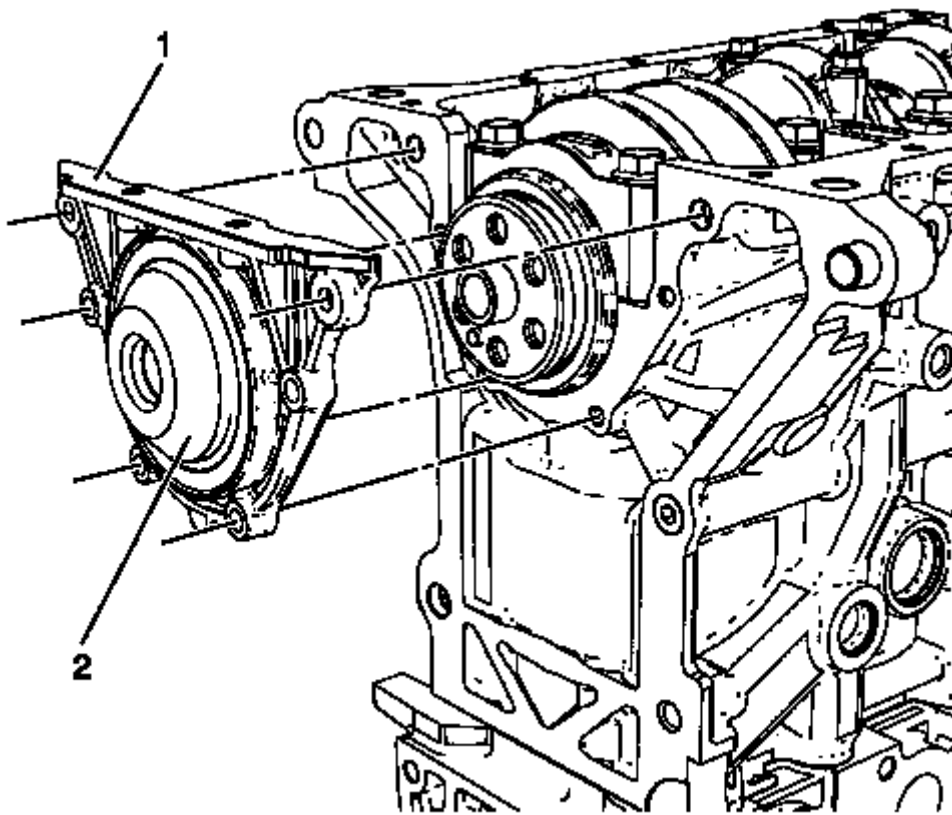


Fig. 365: Crankshaft Rear Oil Seal And Housing
Courtesy of GENERAL MOTORS COMPANY

NOTE: **DO NOT** allow any engine oil on the area where the crankshaft rear oil seal housing is to be installed.

2. Install the **J 45507** Crankshaft Rear Oil Seal Installer (2) to the crankshaft rear oil seal and housing (1).
3. Push the crankshaft rear oil seal and housing (1) until the crankshaft rear oil seal and housing is flush and sits evenly in the cylinder block.
4. Remove the **J 45507** Crankshaft Rear Oil Seal Installer (2) from the crankshaft.

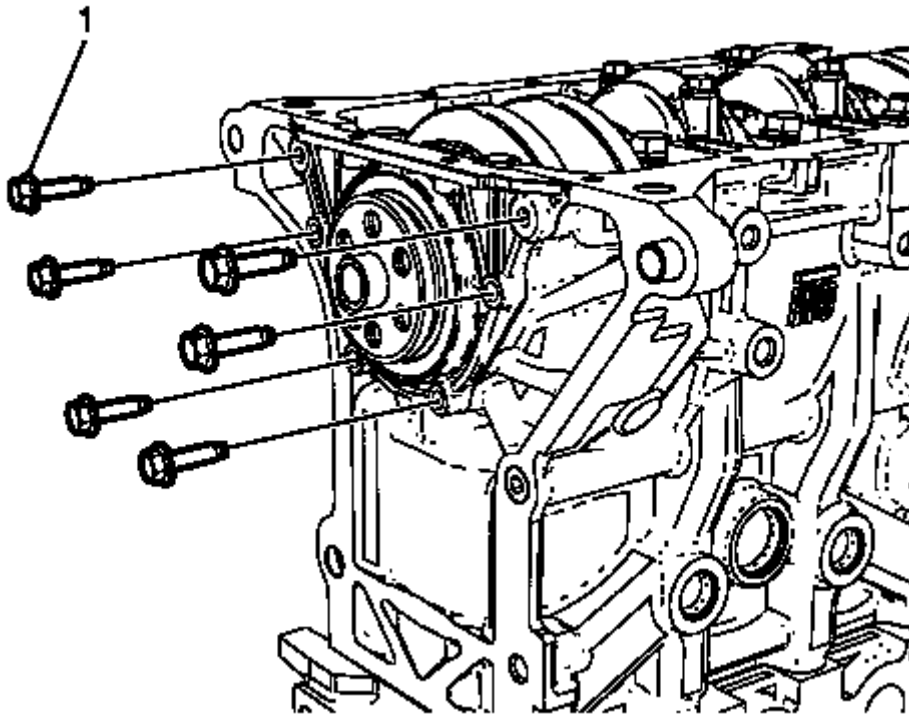


Fig. 366: Crankshaft Rear Oil Seal Housing Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

5. Install the crankshaft rear oil seal housing bolts (1) and tighten to 10 (89 lb in).

PISTON, CONNECTING ROD AND BEARING INSTALLATION

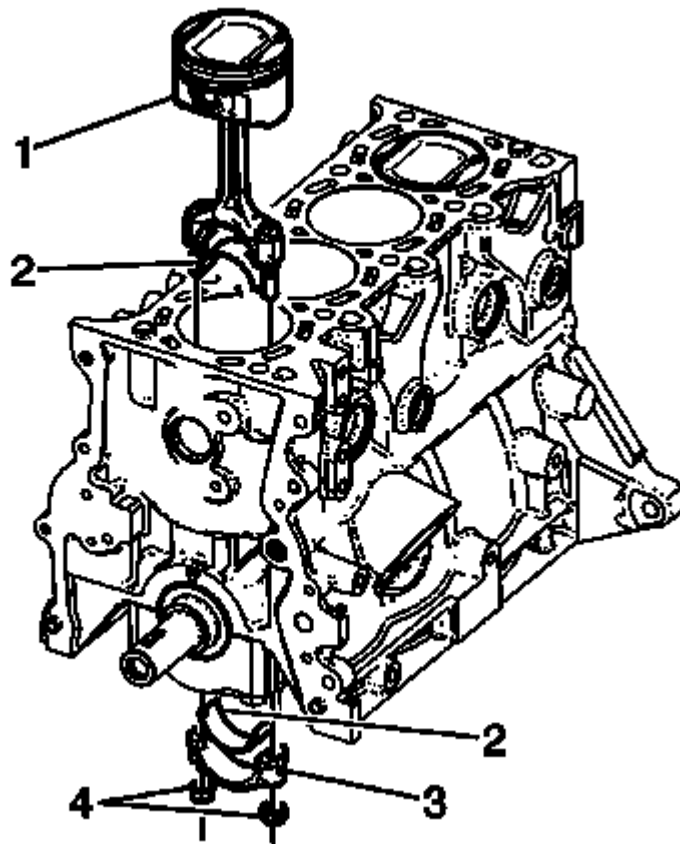


Fig. 367: Piston And Rod Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Rotate the crankshaft to a position where the connecting rod bolts are in the best situation for install.

NOTE: **Arrow on piston head points to engine timing side, bead on connecting rod points to transmission side of engine.**

2. Install the piston and connecting rod assembly (1).
3. Install the connecting rod bearing (2).
4. Assemble the caps and connecting rods in the marked position. Install the connecting rod cap (3).

CAUTION: Refer to Fastener Caution .

5. Install the connecting rod bearing bolts (4) and tighten to 20 + 90° (15 lb ft + 90°).

CAMSHAFT TIMING CHAIN INSTALLATION

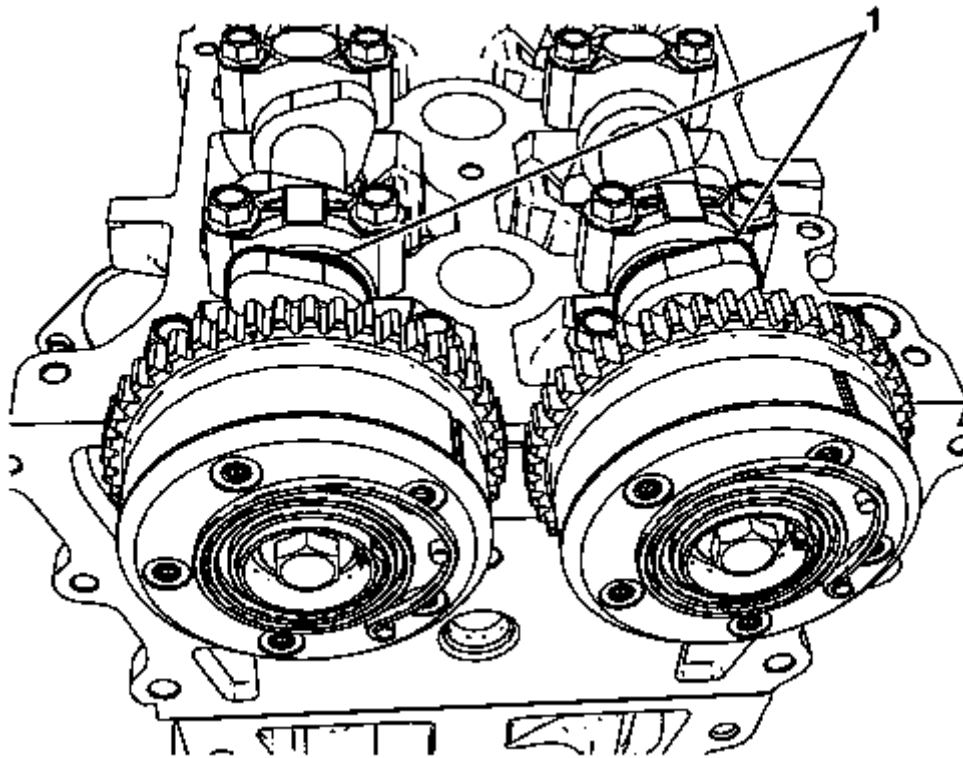


Fig. 368: Camshaft Lobes

Courtesy of GENERAL MOTORS COMPANY

1. Position the camshaft lobes in a neutral position.

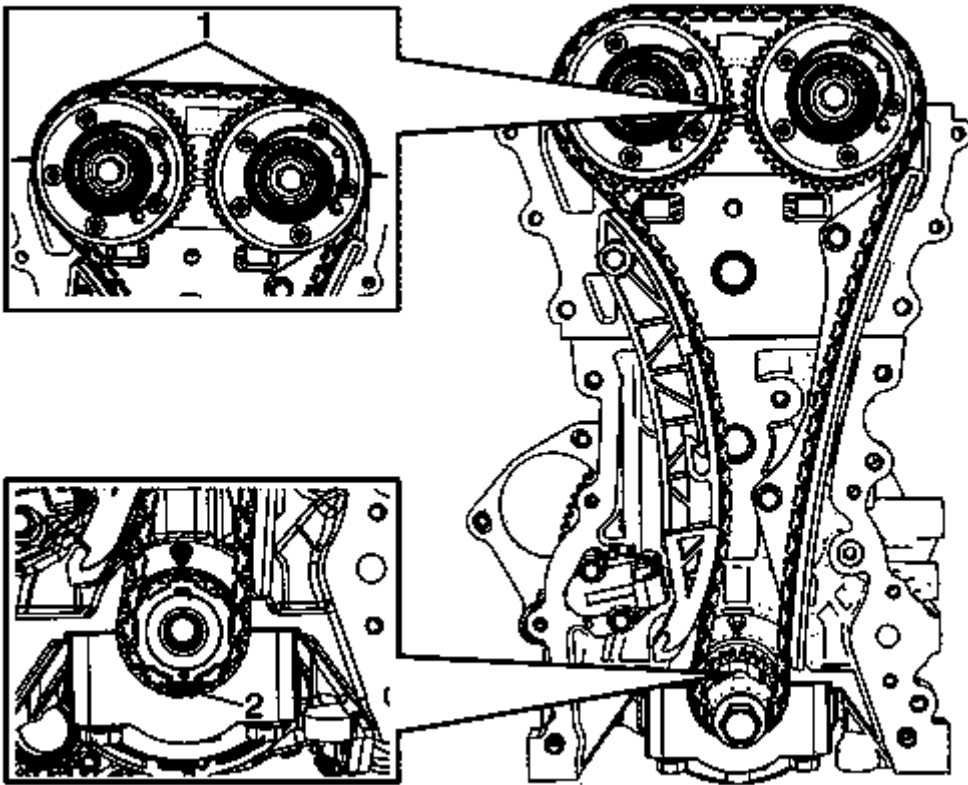


Fig. 369: Camshaft Sprockets And Timing Chain
Courtesy of GENERAL MOTORS COMPANY

2. Install the timing chain after aligning both the marks (1) on the camshaft sprockets and on the timing chain.
3. Align both the timing marks on the crankshaft sprocket and on the timing chain (2).

TIMING CHAIN TENSIONER INSTALLATION

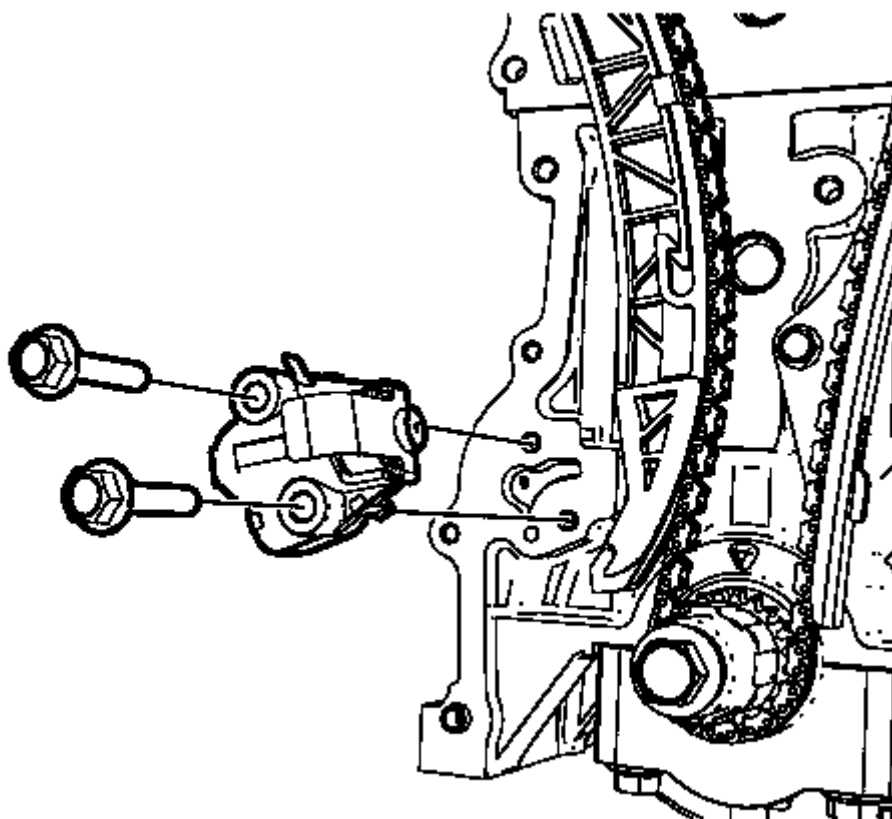


Fig. 370: Timing Chain Tensioner

Courtesy of GENERAL MOTORS COMPANY

1. Inspect the timing chain tensioner mounting surface on the cylinder block for burrs or any defects that may degrade the sealing of the timing chain tensioner.

CAUTION: Refer to Fastener Caution .

2. Push the timing chain shoe towards the timing chain and hold the timing chain shoe. Using the other hand, push the timing chain tensioner towards the timing chain shoe. The timing chain tensioner plunger might be pushed into the timing chain tensioner housing. While holding the timing chain tensioner, install the timing chain tensioner bolts and tighten the timing chain tensioner retaining bolts to 10 (89 lb in).
3. Pull out the shipping clip.

TIMING CHAIN GUIDE INSTALLATION

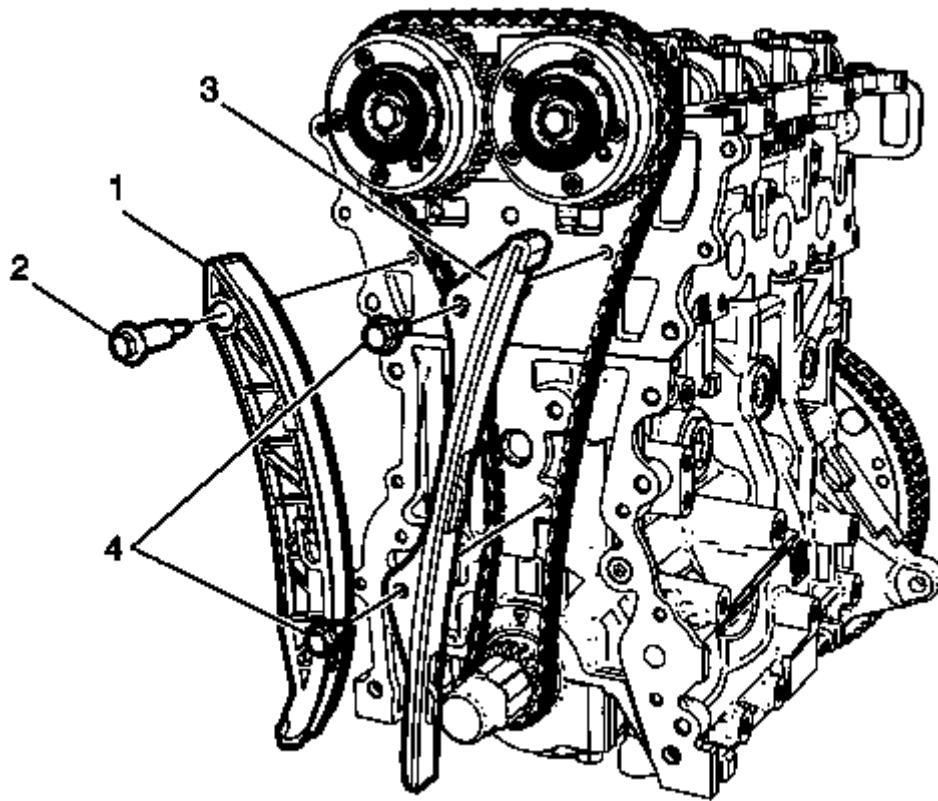


Fig. 371: Left Timing Chain Shoe Retaining Bolt
Courtesy of GENERAL MOTORS COMPANY

1. Install the timing chain shoe (1).

CAUTION: Refer to Fastener Caution .

2. Tighten the timing chain shoe retaining bolt (2) to 10 (89 lb in)
3. Install the timing chain guide (3).
4. Install the timing chain guide retaining bolts (4) to 10 (89 lb in).

CAMSHAFT INSTALLATION (LL0)

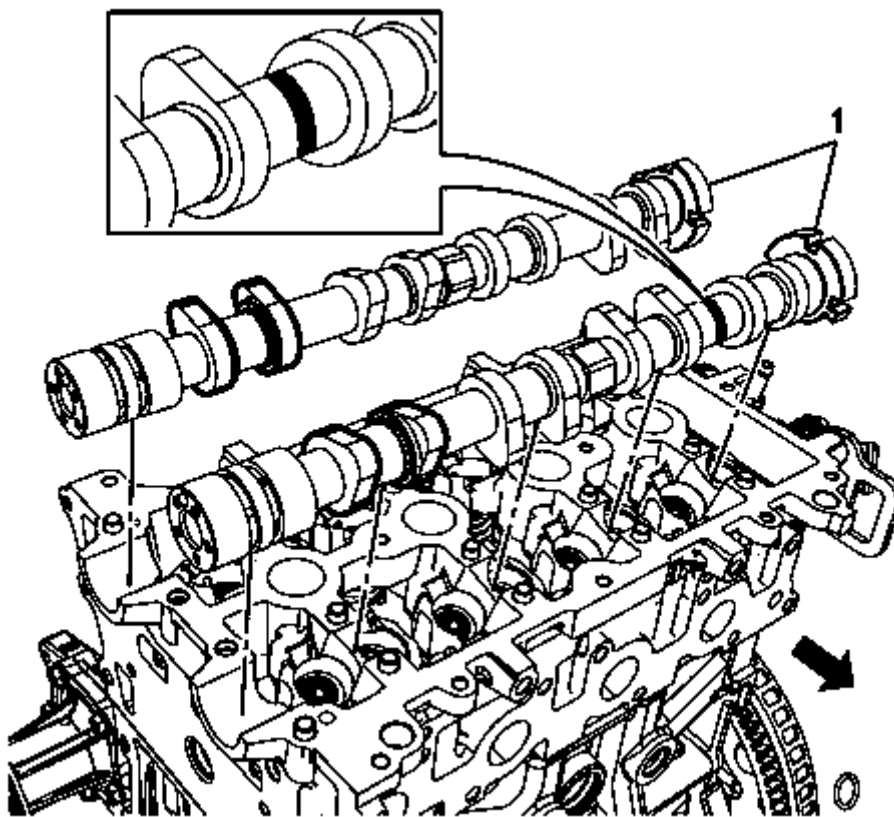


Fig. 372: Camshafts

Courtesy of GENERAL MOTORS COMPANY

NOTE: The exhaust camshaft has a groove between the No. 3 journal and No. 4 journal. The intake camshaft has no groove.

1. Install the intake camshaft and the exhaust camshaft (1).

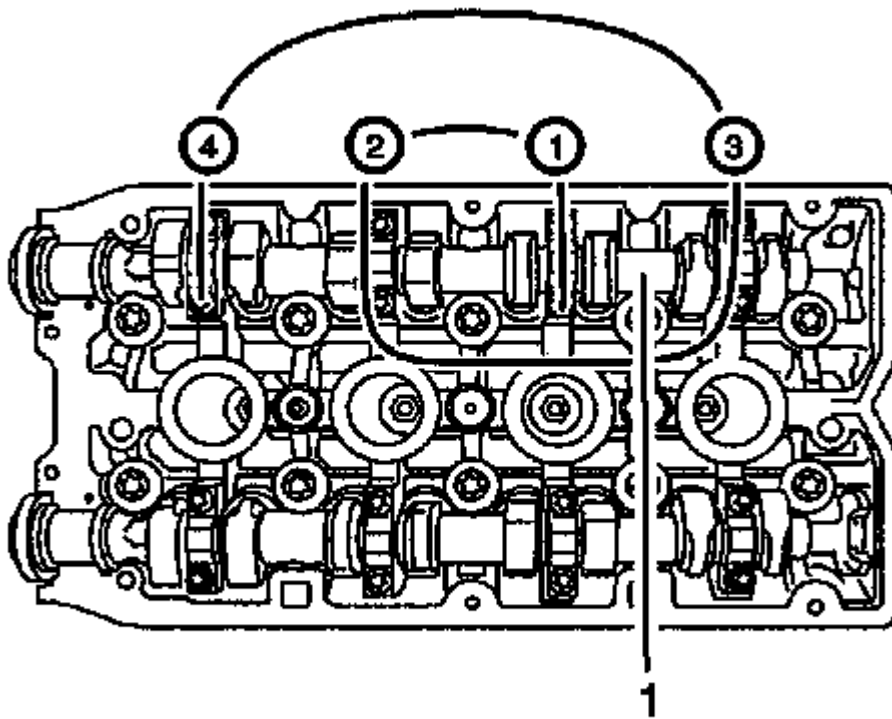


Fig. 373: Camshaft Lobes

Courtesy of GENERAL MOTORS COMPANY

2. Position the camshaft lobes in a neutral position.

NOTE: Note the identification marking on the camshaft bearing cover.

3. Install the 4 intake camshaft bearing caps numbers 2-5 from the cylinder head.

CAUTION: Refer to Fastener Caution .

4. Tighten the 8 intake camshaft bearing cap bolts working from inside to outside in a spiral to 10 (89 lb in).

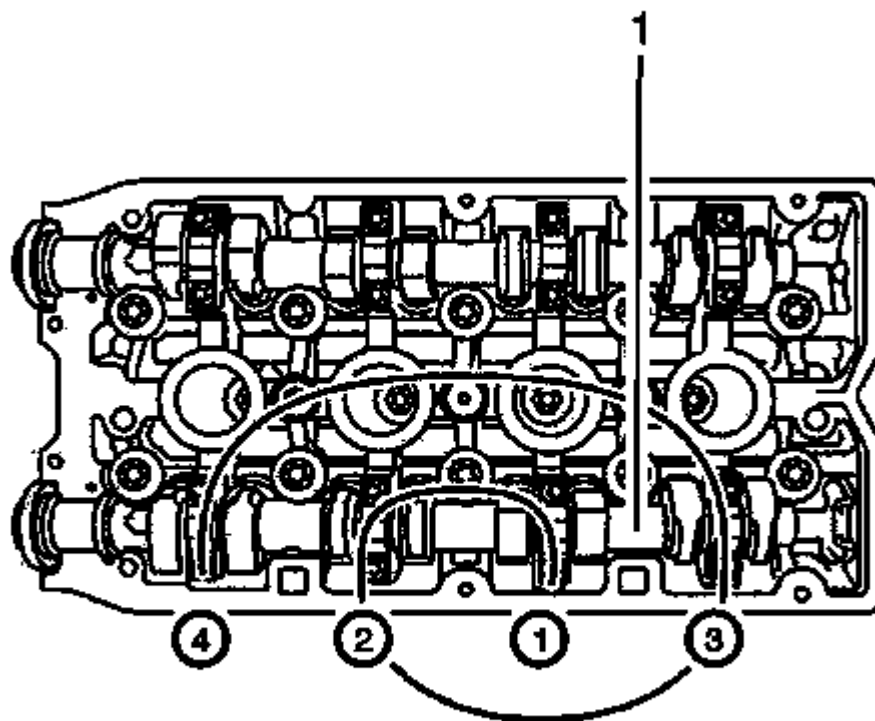


Fig. 374: Exhaust Camshaft Bearing Cap
Courtesy of GENERAL MOTORS COMPANY

NOTE: Note the identification marking on the camshaft bearing cover.

5. Install the 4 exhaust camshaft bearing caps numbers 6-9 from the cylinder head.
6. Tighten the 8 exhaust camshaft bearing cap bolts working from inside to outside in a spiral to 10 (89 lb in).

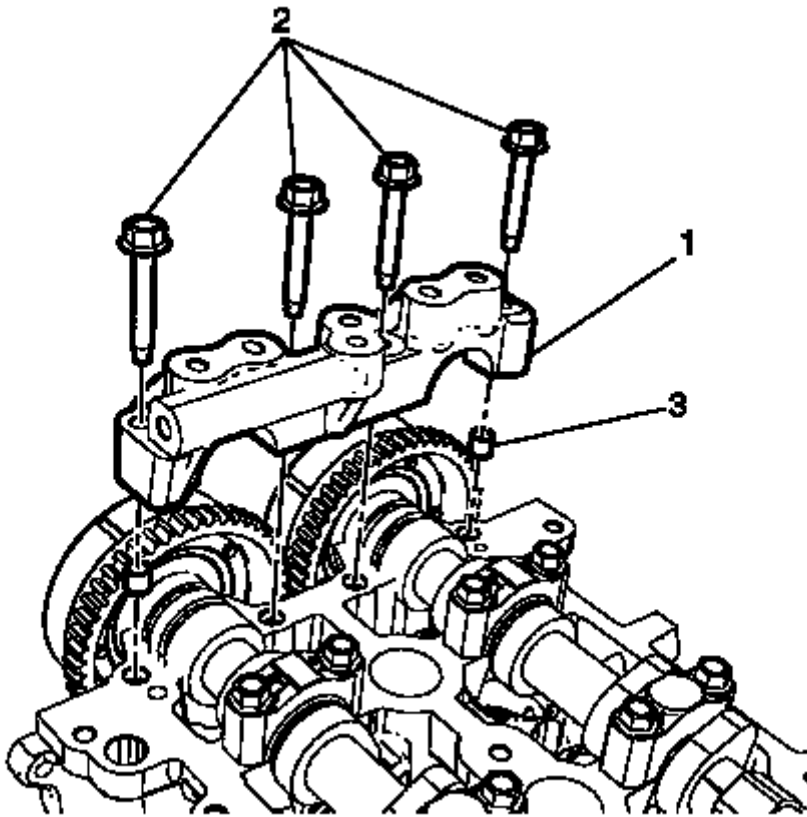


Fig. 375: First Camshaft Bearing Cap Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Clean sealing surfaces of the first camshaft bearing support and the cylinder head with a suitable tool.
8. Clean oil duct from any sealant residue.
9. Install the first camshaft bearing cap (1) and dowel pin (3).
10. Tighten camshaft bearing cap bolts (2) to 10 (89 lb in).

CAMSHAFT INSTALLATION (LFM)

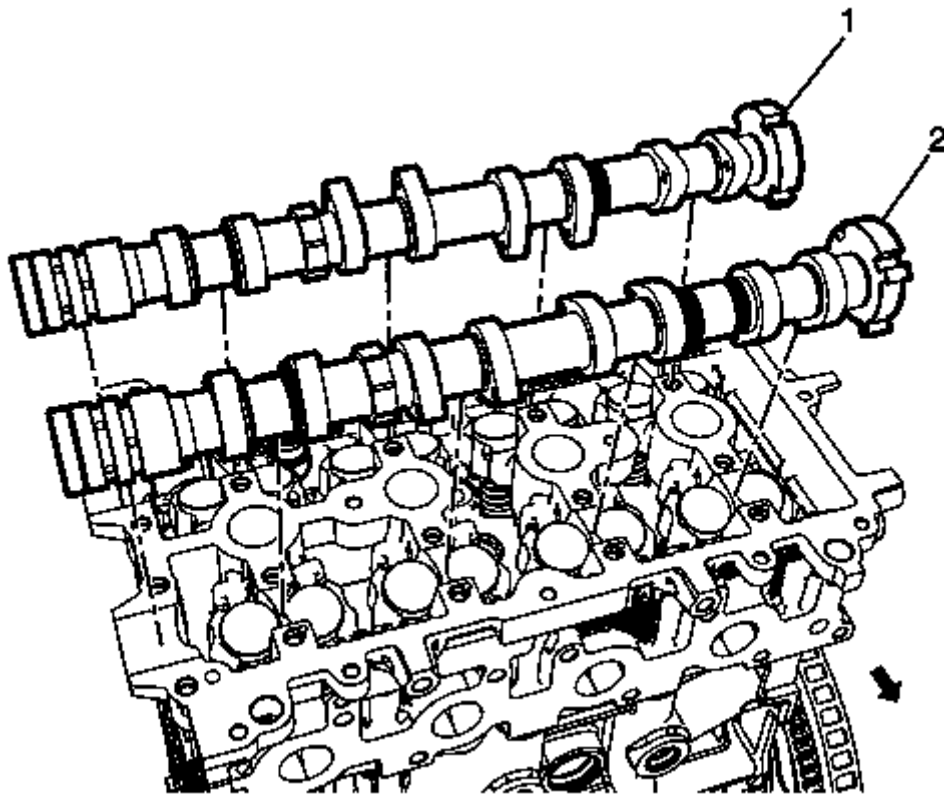


Fig. 376: Intake Camshaft

Courtesy of GENERAL MOTORS COMPANY

NOTE: The exhaust camshaft has 2 grooves between the No. 3 journal and No. 4 journal. The intake camshaft has 1 groove.

1. Install the intake camshaft (1) and the exhaust camshaft (2).

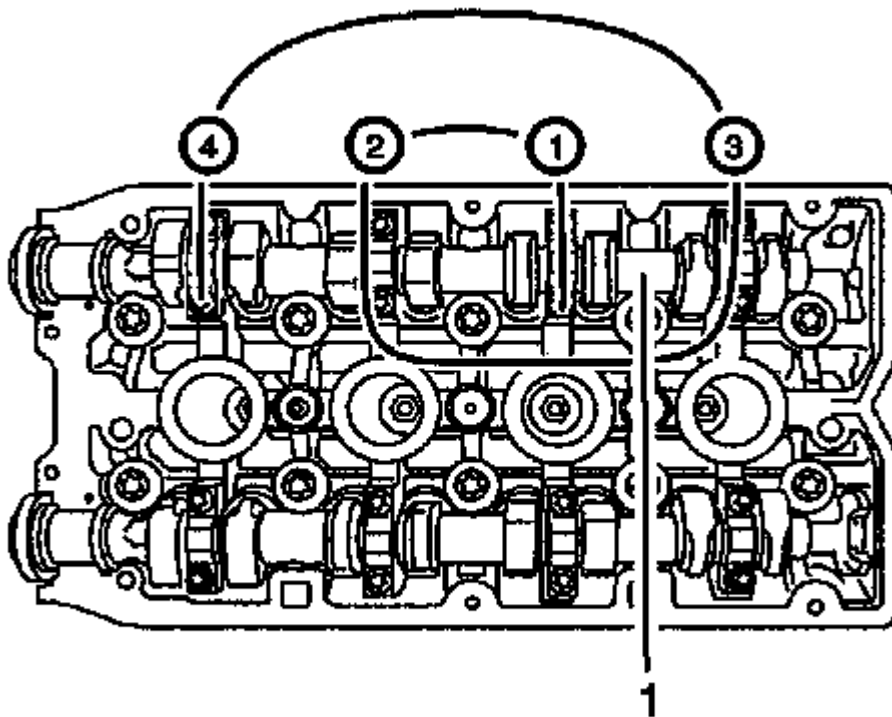


Fig. 377: Camshaft Lobes

Courtesy of GENERAL MOTORS COMPANY

2. Position the camshaft lobes in a neutral position.

NOTE: **Note the identification marking on the camshaft bearing cover.**

3. Install the 4 intake camshaft bearing caps numbers 2-5 from the cylinder head.

CAUTION: Refer to Fastener Caution .

4. Tighten the 8 intake camshaft bearing cap bolts working from inside to outside in a spiral to 10 (89 lb in).

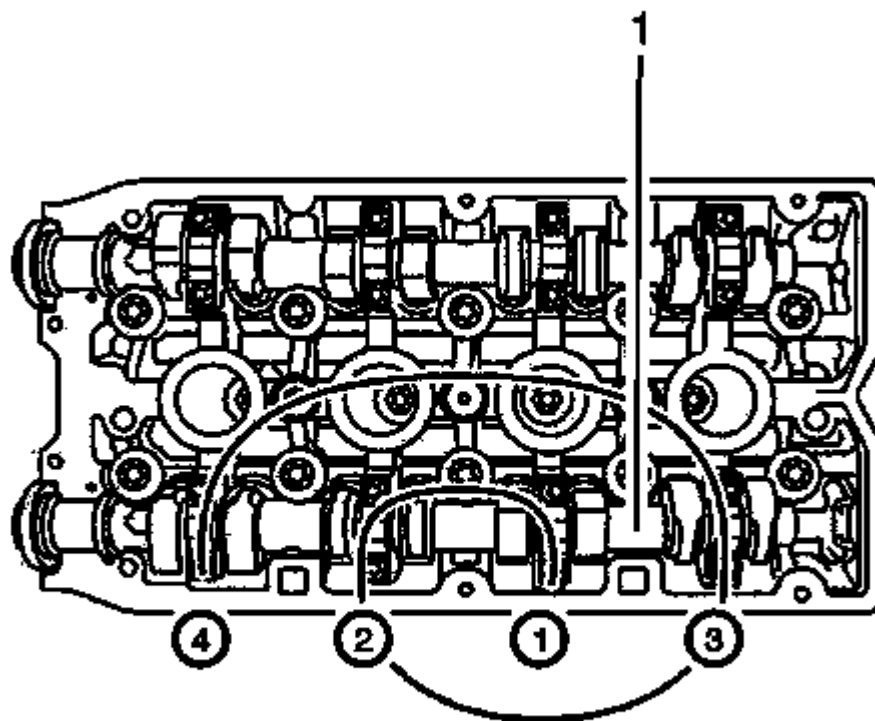


Fig. 378: Exhaust Camshaft Bearing Cap
Courtesy of GENERAL MOTORS COMPANY

NOTE: Note the identification marking on the camshaft bearing cover.

5. Install the 4 exhaust camshaft bearing caps numbers 6-9 from the cylinder head.
6. Tighten the 8 exhaust camshaft bearing cap bolts working from inside to outside in a spiral to 10 (89 lb in).

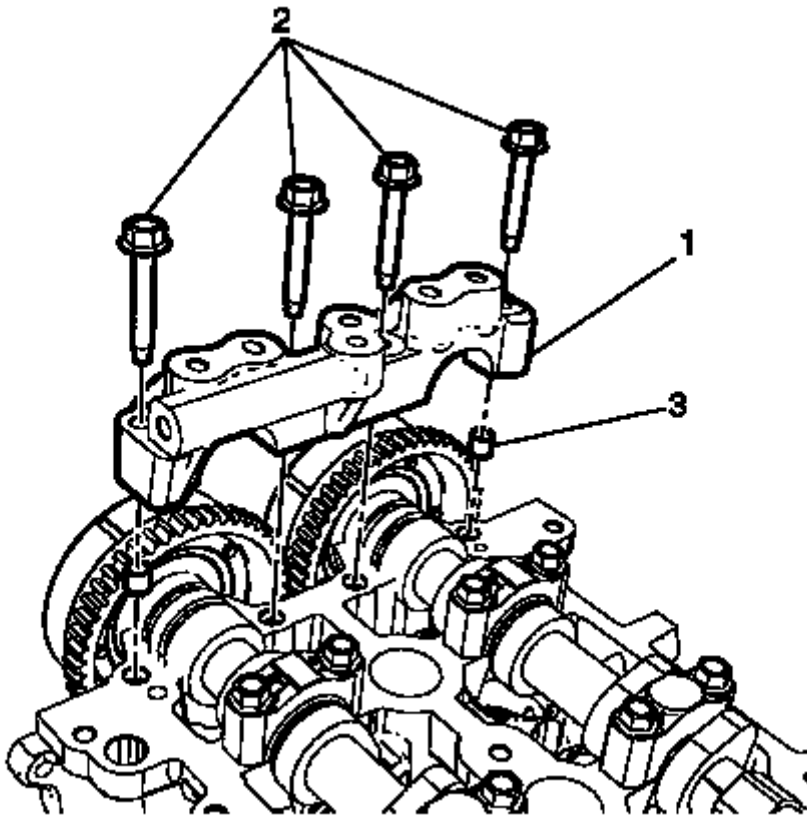


Fig. 379: First Camshaft Bearing Cap Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Clean sealing surfaces of the first camshaft bearing support and the cylinder head with a suitable tool.
8. Clean oil duct from any sealant residue.
9. Install the first camshaft bearing cap (1) and dowel pin (3).
10. Tighten camshaft bearing cap bolts (2) to 10 (89 lb in).

ENGINE LIFT REAR BRACKET INSTALLATION

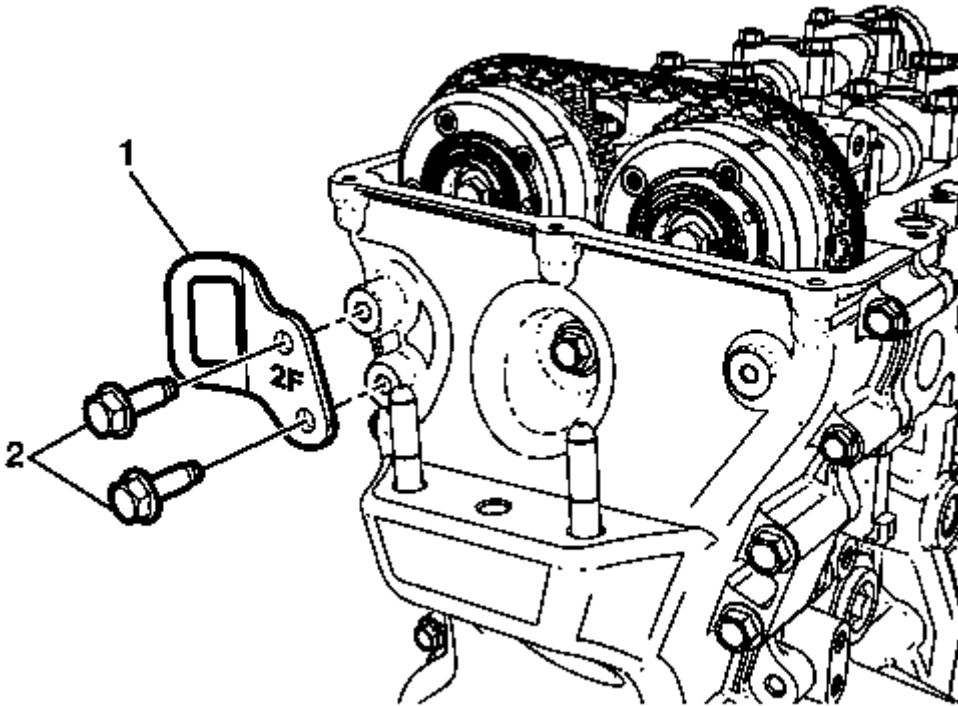


Fig. 380: Engine Lift Rear Bracket And Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the engine lift rear bracket (1).

CAUTION: Refer to Fastener Caution .

2. Install the engine lift rear bracket bolts (2) to the engine lift rear bracket (1) and tighten to 25 (18 lb ft).

ENGINE LIFT FRONT BRACKET INSTALLATION

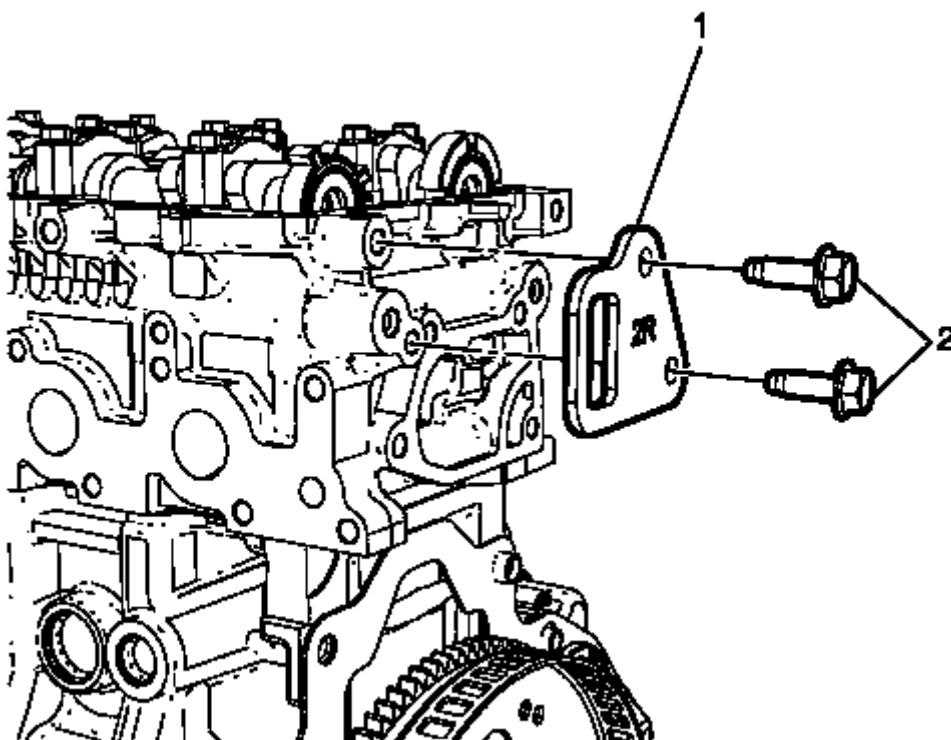


Fig. 381: Engine Lift Front Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the engine lift front bracket (1).

CAUTION: Refer to Fastener Caution .

2. Install the engine lift front bracket bolts (2) to the engine lift front bracket and tighten to 25 (18 lb ft).

CYLINDER HEAD AND GASKET INSTALLATION

Special Tools

GE-42072 Cylinder Head Bolt Remover/Installer

For equivalent regional tools, refer to Special Tools.

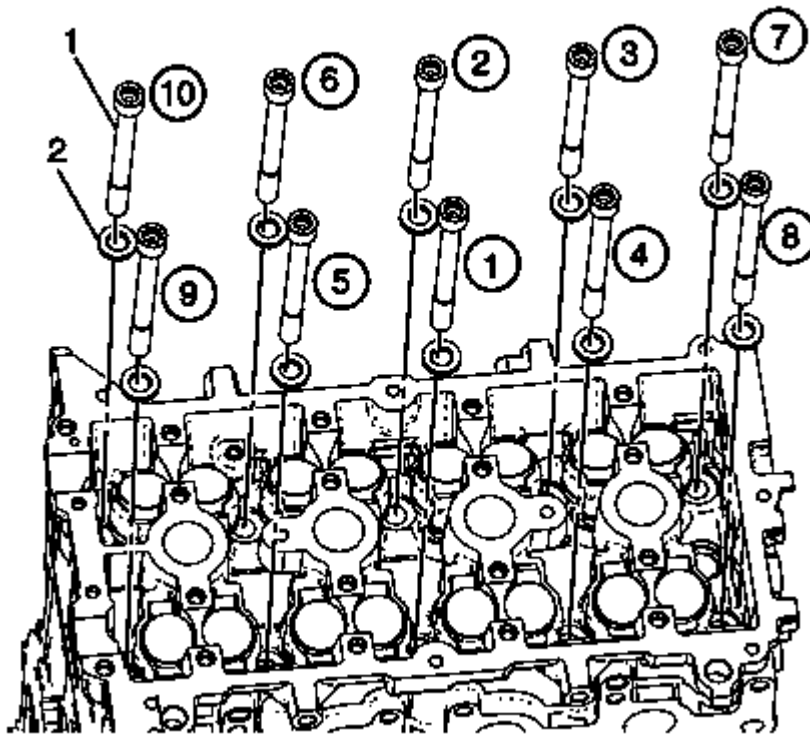


Fig. 382: Cylinder Head Bolts In Sequence
 Courtesy of GENERAL MOTORS COMPANY

NOTE: The cylinder head bolts require a 10 mm 12 point triple square tool for proper servicing. Use GE-42072 Cylinder Head Bolt Remover/Installer or equivalent when servicing head bolts.

1. Clean the sealing surfaces.
2. Inspect for plane surface.
 - Cylinder block, cylinder head
 - Straight-edge, feeler gauge
3. Install the cylinder head gasket.
4. Install the cylinder head.

CAUTION: Refer to Fastener Caution .

5. Install the 10 cylinder head bolts with the GE-42072 cylinder head bolt remover/installer (1) in sequence as shown.

Tighten to 22 + 82° (16 lb ft + 82°)

1. 10 bolts 22 (16 lb ft)
2. Recheck for 10 bolts tightening torque for getting 22 balance.
3. 10 bolts 82°

ENGINE FRONT COVER AND OIL PUMP INSTALLATION

NOTE: There are no serviceable components within the oil pump. Disassemble the pump only to diagnose an oiling concern. A disassembled oil pump must not be reused. A disassembled oil pump must be replaced.

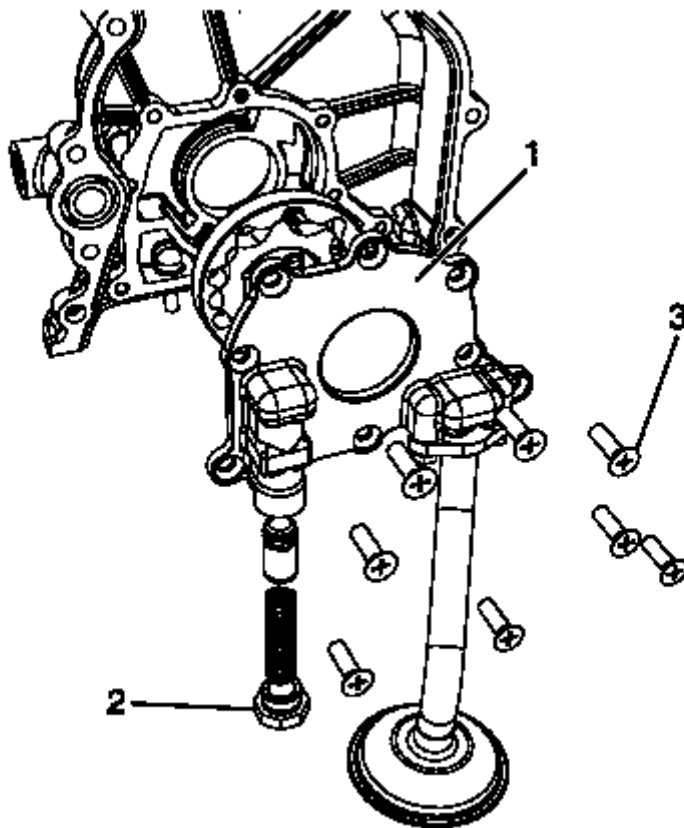


Fig. 383: Oil Pump Screws
Courtesy of GENERAL MOTORS COMPANY

1. Install the oil relief valve components and plug to oil pump housing (1).

CAUTION: Refer to Fastener Caution .

2. Tighten the oil pump housing retaining bolts (3) to 10 (89 lb in).

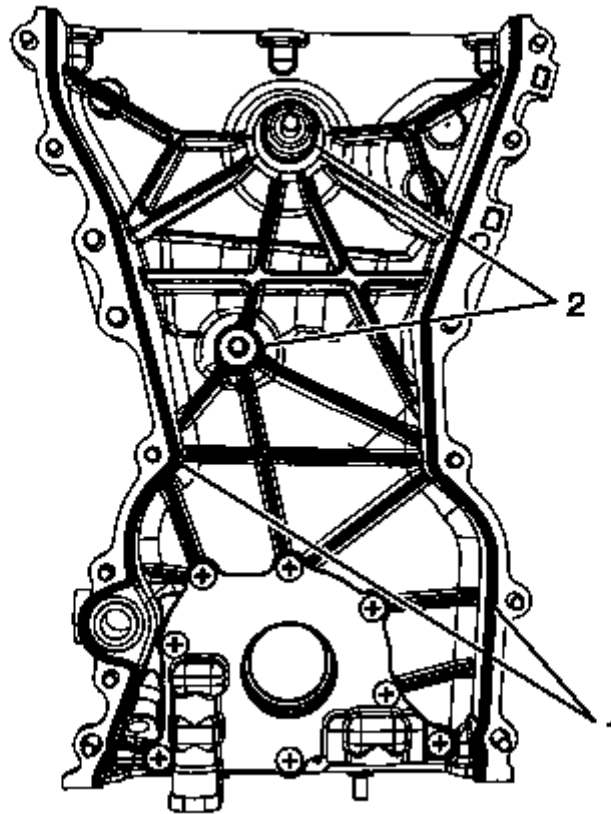


Fig. 384: Engine Front Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage the sealing surfaces.

NOTE: Cleaning of the sealing surfaces (3-6): Refer to Replacing Engine Gaskets.

3. Remove any old thread sealant, gasket material or sealant using remover such as chisel or scraper.
4. Clean the sealing surfaces of front cover and front cover components with solvent.

NOTE: Ensure that the sealing surface is clear of oil, grease and oil sealant material.

5. Clean out debris from the bolt holes.

WARNING: Refer to Safety Glasses and Compressed Air Warning .

6. Dry the front cover and front cover components with compressed air.

NOTE: Do not coat sealant (RTV) on the front cover bolt holes and bolt threads.

NOTE: Apply sealant (RTV) on lines (1) and 2 hole faces (2). Apply sealant (RTV) to the edges of top and bottom step chamfers.

7. Apply approximately a 4.5 mm (0.177 in) thick bead of oil pan sealant (1) to the oil pan.

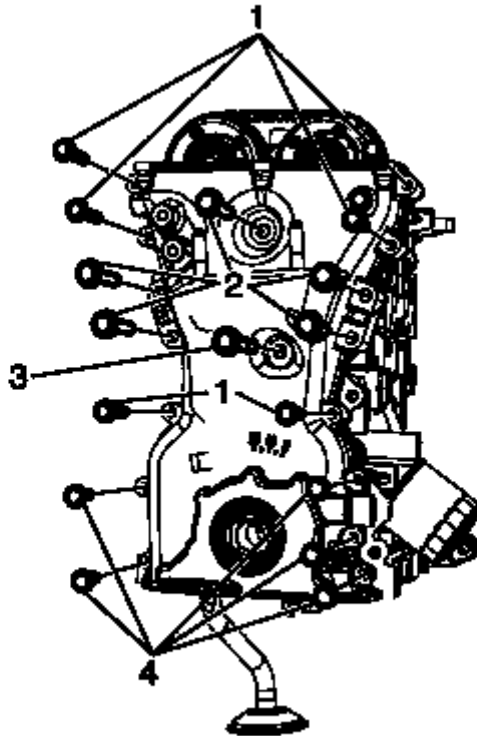


Fig. 385: Engine Front Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

8. Install the engine front cover with the included oil pump.

NOTE: Check the different screw lengths.

9. Install the engine front cover bolts (2, 3) and tighten to 22 (16 lb ft).

NOTE: After sealant (RTV) dispensing, the assembly completion time including torque check must be done within 8 minutes.

10. Install the engine front cover bolts (1, 4) and tighten to.10 (89 lb in).

WATER PUMP INSTALLATION

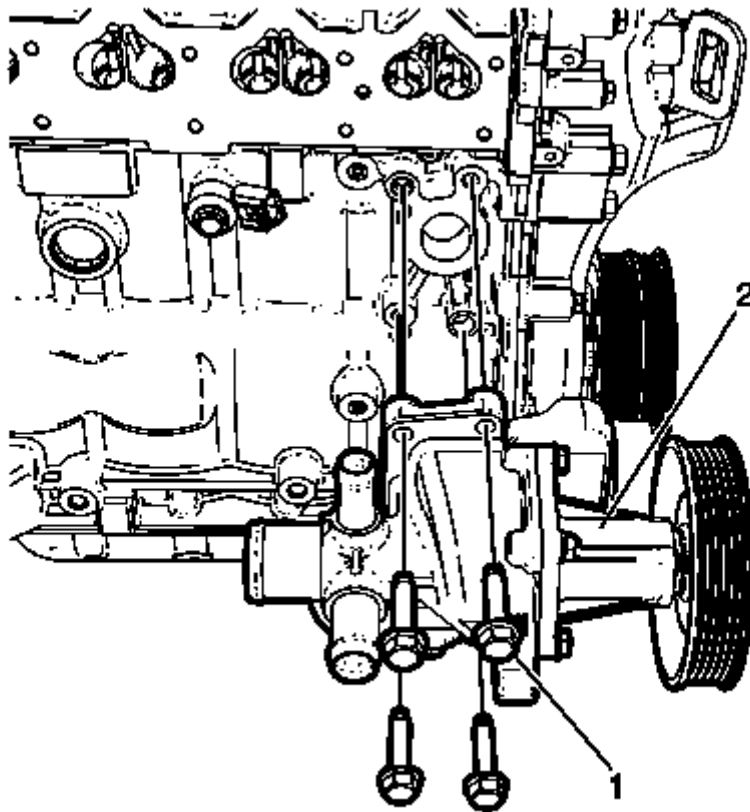


Fig. 386: Water Pump Bolts

Courtesy of GENERAL MOTORS COMPANY

1. Clean the sealing surfaces and the water pump threads.

CAUTION: Refer to Fastener Caution .

CAUTION: Refer to Torque-to-Yield Fastener Caution .

2. Install the water pump (2) and the 4 NEW water pump bolts (1).
3. Tighten the water pump bolts to 25 (89 lb ft).

CRANKSHAFT FRONT OIL SEAL INSTALLATION

Special Tools

EN 50172 Crankshaft Front Oil Seal Installer

For equivalent regional tools, refer to Special Tools.

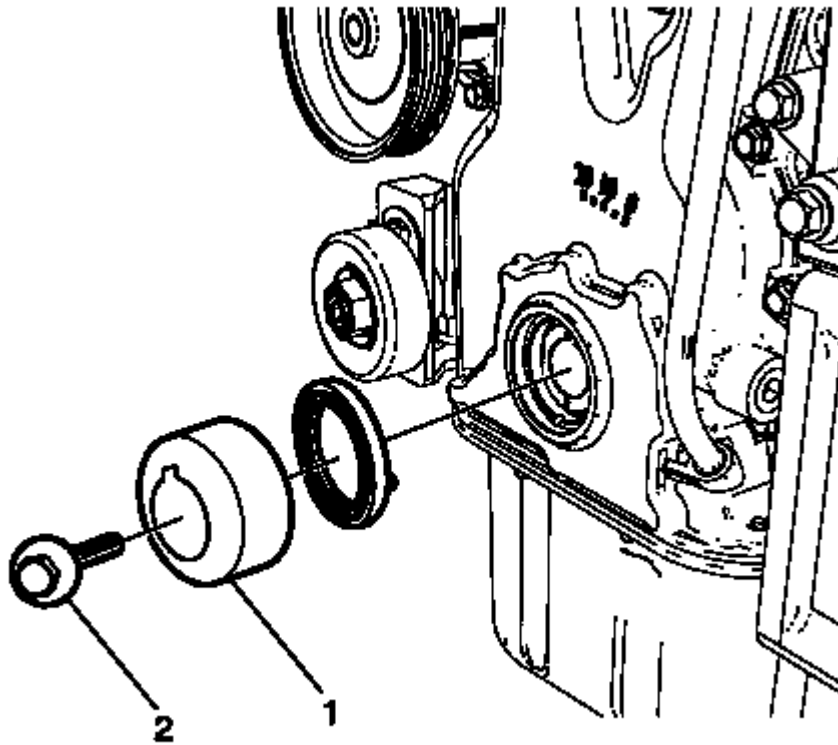


Fig. 387: Crankshaft Bolt And Crankshaft Front Oil Seal Installer
Courtesy of GENERAL MOTORS COMPANY

1. Position the NEW crankshaft front oil seal.
 1. Position the crankshaft front oil seal in such a way that the engine front cover is over the corresponding cut-out on the cylinder block.

NOTE: Do not press in the seal ring all the way.

2. Slide the crankshaft front oil seal over the crankshaft. Push, until the crankshaft front oil seal is flush and sits evenly in the cylinder block.
2. Install the **EN 50172** crankshaft front oil seal installer (1) to the crankshaft.
3. Tighten the **EN 50172** crankshaft front oil seal installer to crankshaft pulley retaining bolt (2).
4. Using the **EN 50172** crankshaft front oil seal installer, install the crankshaft front oil seal.
5. Remove the **EN 50172** crankshaft front oil seal installer (1).

OIL PAN INSTALLATION

NOTE: Cleaning of the sealing surfaces (1-4): Refer to Replacing Engine Gaskets.

1. Remove any old thread sealant, gasket material or sealant.
2. Clean the sealing surfaces of front cover and front cover components with solvent.

NOTE: Ensure that the sealing surface is clear of oil, grease and oil sealant material.

3. Clean out debris from the bolt holes.

WARNING: Refer to Safety Glasses and Compressed Air Warning .

4. Dry the front cover and front cover components with compressed air.

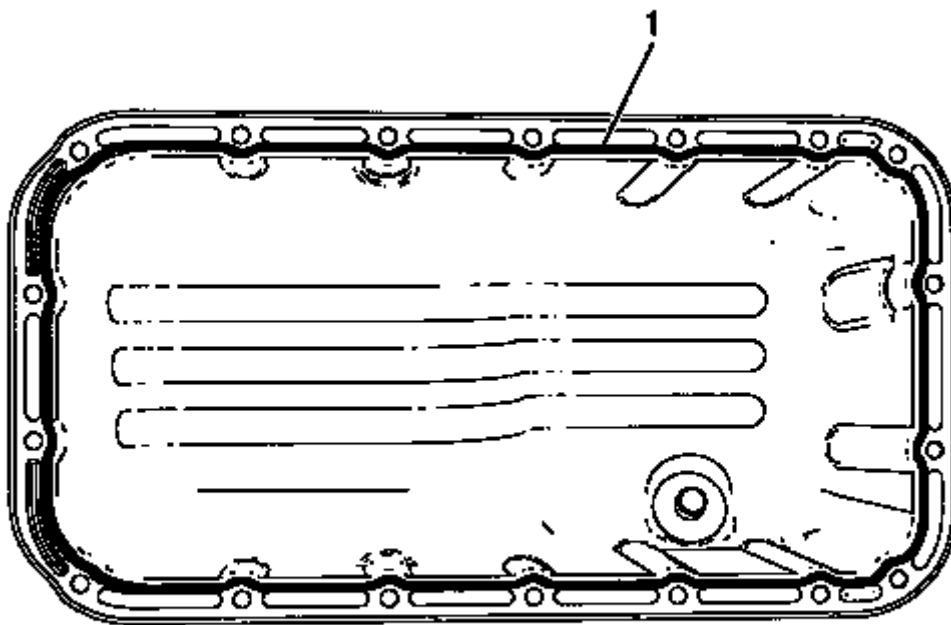


Fig. 388: Oil Pan Sealant
Courtesy of GENERAL MOTORS COMPANY

NOTE: Use a new oil pan.

NOTE: Do not coat sealant (RTV) on the front cover bolt holes and bolt threads

5. Apply approximately a 4.5 mm (0.177 in) thick bead of oil pan sealant (1) to the oil pan.

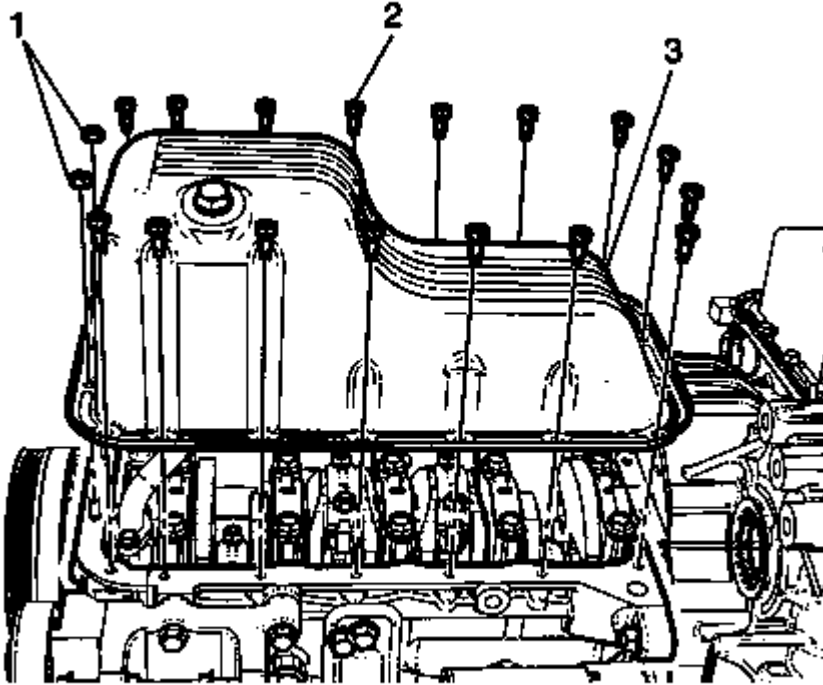


Fig. 389: Oil Pan Bolts And Nuts
Courtesy of GENERAL MOTORS COMPANY

6. Install the oil pan (3).
7. Install the 16 oil pan bolts (2) and 2 nuts (1).

CAUTION: Refer to Fastener Caution .

NOTE: After sealant (RTV) dispensing, the assembly completion time including torque check must be done within 8 minutes.

8. Tighten the oil pan bolts and nuts on the cylinder block to 10 (89 lb in).

CAMSHAFT COVER INSTALLATION

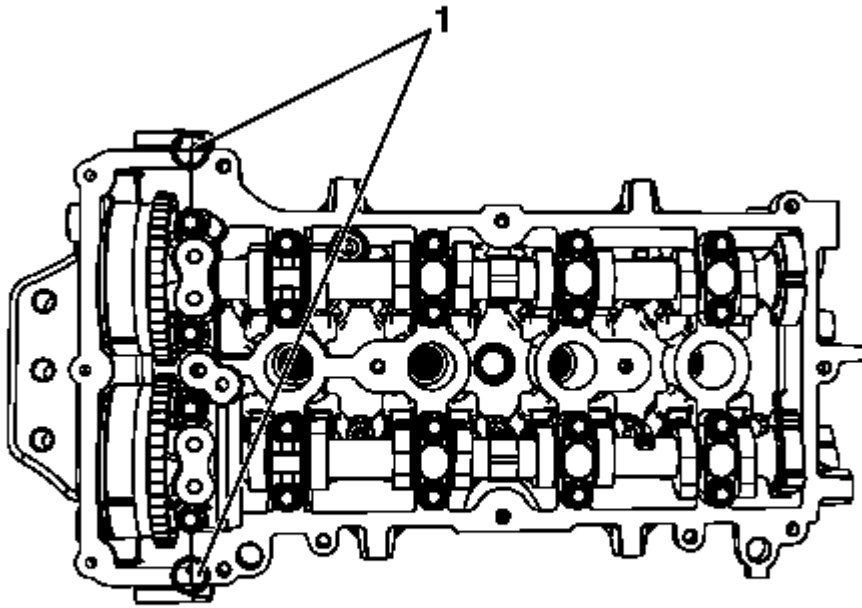


Fig. 390: Cured RTV Carefully

Courtesy of GENERAL MOTORS COMPANY

1. Remove the cured RTV carefully (1) and then clean the sealing surfaces.

NOTE: After RTV applying, the assembly completion time including torque check must be done within 8 minutes.

2. Apply RTV sealant to T-joint between cylinder head and front cover (1).

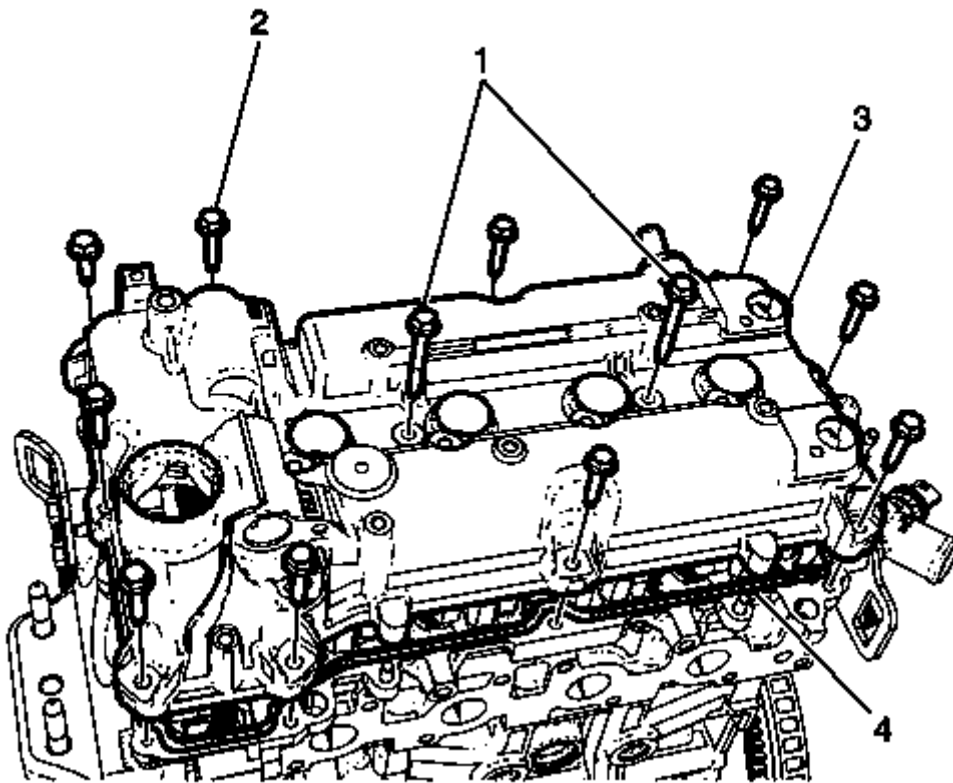


Fig. 391: Camshaft Cover Bolts

Courtesy of GENERAL MOTORS COMPANY

3. Insert a NEW gasket (4) in the camshaft cover.
4. Install the camshaft cover (3).

CAUTION: Refer to Fastener Caution .

5. Install the camshaft cover 12 bolts (1, 2) and tighten to 10 (89 lb in).

IGNITION COIL INSTALLATION

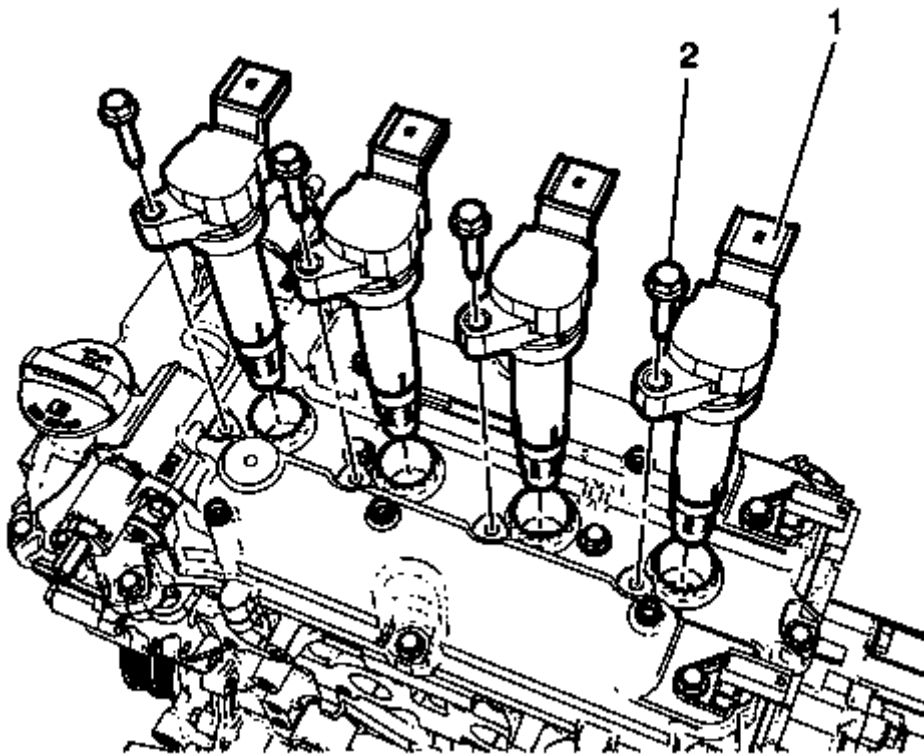


Fig. 392: Ignition Coil
Courtesy of GENERAL MOTORS COMPANY

1. Install the ignition coil (1).

CAUTION: Refer to Fastener Caution .

2. Install the ignition coil bolts (2) and tighten to 10 (89 lb in).

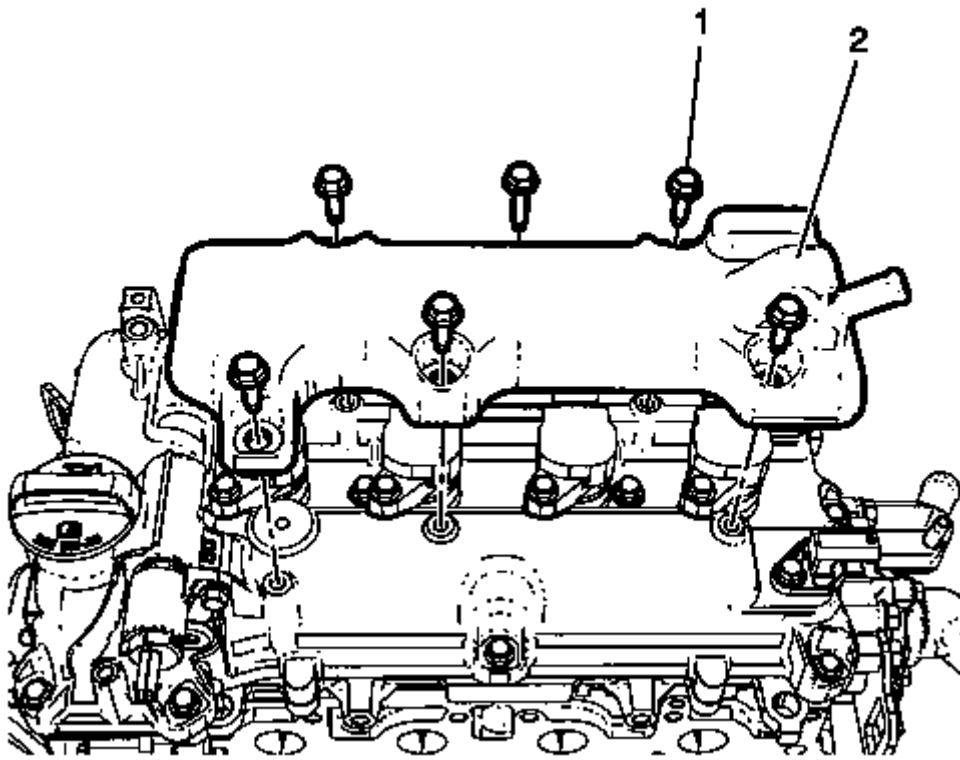


Fig. 393: Ignition Coil Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Install the ignition coil cover (2) and tighten the ignition coil cover bolts (1) to 10 (89 lb in).

OIL LEVEL INDICATOR AND TUBE INSTALLATION

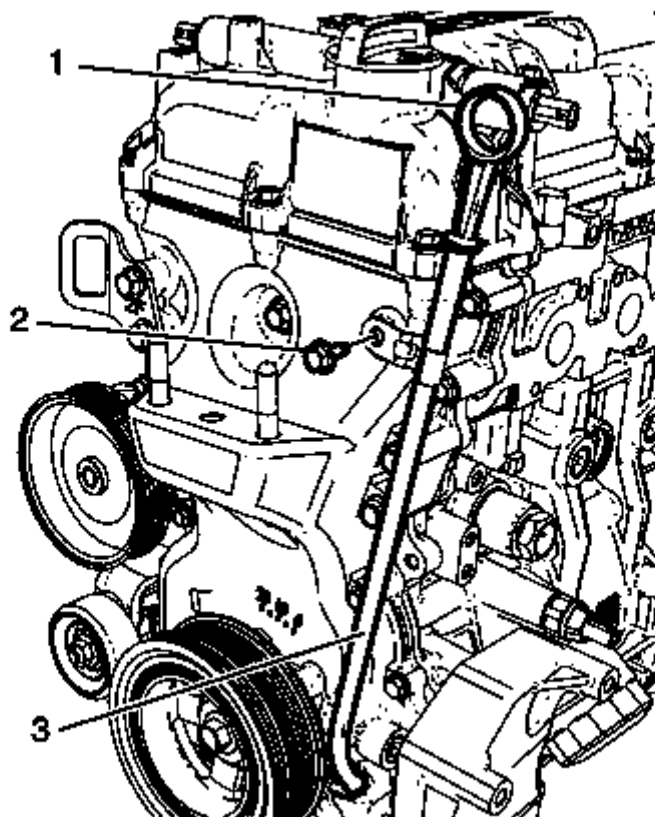


Fig. 394: Oil Dipstick And Oil Level Indicator Tube Bolt
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

1. Install the oil level indicator tube (3) and oil level indicator seal and tighten the oil level indicator tube bolt (2) to 10 (89 lb in).
2. Install the oil dipstick (1).

INTAKE MANIFOLD INSTALLATION (LL0)

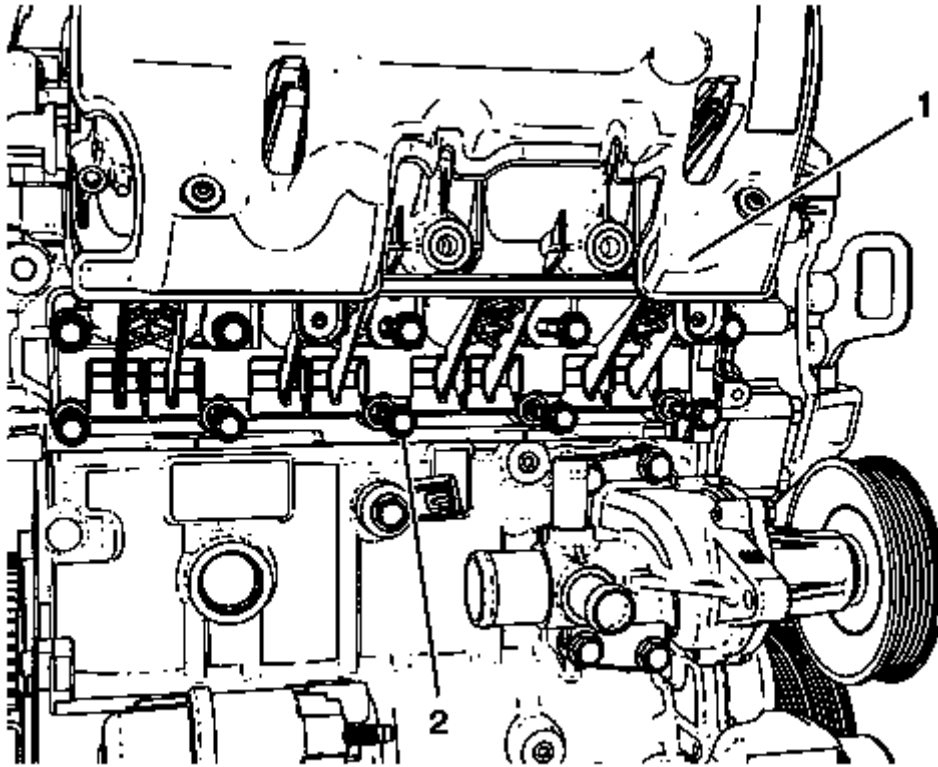


Fig. 395: Intake Manifold 10 Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

1. Install the lower intake manifold (1) and tighten the bolts (2) to 10 (89 lb in)

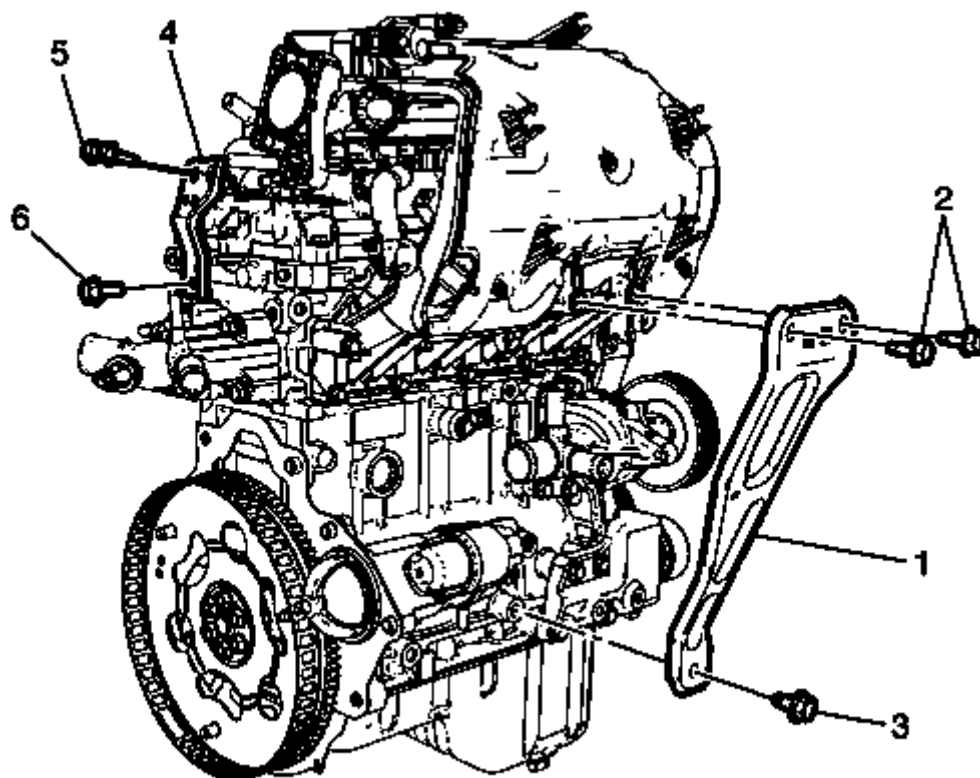


Fig. 396: Intake Manifold Upper Bracket
Courtesy of GENERAL MOTORS COMPANY

2. Install the intake manifold rear bracket (1) and tighten the bolts (2) to 22 (18 lb ft).
3. Install the intake manifold rear bracket bolt (3) and tighten to 58 (42 lb ft).
4. Install the upper intake manifold side bracket (4) and tighten the bolts (5) to 10 (89 lb in).
5. Install the upper intake manifold side bracket bolt (6) and tighten to 10 (89 lb in)

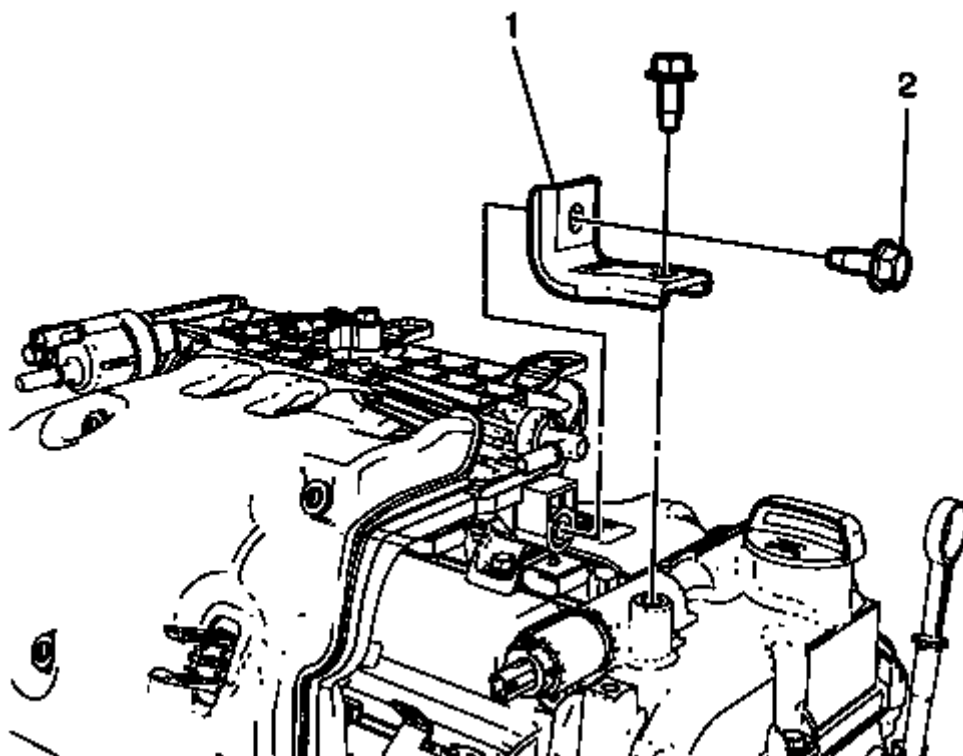


Fig. 397: Intake Manifold Upper Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Install the intake manifold upper bracket (1) tighten the bolts (2) to 25 (18 lb ft).

INTAKE MANIFOLD INSTALLATION (LFM)

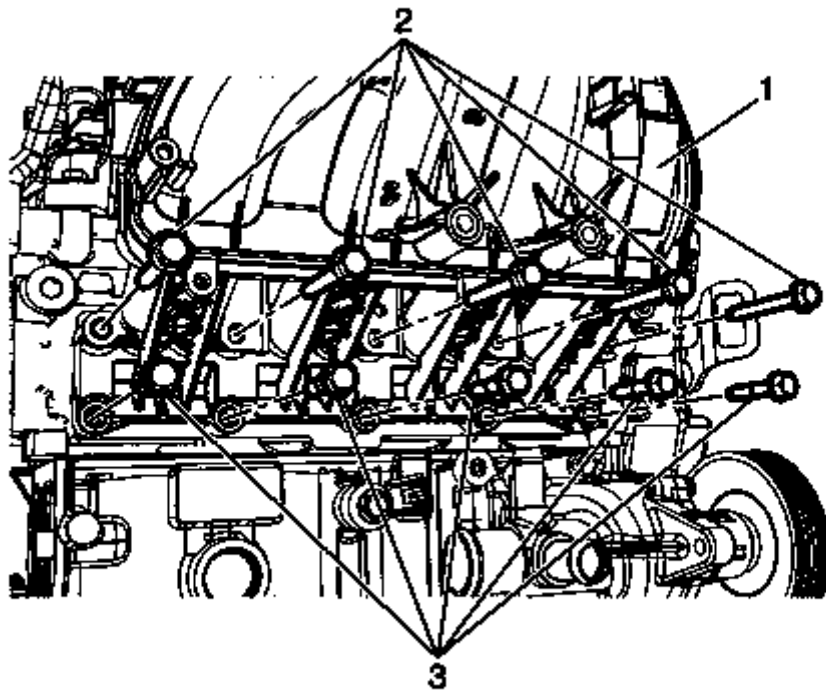


Fig. 398: Lower Intake Manifold And Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

1. Install the lower intake manifold (1) and tighten the lower intake manifold bolts (2, 3) to 10 (89 lb in).

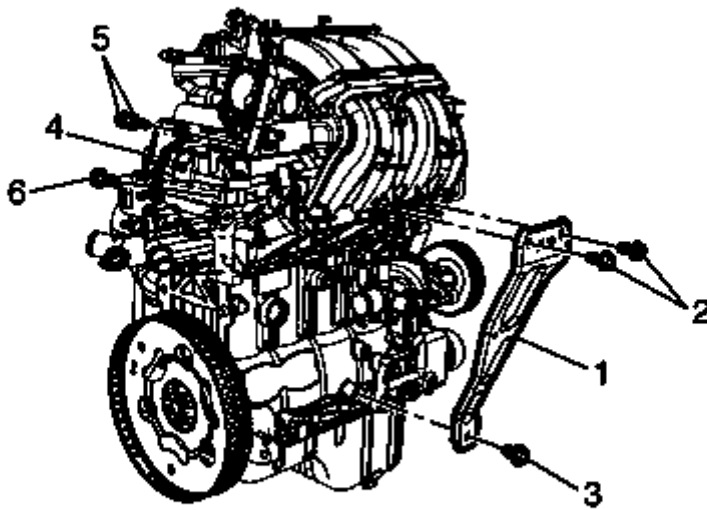


Fig. 399: Intake Manifold Rear Bracket
Courtesy of GENERAL MOTORS COMPANY

2. Install the intake manifold rear bracket (1) and tighten the intake manifold rear bracket bolts (up) (2) to 22 (16 lb ft).
3. Install the intake manifold rear bracket bolt (down) (3) and tighten to 58 (42 lb ft).
4. Install the upper intake manifold side bracket (4) and tighten the upper intake manifold side bracket bolts (5) to 10 (89 lb in).
5. Install the upper intake manifold side bracket bolt (6) and tighten to 25 (18 lb ft).

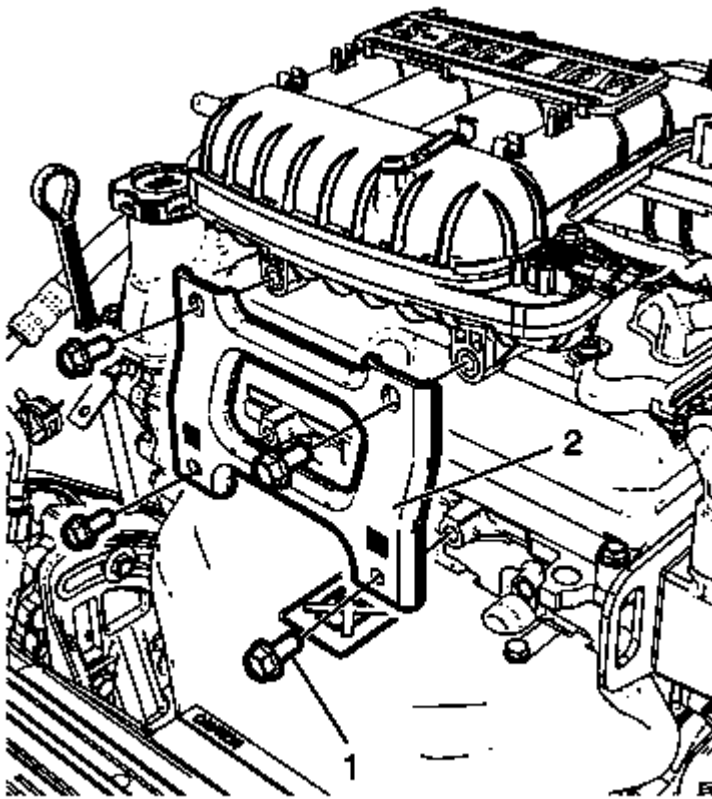


Fig. 400: Upper Intake Manifold Front Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Install the upper intake manifold front bracket (2), tighten the upper intake manifold front bracket bolts (1) to 25 (18 lb ft).

THROTTLE BODY ASSEMBLY INSTALLATION

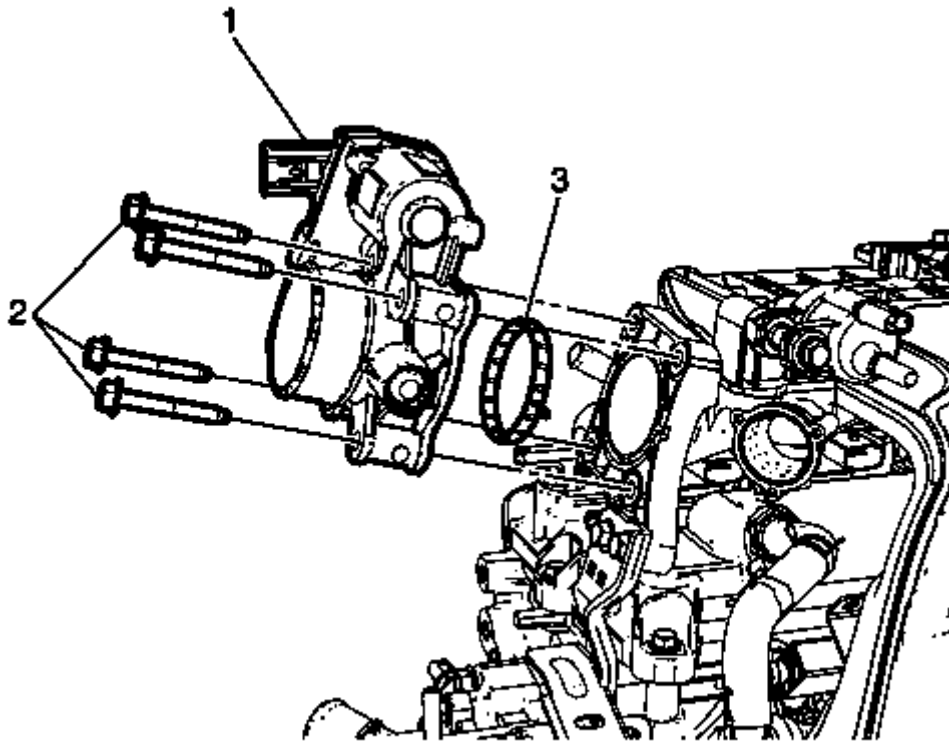


Fig. 401: Throttle Body Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Install the new throttle body seal (3).
2. Install the throttle body (1).

CAUTION: Refer to Fastener Caution .

3. Install the 4 throttle body bolts (2) and tighten to 10 (89 lb in).

ENGINE WATER OUTLET ADAPTER INSTALLATION

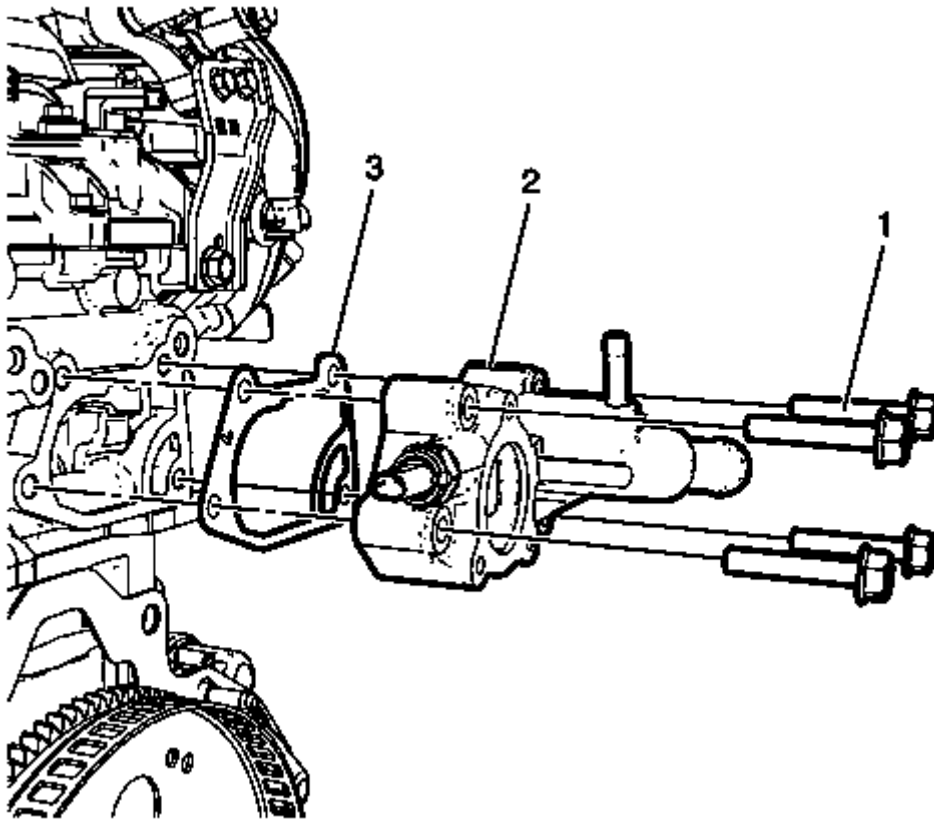


Fig. 402: Engine Water Outlet Adapter Housing Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the engine coolant outlet adapter housing (2) and a NEW gasket (3).

CAUTION: Refer to Fastener Caution .

2. Install the 4 engine coolant outlet adapter housing bolts (1) and tighten to 25 (18 lb ft).

ENGINE COOLANT THERMOSTAT INSTALLATION

1. Clean the engine coolant sealing surfaces.

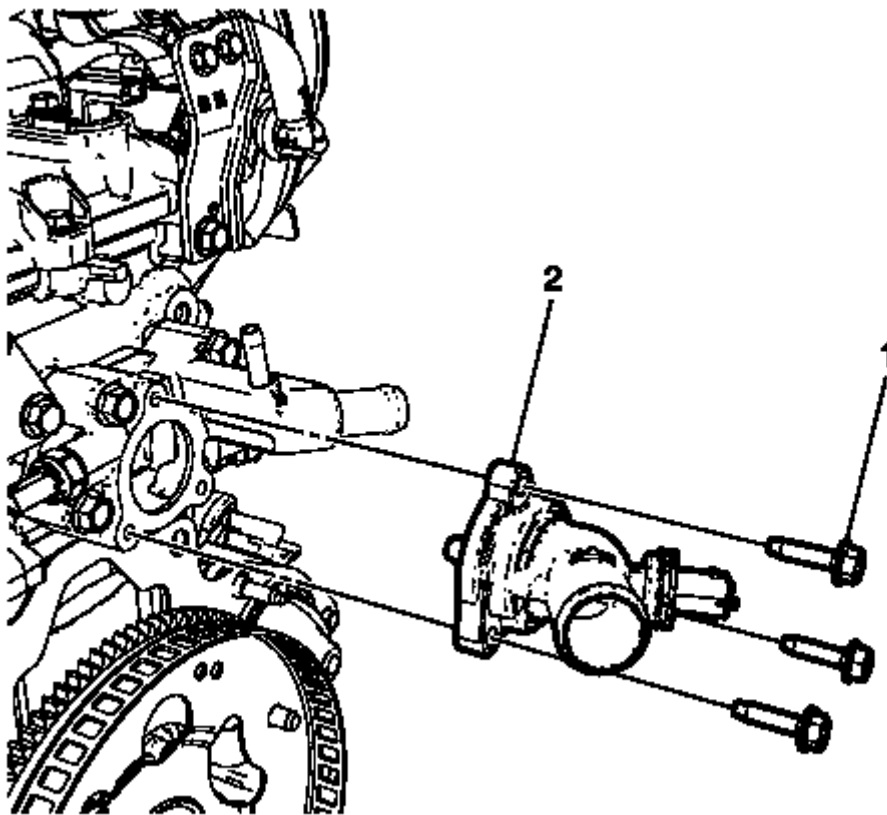


Fig. 403: Engine Coolant Thermostat Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Install the engine coolant thermostat assembly (2).

WARNING: Refer to Safety Glasses and Compressed Air Warning .

CAUTION: Refer to Fastener Caution .

3. Install the 3 engine coolant thermostat bolts (1) and tighten to 10 (89 lb ft).

AIR CONDITIONING COMPRESSOR BRACKET INSTALLATION

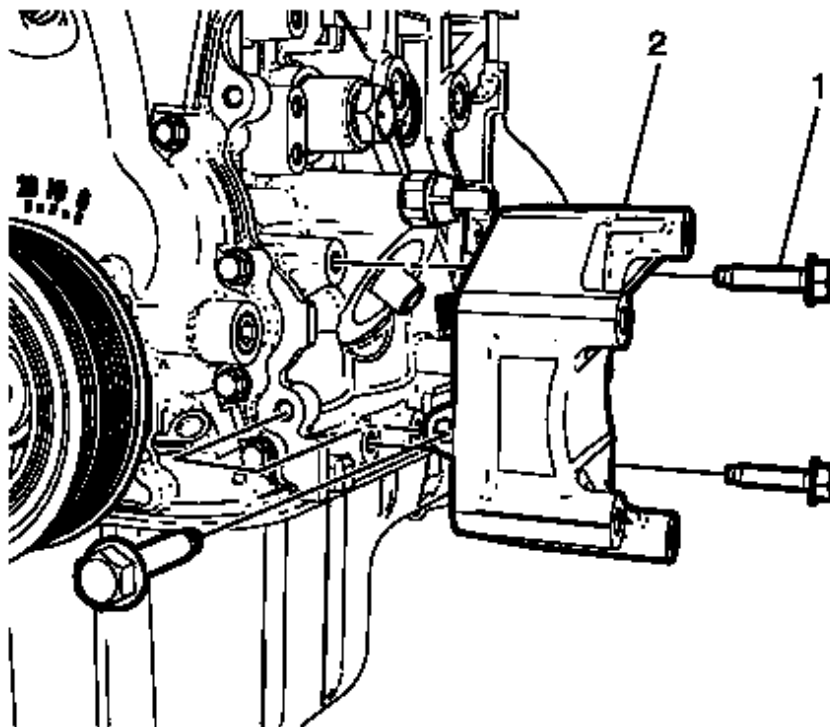


Fig. 404: Air Conditioning Compressor Bolts And Bracket
Courtesy of GENERAL MOTORS COMPANY

1. Install the air conditioning compressor bracket (2).

CAUTION: Refer to Fastener Caution .

2. Install the 3 air conditioning compressor bracket bolts (1) and tighten to 22 (16 lb ft).

GENERATOR BRACKET INSTALLATION

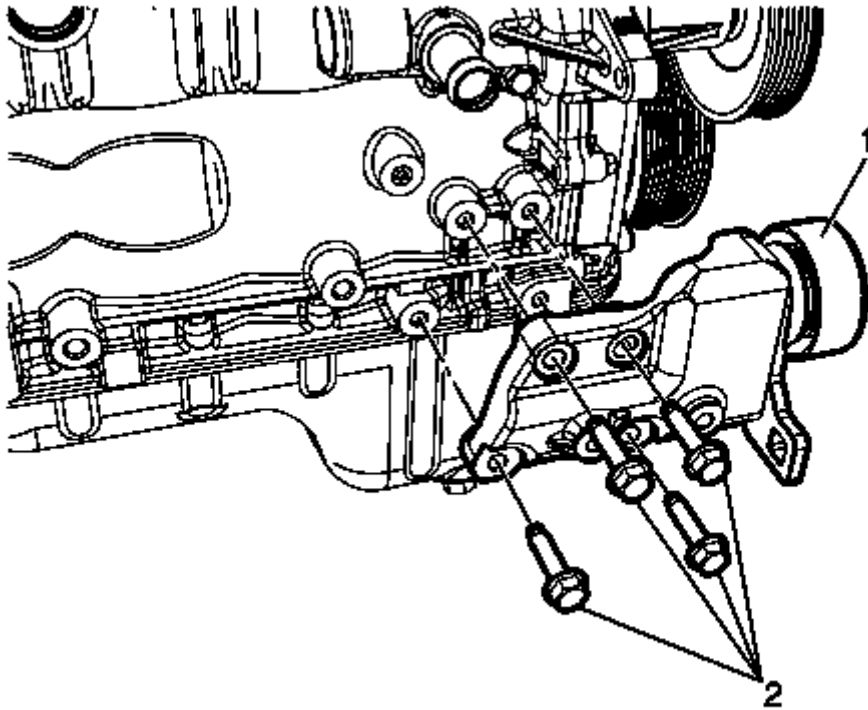


Fig. 405: Generator Bracket Retaining Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

Install the generator bracket (1), generator retaining bolts (2) and tighten to 22 (16 lb ft).

CAMSHAFT POSITION ACTUATOR SOLENOID VALVE INSTALLATION

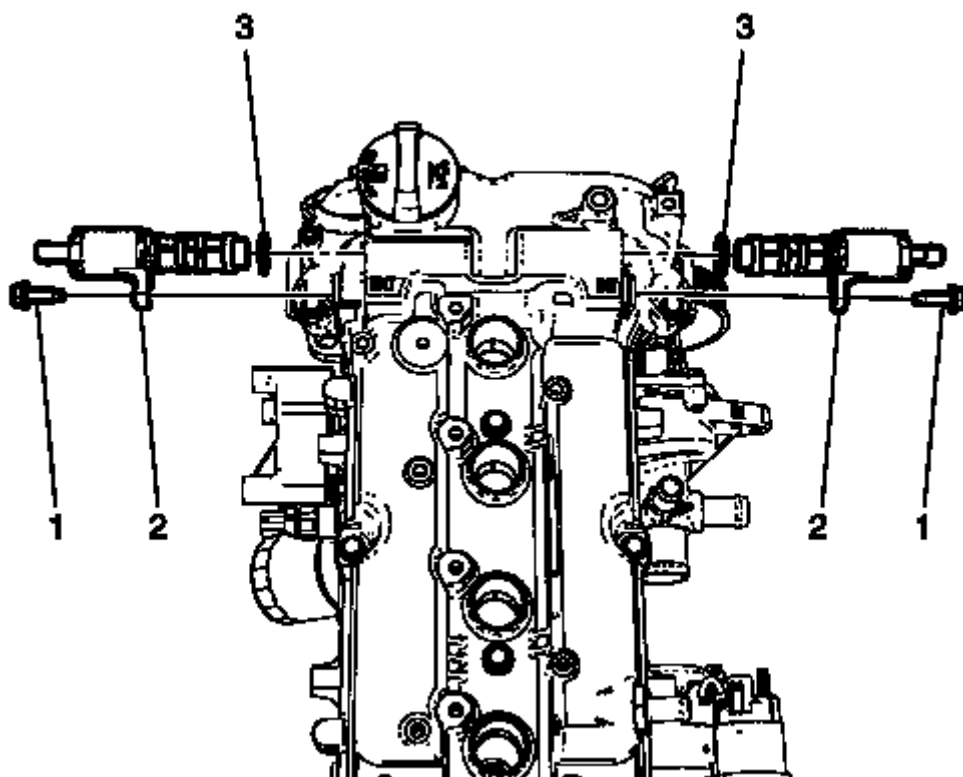


Fig. 406: Camshaft Position Actuator Solenoid Valve Bolts And Valves
Courtesy of GENERAL MOTORS COMPANY

NOTE: Lubricate the NEW camshaft position actuator solenoid valve seals with NEW engine oil. Refer to Adhesives, Fluids, Lubricants and Sealers.

1. Install NEW camshaft position actuator solenoid valve seals (3).
2. Install the camshaft position actuator solenoid valves (2).

CAUTION: Refer to Fastener Caution .

3. Install the camshaft position actuator solenoid valve bolts (1) and tighten to 10 (89 lb in).

CRANKSHAFT SPROCKET INSTALLATION

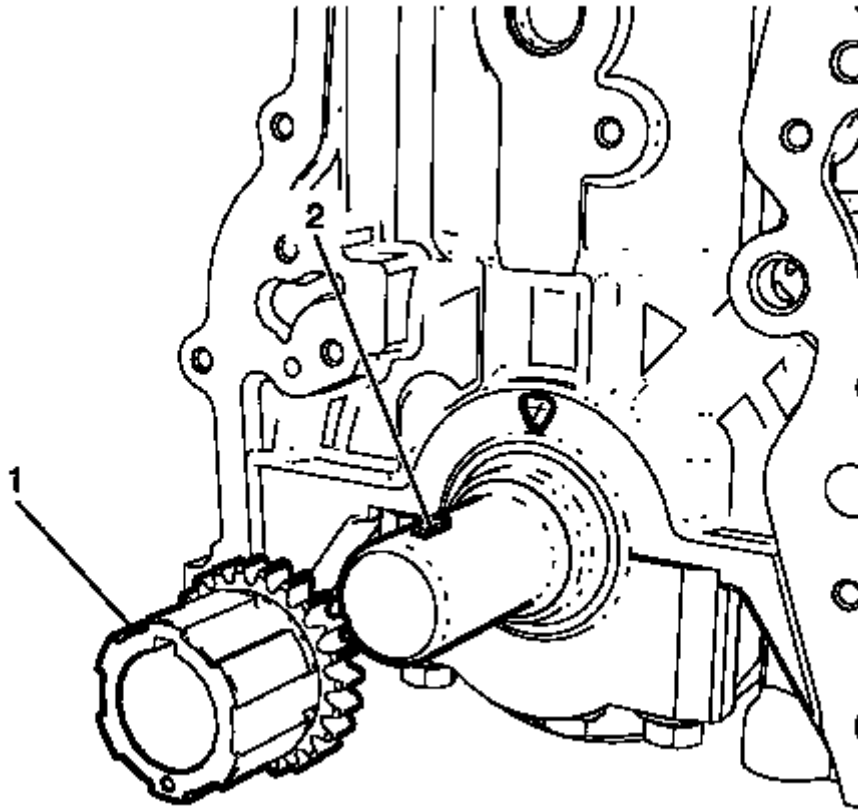


Fig. 407: Crankshaft Sprocket
Courtesy of GENERAL MOTORS COMPANY

NOTE: When installing the crankshaft sprocket, the cam and the groove must align (2).

Install the crankshaft sprocket (1).

CRANKSHAFT BALANCER INSTALLATION

Special Tools

- **EN 50175** Crankshaft Locking Device
- **EN-51218** Crankshaft Balancer Installer

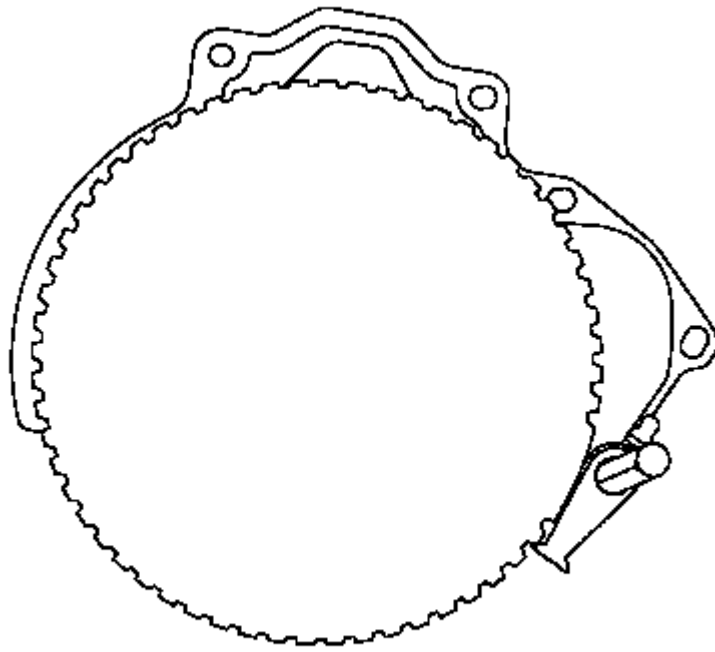


Fig. 408: EN-50050 Crankshaft Locking Device
Courtesy of GENERAL MOTORS COMPANY

1. Install the **EN 50050** crankshaft locking device. Lock the flywheel via the starter ring gear.

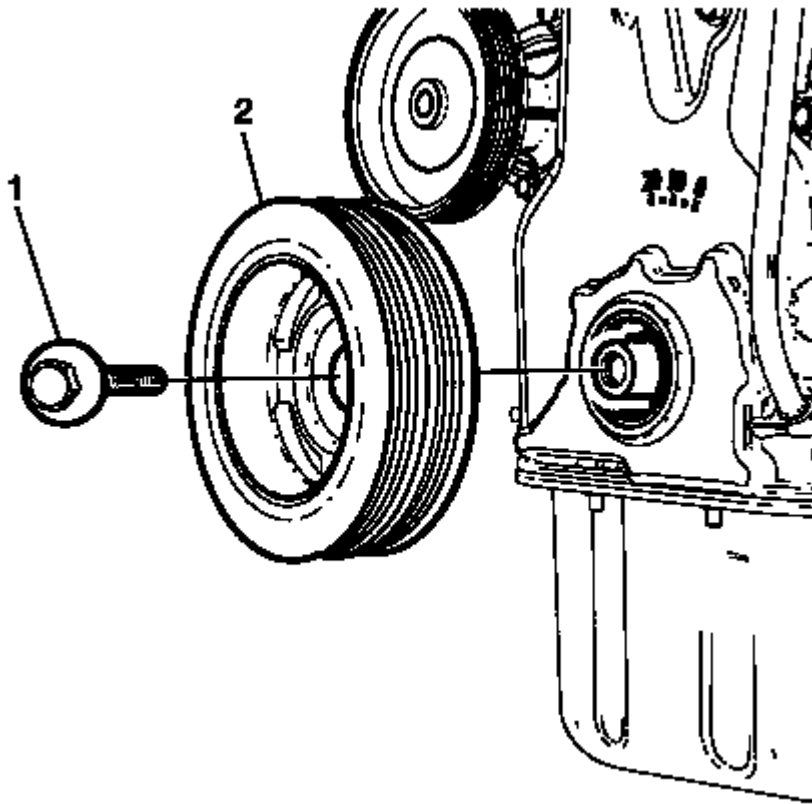


Fig. 409: Crankshaft Balancer Bolt
Courtesy of GENERAL MOTORS COMPANY

2. Install **EN-51218** crankshaft balancer installer or equivalent to the crankshaft balancer (2).

CAUTION: Refer to Fastener Caution .

NOTE: When installing the crankshaft balancer, the cam and the groove must align.

3. Install the crankshaft balancer (2) to the crankshaft and tighten the bolt (1) to $95 + 55^\circ$ (70 lb ft + 55°).

AUTOMATIC TRANSMISSION FLEX PLATE INSTALLATION

Special Tools

EN 50050 Crankshaft Locking Device

For equivalent regional tools, refer to Special Tools.

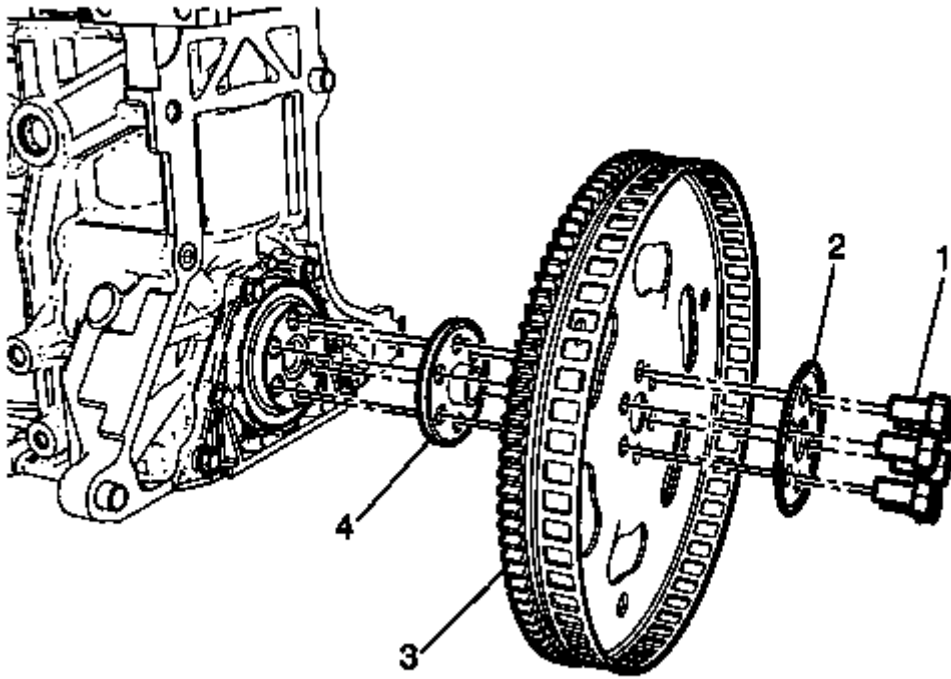


Fig. 410: Automatic Transmission Flex Plate Bolts And Automatic Transmission Flex Plate Retainer

Courtesy of GENERAL MOTORS COMPANY

1. Install the automatic transmission flex plate spacer (4).
2. Install the automatic transmission flex plate (3).
3. Install the automatic transmission flex plate retainer (2).
4. Install the 6 automatic transmission flex plate bolts (1).

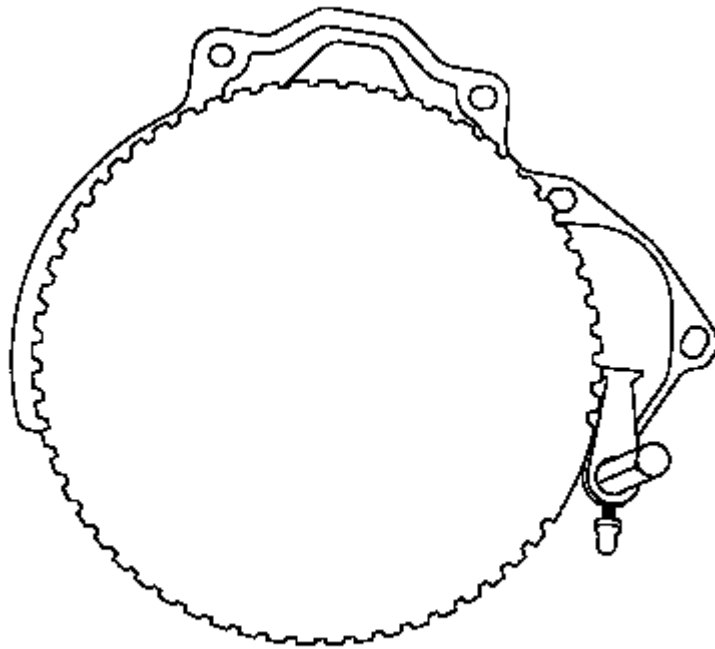


Fig. 411: EN 50050 Crankshaft Locking Device
Courtesy of GENERAL MOTORS COMPANY

5. Install the **EN 50050** crankshaft locking device, lock the automatic transmission flex plate via the starter ring gear.

CAUTION: Refer to Fastener Caution .

6. Tighten the 6 automatic transmission flex plate bolts to 20 + 25° (15 lb ft + 25°).
7. Remove the **EN 50050** crankshaft locking device.

ENGINE FLYWHEEL INSTALLATION

Special Tools

EN-50050 Crankshaft Locking Device

For equivalent regional tools, refer to **Special Tools**.

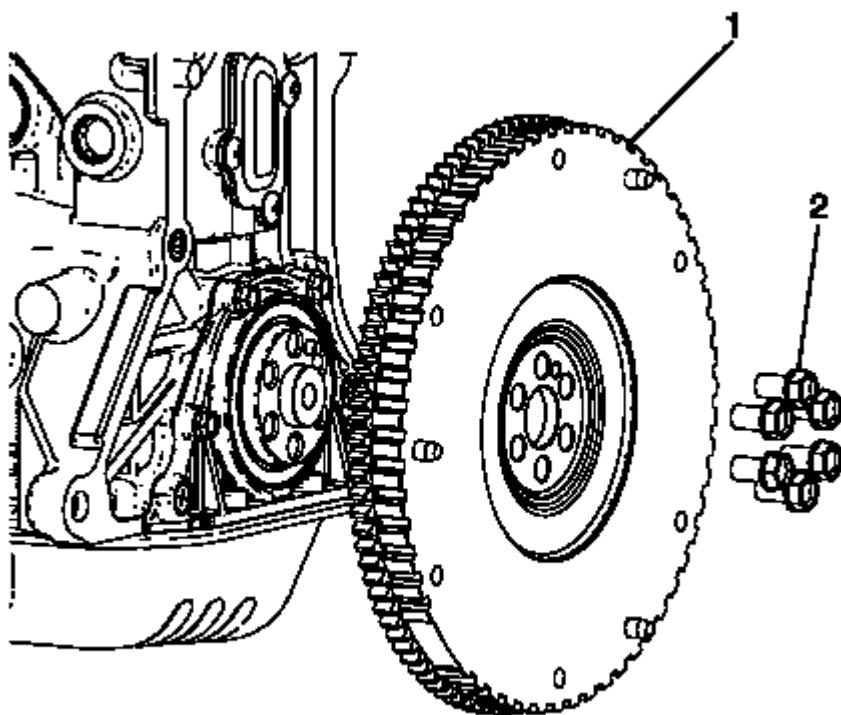


Fig. 412: Flywheel And Bolts

Courtesy of GENERAL MOTORS COMPANY

1. Install the flywheel (1).
2. Install the 6 flywheel bolts (2).
3. Install the **EN-50050** crankshaft locking device and lock the flywheel via the starter ring gear.

CAUTION: Refer to Fastener Caution .

4. Tighten the 6 flywheel bolts to 20 (15 lb ft + 25°).
5. Remove the **EN-50050** crankshaft locking device.

EXHAUST MANIFOLD HEAT SHIELD REMOVAL

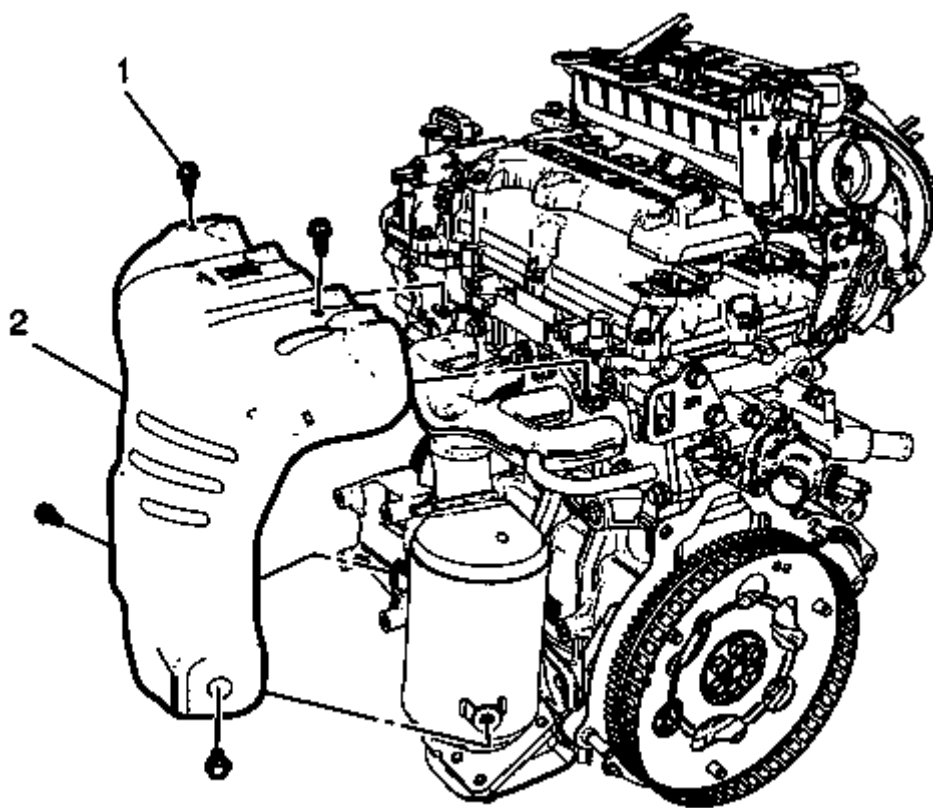


Fig. 413: Exhaust Manifold Heat Shield Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Remove the 4 exhaust manifold heat shield bolts (1).
2. Remove the exhaust manifold heat shield (2).

EXHAUST MANIFOLD REMOVAL

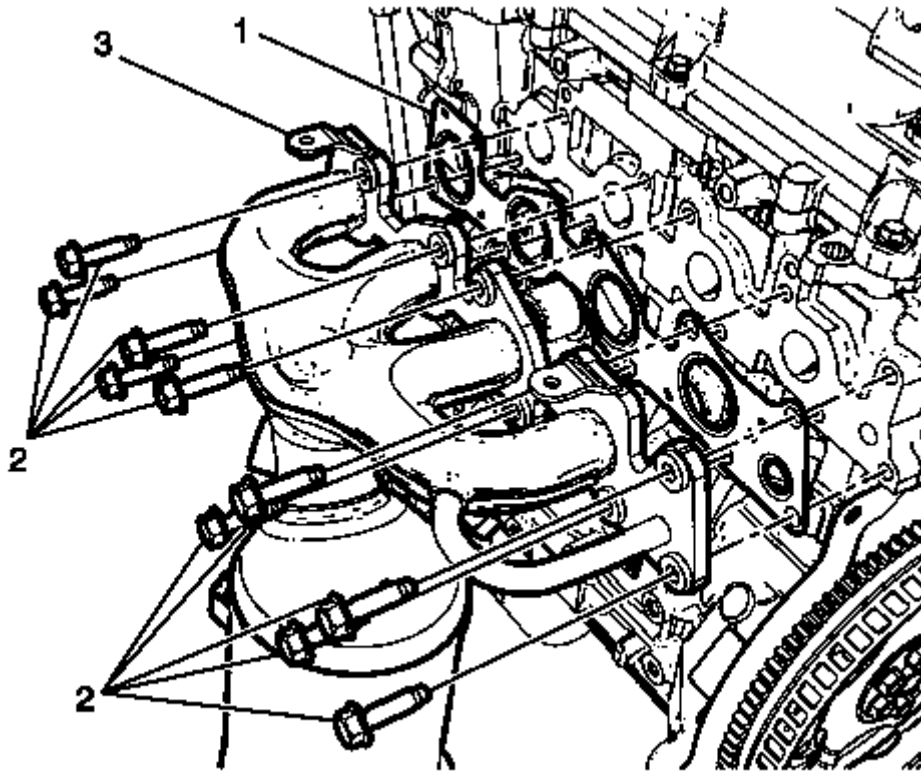


Fig. 414: Exhaust Manifold Bolts

Courtesy of GENERAL MOTORS COMPANY

1. Remove the 10 exhaust manifold bolts (2).
2. Remove the exhaust manifold (3) and gasket (1).
3. Clean all of the gasket surfaces.

CYLINDER HEAD DISASSEMBLE

Special Tools

- EN 46116 Valve Stem Seal Remover/Installer
- EN 46569 Valve Spring Compressor - Head Off
- EN 49075 Valve Spring Compressor Adapter

For equivalent regional tools, refer to **Special Tools**.

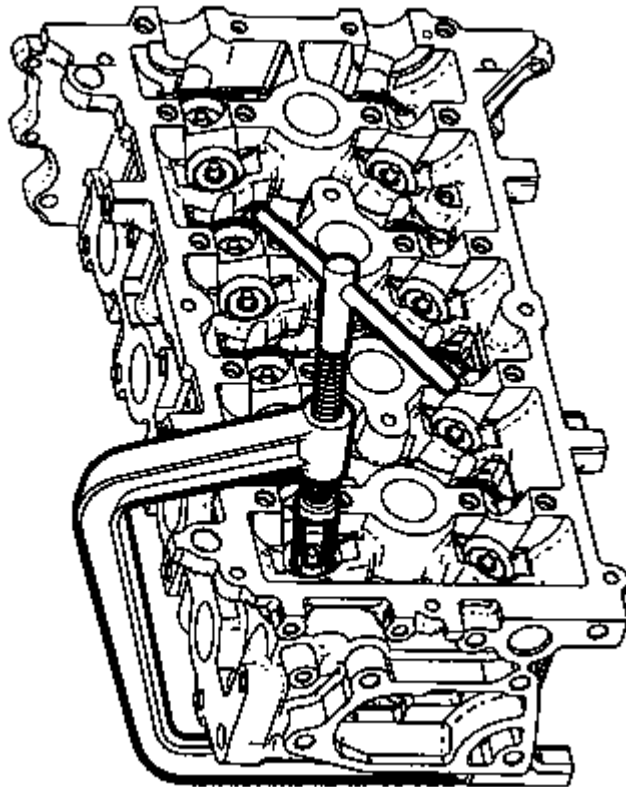


Fig. 415: EN 46569 Valve Spring Compressor
Courtesy of GENERAL MOTORS COMPANY

WARNING: Compressed valve springs have high tension against the valve spring compressor. Valve springs that are not properly compressed by or released from the valve spring compressor can be ejected from the valve spring compressor with intense force. Use care when compressing or releasing the valve spring with the valve spring compressor and when removing or installing the valve stem keys. Failing to use care may cause personal injury.

CAUTION: Do not compress the valve springs to less than 24.0 mm (0.943 in). Contact between the valve spring retainer and the valve stem oil seal can cause potential valve stem oil seal damage.

1. Compress the valve spring using the **EN 46569** valve spring compressor - head off and the **EN 49075** valve spring compressor adapter.
2. Use the magnet of the in order to remove the valve collets.
3. Remove the valve spring compressor and the adapter.

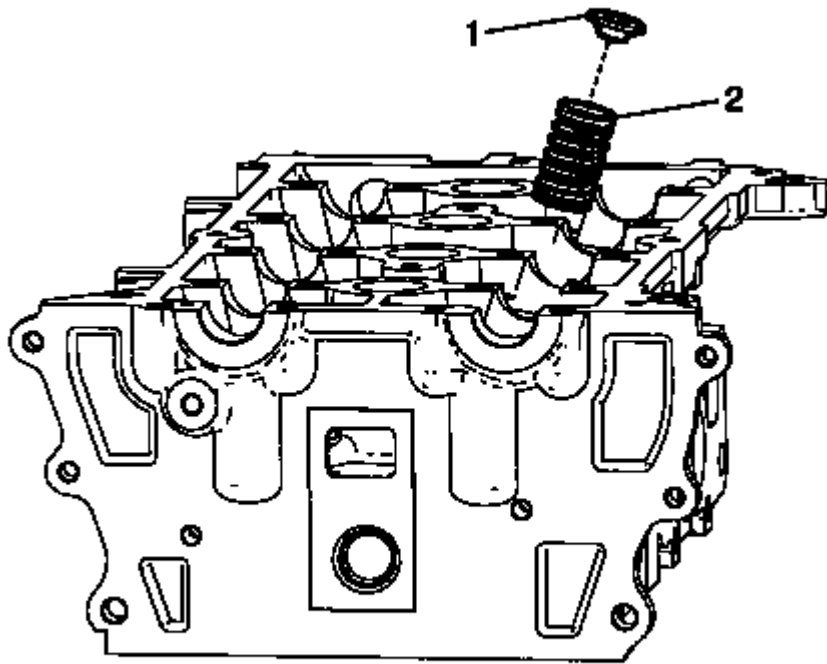


Fig. 416: Retainer And Valve Spring
Courtesy of GENERAL MOTORS COMPANY

4. Remove the valve spring retainer (1).
5. Remove the valve spring (2).

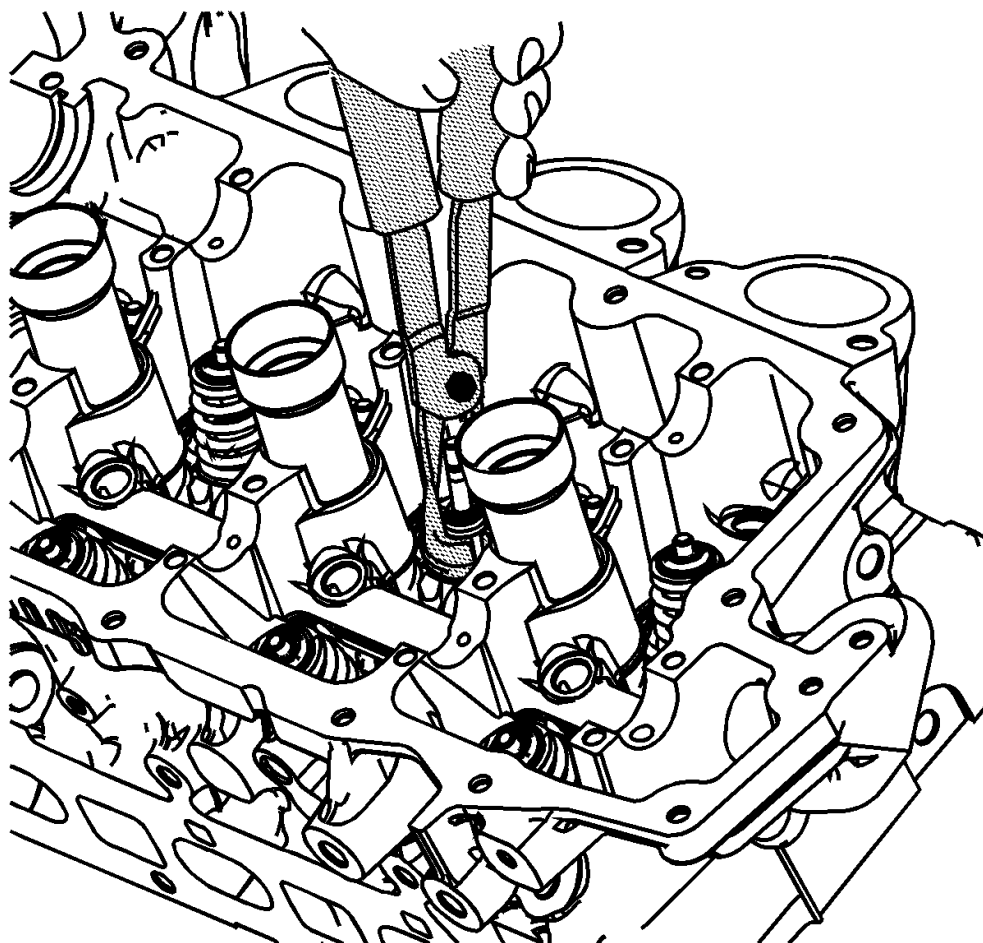


Fig. 417: View of Special Tool EN 46116 & Cylinder Head
Courtesy of GENERAL MOTORS COMPANY

NOTE: **NEVER** reuse a valve stem oil seal.

6. Remove the valve stem oil seal using the **EN 46116** valve stem seal remover/installer.
7. Discard the valve stem oil seals.

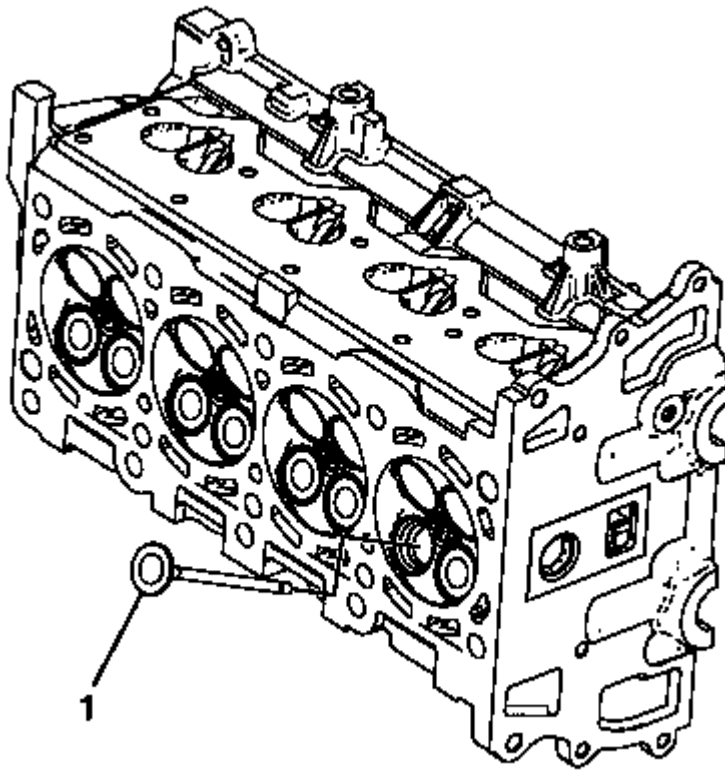


Fig. 418: Valve

Courtesy of GENERAL MOTORS COMPANY

8. Remove the valve (1).
9. Repeat these procedures for the remaining valves.

CYLINDER HEAD CLEANING AND INSPECTION

Cleaning Procedure

1. Remove any old thread sealant, gasket material or sealant.
2. Clean all cylinder head surfaces with non-corrosive solvent.

WARNING: Refer to Safety Glasses and Compressed Air Warning .

3. Blow out all the oil galleries using compressed air.
4. Remove any carbon deposits from the combustion chambers.
5. Clean any debris or build-up from the lifter pockets.

Visual Inspection

1. Inspect the cylinder head camshaft bearing surfaces for the following conditions:
 - Scoring or pitting above acceptable tolerances
 - Discoloration from overheating
 - Deformation from wear above acceptable tolerances
 - If the camshaft bearing journals appear to be scored or damaged, you must replace the cylinder head. DO NOT machine the camshaft bearing journals.
2. If any of the above conditions exist on the camshaft bearing surfaces, replace the cylinder head.
3. Inspect the cylinder head for the following:
 - Cracks, damage or pitting in the combustion chambers
 - Debris in the oil galleries-Continue to clean the galleries until all debris is removed.
 - Coolant leaks or damage to the deck face sealing surface-If coolant leaks are present, measure the surface warpage as described under Cylinder Head Measurement - Deck Flatness Inspection.
 - Burrs or any defects that may degrade the sealing of the NEW secondary camshaft drive chain tensioner gasket
 - Damage to any gasket surfaces
 - Damage to any threaded bolt holes
 - Burnt or eroded areas in the combustion chamber
 - Cracks in the exhaust ports and combustion chambers
 - External cracks in the water passages
 - Restrictions in the intake or exhaust passages
 - Restrictions in the cooling system passages
 - Rusted, damaged or leaking core plugs
4. If the cylinder head is cracked or damaged, it must be replaced. No welding or patching of the cylinder head is recommended.

Cylinder Head Measurement

Deck Flatness Inspection

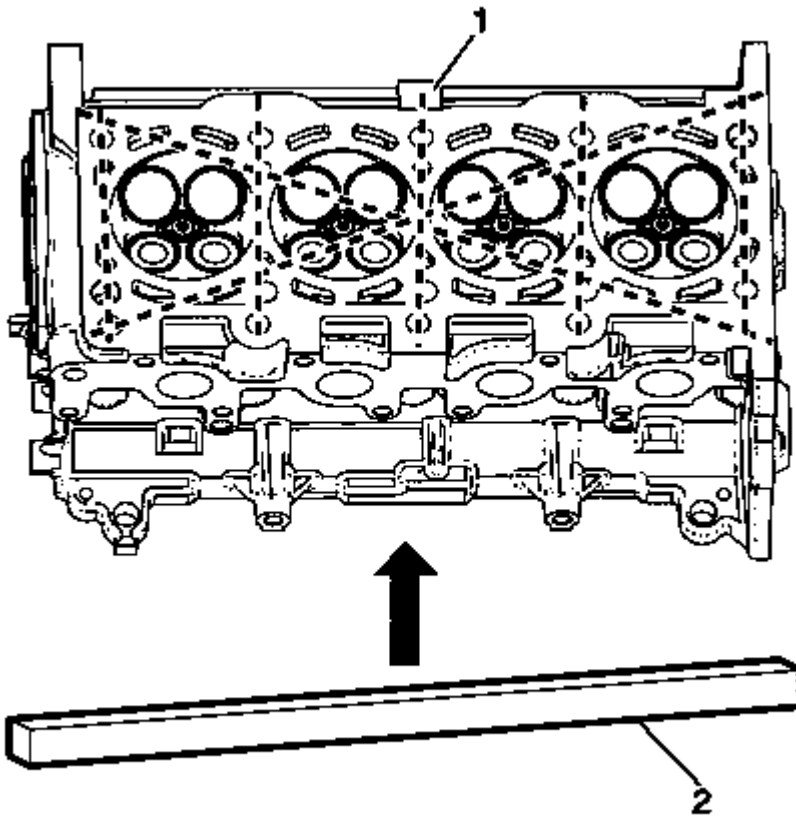


Fig. 419: Cylinder Head And Straight-Edge
Courtesy of GENERAL MOTORS COMPANY

1. Ensure the cylinder head (1) decks are clean and free of gasket material.
2. Inspect the surface for any imperfections or scratches that may inhibit correct cylinder head gasket sealing.
3. Place a straight-edge (2) diagonally across the cylinder head (1) deck face surface.
4. Measure the clearance between the straight-edge (2) and the cylinder head (1) deck face using a feeler gage at 4 points along the straight-edge (2).
 - If the warpage is less than 0.05 mm (0.002 in), the cylinder head (1) deck surface does not require resurfacing.
 - If the warpage is between 0.05-0.20 mm (0.002-0.008 in) or any imperfections or scratches that may inhibit correct cylinder head gasket sealing are present, the cylinder head (1) deck surface requires resurfacing.
 - If the cylinder head (1) deck surface requires more than 0.25 mm (0.010 in) material removal the cylinder head (1) must be replaced.

CYLINDER HEAD ASSEMBLE

Special Tools

- **EN 46116** Valve Stem Seal Remover/Installer
- **EN 46569** Valve Spring Compressor - Head Off
- **EN 49075** Valve Spring Compressor Adapter

For equivalent regional tools, refer to **Special Tools**.

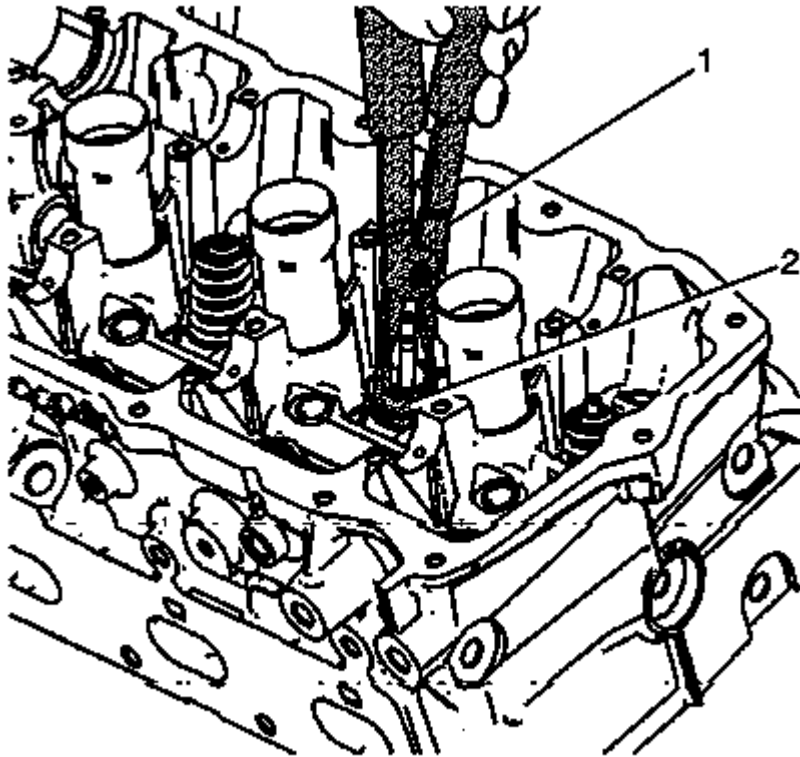


Fig. 420: View Of EN 46116 & Valve Stem Seal
 Courtesy of GENERAL MOTORS COMPANY

NOTE: NEVER reuse a valve stem oil seal (2). Always use new seals when assembling the cylinder head.

1. Mount a new valve stem oil seal (2) using the **EN 46116** valve stem seal remover/installer.

NOTE: Force should only be applied to the valve spring contact area of the new valve stem oil seal (2) during installation.

2. Push and twist the valve stem oil seal (2) into position on the valve guide until the seal positively locks on the guide using the **EN 46116** valve stem seal remover/installer.
3. Lubricate the valve stem and valve guide ID with clean engine oil.

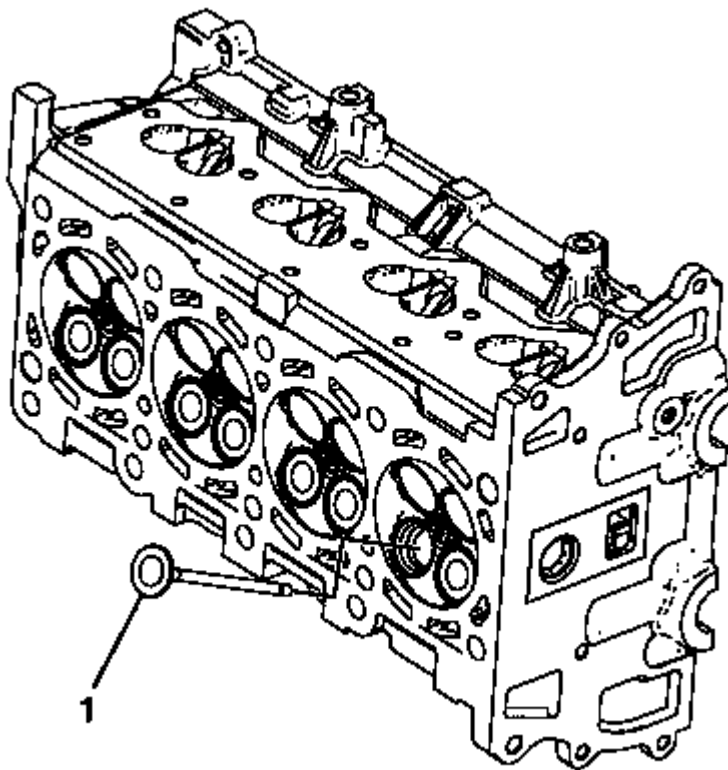


Fig. 421: Valve

Courtesy of GENERAL MOTORS COMPANY

NOTE: The valve stem oil seal must not come loose from the valve guide when the valve is installed.

4. Insert the valve (1) into the valve guide until it bottoms on the valve seat.

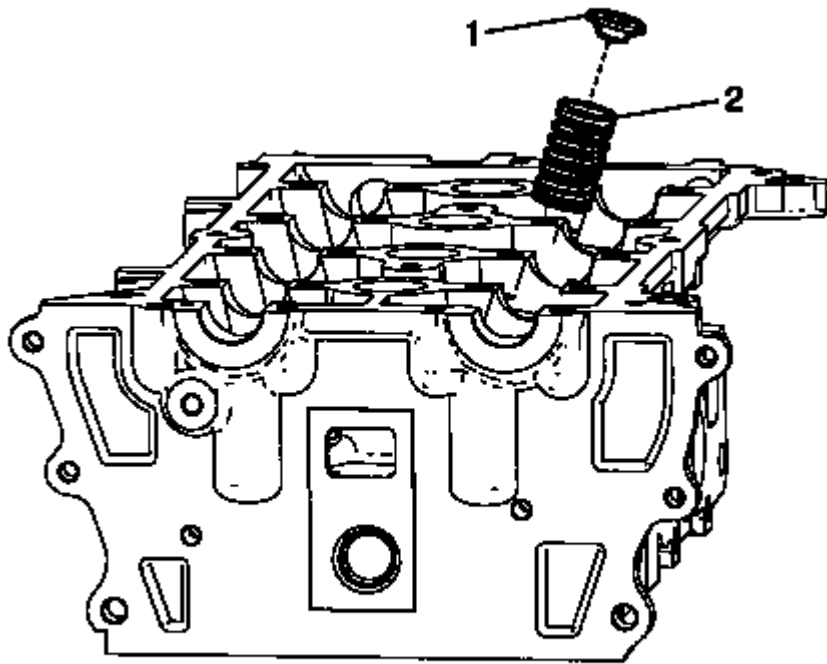


Fig. 422: Retainer And Valve Spring
Courtesy of GENERAL MOTORS COMPANY

5. Install the valve spring (2).
6. Place the valve spring retainer (1) onto the valve spring (2).

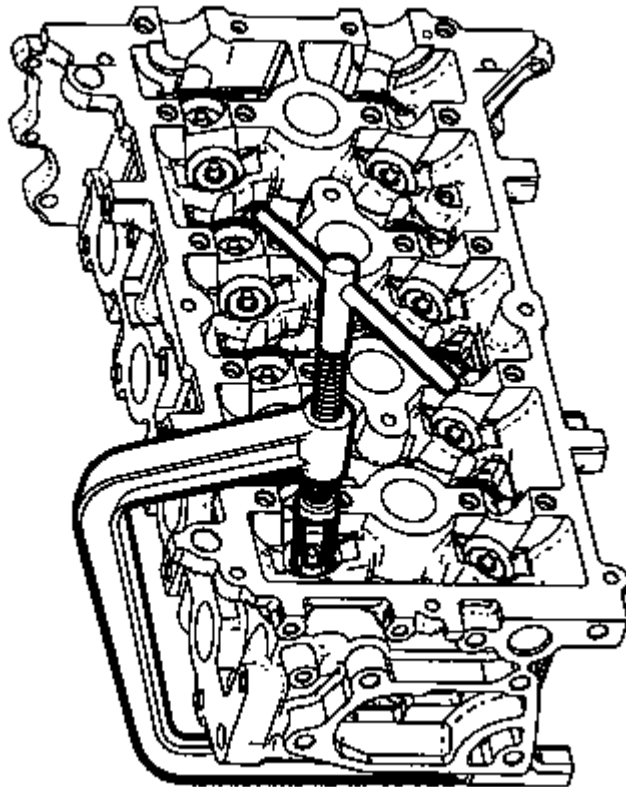


Fig. 423: EN 46569 Valve Spring Compressor
Courtesy of GENERAL MOTORS COMPANY

WARNING: Compressed valve springs have high tension against the valve spring compressor. Valve springs that are not properly compressed by or released from the valve spring compressor can be ejected from the valve spring compressor with intense force. Use care when compressing or releasing the valve spring with the valve spring compressor and when removing or installing the valve stem keys. Failing to use care may cause personal injury.

CAUTION: Do not compress the valve springs to less than 24.0 mm (0.943 in). Contact between the valve spring retainer and the valve stem oil seal can cause potential valve stem oil seal damage.

7. Compress the valve spring using the **EN 46569** valve spring compressor - head off and the **EN 49075** valve spring compressor adapter.

NOTE: Ensure correct directional placement of valve collets. The valve collets must be installed with the tapered end towards the valve stem seal.

8. With the spring compressed, install the valve collets.

9. Remove the **EN 46569** valve spring compressor - head off and the **EN 49075** valve spring compressor adapter.
10. Verify that the valve collets are installed by placing a rag over the valve tip and tapping with a dead-blow hammer. The valve keepers and the spring should remain in place.

EXHAUST MANIFOLD INSTALLATION

1. Clean the exhaust manifold sealing surface.

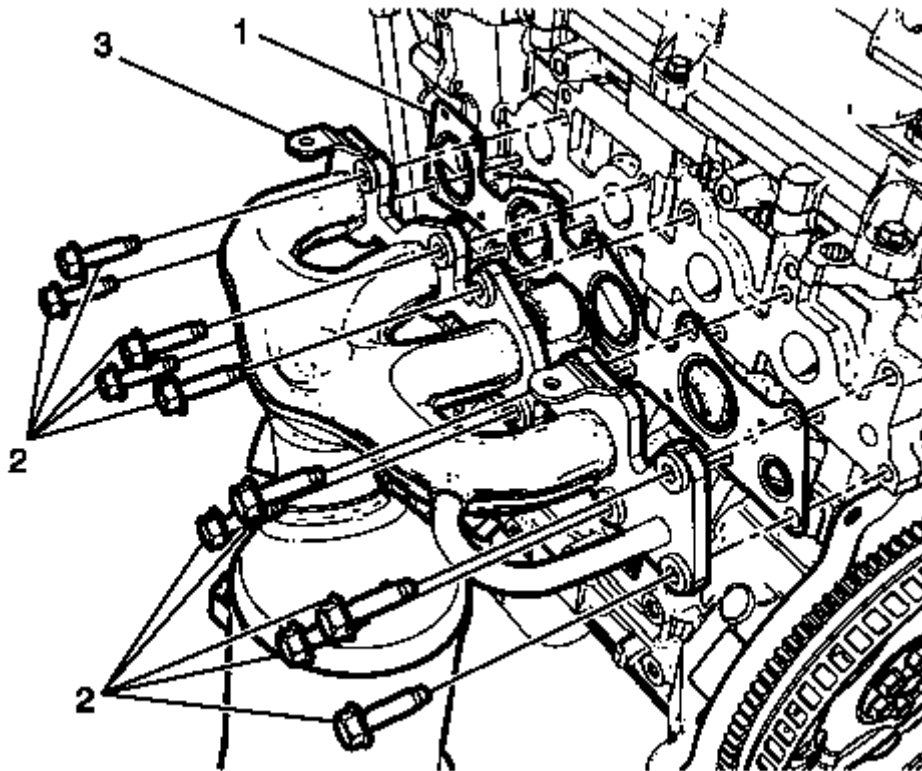


Fig. 424: Exhaust Manifold Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Install a NEW exhaust manifold gasket (1) to the exhaust manifold.
3. Install the exhaust manifold (3).

CAUTION: Refer to Fastener Caution .

4. Install the new exhaust manifold bolts (2) and tighten to 20 (15 lb ft).

EXHAUST MANIFOLD HEAT SHIELD INSTALLATION

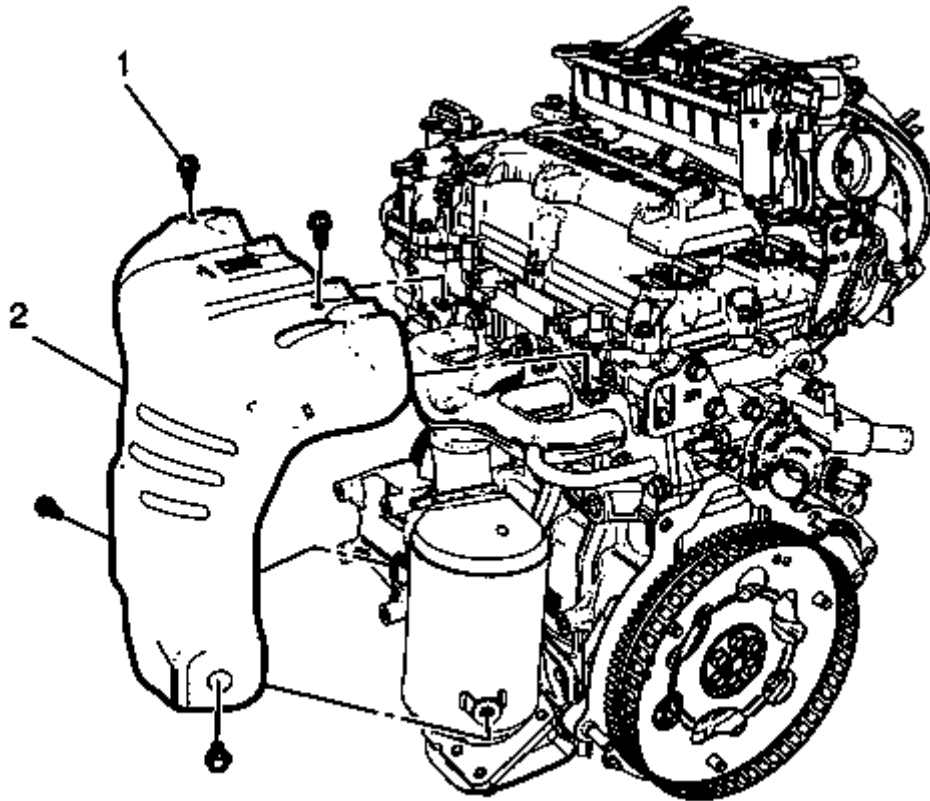


Fig. 425: Exhaust Manifold Heat Shield Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the exhaust manifold heat shield (2).

CAUTION: Refer to Fastener Caution .

2. Install the 4 exhaust manifold heat shield bolts (1) and tighten to 9 (80 lb in).

DESCRIPTION AND OPERATION

ENGINE COMPONENT DESCRIPTION

Cylinder Block

The cylinder hollow frame structured 4 cylinder in-line. The block has 5 crankshaft bearings with the thrust bearing located on the third bearing from the front of the engine.

Crankshaft

The crankshaft is a steel crankshaft. It is supported in 5 main journals with main bearings which have oil

clearance for lubricating. The 3rd bearing of the 5 main bearing is the thrust bearing whose the crankshaft has properly axial end play. A harmonic damper is used to control torsional vibration.

Oil Pump

The oil pump is a crankshaft driven oil pump integrated in pump module. The oil pump draws engine oil from the oil pan and feeds it under pressure to the various parts of the engine. An oil strainer is mounted before the inlet of the oil pump to remove impurities which could clog or damage the oil pump or other engine components. When the crankshaft rotates, the oil pump driven gear rotates. This causes the space between the gears to constantly open and narrow, pulling oil in from the oil pan when the space opens and pumping the oil out to the engine as it narrows. At high engine speeds, the oil pump supplies a much higher amount of oil than required for lubrication of the engine. The oil pressure regulator prevents too much oil from entering the engine lubrication passages.

Oil Pan

The oil pan is a stamping (steel) component include baffle and oil drain plug. The oil pan is attached at the engine block.

Piston and Connecting Rod

The pistons are aluminum pistons with anodized top ring groove. The connecting rods are fractured steel connecting rods with bushing and floating pin type.

Cylinder Head

This cylinder head is double over head camshaft (DOHC) type and has 2 camshafts that open 4 valves per cylinder with tappets. The camshaft sprocket wheels are installed in front of the camshafts. The cylinder head is made of cast aluminum alloy for better strength in hardness with light weight. The combustion chamber of the cylinder head is designed for increasing of squish and swirl efficiency and then this is maximized to gasoline combustion efficiency.

Valves

There are 2 intake and 2 exhaust valves with tappets per cylinder.

Camshaft

Two camshafts are used, one for all intake valves, the other for all exhaust valves. The camshafts are cast iron. The camshafts are driven by the crankshaft over the timing belt.

Camshaft Drive

A timing chain is used for camshaft drive. There is a tensioner to control the tension of the chain.

Intake Manifold

The intake manifold is the air flow passage to the cylinder combustion chamber through the throttle body and has an effect on engine torque, power, noise, driveability, emission, fuel economy and performance. It is made of plastic for better strength in hardness with little weight.

Exhaust Manifold

The exhaust manifold is located to the cylinder head and channels the exhaust gas out of the combustion chamber. It is designed to endure on high pressure and high temperature.

Positive Crankcase Ventilation System

The crankcase ventilation system is used to consume crankcase vapors in the combustion process instead of venting vapors to the atmosphere. Fresh air from the intake system is supplied to the crankcase, mixed with blow-by gases and then passed through a calibrated orifice into the throttle body. The primary control is through the positive crankcase ventilation (PCV) orifice which meters the flow at a rate depending on inlet vacuum. The PCV orifice is an integral part of the camshaft cover. If abnormal operating conditions occur, the system is designed to allow excessive amounts of blow-by gases to back flow through the crankcase vent into the intake system to be consumed by normal combustion.

CLEANLINESS AND CARE

An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in ten thousandths of an inch. When any internal engine parts are serviced, care and cleanliness are important. A liberal coating of engine oil should be applied to friction areas during assembly to protect and lubricate the surfaces during initial operation. Throughout this section, it should be understood that proper cleaning and protection of machined surfaces and friction areas are part of the repair procedure. This is considered standard shop practice even if not specifically stated.

When valve train components are removed for service, they should be retained in order. At the time of installation, they should be installed in the same locations and with the same mating surfaces as when removed.

SEPARATING PARTS

NOTE:

- **Disassembly of the piston, press fit design piston pin and connecting rod may create scoring or damage to the piston pin and piston pin bore. If the piston, pin and connecting rod have been disassembled, replace the components as an assembly.**
- **Many internal engine components will develop specific wear patterns on their friction surfaces.**
- **When disassembling the engine, internal components MUST be separated, marked or organized in a way to ensure installation to their original location and position.**

Separate, mark or organize the following components:

- Piston and the piston pin

- Piston to the specific cylinder bore
- Piston rings to the piston
- Connecting rod to the crankshaft journal
- Connecting rod to the bearing cap-A paint stick or etching/engraving type tool are recommended. Stamping the connecting rod or cap near the bearing bore may affect component geometry.
- Crankshaft main and connecting rod bearings
- Camshaft and valve tappets
- Valve to the valve guide
- Valve spring and shim to the cylinder head location
- Engine block main bearing cap location and direction
- Oil pump drive and driven gears

REPLACING ENGINE GASKETS

Gasket Reuse and Applying Sealants

- Do not reuse any gasket unless specified.
- Gaskets that can be reused will be identified in the service procedure.
- Do not apply sealant to any gasket or sealing surface unless called out in the service information.

Separating Components

- Use a rubber mallet to separate components.
- Bump the part sideways to loosen the components.
- Bumping should be done at bends or reinforced areas to prevent distortion of parts.

Cleaning Gasket Surfaces

- Remove all gasket and sealing material from the part using a scraping tool.
- Care must be used to avoid gouging or scraping the sealing surfaces.
- Do not use any other method or technique to remove sealant or gasket material from a part.
- Do not use abrasive pads, sand paper or power tools to clean the gasket surfaces.
 - These methods of cleaning can cause damage to the component sealing surfaces.
 - Abrasive pads also produce a fine grit that the oil filter cannot remove from the oil.
 - This grit is abrasive and has been known to cause internal engine damage.

Assembling Components

- When assembling components, use only the sealant specified or equivalent in the service procedure.
- Sealing surfaces should be clean and free of debris or oil.
- Specific components such as crankshaft oil seals or valve stem oil seals may require lubrication during assembly.

- Components requiring lubrication will be identified in the service procedure.
- When applying sealant to a component, apply the amount specified in the service procedure.
- Do not allow the sealant to enter into any blind threaded holes, as it may prevent the bolt from clamping properly or cause component damage when tightened.
- Tighten bolts to specifications. Do not over tighten.

Cleaning Sealant (RTV) Surface and Application

- Sealant (RTV) sealing surface and mating surface must be free of any evidence oils, machining fluids and any liquid or solid residue on sealing surface to assure sealant (RTV) adhesion.
- Clean approved solvent based cleaner (LPS Precision, Zero TRI cleaner (PN03520) with dry lint-free clothes to wipe surface. Lint-free cloths cannot be reused.
- In case of maximum open time (8 minutes) with joint not closed after RTV dispensing, Remove cured sealant (RTV) squeeze-out carefully.

Pipe Joint Compound

NOTE: Three types of sealer are commonly used in engines. These are RTV sealer, anaerobic gasket eliminator sealer and pipe joint compound. The correct sealer and amount must be used in the proper location to prevent oil leaks. DO NOT interchange the 3 types of sealers. Use only the specific sealer or the equivalent as recommended in the service procedure.

- Pipe joint compound is a pliable sealer that does not completely harden. This type sealer is used where 2 non-rigid parts, such as the oil pan and the engine block, are assembled together.
- Do not use pipe joint compound in areas where extreme temperatures are expected. These areas include: exhaust manifold, head gasket or other surfaces where gasket eliminator is specified.
- Follow all safety recommendations and directions that are on the container.

To remove the sealant or the gasket material.

- Apply the pipe joint compound to a clean surface. Use a bead size or quantity as specified in the procedure. Run the bead to the inside of any bolt holes. Do not allow the sealer to enter any blind threaded holes, as it may prevent the bolt from clamping properly or cause component damage when the bolt is tightened.
- Apply a continuous bead of pipe joint compound to one sealing surface. Sealing surfaces to be resealed must be clean and dry.
- Tighten the bolts to specifications. Do not over tighten.

TOOLS AND EQUIPMENT

Special tools are listed and illustrated throughout this section with a complete listing at the end of the section. These tools or their equivalents, are specially designed to quickly and safely accomplish the operations for which they are intended. The use of these special tools will also minimize possible damage to engine components. Some precision measuring tools are required for inspection of certain critical components. Torque

wrenches and a torque angle meter are necessary for the proper tightening of various fasteners.

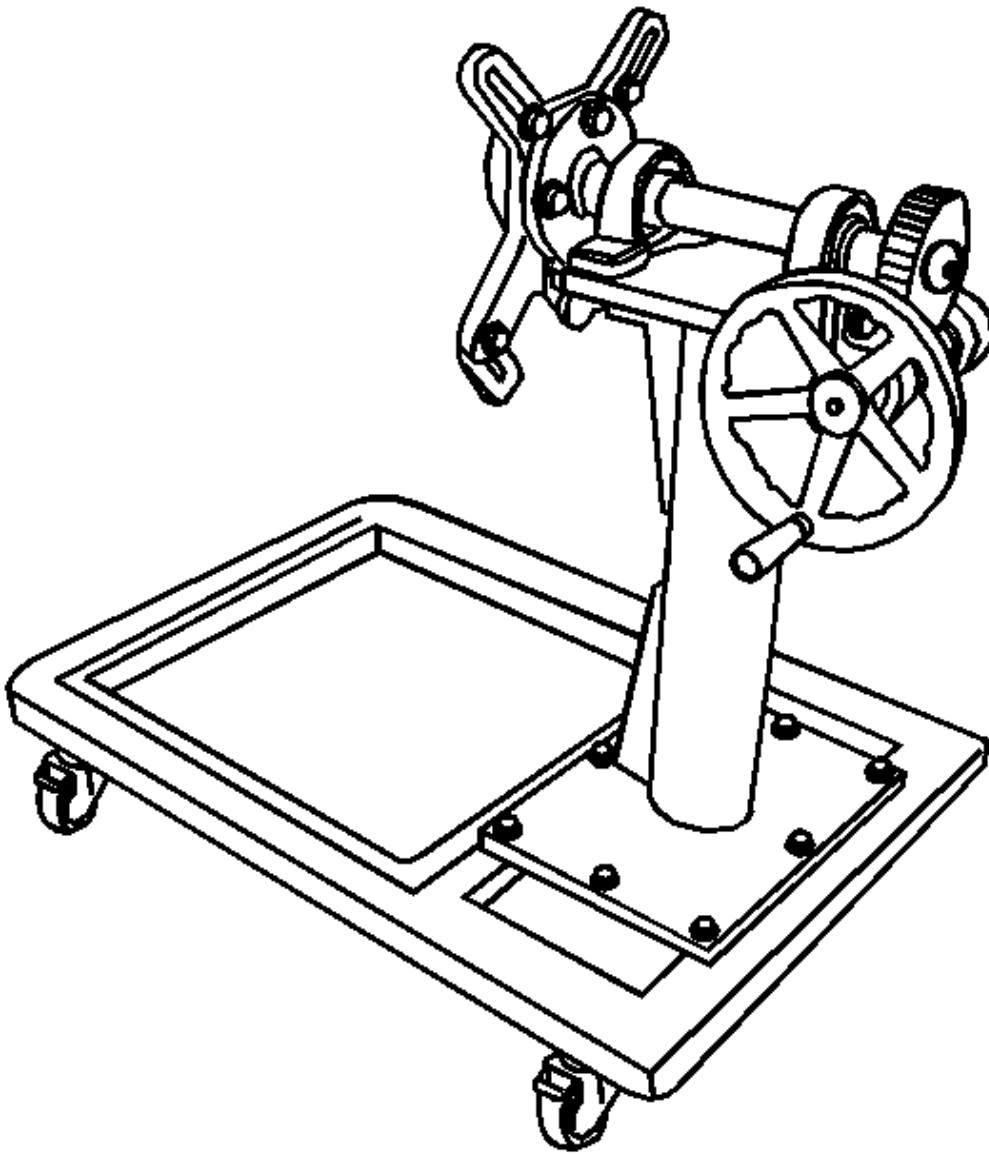
To properly service the engine assembly, the following items should be readily available:

- Approved eye protection and safety gloves
- A clean, well lit, work area
- A suitable parts cleaning tank
- A compressed air supply
- Trays or storage containers to keep parts and fasteners organized
- An adequate set of hand tools
- Approved engine repair stand
- An approved engine lifting device that will adequately support the weight of the components

SPECIAL TOOLS AND EQUIPMENT

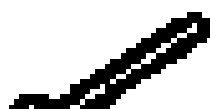
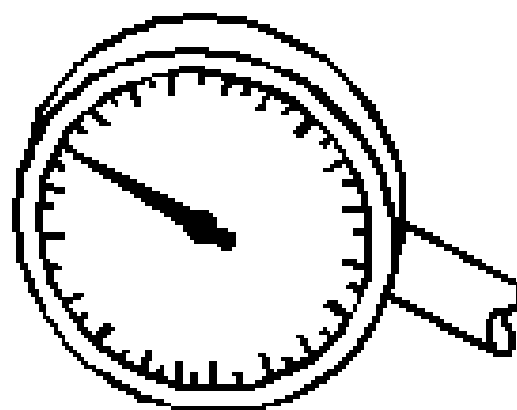
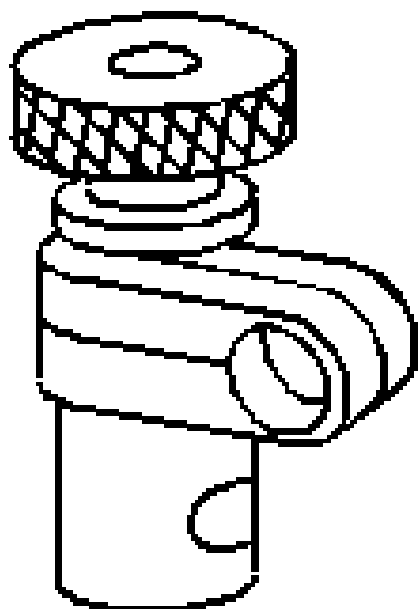
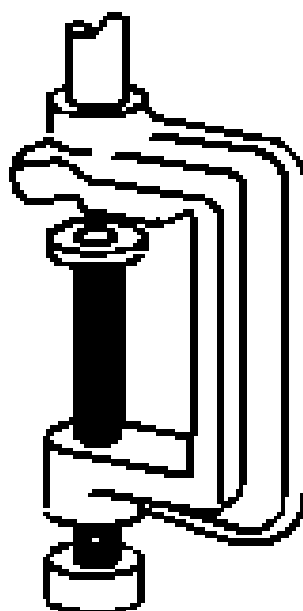
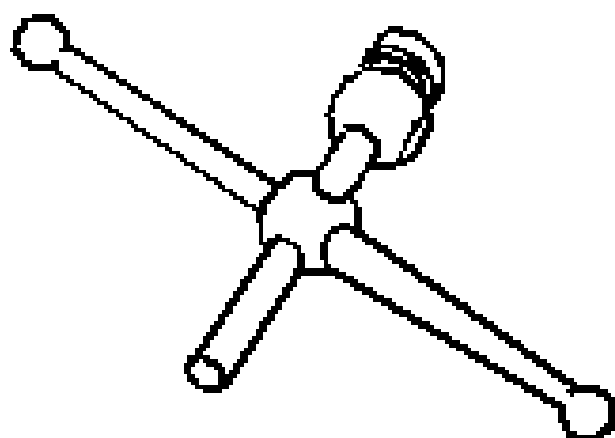
SPECIAL TOOLS

Illustration	Tool Number/ Description
	EN-50057 Engine Overhaul Stand



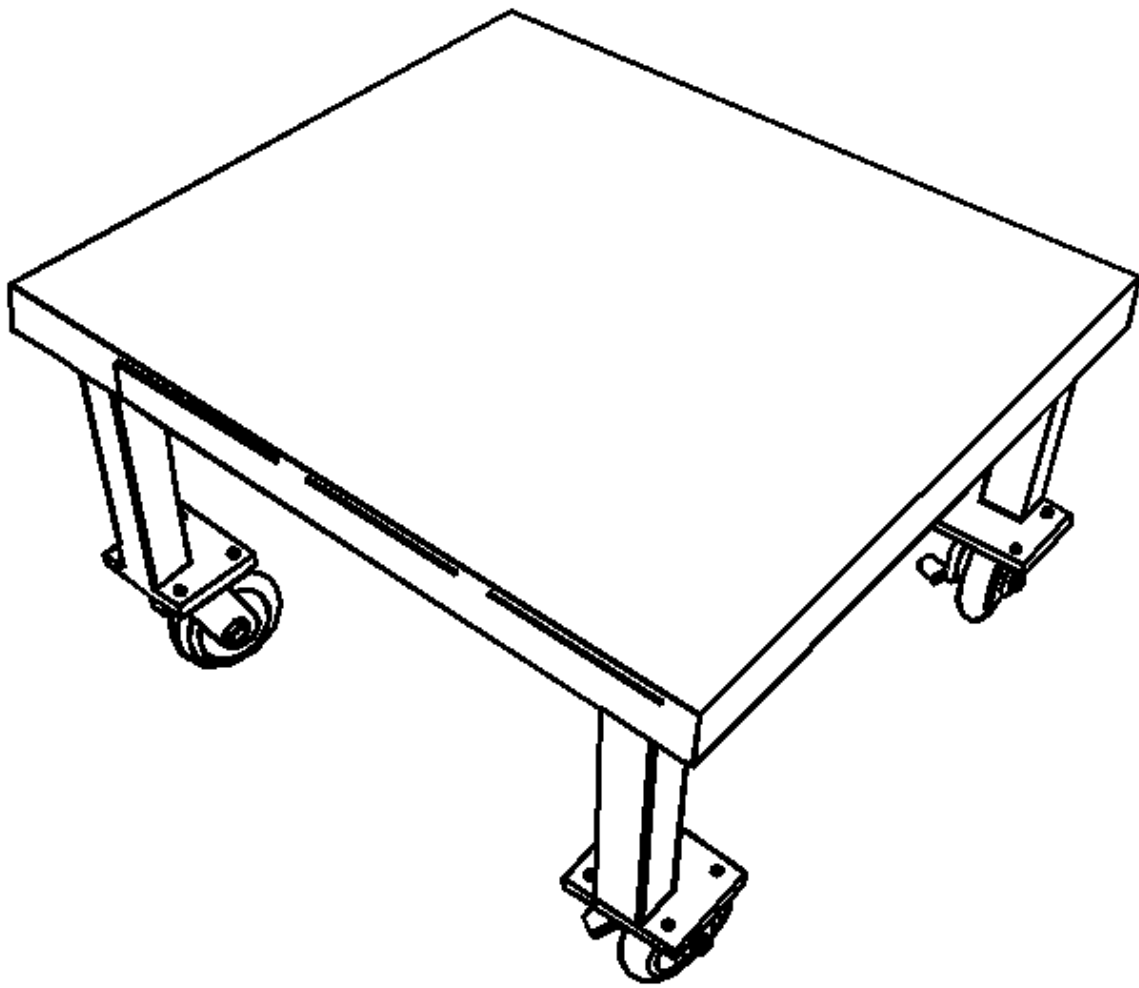
EN-28467-B
J-28467-B
Universal Engine
Support Fixture

EN-46116
Valve Stem Seal
Remover



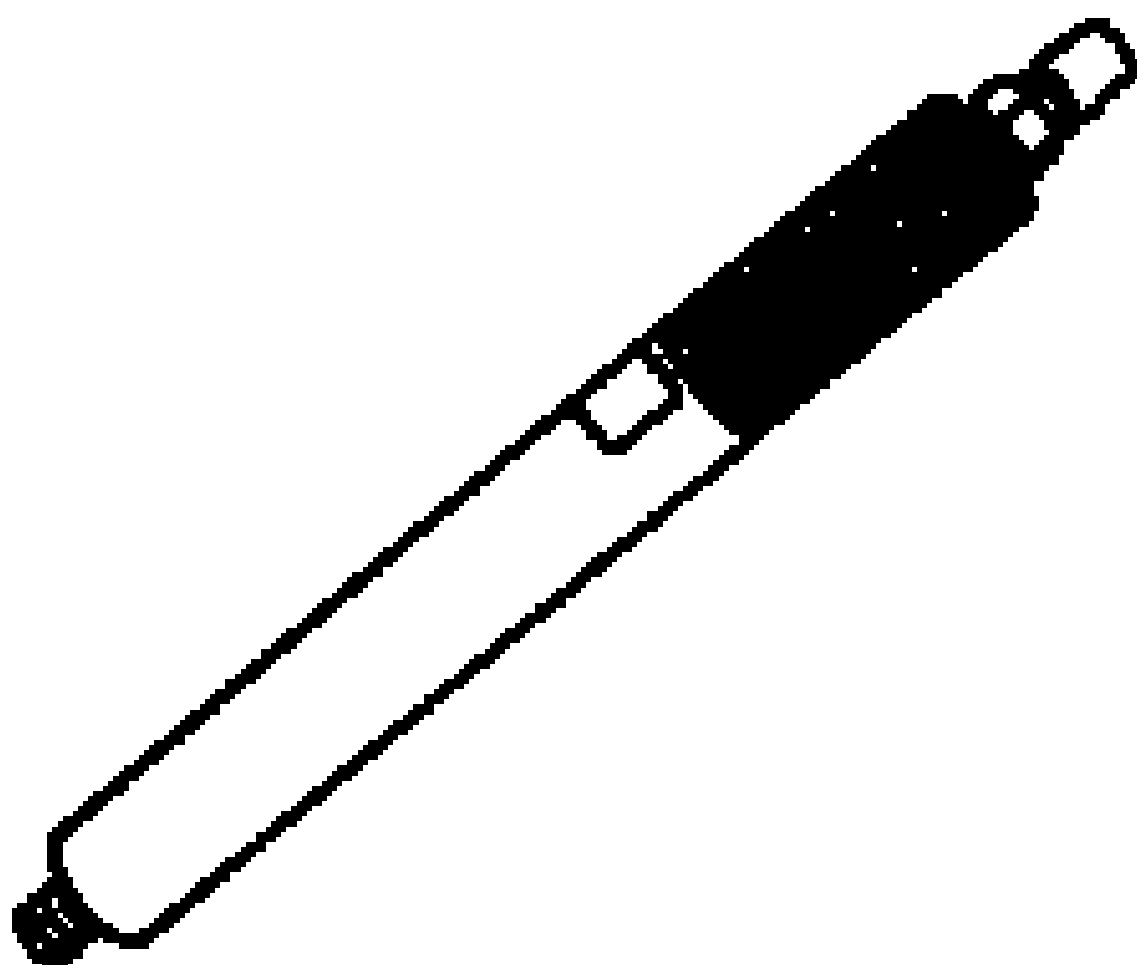
EN 46569
J-8062
Valve Spring
Compressor (Off
Vehicle)

EN-48244
Engine Assembly
Remove/Install
Pallet Supporter



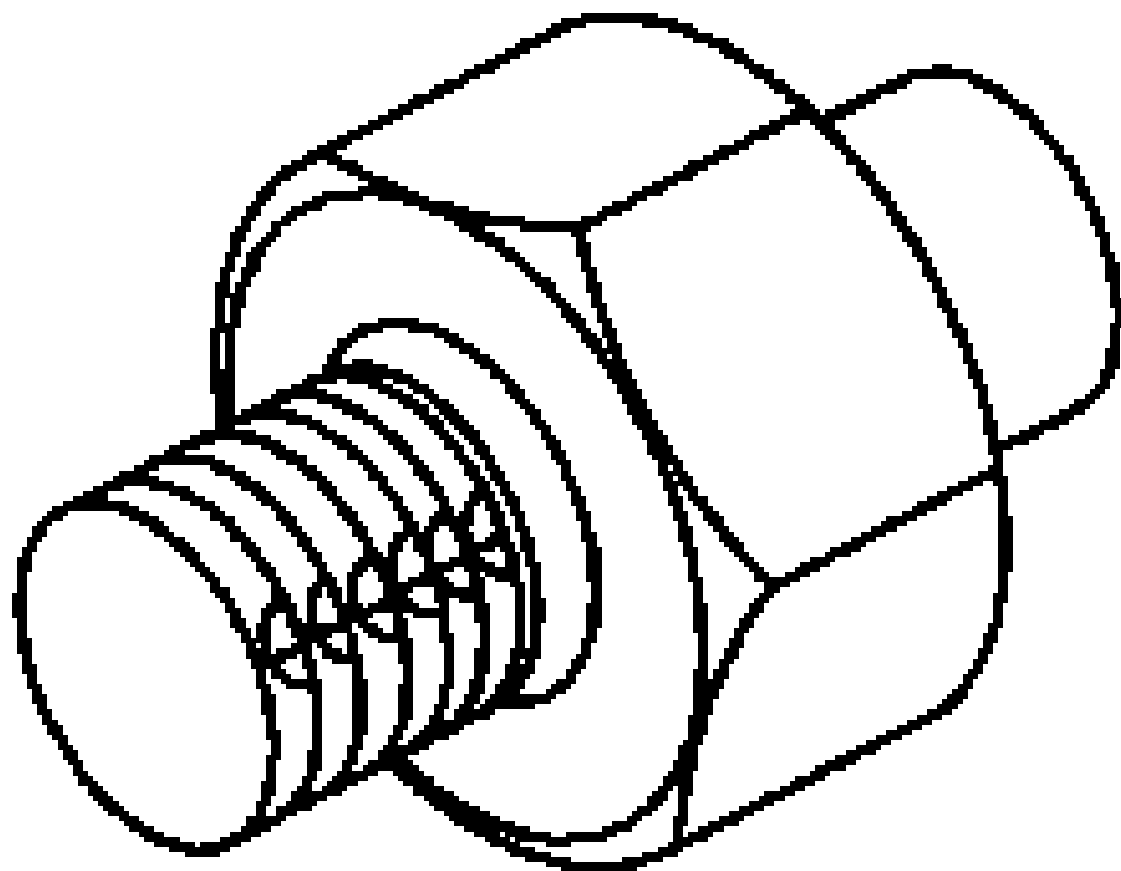
EN-49075
EN-50717
Valve Spring
Compressor
Adapter

EN-49076
Cylinder Pressure
Adapter



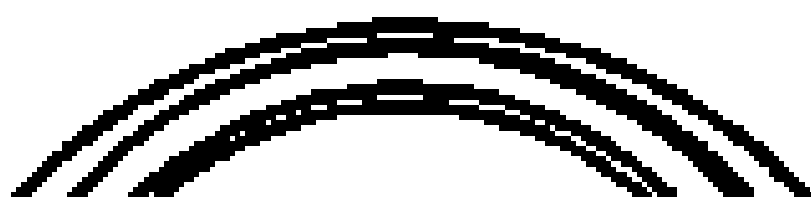
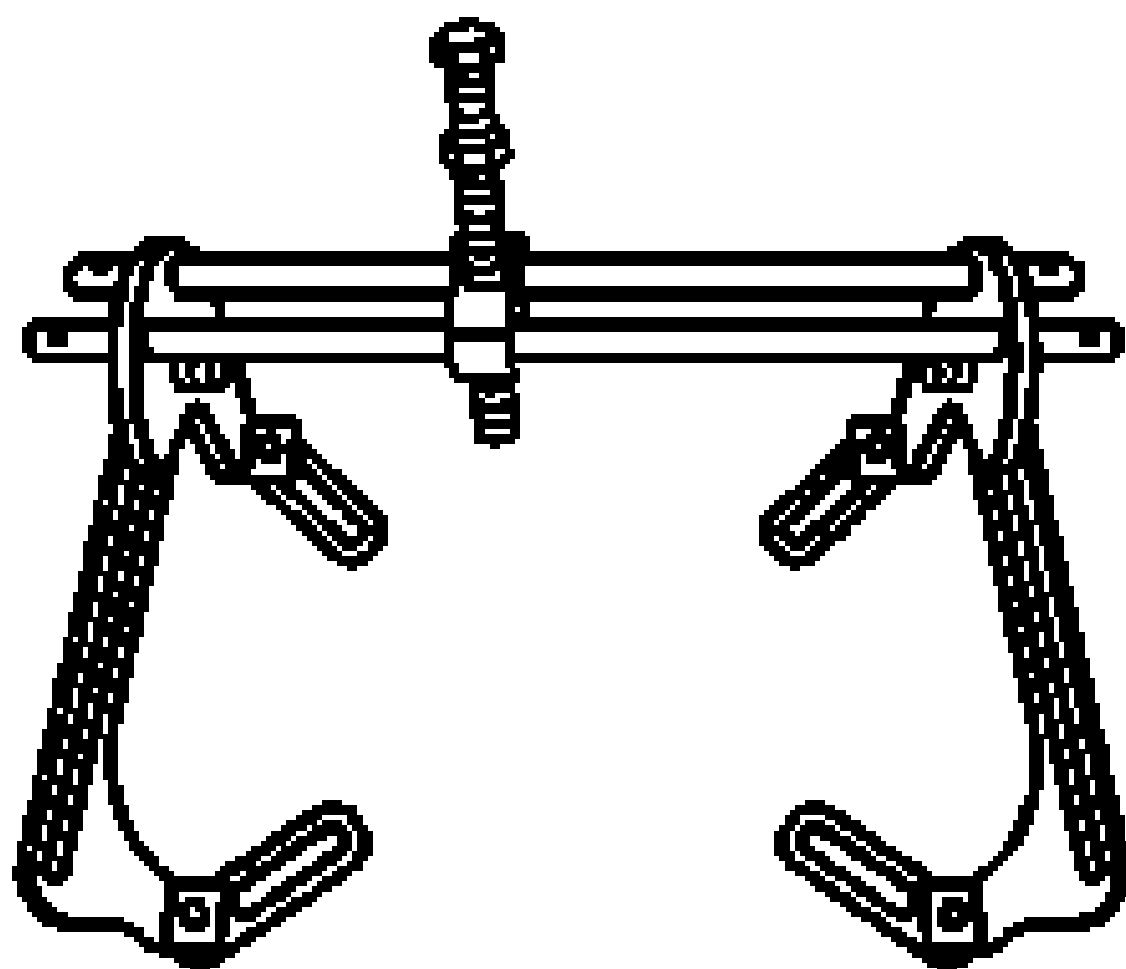
EN-50050
DT-47562
09924-17810
Crankshaft
Locking Device
(Off vehicle)

EN-50170-01
Engine Oil
Pressure Gauge
Adapter



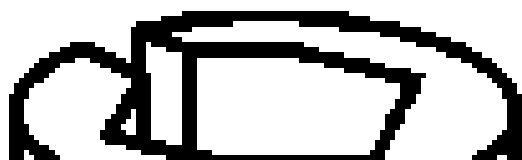
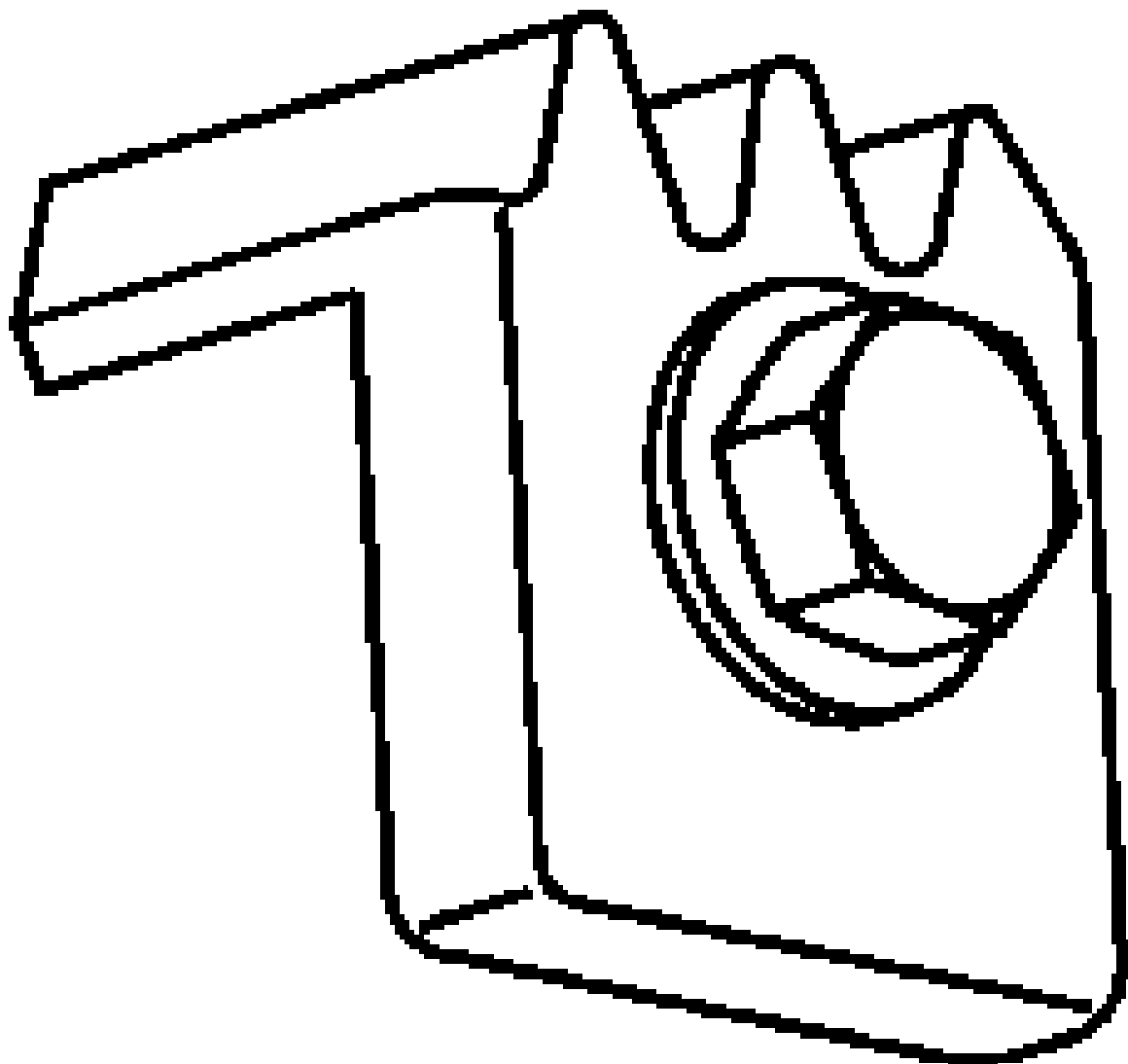
EN-50172
Crankshaft Front
Seal Installer

EN-50173
EN-50717
Universal Valve
Spring
Compressor



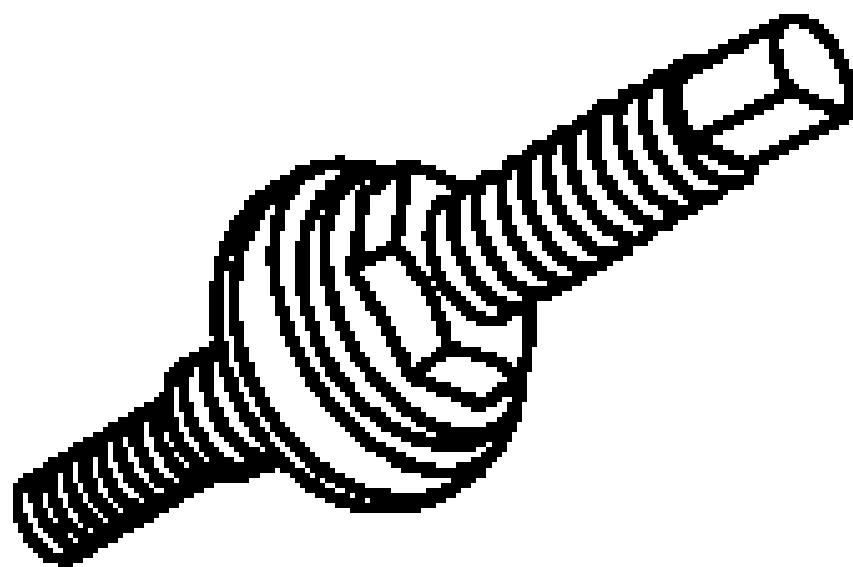
EN-50174
J-8037
Piston Installer

EN-50175
Crankshaft
Locking Device
(On Vehicle)



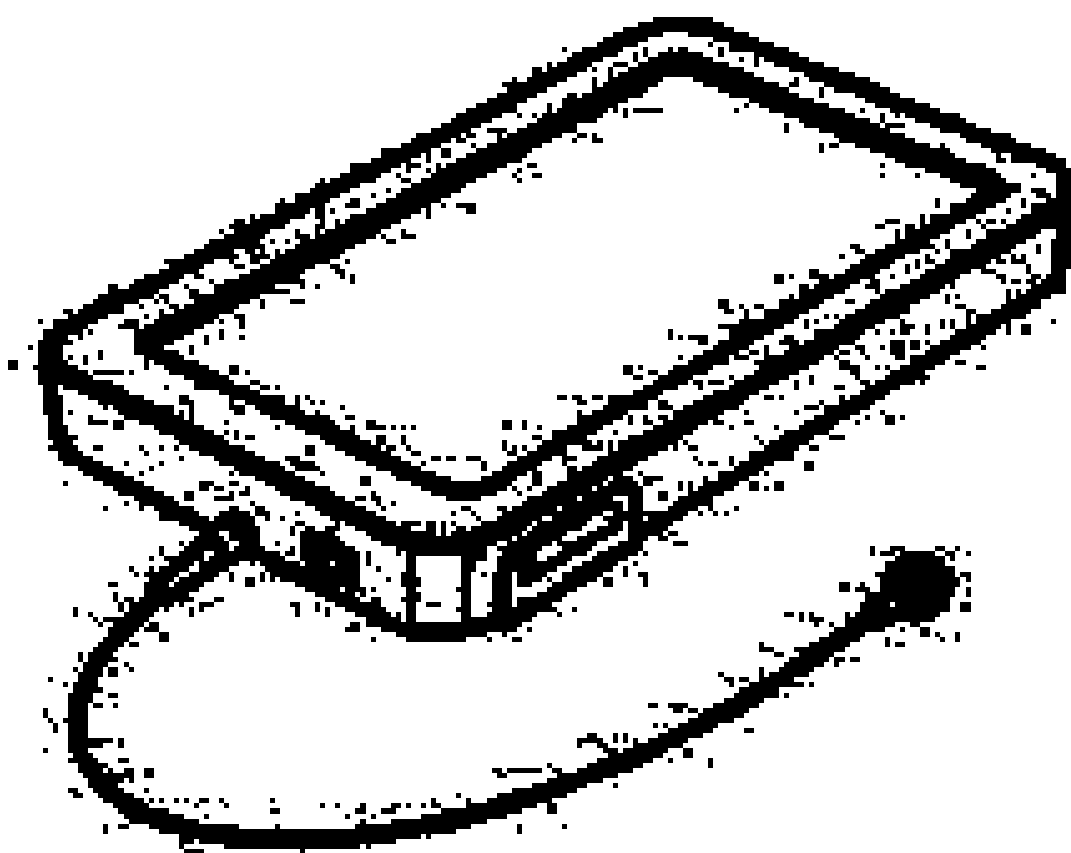
EN-50207
Oil Pressure
Switch
Remover/Installer

EN-51218
Crankshaft
Balancer Installer



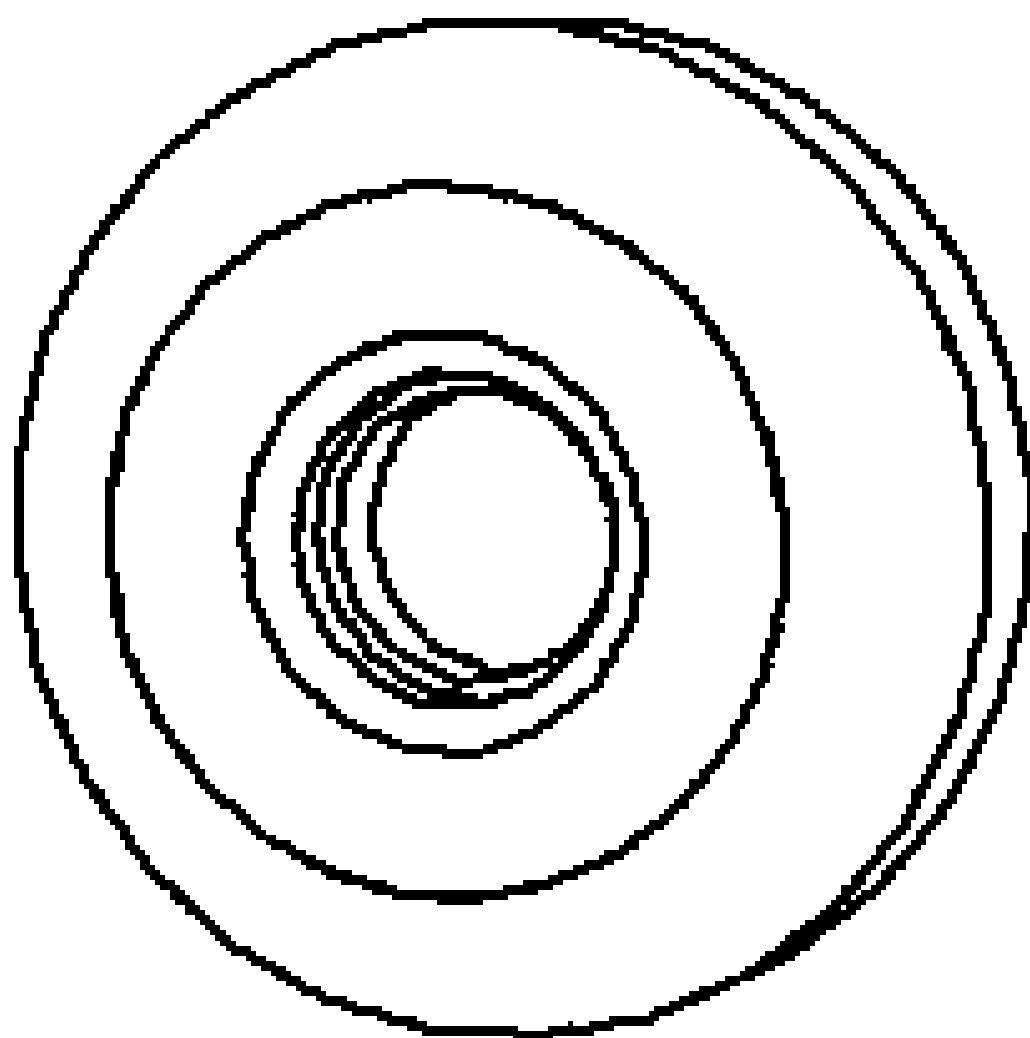
GE-42072
Cylinder Head
Bolt
Remover/Installer

GE-50576
Acoustic Belt
Tension Tester



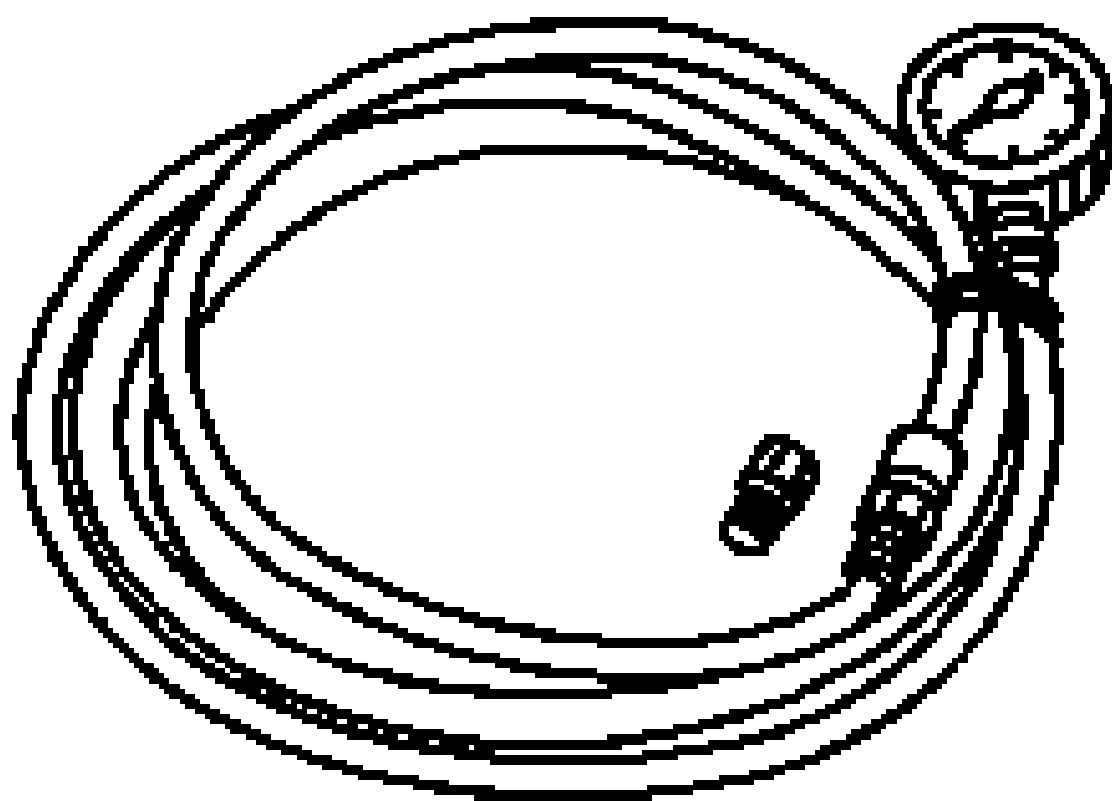
J-22888-20A
Crankshaft
Balancer Puller

J-45507
Crankshaft Rear
Oil Seal Installer



KM-470-B
J-45059
Angular Torque
Gauge

KM-498-B
Pressure Gauge



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KM-845
Tappet Suction
Device

ACCESSORIES & EQUIPMENT

Exterior Trim - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Front Fog Lamp Bezel Screw	2	18 lb in
Front Fog Lamp Cover Screw	2	18 lb in
Front License Plate Bracket Screw	2.5	23 lb in
Radiator Grille Emblem Screw	2.5	23 lb in
Radiator Lower Grille Screw	2	18 lb in
Radiator Upper Grille Screw	2	18 lb in
Rear End Spoiler Nuts	5	44 lb in
Rocker Panel Molding Replacement	1.5	13 lb in

REPAIR INSTRUCTIONS

CENTER PILLAR APPLIQUE REPLACEMENT

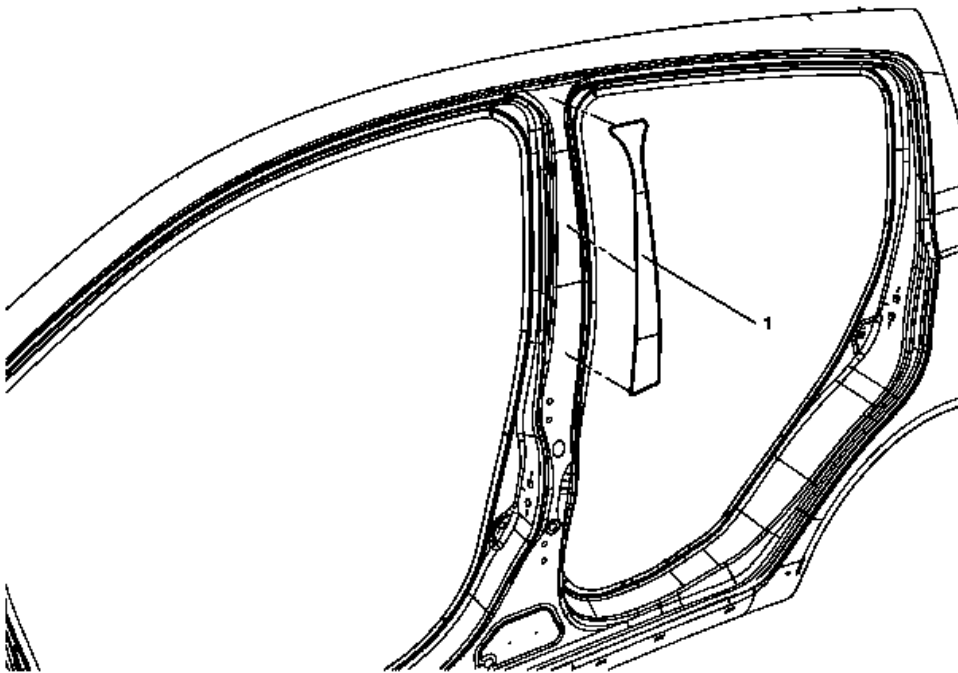


Fig. 1: Center Pillar Applique

Courtesy of GENERAL MOTORS COMPANY

Center Pillar Applique Replacement

Callout	Component Name
Preliminary Procedure Open the front and rear side doors.	
1	Center Pillar Applique Procedure 1. Fit the tape pre-mask line to the panel character line. 2. Peel off the inside paper. 3. Attach the tape to the door panel. 4. Press the tape by using the squeegee or equivalent. 5. Peel off the outside paper. 6. Inspect the tape is properly attached. NOTE: This applique is an adhesive tape.

FRONT SIDE DOOR WINDOW FRAME FRONT APPLIQUE REPLACEMENT

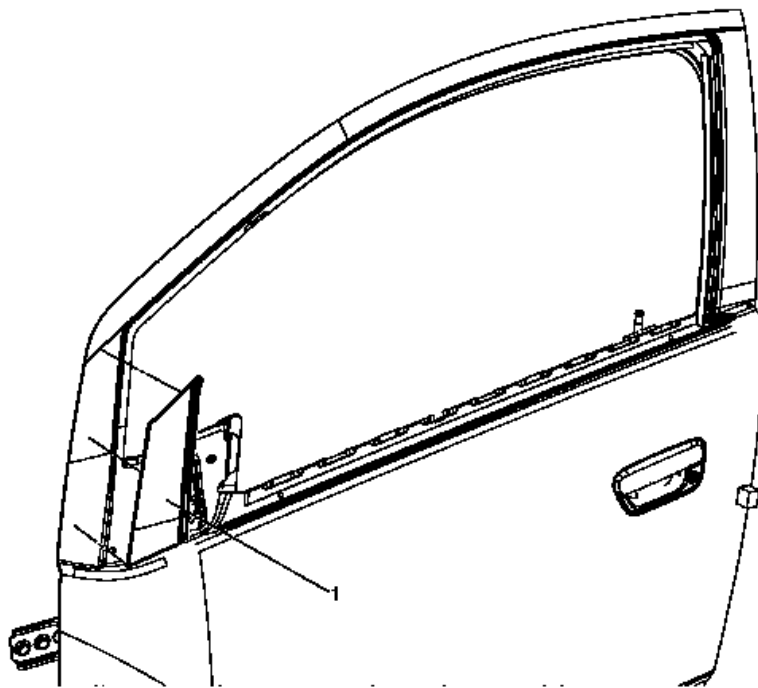


Fig. 2: Front Side Door Window Frame Front Applique
Courtesy of GENERAL MOTORS COMPANY

Front Side Door Window Frame Front Applique Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the outside rearview mirror. Refer to <u>Outside Rearview Mirror Replacement</u> . 2. Remove the front side door stationary window. Refer to <u>Front Side Door Stationary Window Replacement</u> .	
1	Front Side Door Window Frame Front Applique Procedure 1. Fit the tape pre-mask line to the panel character line. 2. Peel off the inside paper. 3. Attach the tape to the door panel. 4. Press the tape by using a squeegee or equivalent. 5. Peel off the outside paper. 6. Wrap the corner areas of the tape. 7. Inspect the tape is properly attached. NOTE: This applique is an adhesive tape.

FRONT SIDE DOOR WINDOW FRAME REAR APPLIQUE REPLACEMENT

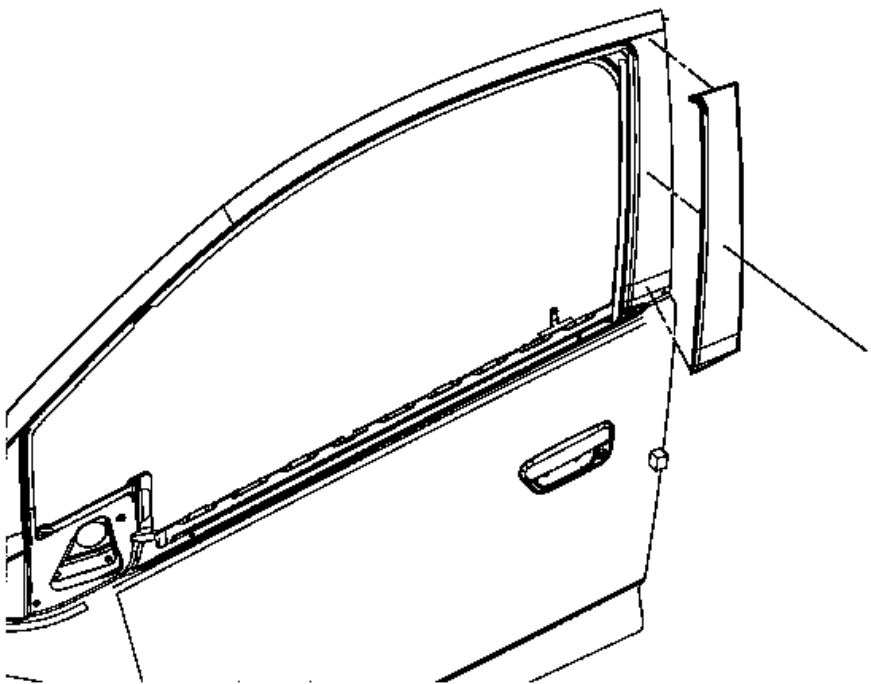


Fig. 3: NO CONTENT

Courtesy of GENERAL MOTORS COMPANY

Front Side Door Window Frame Rear Applique Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the front side door window outer sealing strip. Refer to <u>Front Side Door Window Outer Sealing Strip Replacement</u> . 2. Grasp upper corner of the window weatherstrip, pull downward releasing the assembly from the door frame. NOTE: Do not need to remove the weatherstrip assembly. Just partially peel off the weatherstrip to attach the tape.	
1	Front Side Door Window Frame Rear Applique Procedure 1. Fit the tape pre-mask line to the panel character line. 2. Peel off the inside paper. 3. Attach the tape to the door panel. 4. Press the tape by using a squeegee or equivalent. 5. Peel off the outside paper. 6. Wrap the corner areas of the tape. 7. Inspect the tape is properly attached. NOTE: This applique is an adhesive tape.

FRONT FOG LAMP BEZEL REPLACEMENT

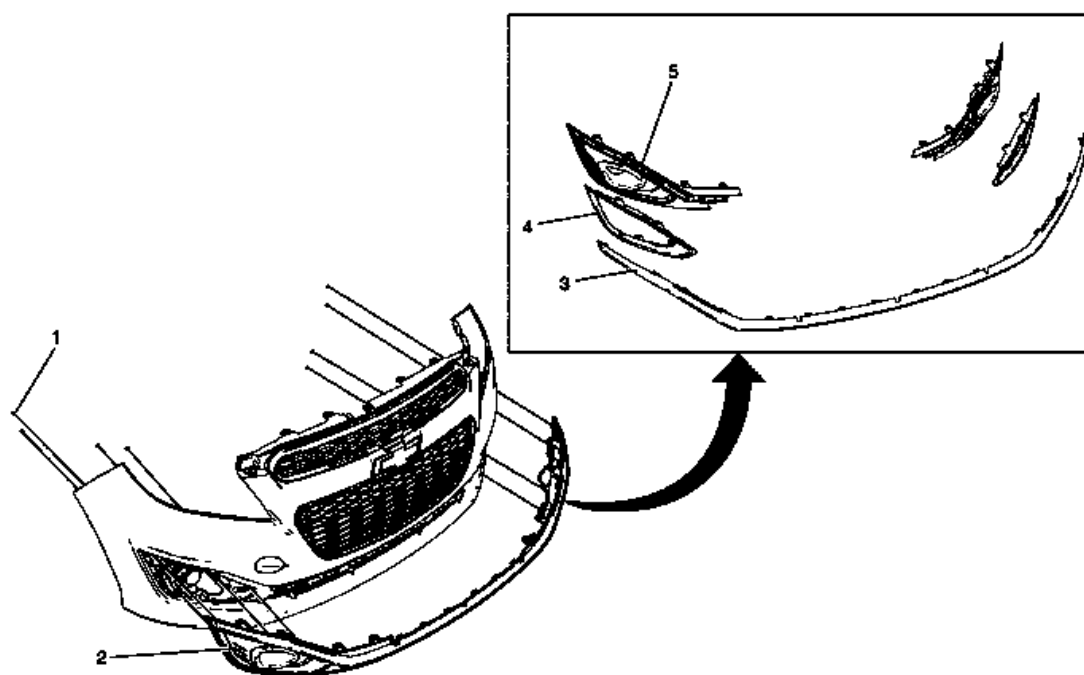
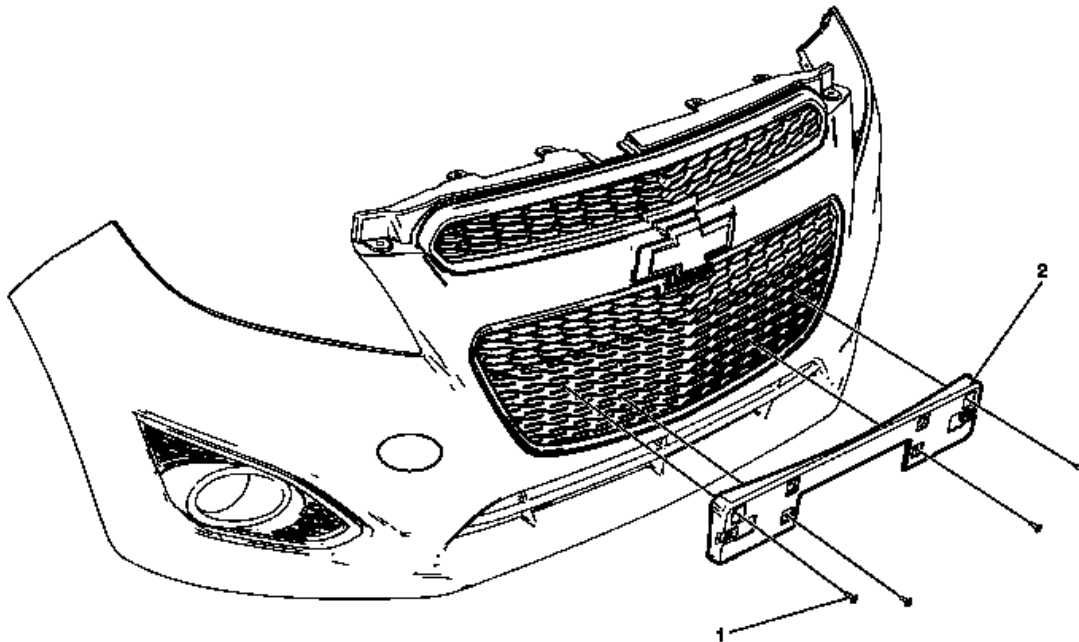


Fig. 4: Front Fog Lamp Bezel
 Courtesy of GENERAL MOTORS COMPANY

Front Fog Lamp Bezel Replacement

Callout	Component Name
1	Front Fog Lamp Bezel Screw (Qty: 8) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2.5 (23 lb in)
2	Front Fog Lamp Bezel Assembly Procedure 1. Lift the vehicle. 2. Remove the tire and wheel. Refer to <u>Tire and Wheel Removal and Installation</u> . 3. Remove the front wheelhouse liner. Refer to <u>Front Wheelhouse Liner Replacement</u> . 4. Release the bezel assembly taps. 5. Remove the front fog lamp bezel assembly.
3	Front Bumper Fascia Lower Molding
4	Front Fog Lamp Chrome Insert

FRONT LICENSE PLATE BRACKET REPLACEMENT**Fig. 5: Front License Plate Bracket**

Courtesy of GENERAL MOTORS COMPANY

Front License Plate Bracket Replacement

Callout	Component Name
1	Front License Plate Bracket Screw (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2.5 (23 lb in)
2	Front License Plate Bracket

DECAL OR STRIPE REPLACEMENT**Decal Work Overview**

1. Wash the car.
2. Check the car surface.
3. If the metal or underlying painted surfaces are damaged, repair and refinish the metal as needed before

you install the stripes or decals.

CAUTION: Striping material highlights vehicle surface imperfection. All dings, rough metal, paint defects and uneven two-tone paint breaklines must be eliminated before stripe/decals application. Freshly painted surfaces must be allowed to dry thoroughly before installing stripe or decal. Residual solvents in fresh painted surfaces can lead to subsequent blistering problems if stripe or decal is applied before complete release of solvents.

4. Maintain body surface and decal temperature between 21-38°C (70 -100°F) during installation.

NOTE: DO NOT apply the decals when the body surface and the decal temperatures are below 21°C (70°F).

5. Use auxiliary heat sources to warm the body surface and decals if the temperature is less than 21°C (70°F).
6. Follow the decal installation order.
 - Liftgate Decal - Spoiler Decal - Roof Decal
 - Hood Decal is not related to installation order.
7. Dry decals at least 20 minute.
8. DO NOT wash the car for 72 hours after decal installation.

Necessary Equipment and Materials

- Soap and water solution
- Isopropyl alcohol
- Squeegee about 75-100 mm (3-4 in) wide, plastic or hard rubber. Deburr any sharp or rough edges in order to prevent scratching of the stripe or decal
- Water bucket and sponge or spray bottle
- Heat gun
- Clean, lint-free wiping cloth
- Sharp knife or razor blade
- Fine pin or needle
- Marking pencil
- Roof decal template (attached at the end of the decal installation procedure)

Decal Composition

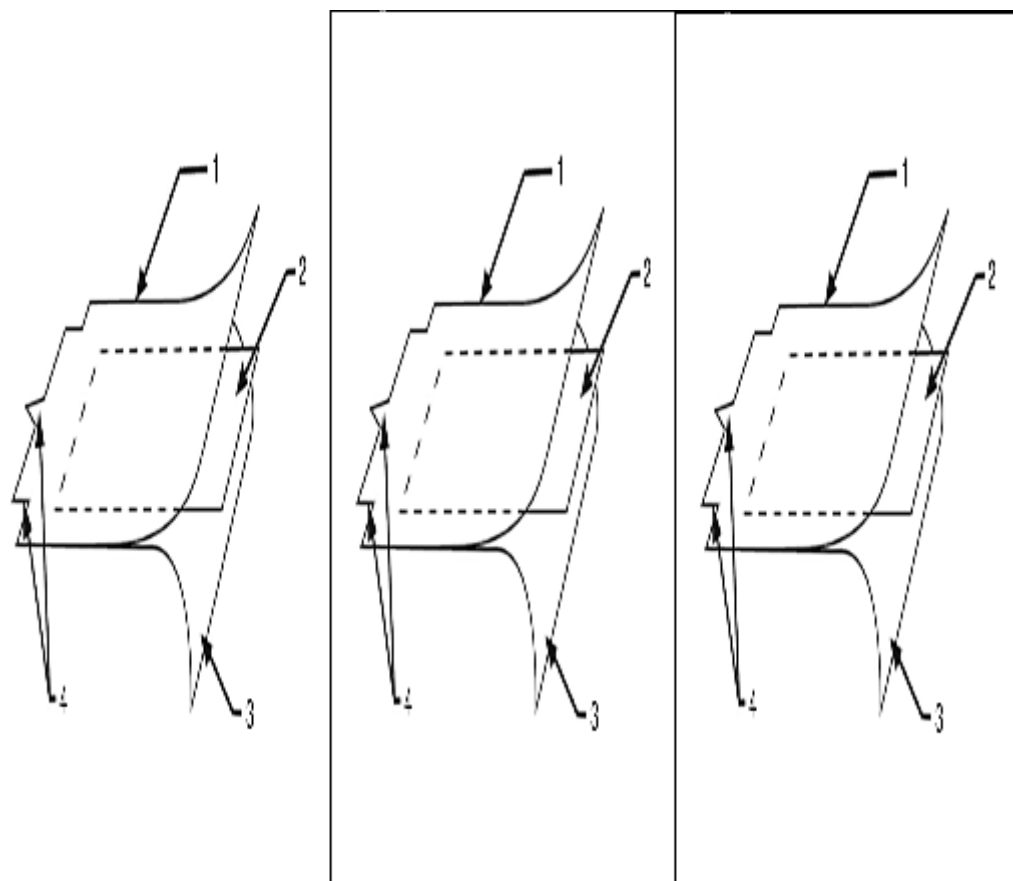


Fig. 6: Identifying Premask Carrier Stripe And Release Liner
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Premask Carrier
2	Stripe (Decal)
3	Release Liner
4	Carrier Extension Locating Fixture

Decal Location

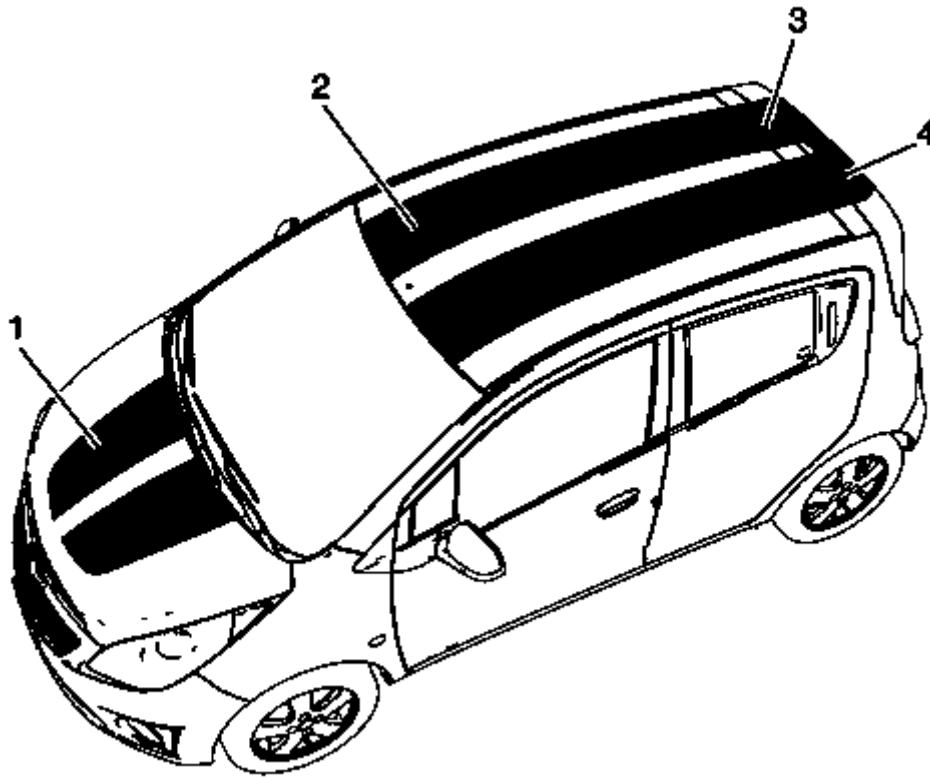


Fig. 7: Identifying Hood Decal And Roof Decal (Stripe)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Hood Decal (Stripe)
2	Roof Decal (Stripe)
3	Liftgate Decal (Stripe)
4	Spoiler Decal (Stripe)

Removal Procedure

1. Wash and clean the following items using Liquid Wash and Wax GM P/N 1052870 or the equivalent:
 - The repair surfaces
 - The adjacent panel

CAUTION: To avoid damaging the paint finish, do not use pointed or sharp instruments to remove the stripe or the decal.

2. Use heat in order to remove the stripe or decal.

Start at one edge and peel the stripe or decal from the panel surface.

3. Remove all traces of adhesive residue from the painted surfaces using the following items:

- Silicone, wax and grease remover
- Varnish makers and painters (VM&P) naphtha

Installation Procedure

Hood Stripe

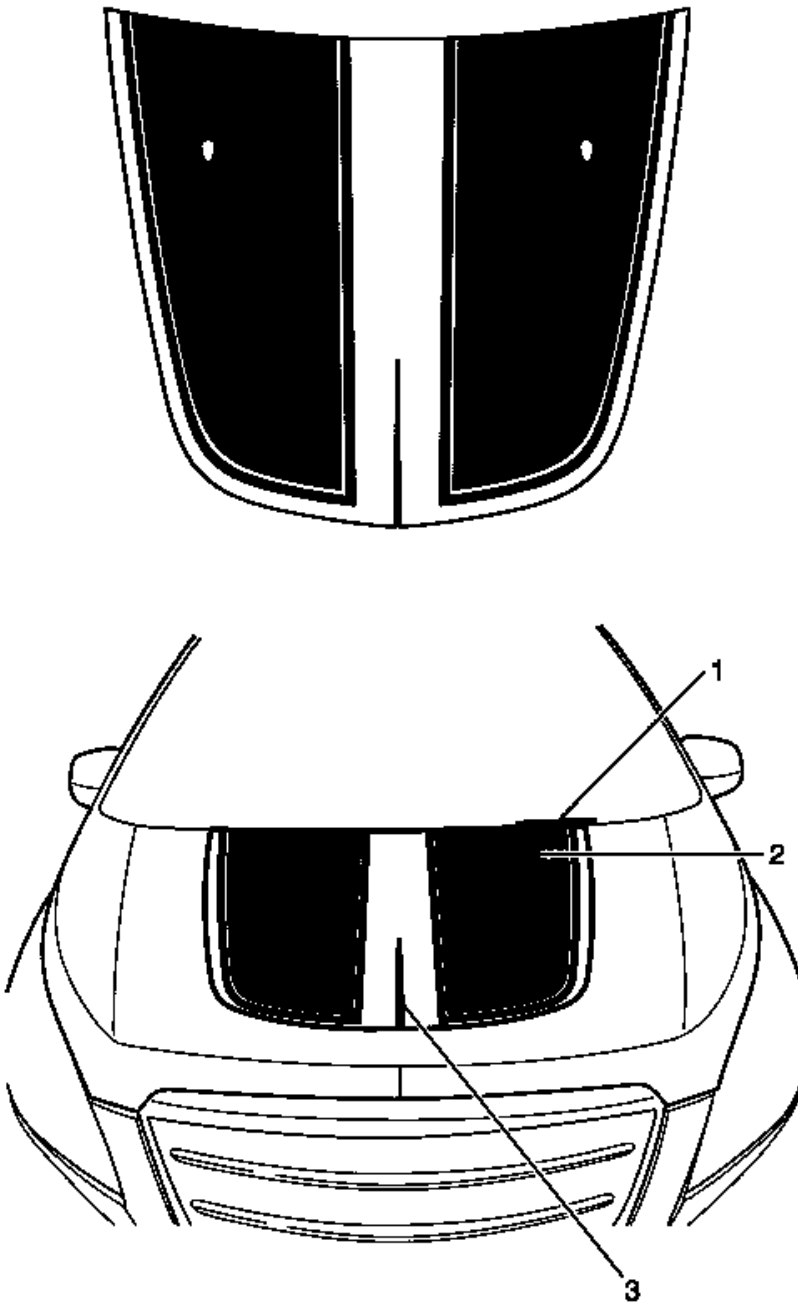


Fig. 8: Hood Stripe

Courtesy of GENERAL MOTORS COMPANY

1. Clean the hood area where you apply the stripe or decal. Use a 70/30 mixture of isopropyl alcohol and water.

2. Wipe the panel surface with a clean cloth while the solvent dries.
3. Spray the surface of the hood with the soap and water solution.
4. Place the stripe on a flat surface with the premask side down (the smooth white liner will be facing up).
5. Remove the liner from the stripe. This will expose the adhesive layer of the stripe.
6. Spray the adhesive layer with the soap and water solution.
7. Slide the stripe into place, aligning the holes in the stripe around the nozzles (2) while aligning the rear premask edge to the rear of the hood panel (1).
8. Spray the soap and water solution on the surface of the premask and use a squeegee to press the stripe into place. Begin at the center and press into place across the width (side to side).
9. Use the squeegee to press the rear portions into place.
10. Press each of the front stripe portions into place independently of each other. Note that the center cut line (3) in the premask in the front of the stripe will align together, leaving the stripe in the proper position.
11. Carefully remove the premask from the stripe. Do not pull off at a 90 degree angle, remove it at 180 degrees (back on top of itself).
12. Inspect the stripe for bubbles and repress into place with the squeegee or use the pin to put a small hole into the side of the bubble and press the solution out.

Liftgate Stripe

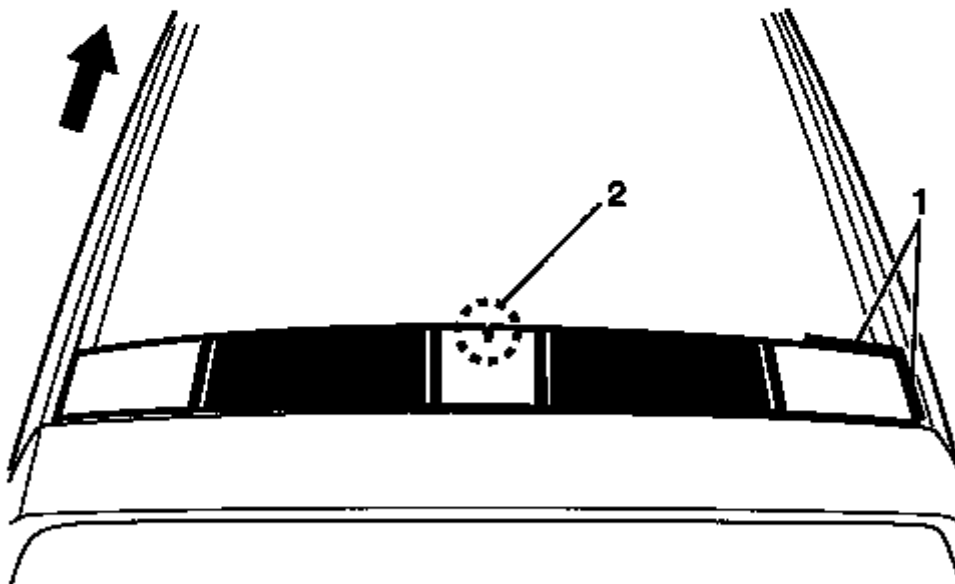


Fig. 9: Liftgate Stripe

Courtesy of GENERAL MOTORS COMPANY

1. Clean the liftgate area where you apply the stripe or decal. Use a 70/30 mixture of isopropyl alcohol and water.
2. Wipe the panel surface with a clean cloth while the solvent dries.
3. Spray the surface of the liftgate with the soap and water solution.
4. The side to side center-point and mark with panel must be determined. Use a tape measure to find the center-point and mark with a grease pencil or a piece of masking tape.

5. Place the stripe on a flat surface with the premask side down (the smooth white liner will be facing up).
6. Remove the liner from the stripe. This will expose the adhesive layer of the stripe.
7. Spray the adhesive layer with the soap and water solution.
8. Slide the stripe into place, aligning the front and side premask edges to the liftgate panel edges (1) and to the "arrow (2)" in the center of the premask with the center-point.
9. Spray the soap and water solution on the surface of the premask and use a squeegee to press the stripe into place. Begin at the center and press into place across the width (side to side).
10. Carefully remove the premask from the stripe. Do not pull off at a 90 degree angle, remove it at 180 degrees (back on top of itself).
11. Inspect the stripe for bubbles and repress into place with the squeegee or use the pin to put a small hole into the side of the bubble and press the solution out.

Spoiler Stripe

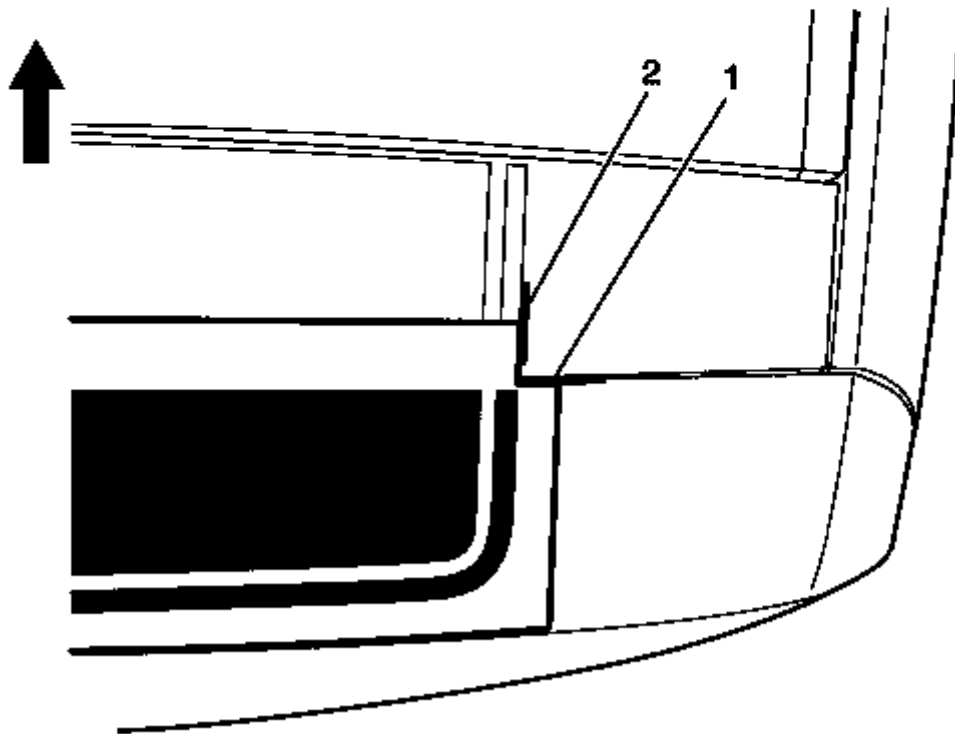


Fig. 10: Liftgate Stripe And Spoiler Panel Edge
Courtesy of GENERAL MOTORS COMPANY

1. Install after the liftgate stripe.
2. Clean the spoiler area where you apply the stripe or decal. Use a 70/30 mixture of isopropyl alcohol and water.
3. Wipe the panel surface with a clean cloth while the solvent dries.
4. Spray the surface of the spoiler with the soap and water solution.

5. Place the stripe on a flat surface with the premask side down (the smooth white liner will be facing up).
6. Remove the liner from the stripe. This will expose the adhesive layer of the stripe.
7. Spray the adhesive layer with the soap and water solution.
8. Slide the stripe into place, aligning the front premask edge to the spoiler panel edge (1) and the premask extension tabs in alignment with the installed liftgate stripe (2).
9. Spray the soap and water solution on the surface of the premask and use a squeegee to press the stripe into place. Begin at the center and press into place across the width (side to side).
10. Carefully remove the premask from the stripe. Do not pull off at a 90 degree angle, remove it at 180 degrees (back on top of itself).
11. Inspect the stripe for bubbles and repress into place with the squeegee or use the pin to put a small hole into the side of the bubble and then press the solution out.

Roof Stripe

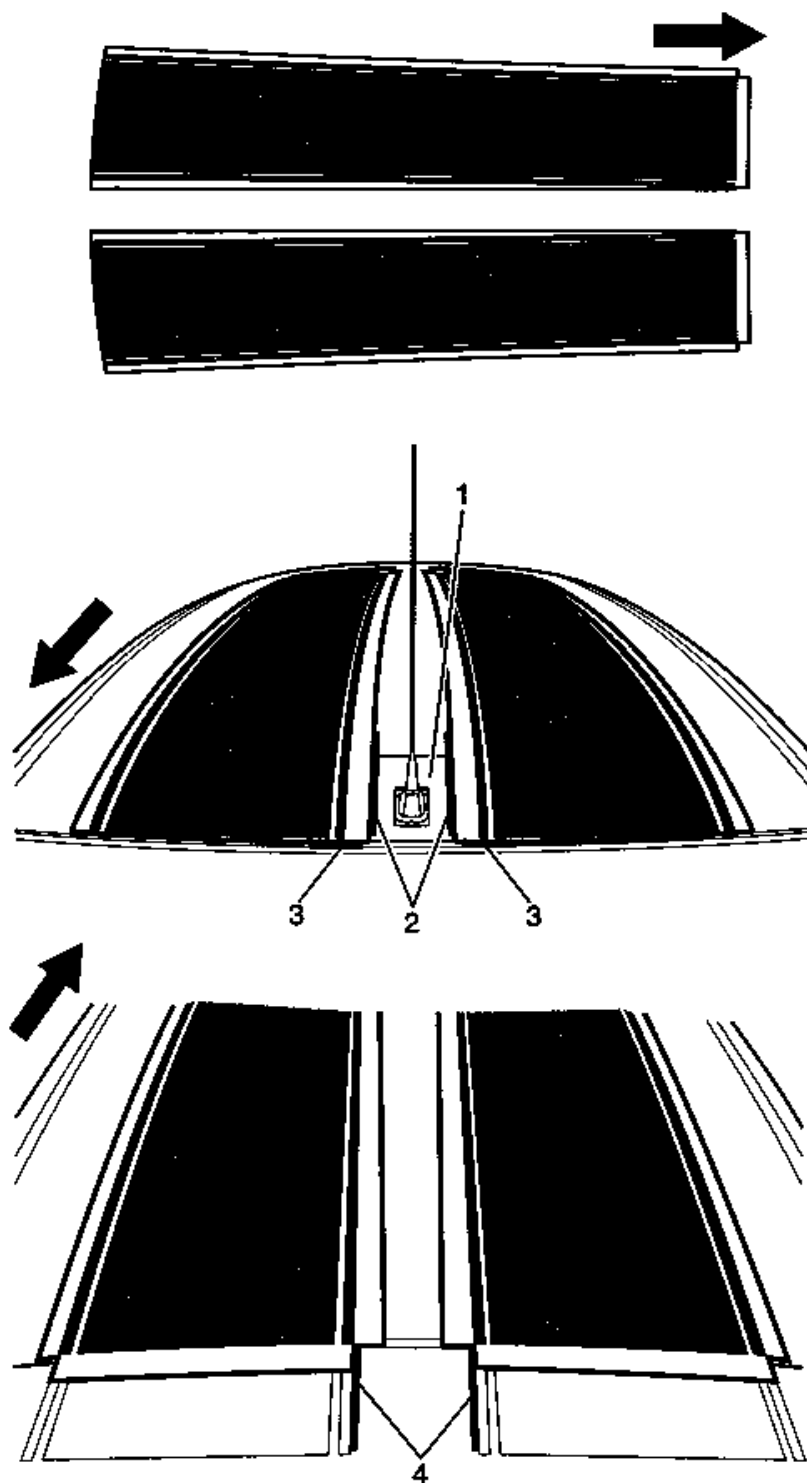


Fig. 11: Roof Stripe

Courtesy of GENERAL MOTORS COMPANY

1. Install after the liftgate and spoiler stripes.

NOTE: Print and use the attached roof decal template when installing the roof decal.

2. Use a tape measure to find the center point of the roof at the front and mark with a grease pencil or with masking tape.
3. Clean the roof area where you apply the stripe or decal. Use a 70/30 mixture of isopropyl alcohol and water.
4. Wipe the panel surface with a clean cloth while the solvent dries.
5. Align a roof decal template (1) at the marked front - center points and mark side edge of roof decal template with a grease pencil.
6. Spray the surface of the spoiler with the soap and water solution.
7. Place the stripe on a flat surface with the premask side down (the smooth white liner will be facing up).
8. Remove the liner from the left roof stripe. This will expose the adhesive layer of the stripe.
9. Spray the adhesive layer with the soap and water solution.
10. Slide the roof stripe into place, aligning the inner edge (2) of the premask to the side edges of the roof decal template. The front premask edges should also align to the panel edges (3). And align the roof stripe premask extension tabs to the installed liftgate stripe (4).
11. Spray the soap and water solution on the surface of the premask and use a squeegee to press the stripe into place. Begin at the center and press into place across the width (side to side) and then toward the front and rear of the stripe.
12. Carefully remove the premask from the left roof stripe. Do not pull off at a 90 degree angle, remove it at 180 degrees (back on top of itself).
13. Inspect the left roof stripe for bubbles and repress into place with the squeegee or use the pin to put a small hole into the side of the bubble and press the solution out.
14. Repeat for the other side roof stripe.

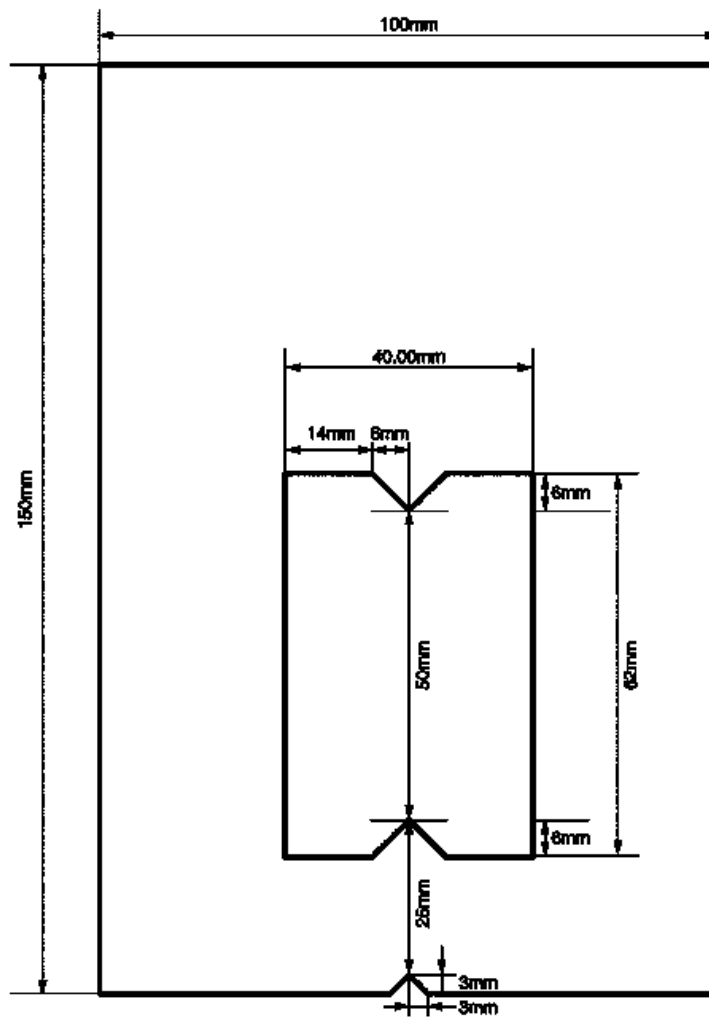


Fig. 12: Measuring Center Point Of Roof
 Courtesy of GENERAL MOTORS COMPANY

RADIATOR GRILLE EMBLEM/NAMEPLATE REPLACEMENT

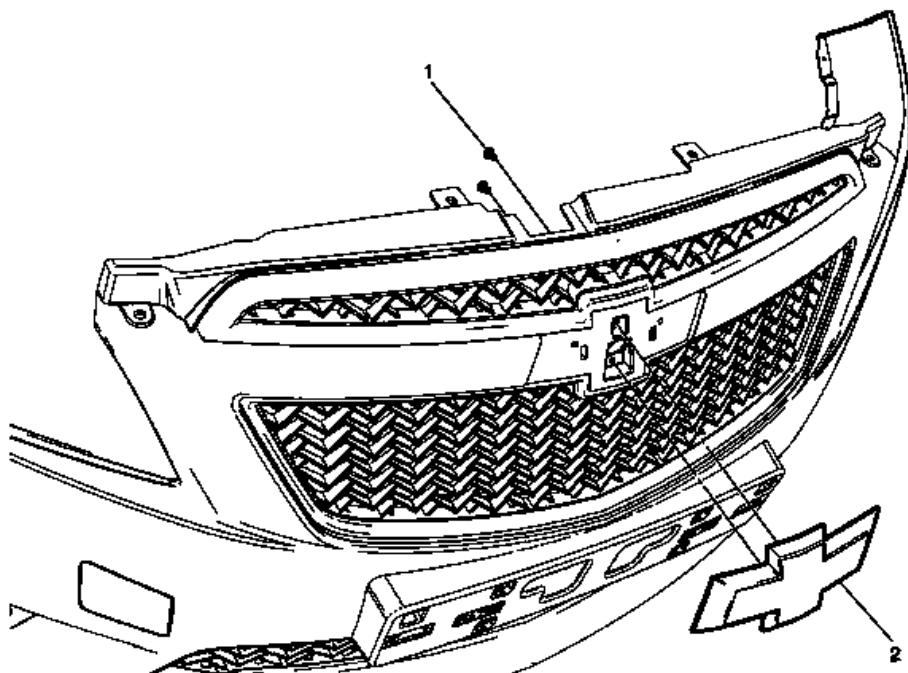


Fig. 13: Radiator Grille Emblem Assembly
 Courtesy of GENERAL MOTORS COMPANY

Radiator Grille Emblem/Nameplate Replacement

Callout	Component Name
Preliminary Procedure Remove the front bumper fascia. Refer to <u>Front Bumper Fascia Replacement</u> .	
1	Radiator Grille Emblem Screw (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2.5 N.m (23 lb in)
2	Radiator Grille Emblem Assembly

LIFTGATE EMBLEM/NAMEPLATE REPLACEMENT

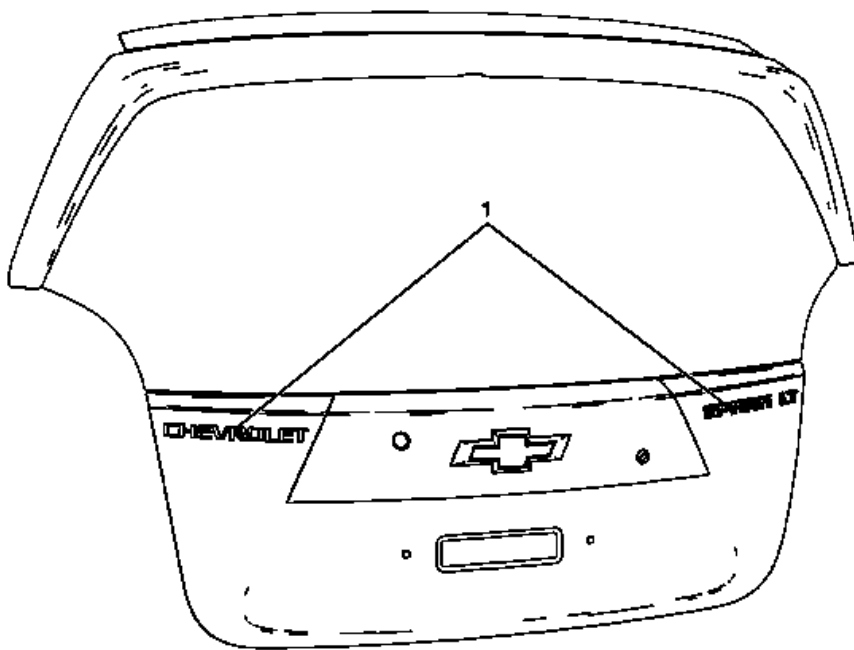


Fig. 14: Liftgate Emblem/Nameplate
 Courtesy of GENERAL MOTORS COMPANY

Liftgate Emblem/Nameplate Replacement

Callout	Component Name
1	Liftgate Emblem Assembly CAUTION: Refer to <u>Exterior Trim Emblem Removal Caution</u> . Procedure 1. The part and surface should be 21°C (70°F) prior to installation. The vehicle should remain 21°C (70°F) for one hour after assembly to allow adhesive to develop sufficient bond strength. 2. Use a Heat Gun or equivalent to remove the old nameplate. Clean all adhesive from the rear compartment panel and wipe the surface dry with a clean lint-free towel prior to installing the new nameplate. 3. When removing protective liners from the adhesive tape, be careful not to touch tape with hands and do not allow tape to come in contact with dirt or any foreign matter prior to adhesion. 4. Close the rear compartment lid prior to adhesion. 5. Using the palm of the hand, wet out the emblem to the rear compartment lid to ensure full adhesion of the emblem is made.

FRONT GRILLE REPLACEMENT

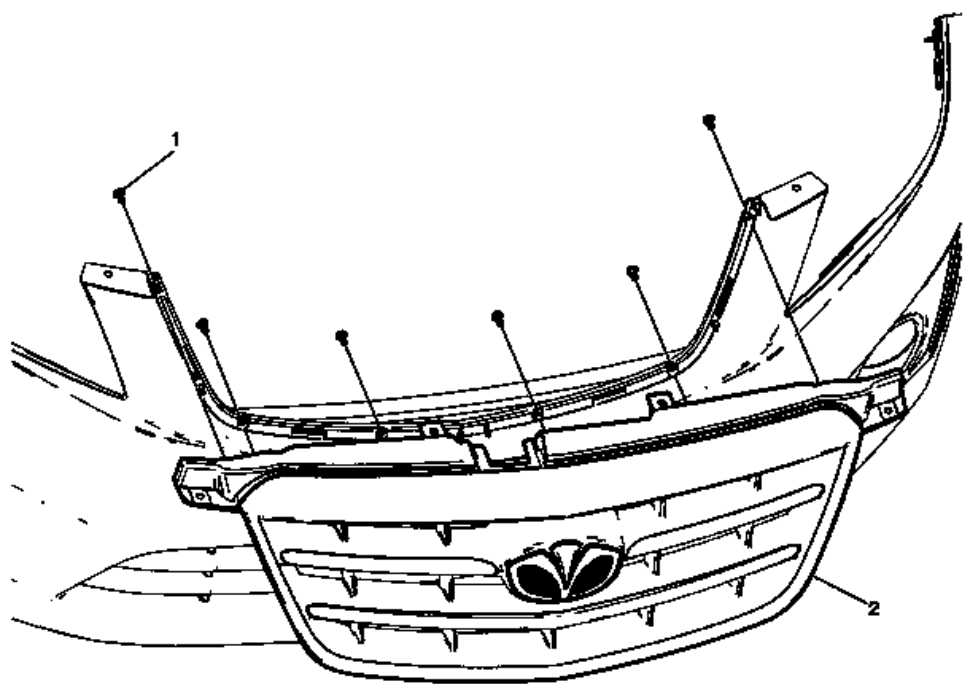


Fig. 15: Radiator Grille Assembly
Courtesy of GENERAL MOTORS COMPANY

Front Grille Replacement

Callout	Component Name
Preliminary Procedure Remove the front bumper fascia. Refer to Front Bumper Fascia Replacement .	
1	Radiator Grille Screw (Qty: 6) CAUTION: Refer to Fastener Caution . Tighten 2.0 N.m (18 lb in)
2	Radiator Grille Assembly

FRONT UPPER GRILLE REPLACEMENT

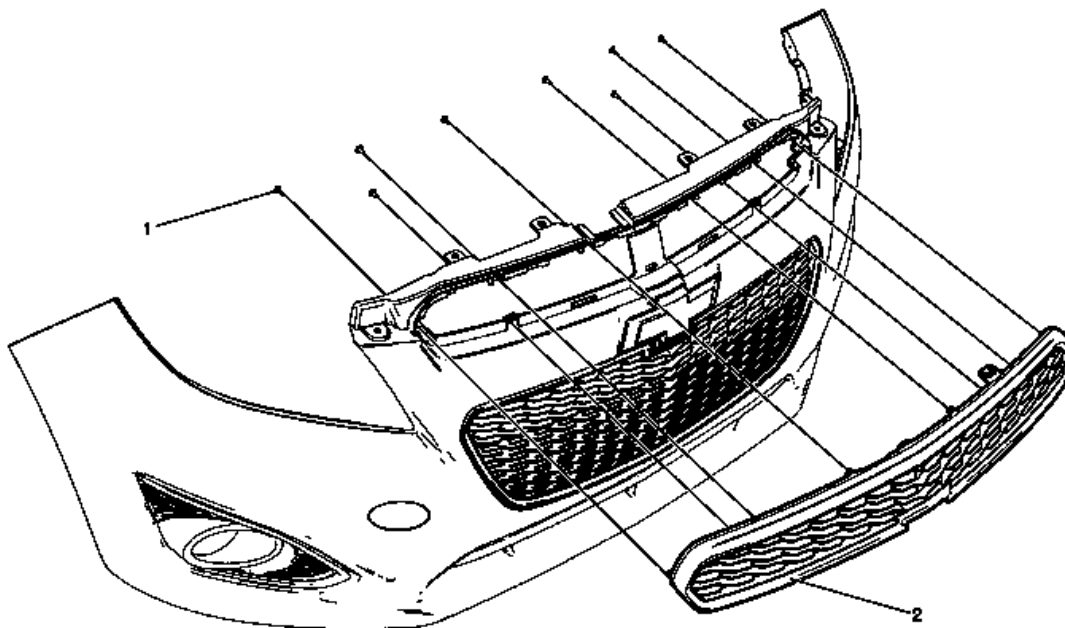


Fig. 16: Front Upper Grille
 Courtesy of GENERAL MOTORS COMPANY

Front Upper Grille Replacement

Callout	Component Name
Preliminary Procedure Remove the front bumper fascia. Refer to Front Bumper Fascia Replacement .	
1	Radiator Upper Grille Screw (Qty: 8) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2 (18 lb in)
2	Radiator Upper Grille Assembly

FRONT LOWER GRILLE REPLACEMENT

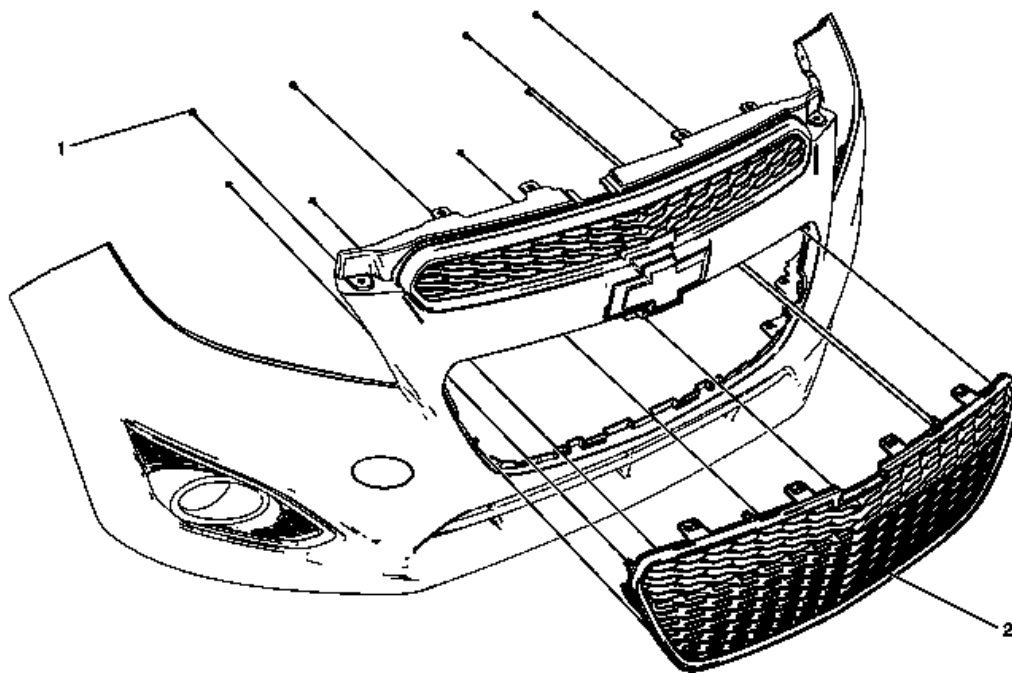


Fig. 17: Front Lower Grille
 Courtesy of GENERAL MOTORS COMPANY

Front Lower Grille Replacement

Callout	Component Name
Preliminary Procedure Remove the front bumper fascia. Refer to Front Bumper Fascia Replacement .	
1	Radiator Lower Grille Screw (Qty: 8) CAUTION: Refer to Fastener Caution . Tighten 2 (18 lb in)
2	Radiator Lower Grille Assembly

ROCKER PANEL MOLDING REPLACEMENT

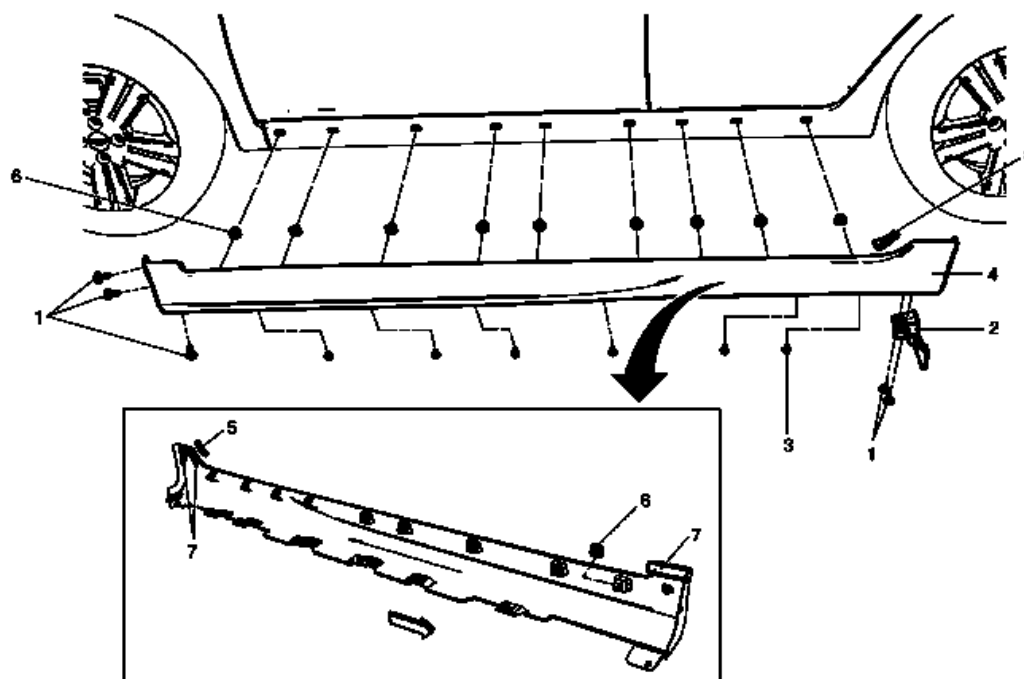


Fig. 18: Rocker Panel Molding
Courtesy of GENERAL MOTORS COMPANY

Rocker Panel Molding Replacement

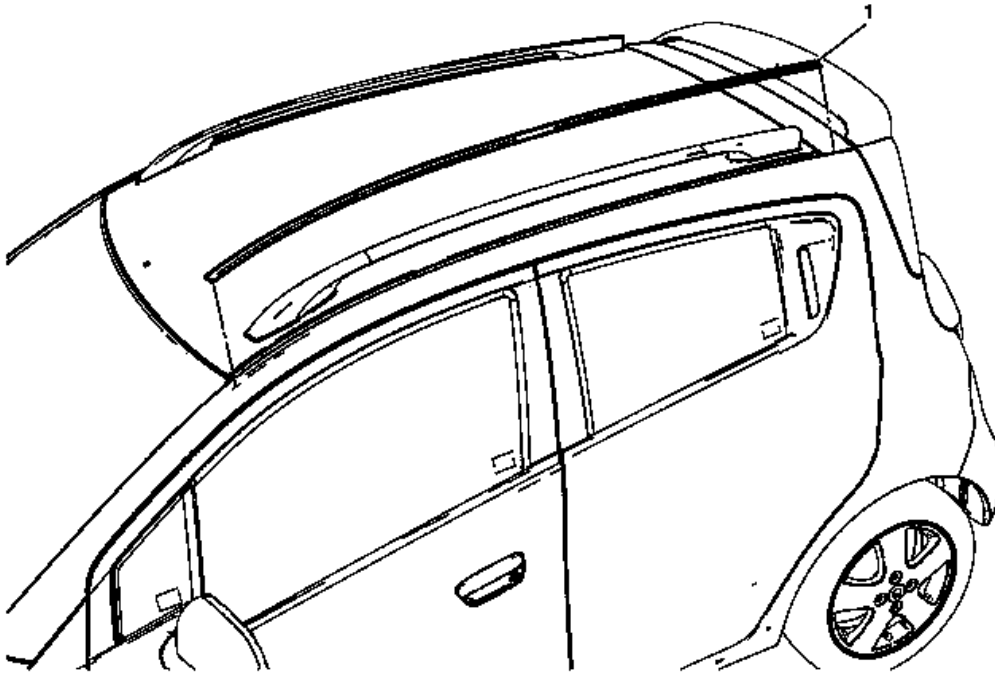
Callout	Component Name
Preliminary Procedures	
1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Remove the wheel and wheel assemblies. Refer to <u>Tire and Wheel Removal and Installation</u> .	
1	Rocker Panel Molding Screw (Qty: 5) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 1.5 (13 lb in)
2	Rear Wheelhouse Extension
3	Rocker Panel Molding Retaining Clip (Qty: 6)
4	Rocker Panel Molding
5	Front Rocker Panel Molding Protect Film NOTE: When installing new parts, attach the protect film to molding.
6	Front Rocker Panel Molding Inside Clip (Qty: 9)

7

Front Rocker Panel Molding Double-Sided Adhesive Tape (Qty: 3)

NOTE:

When installing new parts, attach the double-sided adhesive tape to molding.

ROOF PANEL JOINT FINISH MOLDING REPLACEMENT**Fig. 19: Roof Panel Joint Finish Molding**

Courtesy of GENERAL MOTORS COMPANY

Roof Panel Joint Finish Molding Replacement

Callout	Component Name
Preliminary Procedure Begin at the rear window and lift the molding from the ditch, disengaging the molding from the four integral ditch retaining clips.	
1	Roof Panel Joint Finish Molding Assembly Procedure 1. Begin at the front windshield, tuck the finish molding tab to the front roof header. 2. Using a roller-type tool, roll the ditch molding into the ditch securing the molding to each of the four integral ditch retainers. 3. Inspect the levelness of the ditch molding to the roof panel. 4. If not level, roll the area again to achieve a smooth fit to the ditch.

REAR END SPOILER REPLACEMENT

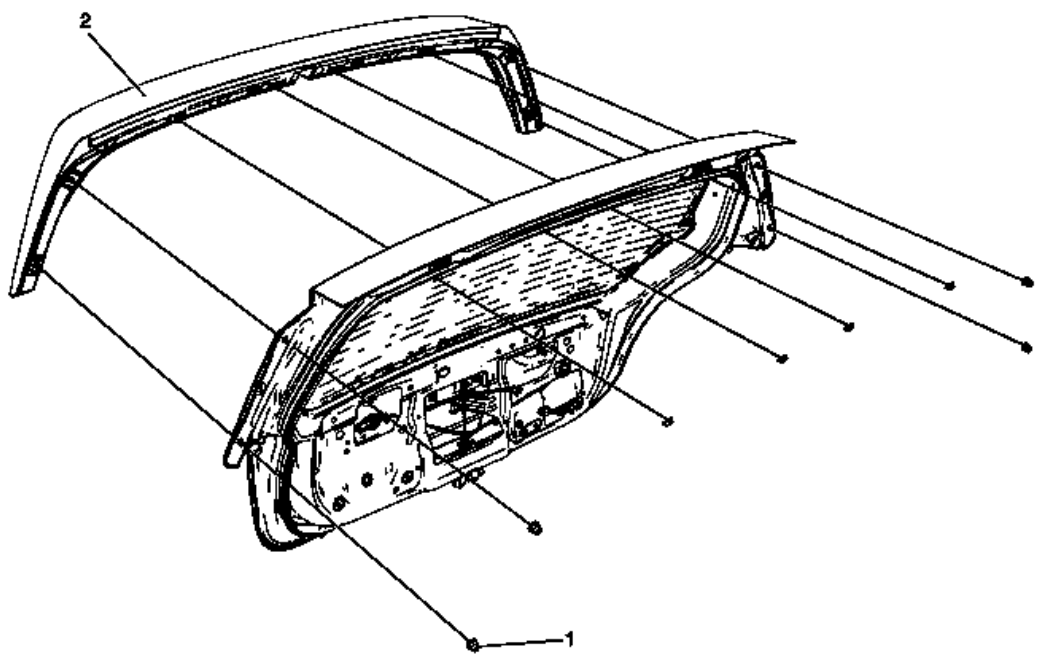


Fig. 20: Rear End Spoiler
Courtesy of GENERAL MOTORS COMPANY

Rear End Spoiler Replacement

Callout	Component Name
Preliminary Procedures 1. Open the liftgate. 2. Detach the nut cover tape.	
1	Rear End Spoiler Nut (Qty: 8) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 5 (44 lb in)
2	Rear End Spoiler NOTE: If the stop lamp is equipped, disconnect the center high mount stop lamp wiring harness before removing the rear end spoiler.

ENGINE PERFORMANCE

Firing Order & Cylinder Identification - GM, & Saturn - All Models

FIRING ORDER & CYLINDER IDENTIFICATION

NOTE: This information is intended as a quick reference for firing order and cylinder identification only. The information provided covers many vehicles and may include some information that does not apply to the vehicle you have currently selected.

3 CYLINDER ENGINE

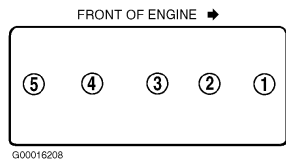
Engine Configuration	Firing Order	Cylinder Identification
In-Line 3	1-3-2	FRONT ① ② ③ G00016189

4 CYLINDER ENGINE

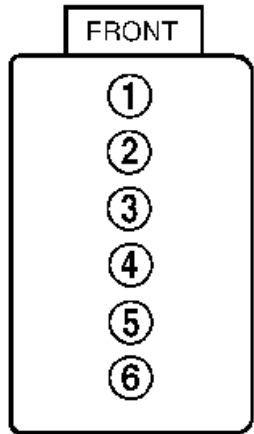
Engine Configuration	Firing Order	Cylinder Identification
In-Line 4	1-3-4-2	FRONT ① ② ③ ④ G00016200

5 CYLINDER ENGINE

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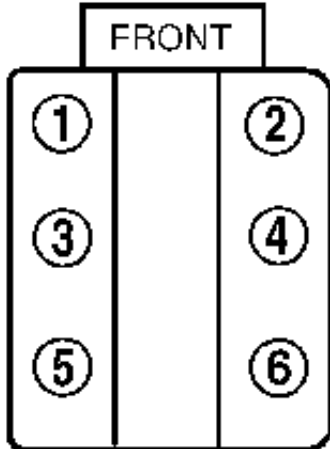
Engine Configuration	Firing Order	Cylinder Identification
In-Line 5	1-3-5-4-2	

IN-LINE 6 ENGINE

Engine Configuration	Firing Order	Cylinder Identification
In-Line 6	1-5-3-6-2-4	

V6 ENGINE

2.5L V6 Engine - Tracker

Engine Configuration	Firing Order	Cylinder Identification
2.5L Tracker	1-2-3-4-5-6	

3.5L VIN 4 V6 Engine

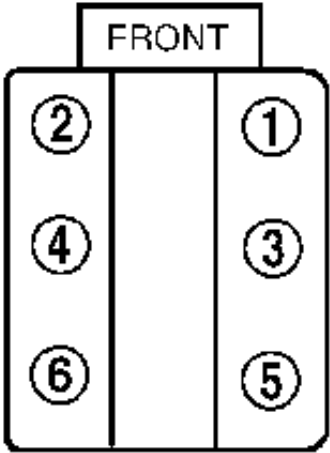
Engine Configuration	Firing Order	Cylinder Identification
3.5L VIN 4	1-4-2-5-3-6	FRONT 4 5 6 1 2 3 G00016204

3.8L & 4.3L V6 Engines

Engine Configuration	Firing Order	Cylinder Identification
3.8L & 4.3L	1-6-5-4-3-2	FRONT 1 3 5 2 4 6 G00016202

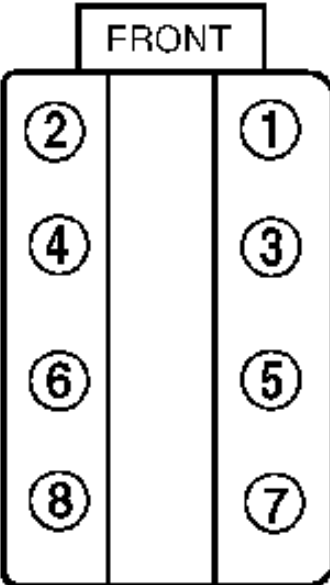
All Other V6 Engines

Engine Configuration	Firing Order	Cylinder Identification

All Others	1-2-3-4-5-6	 G00016203
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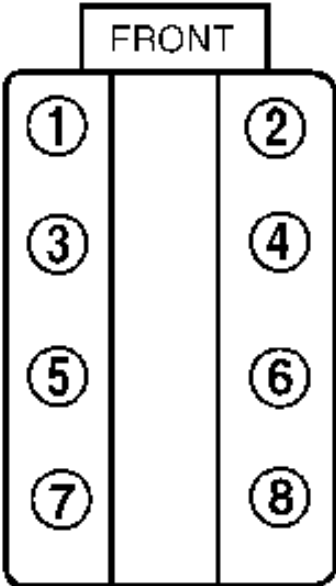
8 CYLINDER ENGINE

4.0L, 4.4L & 4.6L V8 Engines

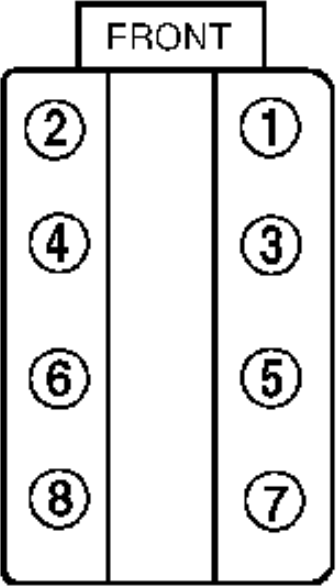
Engine Configuration	Firing Order	Cylinder Identification
4.0L, 4.4L, 4.6L	1-2-7-3-4-5-6-8	 G00016206

5.0L, 5.7L (VIN R & VIN K) & 7.4L V8 Engines

Engine Configuration	Firing Order	Cylinder Identification

5.0L, 5.7L (VIN R & K), 7.4L	1-8-4-3-6-5-7-2	 G00016205
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6.6L Diesel V8 Engine

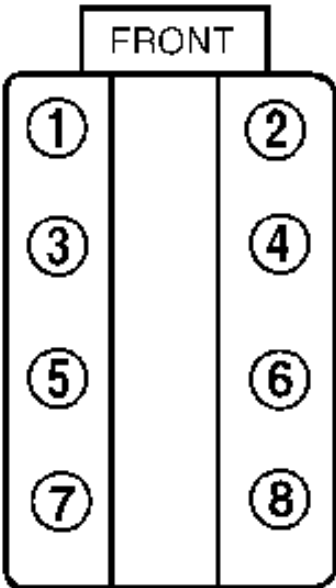
Engine Configuration	Firing Order	Cylinder Identification
6.6L Diesel	1-2-7-8-4-5-6-3	 G00016206

All Other V8 Engines

Engine Configuration	Firing Order	Cylinder Identification

All Others

1-8-7-2-6-5-4-3



G00016205

ACCESSORIES & EQUIPMENT

Fixed and Moveable Windows - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Front Side Door Window Channel Bolt	8 N.m	71 lb in
Front Side Door Window Channel Screw	1.3 N.m	12 lb in
Front Side Door Window Outer Sealing Strip Screw	2 N.m	18 lb in
Front Side Door Window Regulator Nut	8 N.m	71 lb in
Front Side Door Window Regulator Sash Screw	2 N.m	18 lb in
Liftgate Window Strut Bolt (Body)	25 N.m	18 lb ft
Liftgate Window Strut Securing Bolt (Door)	22 N.m	16 lb ft
Rear Side Door Window Channel Screw	8 N.m	71 lb in
Rear Side Door Window Regulator Nut	8 N.m	71 lb in
Rear Side Door Window Regulator Sash Screw	2 N.m	18 lb in

SCHEMATIC WIRING DIAGRAMS

MOVEABLE WINDOW WIRING SCHEMATICS

Front Power Windows (A32) Wiring Schematics

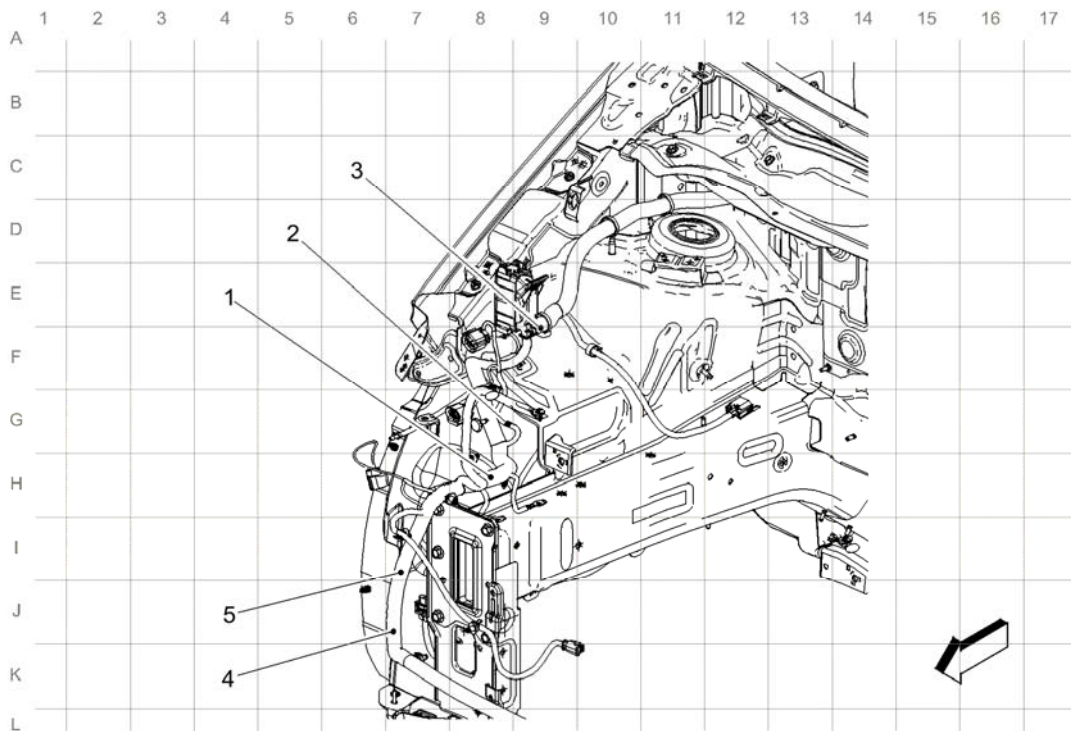


Fig. 1: Front Power Windows (A32) Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Front and Rear Power Windows (AE3) Wiring Schematics

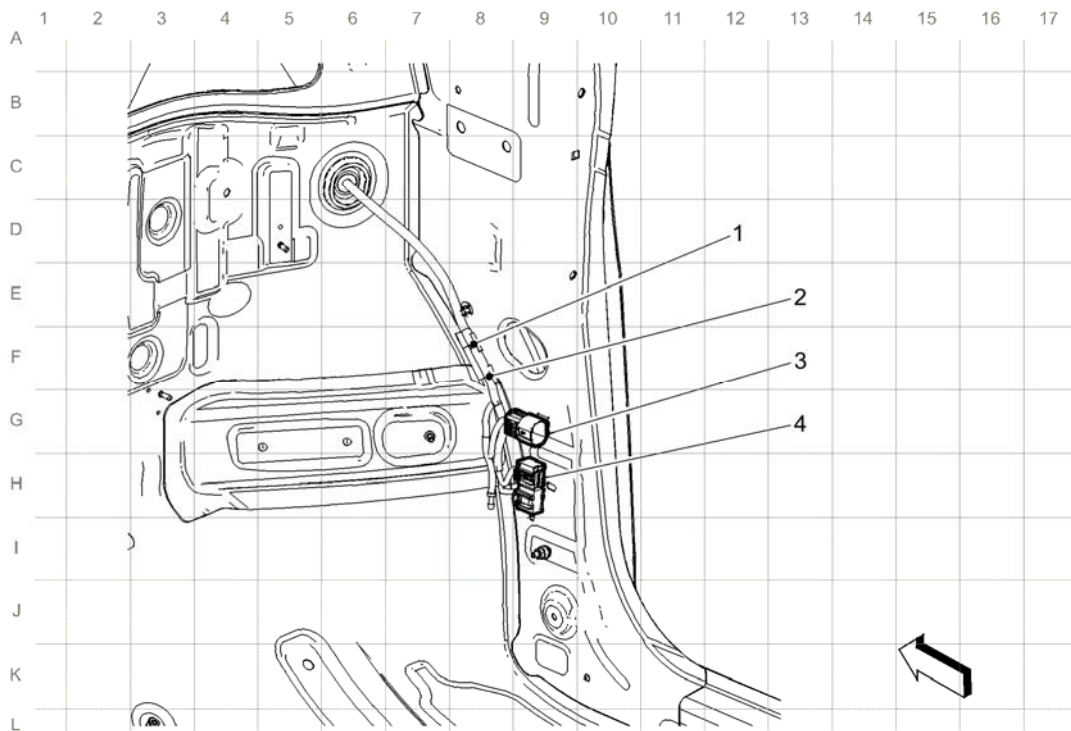


Fig. 2: Front and Rear Power Windows (AE3) Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

DEFOGGER WIRING SCHEMATICS

Rear Window Defogger Wiring Schematics

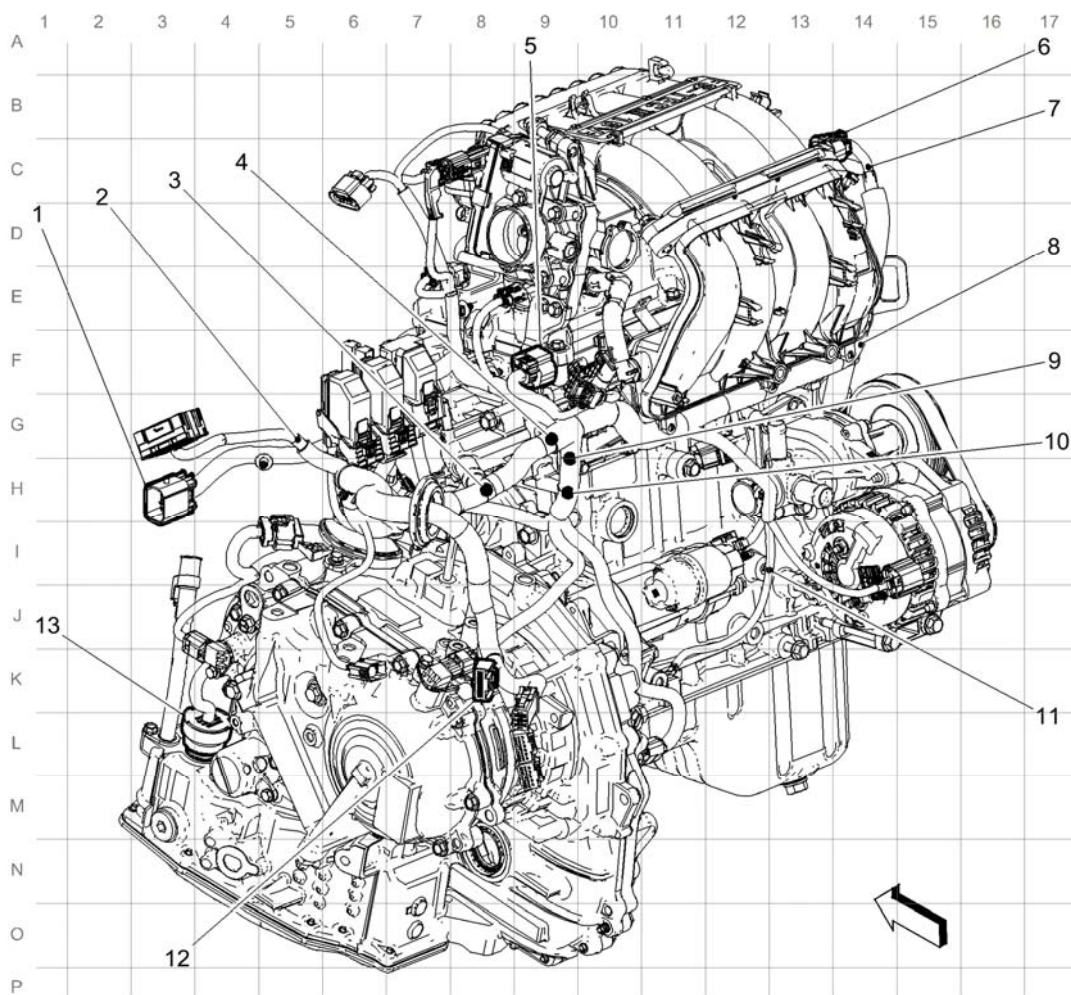


Fig. 3: Rear Window Defogger Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC B0283</u>	DTC B0283 02 Rear Defrost Circuit Short To Ground DTC B0283 05 Rear Defrost Circuit High Voltage/Open
<u>DTC B0969</u>	DTC B0969 Rear Defog Indicator Circuit

DTC B0283: REAR DEFROST CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0283 02

Rear Defrost Circuit Short To Ground

DTC B0283 05

Rear Defrost Circuit High Voltage/Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	B0283 02	B0283 05	B0283 05	-
Ground	-	B0283 05	-	-

Circuit/System Description

Battery positive voltage is supplied through a 30A fuse in the underhood fuse block, to the rear defogger relay switched input. When the rear window defogger switch is pressed, The Body Control Module commands the rear window defogger system by supplying voltage to the rear defogger relay coil. The rear defogger relay is energized and the defogger indicator is illuminated. With the relay energized, battery positive voltage is allowed from the relay switched input through the switch contacts and out the relay switched output to the rear window defogger grid.

Conditions for Running the DTC

Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

B0283 02

The Body Control Module detects a short to ground in the relay control circuit.

B0283 05

The Body Control Module detects a short to voltage or an open/high resistance in the relay control circuit.

Action Taken When the DTC Sets

The Body Control Module will attempt to command the rear defog relay, but the rear window defogger grid will

remain inoperative.

Conditions for Clearing the DTC

- The DTC will be current for as long as the fault is present.
- When the fault is no longer present, the DTC will be a history DTC.
- A history DTC will clear after 50 ignition cycles.

Reference Information

Schematic Reference

Defogger Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Rear Window Defogger Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Engine Running.
2. Verify the E18 Rear Defogger Grid turns ON and OFF when commanding the Rear Defogger Active and Inactive with a scan tool.
 - **If the E18 Rear Defogger Grid does not turn ON or OFF**

Refer to Circuit/System Testing

- **If the E18 Rear Defogger Grid turns ON and OFF**

3. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the KR5 Rear Defogger Relay. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 85 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - **If less than 10 ohms**
3. Connect a test lamp between the control circuit terminal 86 and the ground circuit terminal 85, Engine Running.
4. Verify the test lamp turns ON and OFF when commanding the Rear Defogger Active and Inactive with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module, Engine Running.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
5. Test or replace the KR5 Rear Defogger Relay.

Component Testing

Relay Test

1. Ignition OFF, disconnect the KR5 Rear Defogger Relay.
2. Test for 60-180 ohms between terminals 85 and 86.
 - **If less than 60 ohms or greater than 180 ohms**

Replace the KR5 Rear Defogger Relay.
 - **If between 60-180 ohms**

3. Test for infinite resistance between the terminals listed below:

- 30 and 86
- 30 and 87
- 30 and 85
- 85 and 87
- **If less than infinite resistance**

Replace the KR5 Rear Defogger Relay.

- **If infinite resistance**

4. Install a 3 A fused jumper wire between relay terminal 85 and 12 V. Install a jumper wire between relay terminal 86 and ground.

5. Test for less than 2 ohms between terminals 30 and 87.

- **If 2 ohms or greater**

Replace the KR5 Rear Defogger Relay.

- **If less than 2 ohms**

6. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Relay Replacement (Within an Electrical Center)** , **Relay Replacement (Attached to Wire Harness)**
- **Control Module References** for the Body Control Module replacement, programming and setup

DTC B0969: REAR DEFOG INDICATOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B0969

Rear Defog Indicator Circuit

For symptom byte information refer to: **Symptom Byte List**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	B0969 02	B0969 04	B0969 01	-

Circuit/System Description

The Body Control Module monitors the voltage level in the rear defog indicator control circuit. The voltage level should be low while the rear defog indicator is illuminated and the voltage will be near system voltage when the rear defog indicator is not illuminated.

Conditions for Running the DTC

When the rear defog indicator has been commanded ON.

Conditions for Setting the DTC

B0969 01

- The Body Control Module has detected a short to voltage while commanding the rear defog indicator.
- The condition must be present for greater than 2 seconds

B0969 02

- The Body Control Module has detected a short to ground while commanding the rear defog indicator.
- The condition must be present for greater than 2 seconds.

B0969 04

- The Body Control Module has detected an open/high resistance while commanding the rear defog indicator.
- The condition must be present for greater than 2 seconds.

Action Taken When the DTC Sets

B0969 01

The rear defog indicator will always be illuminated.

B0969 02 or B0969 04

The rear defog indicator will not illuminate when commanded by the Body Control Module.

Conditions for Clearing the DTC

- The DTC will be current for as long as the fault is present.
- When the fault is no longer present, the DTC will be a history DTC.

- A history DTC will clear after 50 ignition cycles.

Reference Information

Schematic Reference

Defogger Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Rear Window Defogger Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Engine running.
2. Verify rear defog indicator turns ON and OFF when commanding the Rear Defog Indicator Active and Inactive with a scan tool.

- **If the rear defog indicator does not turn ON and OFF**

Refer to Circuit/System Testing.

- **If the rear defog indicator turns ON and OFF**

3. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the K33 HVAC Control Module. Ignition ON
2. Connect a test lamp between the control circuit terminal 3 and ground.
3. Verify the test lamp turns ON and OFF when commanding the Rear Defog Indicator Active and Inactive with a scan tool.

- **If the test lamp is always OFF**

1. Ignition OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.

- **If the test lamp is always ON**

1. Ignition OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module, ignition ON.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.

- **If the test lamp turns ON and OFF**

4. Test or replace the K33 HVAC Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Body Control Module and HVAC Control Module replacement, programming and setup

SYMPTOMS - FIXED AND MOVEABLE WINDOWS

Important Preliminary Checks Before Starting:

1. Perform the **Diagnostic System Check - Vehicle** before using the symptom tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data link.
2. Review the power window system operation or rear window defogger system operation in order to familiarize yourself with the system functions. Refer to the following:
 - **Rear Window Defogger Description and Operation**
 - **Power Windows Description and Operation**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the rear window defogger. Refer to **Checking Aftermarket Accessories**.

- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

NOTE:

- Inspect for proper installation of electrical components if an intermittent condition exists. Inspect for aftermarket theft deterrent devices, lights and cellular phones. Ensure that no aftermarket equipment is connected to the class 2 circuit. If you can not locate an intermittent condition, a cellular phone signal may cause the condition. Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to Testing for Intermittent Conditions and Poor Connections .
- The problem may or may not turn ON the SERVICE VEHICLE SOON indicator or store a DTC. Do not use the symptom tables to diagnose intermittent conditions. The malfunction must be present in order to locate the problem.

Poor electrical connections or wiring cause most intermittent conditions. Perform a careful visual/physical check for the following conditions:

- Poor mating of the connector halves or a terminal not fully seated in the connector body
- An improperly formed or damaged terminal
- Reform or replace connector terminals in the problem circuit in order to ensure proper contact tension.
- Poor terminal to wire connection requires removing the terminal from the connector body in order to perform the check.

Use a scan tool in order to help detect intermittent conditions. The scan tool has several features that can be used to locate an intermittent condition. The snapshot feature can capture and store data parameters within the scan tool when the malfunction occurs. This information can then be reviewed in order to see what caused the malfunction.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- Rear Window Defogger Malfunction
- Power Windows Malfunction (With A32), Power Windows Malfunction (With AE3)

REAR WINDOW DEFOGGER MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Relay B+	1	1	-	-
Rear Defog Switch Signal	2	1	1	-
Relay Control	B0283 02	B0283 04	B0283 01	-
Rear Defogger Grid Control	1	1	2	-
Rear Defog Indicator Control	B0969 02	B0969 04	B0969 01	-
Relay Ground	-	B0283 04	-	-
Rear Defogger Grid Ground	-	1	-	-
1. Rear Defogger Grid Inoperative 2. Rear Defogger Grid Always ON				

Circuit/System Description

The Body Control Module supplies 12 V on the rear window defogger switch signal circuit to the HVAC Control Module. When the rear window defogger switch is pressed, the rear window defogger switch pulls the signal circuit low. The Body Control Module will detect the drop in voltage in the signal circuit and will supply voltage to the rear defogger relay coil. The relay coil supply voltage is also spliced off internally in the Body Control Module to the supply voltage circuit of the rear defog indicator. The rear defogger relay is energized and the rear defog indicator is illuminated. With the relay energized, battery positive voltage is allowed from the relay switched input through the switch contacts and out the relay switched output to the rear window defogger grid.

Reference Information

Schematic Reference

Defogger Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Rear Window Defogger Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Engine running.
2. Verify the E18 Rear Defogger Grid turns ON and OFF when commanding the Rear Defogger Active and Inactive with a scan tool
 - **If the E18 Rear Defogger Grid does not turn ON and OFF**

Refer to Circuit/System Testing - Rear Window Defogger Grid Malfunction

- **If the E18 Rear Defogger Grid does turn ON and OFF**
- 3. Verify rear defog indicator turns ON and OFF when commanding the Rear Defog Indicator Active and Inactive with a scan tool.
 - **If the rear defog indicator does not turn ON and OFF**

Refer to Circuit/System Testing - Rear Defog Indicator Malfunction

- **If the rear defog indicator does turn ON and OFF**
- 4. Verify the scan tool Rear Defogger Status parameter changes between Off and On when pressing the rear window defogger switch.
 - **If the parameter does not change**

Refer to Circuit/System Testing - Rear Defogger Switch Malfunction.

- **If the parameter changes**
- 5. All OK.

Circuit/System Testing

Rear Window Defogger Grid Malfunction

1. Ignition OFF and all vehicle systems OFF, disconnect the KR5 Rear Defogger Relay. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 85 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Engine Running.

4. Verify a test lamp illuminates between the B+ circuit terminal 30 and ground.
 - **If the test lamp does not illuminate**
 - Replace the X50A Fuse Block-Underhood
 - **If the test lamp illuminates**
5. Connect a test lamp between the control circuit terminal 86 and the ground circuit terminal 85.
6. Verify the test lamp turns ON and OFF when commanding the Rear Defogger Active and Inactive with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module, Engine Running.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
 - 7. Verify that a test lamp does not illuminate between the control circuit terminal 87 and ground.
 - **If the test lamp illuminates**

Repair the short to voltage on the control circuit
 - **If the test lamp does not illuminate**
 - 8. Ignition OFF and all vehicle systems OFF, disconnect the X2 harness connector at the E18 Rear Defogger Grid. It may take up to 2 minutes for all vehicle systems to power down.
 - 9. Test for less than 10 ohms between the ground circuit terminal 1 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
 - 10. Connect the X2 harness connector at the E18 Rear Defogger Grid.

11. Engine Running, connect a 20 A fused jumper wire between the B+ circuit terminal 30 and the control circuit terminal 87.
12. Verify the E18 Rear Defogger Grid is activated.
 - **If the E18 Rear Defogger Grid does not activate**
 1. Ignition OFF, remove the jumper wire, disconnect the X1 harness connector at the E18 Rear Defogger Grid.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the E18 Rear Defogger Grid.
 - **If the E18 Rear Defogger Grid activates**
13. Test or replace the KR5 Rear Defogger Relay.

Rear Defog Indicator Malfunction

1. Ignition OFF, disconnect the harness connector at the K33 HVAC Control Module. Engine Running
2. Connect a test lamp between the control circuit terminal 3 and ground.
3. Verify the test lamp turns ON and OFF when commanding the Rear Defog Indicator Active and Inactive with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module, Engine Running.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
4. Replace the K33 HVAC Control Module.

Rear Defogger Switch Malfunction

1. Ignition OFF, disconnect the harness connector at the K33 HVAC Control Module. Engine running.
2. Test for greater than 7 V between the signal circuit terminal 2 and ground.
 - **If 7 V or less**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance on the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If greater than 7 V**
3. Replace the K33 HVAC Control Module.

Component Testing

Relay Test

1. Ignition OFF, disconnect the KR5 Rear Defogger Relay.
2. Test for 60-180 ohms between terminals 85 and 86.
 - **If less than 60 ohms or greater than 180 ohms**

Replace the KR5 Rear Defogger Relay.

- **If between 60-180 ohms**
3. Test for infinite resistance between the terminals listed below:
 - 30 and 86
 - 30 and 87
 - 30 and 85
 - 85 and 87
 - **If less than infinite resistance**

Replace the KR5 Rear Defogger Relay.

- **If infinite resistance**
4. Install a 3 A fused jumper wire between relay terminal 85 and 12 V. Install a jumper wire between relay terminal 86 and ground.
 5. Test for less than 2 ohms between terminals 30 and 87.
 - **If 2 ohms or greater**

Replace the KR5 Rear Defogger Relay.

- If less than 2 ohms

6. All OK

Rear Defogger Grid Test

NOTE: Lightly touch the grid lines when testing with the test lamp. If the test lamp point is scraped through the grid line it can cause an open in the circuit

1. Engine running, command the Rear Defogger ON by pressing the rear window defogger switch.
2. Verify that a test lamp illuminates between each rear window defogger grid line and ground. The test lamp should be off when testing at the ground side of the grid and get brighter as the test lamp moves closer to the voltage supply side of the grid. The test lamp should be dim when testing each grid line in the middle

- If the test lamp remains bright at the middle of the grid line.

The grid line is open between the test point and the ground side of the grid.

Replace the rear window

- If the test lamp remains off at the middle of the grid line.

The grid line is open between the test point and the voltage supply side of the grid.

Replace the rear window

- If the test lamp remains dim at the middle of each grid line.

3. All OK

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Relay Replacement (Within an Electrical Center) , Relay Replacement (Attached to Wire Harness)
- Rear Window Replacement
- Control Module References for the Body Control Module and HVAC Control Module replacement, programming and setup

POWER WINDOWS MALFUNCTION (WITH A32)

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Driver Window Switch Ignition	5	2	-	-
Driver Window Switch Ground	-	5	-	-
Driver Window Motor Control	5	1	1	-
Passenger Window Switch Ignition	5	3	-	-
Passenger Window Switch Signal	5	4	4	-
Passenger Window Motor Control	5	4	4	-
1. Driver Window Inoperative 2. Driver and Passenger Window Inoperative From Driver Window Switch 3. Passenger Window Inoperative from The Passenger Window Switch 4. Passenger Window Inoperative from Both Window Switches 5. Both Driver and Passenger Windows Inoperative				

Circuit/System Description

The power window system will operate any time the ignition is the ACC or RUN position. The driver power window switch contains individual window switches for the passenger power window. Both windows may be controlled up and down from the driver power window switch. The passenger power window switches will only control the up and down operation of the passenger power window.

Each power window contains a reversible power window motor. The direction the window travels is dependent upon the polarity of the supply voltage. By reversing polarity of the supply voltage the window motor will move up or down. Each power window motor is internally circuit breaker protected.

Battery voltage is supplied to the power window switch through the ignition voltage supply circuit. The power window switch also receives a constant ground source. The power window motor control circuits are connected to ground through the normally closed up and down contacts of the power window switch. When the power switch is placed in the down position, the power window motor down control circuit is switched to 12 V and is applied to the down side of the power window motor. Since the other side of the power motor is connected to ground through the normally closed contacts of the up switch, the window travels down. By placing the power window switch in the up position, the polarity of the power window motor is reversed and the window travels up.

Reference Information

Schematic Reference

Moveable Window Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Windows Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Circuit/System Verification

1. Ignition ON.
2. Verify the driver window performs the UP and DOWN functions.
 - **If the driver window does not perform the UP or DOWN functions**

Refer to Circuit/System Testing - Driver Window Inoperative
 - **If the driver window performs the UP and DOWN functions**
3. Verify the M74P Window Motor-Passenger performs the UP and DOWN functions at both the S79D Window Switch-Driver and S79P Window Switch-Passenger.
 - **If the M74P Window Motor-Passenger is inoperative from both the S79D Window Switch-Driver and S79P Window Switch-Passenger**

Refer to Circuit/System Testing - Passenger Window Inoperative From Both Switches.
 - **If the M74P Window Motor-Passenger is inoperative from the passenger window switch only**

Refer to Circuit/System Testing - Passenger Window Switch Inoperative.
 - **If the M74P Window Motor-Passenger is inoperative from the S79D Window Switch-Driver only**

Test or replace the S79D Window Switch-Driver.
 - **If the M74P Window Motor-Passenger performs the UP and DOWN functions at both switches**
4. All OK.

Circuit/System Testing

Driver Window Inoperative

1. Ignition OFF, disconnect the harness connector at the S79D Window Switch-Driver. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 3 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Ignition ON.
4. Verify a test lamp illuminates between the ignition circuit terminal 6 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, refer to **Retained Accessory Power Malfunction** .
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for infinite resistance between the control circuits listed below and ground:
 - Control circuit terminal 1
 - Control circuit terminal 2
 - Control circuit terminal 4
 - Control circuit terminal 5
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the S79D Window Switch-Driver.
 - **If the test lamp illuminates**
5. Ignition OFF, connect the harness connector at the S79D Window Switch-Driver and disconnect the harness connector at the M74D Window Motor-Driver. It may take up to 2 minutes for all vehicle systems to power down.
6. Test for less than 10 ohms between the control circuit terminal 1 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the S79D Window Switch-Driver.
 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the S79D Window Switch-Driver.

- **If less than 10 ohms**
- 7. Test for less than 10 ohms between the control circuit terminal 2 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the S79D Window Switch-Driver.
 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the S79D Window Switch-Driver.
 - **If less than 10 ohms**
- 8. Connect a test lamp between the control circuit terminal 1 and control circuit terminal 2, Ignition ON.
- 9. Verify the test lamp turns ON when commanding the UP and DOWN states with the S79D Window Switch-Driver.
 - **If the test lamp remains OFF during either of the commands**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S79D Window Switch-Driver.
 2. Test for infinite resistance between each control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in each control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the S79D Window Switch-Driver.
 - **If the test lamp is always ON**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S79D Window Switch-Driver, Ignition ON.
 2. Test for less than 1 V between each control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, test or replace the S79D Window Switch-Driver
 - **If the test lamp turns ON during each of the commands**
- 10. Test or replace the M74D Window Motor-Driver.

Passenger Window Inoperative From Both Switches

1. Ignition OFF, disconnect the harness connector at the S79P Window Switch-Passenger. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the control circuit terminal 4 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the S79D Window Switch-Driver.
 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the S79D Window Switch-Driver.

- **If less than 10 ohms**
- 3. Test for less than 10 ohms between the control circuit terminal 8 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the S79D Window Switch-Driver.
 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the S79D Window Switch-Driver.
 - **If less than 10 ohms**
- 4. Connect a test lamp between the control circuit terminal 4 and control circuit terminal 8, Ignition ON.
- 5. Verify the test lamp turns ON when commanding the UP and DOWN functions with the S79D Window Switch-Driver.
 - **If the test lamp remains OFF during either of the commands**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S79D Window Switch-Driver.
 2. Test for infinite resistance between each control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in each control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the S79D Window Switch-Driver.
 - **If the test lamp is always ON**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S79D Window Switch-Driver, Ignition ON.
 2. Test for less than 1 V between each control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, test or replace the S79D Window Switch-Driver
 - **If the test lamp turns ON during each of the commands**
- 6. Ignition OFF, connect the harness connector at the S79P Window Switch-Passenger and disconnect the harness connector at the M74P Window Motor-Passenger. It may take up to 2 minutes for all vehicle systems to power down.
- 7. Test for less than 10 ohms between the control circuit terminal 1 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the S79P Window Switch-Passenger.
 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the S79P Window Switch-Passenger.
 - **If less than 10 ohms**
- 8. Test for less than 10 ohms between the control circuit terminal 2 and ground.
 - **If 10 ohms or greater**

1. Ignition OFF, disconnect the harness connector at the S79P Window Switch-Passenger.
2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the S79P Window Switch-Passenger.
- **If less than 10 ohms**
9. Connect a test lamp between the control circuit terminal 1 and control circuit terminal 2, Ignition ON.
10. Verify the test lamp turns ON when commanding the UP and DOWN functions with the S79P Window Switch-Passenger.
 - **If the test lamp remains OFF during either of the commands**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S79P Window Switch-Passenger.
 2. Test for infinite resistance between each control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in each control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the S79P Window Switch-Passenger.
 - **If the test lamp is always ON**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S79P Window Switch-Passenger, Ignition ON.
 2. Test for less than 1 V between each control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, test or replace the S79P Window Switch-Passenger
 - **If the test lamp turns ON during each of the commands**
11. Test or replace the M74P Window Motor-Passenger.

Passenger Window Switch Inoperative

1. Ignition OFF, disconnect the harness connector at the S79P Window Switch-Passenger, Ignition ON
2. Verify a test lamp illuminates between the ignition circuit terminal 6 and ground.
 - **If the test lamp does not illuminate**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp illuminates**
3. Test or replace the S79P Window Switch-Passenger.

Component Testing

Window Motor

1. Ignition OFF, disconnect the harness connector at the appropriate M74 Window Motor.
2. Install a 20 A fused jumper wire between one of the control terminals and 12 V. Momentarily install a jumper wire between the other control terminal and ground. Reverse the jumper wires at least two times, the M74 Window Motor should perform the UP and DOWN functions.
 - **If the M74 Window Moto does not perform the UP and DOWN functions**

Replace the M74 Window Motor.

- **If the M74 Window Moto performs the UP and DOWN functions**

3. All OK

Driver Window Switch

1. Ignition OFF, disconnect the harness connector at the S79D Window Switch-Driver.
2. Test for infinite resistance between the terminals listed below with the switch in the open position:
 - Ignition terminal 6 and control terminal 1
 - Ignition terminal 6 and control terminal 2
 - Ignition terminal 6 and control terminal 4
 - Ignition terminal 6 and control terminal 5
 - **If less than infinite resistance**

Replace the S79D Window Switch-Driver.

- **If infinite resistance**

3. Test for less than 3 ohms between the terminals listed below with the switch in the open position:
 - Ground terminal 3 and control terminal 1
 - Ground terminal 3 and control terminal 2
 - Ground terminal 3 and control terminal 4
 - Ground terminal 3 and control terminal 5
 - **If 3 ohms or greater**

Replace the S79D Window Switch-Driver.

- **If less than 3 ohms**

4. Test for less than 3 ohms between the terminals listed below with the switch in the Up position.
 - Driver window left hand drive - ignition terminal 6 and control terminal 5
 - Driver window right hand drive - ignition terminal 6 and control terminal 1
 - Passenger window left hand drive - ignition terminal 6 and control terminal 4
 - Passenger window right hand drive - ignition terminal 6 and control terminal 2
 - **If 3 ohms or greater**

Replace the S79D Window Switch-Driver.

- **If less than 3 ohms**

5. Test for less than 3 ohms between the terminals listed below with the switch in the Down position:

- Driver window left hand drive - ignition terminal 6 and control terminal 2
- Driver window right hand drive - ignition terminal 6 and control terminal 4
- Passenger window left hand drive - ignition terminal 6 and control terminal 1
- Passenger window right hand drive - ignition terminal 6 and control terminal 5

- **If 3 ohms or greater**

Replace the S79D Window Switch-Driver.

- **If less than 3 ohms**

6. All OK

Passenger Window Switch

1. Ignition OFF, disconnect the harness connector at the S79P Window Switch-Passenger.

2. Test for infinite resistance between the terminals listed below with the switch in the open position:

- Ignition terminal 6 and control terminal 1
- Ignition terminal 6 and control terminal 3

- **If less than infinite resistance**

Replace the S79P Window Switch-Passenger.

- **If infinite resistance**

3. Test for less than 3 ohms between the control terminals listed below with the switch in the open position:

- Control terminal 4 and control terminal 1
- Control terminal 8 and control terminal 3

- **If 3 ohms or greater**

Replace the S79P Window Switch-Passenger.

- **If less than 3 ohms**

4. Test for less than 3 ohms between the ignition terminal 6 and the control terminal 1 with the switch in the Up position.

- **If 3 ohms or greater**

Replace the S79P Window Switch-Passenger.

- **If less than 3 ohms**

5. Test for less than 3 ohms between the ignition terminal 6 and the control terminal 3 with the switch in the Down position.

- **If 3 ohms or greater**

Replace the S79P Window Switch-Passenger.

- **If less than 3 ohms**

6. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Front Side Door Window Switch Replacement - Right Side**
- **Front Side Door Window Switch Replacement - Left Side**
- **Front Side Door Window Regulator Replacement**

POWER WINDOWS MALFUNCTION (WITH AE3)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Driver Window Switch Ignition, Terminal 2	7, 9	7, 9	-	-
Driver Window Switch Ignition, Terminal 8	2, 5	2, 4	-	-
Driver Window Switch Ground	-	1	-	-
Driver Window Motor Control	2, 5	2	2	-
Passenger Window Switch Ignition	2, 5	3	-	-
Passenger Window Switch Signal	2, 5	5	5	-
Passenger Window Motor Control	2, 5	5	5	-
Left Rear Window Switch Signal	7, 9	7	7	-
Left Rear Window Switch Lockout Control	7, 9	6	10	-
Left Rear Window Motor	7, 9	7	7	-

Control				
Right Rear Window Switch Signal	7, 9	9	9	-
Right Rear Window Switch Lockout Control	7, 9	8	10	-
Right Rear Window Motor Control	7, 9	9	9	-
1. All Power Windows Inoperative 2. Driver Window Inoperative 3. Passenger Window Inoperative from Passenger Switch 4. Passenger Window Inoperative from Driver Switch 5. Passenger Window Inoperative from Driver and Passenger Switches 6. Left Rear Window Inoperative from Left Rear Switch 7. Left Rear Window Inoperative from Driver and Left Rear Switches 8. Right Rear Window Inoperative from Right Rear Switch 9. Right Rear Window Inoperative from Driver and Right Rear Switches 10. Rear Window Lockout Inoperative				

Circuit/System Description

The driver power window switch contains individual window switches for each of power windows. All windows may be controlled up and down from the driver power window switch. The individual passenger power window switches will only control the up and down operation of their respective power window.

Each power window contains a reversible power window motor. The direction the window travels is dependent upon the polarity of the supply voltage. By reversing polarity of the supply voltage the window motor will move up or down. Each power window motor is internally circuit breaker protected.

Battery voltage is supplied to the power window switch through the accessory voltage supply circuit. The power window switch also receives a constant ground source. The power window motor control circuits are connected to ground through the normally closed up and down contacts of the power window switch. When the power switch is placed in the down position, the power window motor down control circuit is switched to 12 V and is applied to the down side of the power window motor. Since the other side of the power motor is connected to ground through the normally closed contacts of the up switch, the window travels down. By placing the power window switch in the up position, the polarity of the power window motor is reversed and the window travels up.

Reference Information

Schematic Reference

Moveable Window Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Windows Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Circuit/System Verification

1. Ignition ON.
2. Verify the driver window performs the UP and DOWN functions.
 - **If the driver window does not perform the UP or DOWN functions**

Refer to Circuit/System Testing - Driver Window Inoperative
 - **If the driver window performs the UP and DOWN functions**
3. Verify the passenger window performs the UP and DOWN functions at both the S79D Window Switch-Driver and S79P Window Switch-Passenger.
 - **If the passenger window is inoperative from both the S79D Window Switch-Driver and S79P Window Switch-Passenger**

Refer to Circuit/System Testing - Passenger Window Inoperative From Both Switches.
 - **If the passenger window is inoperative from the S79P Window Switch-Passenger only**

Refer to Circuit/System Testing - Passenger Window Switch Inoperative.
 - **If the passenger window is inoperative from the S79D Window Switch-Driver only**

Test or replace the S79D Window Switch - Driver.
 - **If the passenger window performs the UP and DOWN functions at both switches**
4. Verify the left rear and right rear window performs the UP and DOWN functions at both the S79D Window Switch-Driver and each of the S79 Window Switch-Rear.
 - **If a rear window is inoperative from both the S79D Window Switch-Driver and S79 Window Switch-Rear.**

Refer to Circuit/System Testing - Rear Window Inoperative From Both Switches
 - **If a rear window is inoperative from the S79 Window Switch-Rear only**

Refer to Circuit/System Testing - Rear Window Lockout Malfunction

- **If a rear window is inoperative from the S79D Window Switch-Driver only**

Test or replace the S79D Window Switch - Driver.

- **If the rear window performs the UP and DOWN functions at both the S79D Window Switch-Driver and S79 Window Switch-Rear**

5. Lock out the rear window switches by pressing the lockout switch on the S79D Window Switch-Driver.
6. Verify the left rear and right rear windows are inoperative at both of the S79 Window Switch-Rear.

- **If both rear windows continue to function from the S79 Window Switch-Rear**

Refer to Circuit/System Testing - Rear Window Lockout Malfunction

- **If both rear windows are inoperative from the S79 Window Switch-Rear**

7. All OK.

Circuit/System Testing

Driver Window Inoperative

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S79D Window Switch-Driver. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 13 and ground.

- **If 10 ohms or greater**

1. Ignition OFF.
2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.

- **If less than 10 ohms**

3. Ignition ON.
4. Verify a test lamp illuminates between the ignition circuit terminal 8 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Ignition OFF.
2. Test for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, refer to **Retained Accessory Power Malfunction** .

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Ignition OFF.
2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance
- 3. Test for infinite resistance between the control circuits listed below and ground:
 - Control circuit terminal 7
 - Control circuit terminal 9
 - Control circuit terminal 12
 - Control circuit terminal 14
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the S79D Window Switch-Driver.
 - **If the test lamp illuminates**
- 5. Ignition OFF and all vehicle systems OFF, connect the harness connector at the S79D Window Switch-Driver and disconnect the harness connector at the M74D Window Motor-Driver. It may take up to 2 minutes for all vehicle systems to power down
- 6. Test for less than 10 ohms between the control circuit terminal 1 and ground.
 - **If 10 ohms or greater**
 - 1. Ignition OFF, disconnect the harness connector at the S79D Window Switch-Driver.
 - 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the S79D Window Switch-Driver.
 - **If less than 10 ohms**
- 7. Test for less than 10 ohms between the control circuit terminal 2 and ground.
 - **If 10 ohms or greater**
 - 1. Ignition OFF, disconnect the harness connector at the S79D Window Switch-Driver.
 - 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the S79D Window Switch-Driver.
 - **If less than 10 ohms**
- 8. Connect a test lamp between control circuit terminal 1 and control circuit terminal 2, Ignition ON.
- 9. Verify the test lamp turns ON when commanding the UP and DOWN states with the S79D Window Switch-Driver.
 - **If the test lamp remains OFF during either of the commands**
 - 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S79D Window Switch-Driver.
 - 2. Test for infinite resistance between each control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the S79D Window Switch-Driver.
 - **If the test lamp is always ON**
 - 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S79D Window Switch-Driver, Ignition ON.
 - 2. Test for less than 1 V between the control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the S79D Window Switch-Driver.
 - **If the test lamp turns ON and OFF**
10. Test or replace the M74D Window Motor-Driver.

Passenger Window Inoperative From Both Switches

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S79P Window Switch-Passenger. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the control circuit terminal 4 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the S79D Window Switch-Driver.
 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the S79D Window Switch-Driver.
 - **If less than 10 ohms**
3. Test for less than 10 ohms between the control circuit terminal 8 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the S79D Window Switch-Driver.
 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the S79D Window Switch-Driver.
 - **If less than 10 ohms**
4. Connect a test lamp between the control circuit terminal 4 and control circuit terminal 8, Ignition ON.
5. Verify the test lamp turns ON when commanding the UP and DOWN functions with the S79D Window Switch-Driver.
 - **If the test lamp remains OFF during either of the commands**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S79D Window Switch-Driver.
 2. Test for infinite resistance between each control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the S79D Window Switch-Driver.
 - **If the test lamp is always ON**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S79D Window Switch-Driver, Ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the S79D Window Switch-Driver.
 - **If the test lamp turns ON and OFF**

6. Ignition OFF and all vehicle systems OFF, connect the harness connector at the S79P Window Switch-Passenger and disconnect the harness connector at the M74P Window Motor-Passenger. It may take up to 2 minutes for all vehicle systems to power down.
7. Test for less than 10 ohms between the control circuit terminal 1 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the S79P Window Switch-Passenger.
 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the S79P Window Switch-Passenger.
 - **If less than 10 ohms**
8. Test for less than 10 ohms between the control circuit terminal 2 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the S79P Window Switch-Passenger.
 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the S79P Window Switch-Passenger.
 - **If less than 10 ohms**
9. Connect a test lamp between control circuit terminal 1 and control circuit terminal 2, Ignition ON.
10. Verify the test lamp turns ON when commanding the UP and DOWN functions with the S79P Window Switch-Passenger.
 - **If the test lamp remains OFF during either of the commands**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S79P Window Switch-Passenger.
 2. Test for infinite resistance between each control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the S79P Window Switch-Passenger.
 - **If the test lamp is always ON**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S79P Window Switch-Passenger, Ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the S79P Window Switch-Passenger.
 - **If the test lamp turns ON and OFF**
11. Test or replace the M74P Window Motor-Passenger.

Passenger Window Switch Inoperative

1. Ignition OFF, disconnect the harness connector at the S79P Window Switch-Passenger, Ignition ON
2. Verify a test lamp illuminates between the ignition circuit terminal 6 and ground.

- **If the test lamp does not illuminate**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is OK and there is voltage at the fuse.
- **If the test lamp illuminates**
- 3. Test or replace the S79P Window Switch-Passenger.

Rear Window Inoperative From Both Switches

1. Ignition OFF, disconnect the harness connector at the S79D Window Switch-Driver. Ignition ON
2. Verify a test lamp illuminates between the ignition circuit terminal 2 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, refer to **Retained Accessory Power Malfunction** .
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for infinite resistance between the control circuit terminals listed below and ground:
 - Control circuit terminal 1
 - Control circuit terminal 3
 - Control circuit terminal 4
 - Control circuit terminal 6
 - Control circuit terminal 11
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the S79D Window Switch-Driver.
 - **If the test lamp illuminates**
3. Ignition OFF, connect the harness connector at the S79D Window Switch-Driver and disconnect the harness connector at the appropriate S79 Window Switch-Rear.
4. Ignition ON, verify that a test lamp illuminates between the control circuit terminal 6 and ground.
 - **If the test lamp does not illuminate**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the S79D Window Switch-Driver

- **If the test lamp illuminates**
- 5. Ignition OFF and all vehicle systems OFF, it may take up to 2 minutes for all vehicle systems to power down
- 6. Test for less than 10 ohms between the control circuit terminal 4 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the S79D Window Switch-Driver.
 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the S79D Window Switch-Driver.
 - **If less than 10 ohms**
- 7. Test for less than 10 ohms between the control circuit terminal 8 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the S79D Window Switch-Driver.
 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the S79D Window Switch-Driver.
 - **If less than 10 ohms**
- 8. Connect a test lamp between the control circuit terminal 4 and control circuit terminal 8, Ignition ON.
- 9. Verify the test lamp turns ON when commanding the UP and DOWN states with the S79D Window Switch-Driver.
 - **If the test lamp remains OFF during either of the commands**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S79D Window Switch-Driver.
 2. Test for infinite resistance between each control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the S79D Window Switch-Driver.
 - **If the test lamp is always ON**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S79D Window Switch-Driver, Ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the S79D Window Switch-Driver.
 - **If the test lamp turns ON and OFF**
- 10. Ignition OFF and all vehicle systems OFF, connect the harness connector at the S79 Window Switch-Rear and disconnect the harness connector at the rear M74 Window Motor-Rear. It may take up to 2 minutes for all vehicle systems to power down.
- 11. Test for less than 10 ohms between the control circuit terminal listed below and ground:
 - Control terminal 1
 - Control terminal 2

- **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the S79 Window Switch-Rear.
 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the S79 Window Switch-Rear.
- **If less than 10 ohms**
- 12. Connect a test lamp between the control circuit terminal 1 and the control circuit terminal 2, Ignition ON.
- 13. Verify the test lamp turns ON when commanding the UP and DOWN states with the S79 Window Switch-Rear.
 - **If the test lamp remains OFF during either of the commands**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S79 Window Switch-Rear.
 2. Test for infinite resistance between each control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the S79 Window Switch-Rear.
 - **If the test lamp is always ON**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S79 Window Switch-Rear, Ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the S79 Window Switch-Rear.
 - **If the test lamp turns ON and OFF**
- 14. Test or replace the M74 Window Motor-Rear.

Rear Window Lockout Malfunction

1. Ignition OFF, disconnect the harness connector at the appropriate S79 Window Switch-Rear.
2. Ignition ON, connect a test lamp between the control circuit terminal 6 and ground.
3. Verify the test lamp turns ON and OFF when pressing the rear window lockout switch ON and OFF on the S79D Window Switch-Driver.
 - **If the test lamp is always OFF**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S79D Window Switch-Driver.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the S79D Window Switch-Driver.

- **If the test lamp is always ON**

1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S79D Window Switch-Driver, Ignition ON.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the S79D Window Switch-Driver.

- **If the test lamp turns ON and OFF**

4. Test or replace the S79 Window Switch-Rear.

Component Testing

Window Motor

1. Ignition OFF, disconnect the harness connector at the appropriate M74 Window Motor.
2. Install a 25 A fused jumper wire between one of the control terminals and 12 V. Momentarily install a jumper wire between the other control terminal and ground. Reverse the jumper wires at least two times, the M74 Window Motor should perform the UP and DOWN functions.
 - **If the M74 Window Motor does not perform the UP and DOWN functions**

Replace the M74 Window Motor.

- **If the M74 Window Motor performs the UP and DOWN functions**

3. All OK

Driver Window Switch

1. Ignition OFF, disconnect the harness connector at the S79D Window Switch-Driver.
2. Test for infinite resistance between the terminals listed below with the switch in the open position:
 - Ignition terminal 8 and control terminal 7
 - Ignition terminal 8 and control terminal 9
 - Ignition terminal 8 and control terminal 12
 - Ignition terminal 8 and control terminal 14
 - Ignition terminal 2 and control terminal 1
 - Ignition terminal 2 and control terminal 3
 - Ignition terminal 2 and control terminal 4
 - Ignition terminal 2 and control terminal 6
 - **If less than infinite resistance**

Replace the S79D Window Switch-Driver.

- **If infinite resistance**

3. Test for less than 3 ohms between the terminals listed below with the switch in the open position:

- Ground terminal 13 and control terminal 1
- Ground terminal 13 and control terminal 3
- Ground terminal 13 and control terminal 4
- Ground terminal 13 and control terminal 6
- Ground terminal 13 and control terminal 7
- Ground terminal 13 and control terminal 9
- Ground terminal 13 and control terminal 12
- Ground terminal 13 and control terminal 14
- **If 3 ohms or greater**

Replace the S79D Window Switch-Driver.

- **If less than 3 ohms**

4. Test for less than 3 ohms between the terminals listed below with the switch in the Up position.

- Driver window left hand drive - Ignition terminal 8 and control terminal 9
- Driver window right hand drive - Ignition terminal 8 and control terminal 14
- Passenger window left hand drive - Ignition terminal 8 and control terminal 14
- Passenger window right hand drive - Ignition terminal 8 and control terminal 9
- Left rear - Ignition terminal 2 and control terminal 3
- Right rear - Ignition terminal 2 and control terminal 6
- **If 3 ohms or greater**

Replace the S79D Window Switch-Driver.

- **If less than 3 ohms**

5. Test for less than 3 ohms between the terminals listed below with the switch in the Down position:

- Driver window left hand drive - Ignition terminal 8 and control terminal 7
- Driver window right hand drive - Ignition terminal 8 and control terminal 12
- Passenger window left hand drive - Ignition terminal 8 and control terminal 12
- Passenger window right hand drive - Ignition terminal 8 and control terminal 7
- Left rear - Ignition terminal 2 and control terminal 1
- Right rear - Ignition terminal 2 and control terminal 4
- **If 3 ohms or greater**

Replace the S79D Window Switch-Driver.

- **If less than 3 ohms**

6. All OK

Passenger Window Switch

1. Ignition OFF, disconnect the harness connector at the S79P Window Switch-Passenger.
2. Test for infinite resistance between the terminals listed below with the switch in the open position:
 - Ignition terminal 6 and control terminal 1
 - Ignition terminal 6 and control terminal 3
 - **If less than infinite resistance**

Replace the S79P Window Switch-Passenger.

- **If infinite resistance**
3. Test for less than 3 ohms between the control terminals listed below with the switch in the open position:
 - Control terminal 4 and control terminal 1
 - Control terminal 8 and control terminal 3
 - **If 3 ohms or greater**

Replace the S79P Window Switch-Passenger.

- **If less than 3 ohms**
4. Test for less than 3 ohms between the Ignition terminal 6 and the control terminal 1 with the switch in the Up position.
 - **If 3 ohms or greater**

Replace the S79P Window Switch-Passenger.

- **If less than 3 ohms**
5. Test for less than 3 ohms between the Ignition terminal 6 and the control terminal 3 with the switch in the Down position.
 - **If 3 ohms or greater**

Replace the S79P Window Switch-Passenger.

- **If less than 3 ohms**
6. All OK

Rear Window Switch

1. Ignition OFF, disconnect the harness connector at the appropriate S79 Window Switch-Rear.
2. Test for infinite resistance between the terminals listed below with the switch in the open position:
 - Control terminal 6 and control terminal 1
 - Control terminal 6 and control terminal 3
 - **If less than infinite resistance**

Replace the S79 Window Switch-Rear.

- **If infinite resistance**

3. Test for less than 3 ohms between the control terminals listed below with the switch in the open position:

- Control terminal 4 and control terminal 1
- Control terminal 8 and control terminal 3
- **If 3 ohms or greater**

Replace the S79 Window Switch-Rear.

- **If less than 3 ohms**

4. Test for less than 3 ohms between the control terminal 6 and the control terminal 1 with the switch in the Up position.

- **If 3 ohms or greater**

Replace the S79 Window Switch-Rear.

- **If less than 3 ohms**

5. Test for less than 3 ohms between the control terminal 6 and the control terminal 3 with the switch in the Down position.

- **If 3 ohms or greater**

Replace the S79 Window Switch-Rear.

- **If less than 3 ohms**

6. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Front Side Door Window Switch Replacement - Right Side**
- **Front Side Door Window Switch Replacement - Left Side**
- **Front Side Door Window Regulator Replacement**
- **Rear Side Door Window Regulator Replacement**

REPAIR INSTRUCTIONS

WINDSHIELD REPLACEMENT

Special Tools

J-24402 Glass Sealant Remover

Removal Procedure

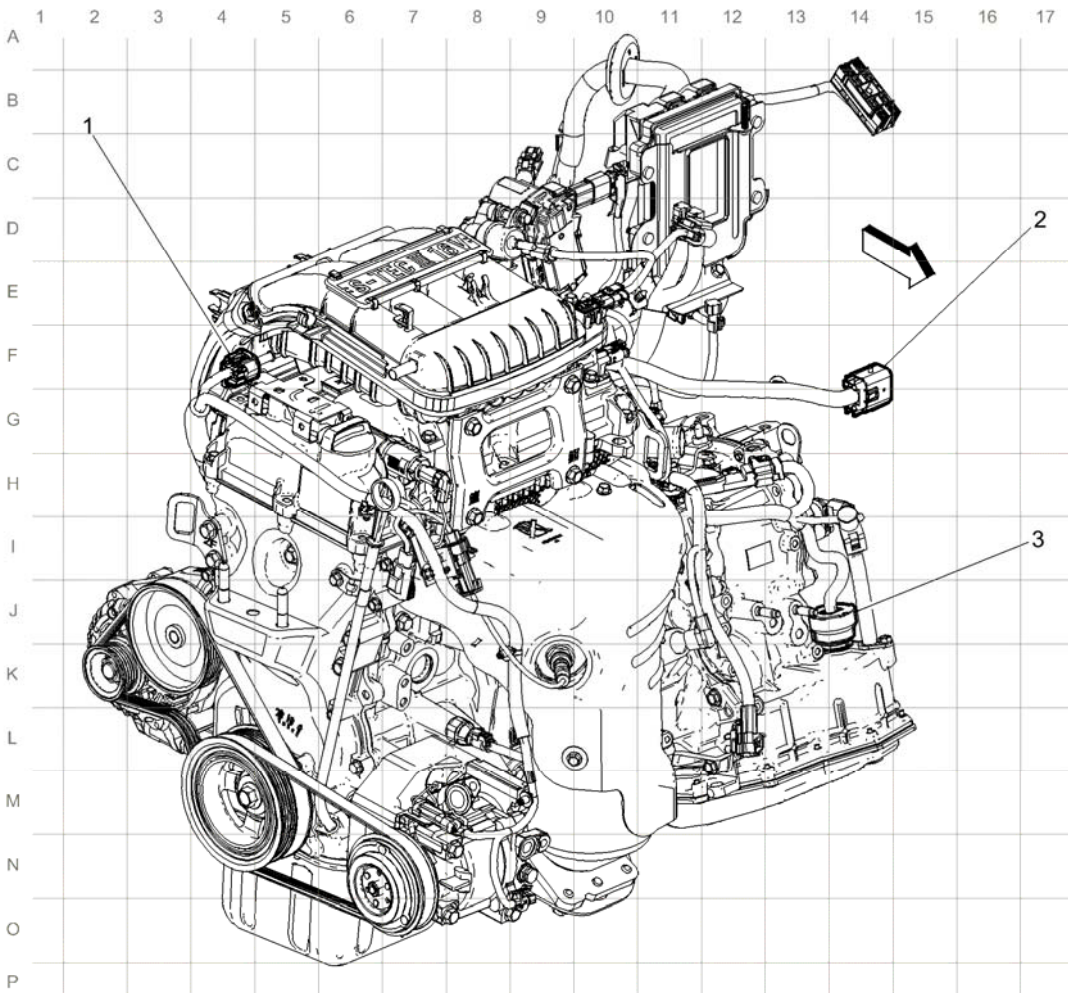


Fig. 4: Removing Air Inlet Grille

Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to Defroster Outlet Warning .

1. Remove the air inlet grille. Refer to Air Inlet Grille Panel Replacement .
2. Remove the inside rearview mirror. Refer to Inside Rearview Mirror Replacement .
3. Remove the weatherstrip around the windshield.

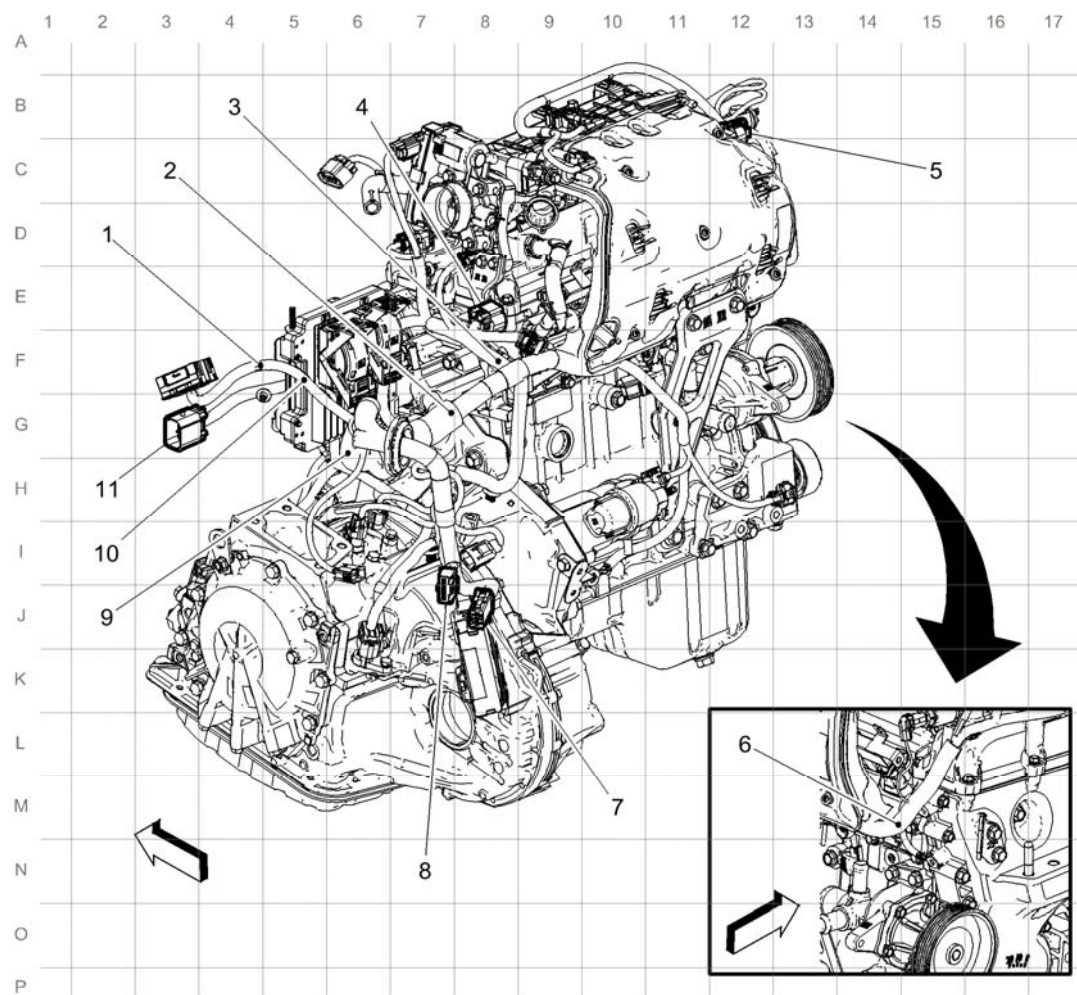


Fig. 5: Cutting Adhesive Around Windshield Using J-24402
Courtesy of GENERAL MOTORS COMPANY

4. Using the J-24402 glass sealant remover (1), cut the adhesive around the windshield.

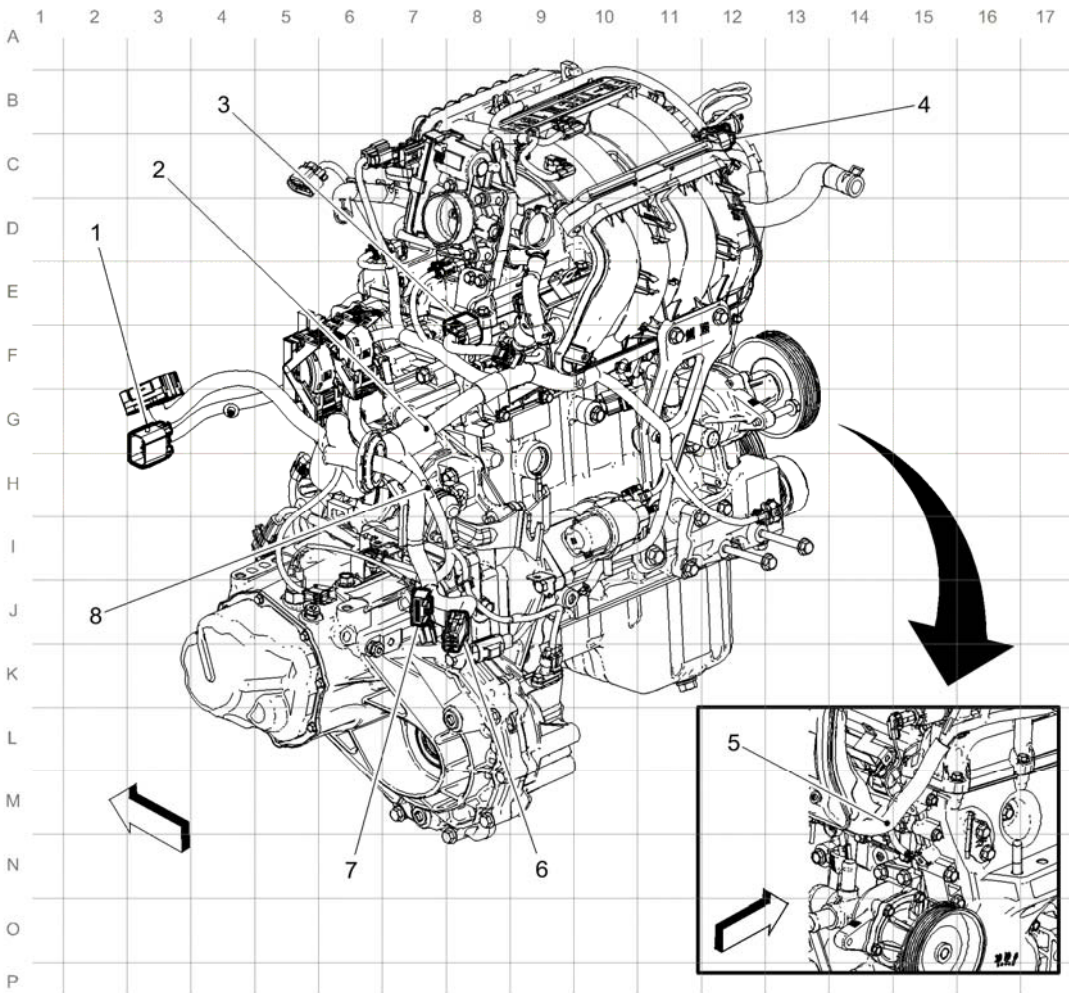


Fig. 6: Removing Windshield From Vehicle
Courtesy of GENERAL MOTORS COMPANY

5. Remove the windshield from the vehicle.
6. Using a knife, remove the adhesive from the windshield.

Installation Procedure

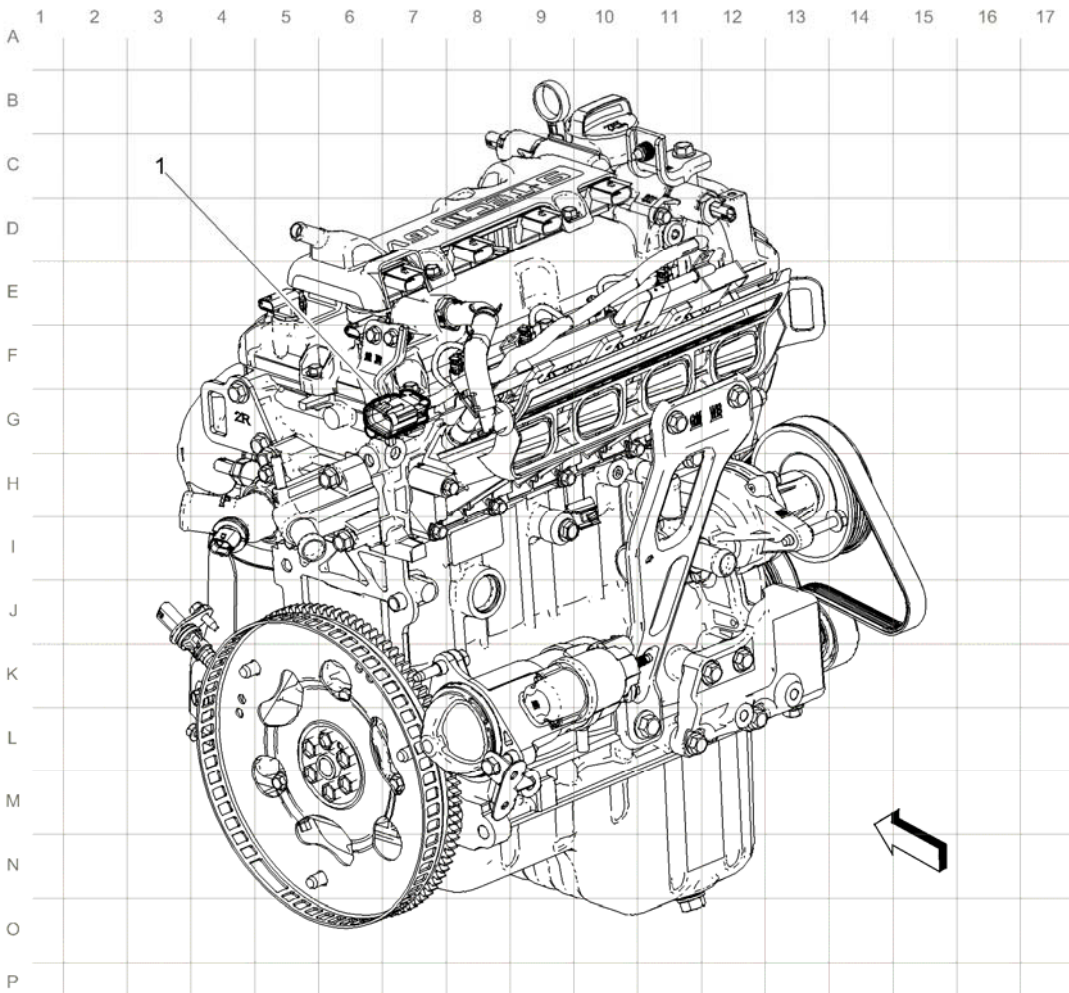


Fig. 7: Installing New Weatherstrip To Windshield
Courtesy of GENERAL MOTORS COMPANY

1. Install the new weatherstrip to the windshield.

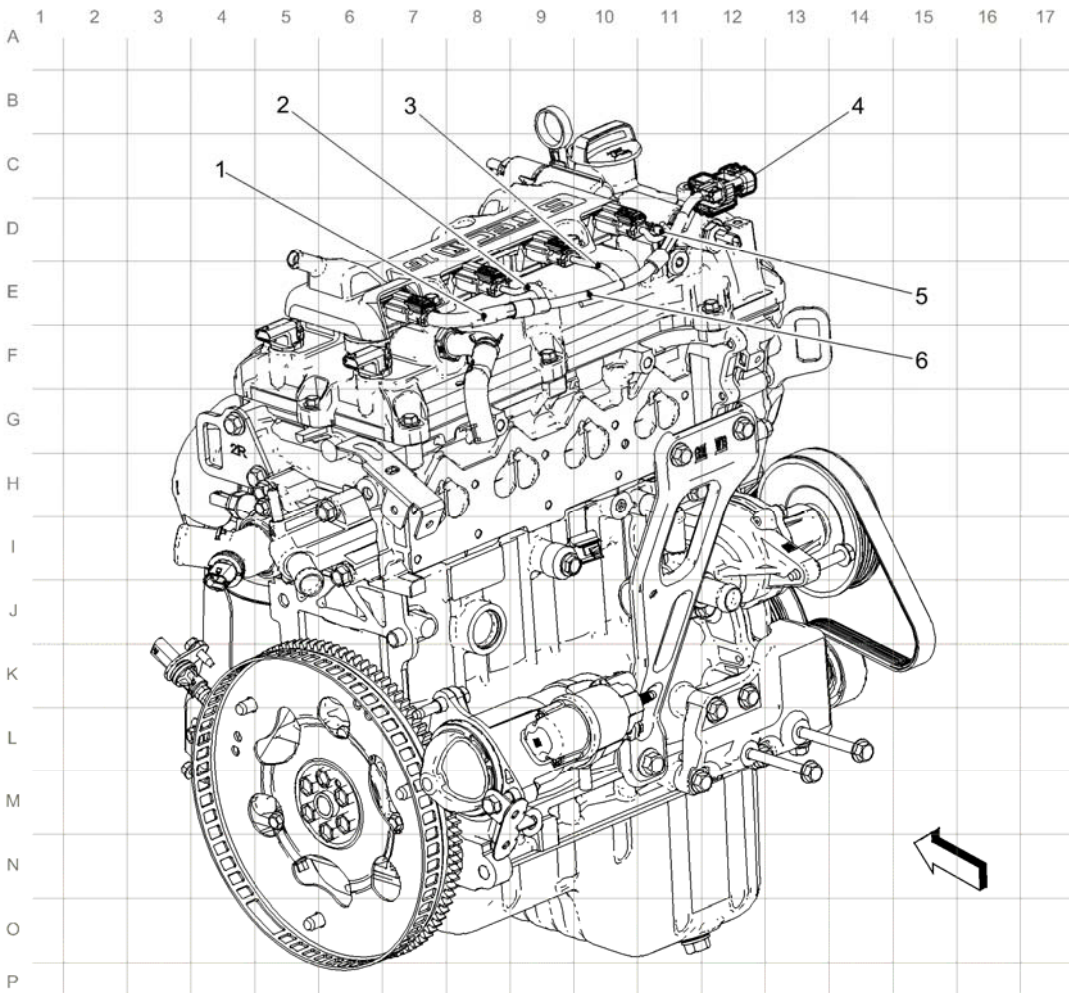


Fig. 8: Applying Tape To New Weatherstrip And Windshield
Courtesy of GENERAL MOTORS COMPANY

2. Apply tape to the new weatherstrip and the windshield to hold the weatherstrip in place.
3. Apply adhesive primer to the windshield frame and the perimeter of the windshield.

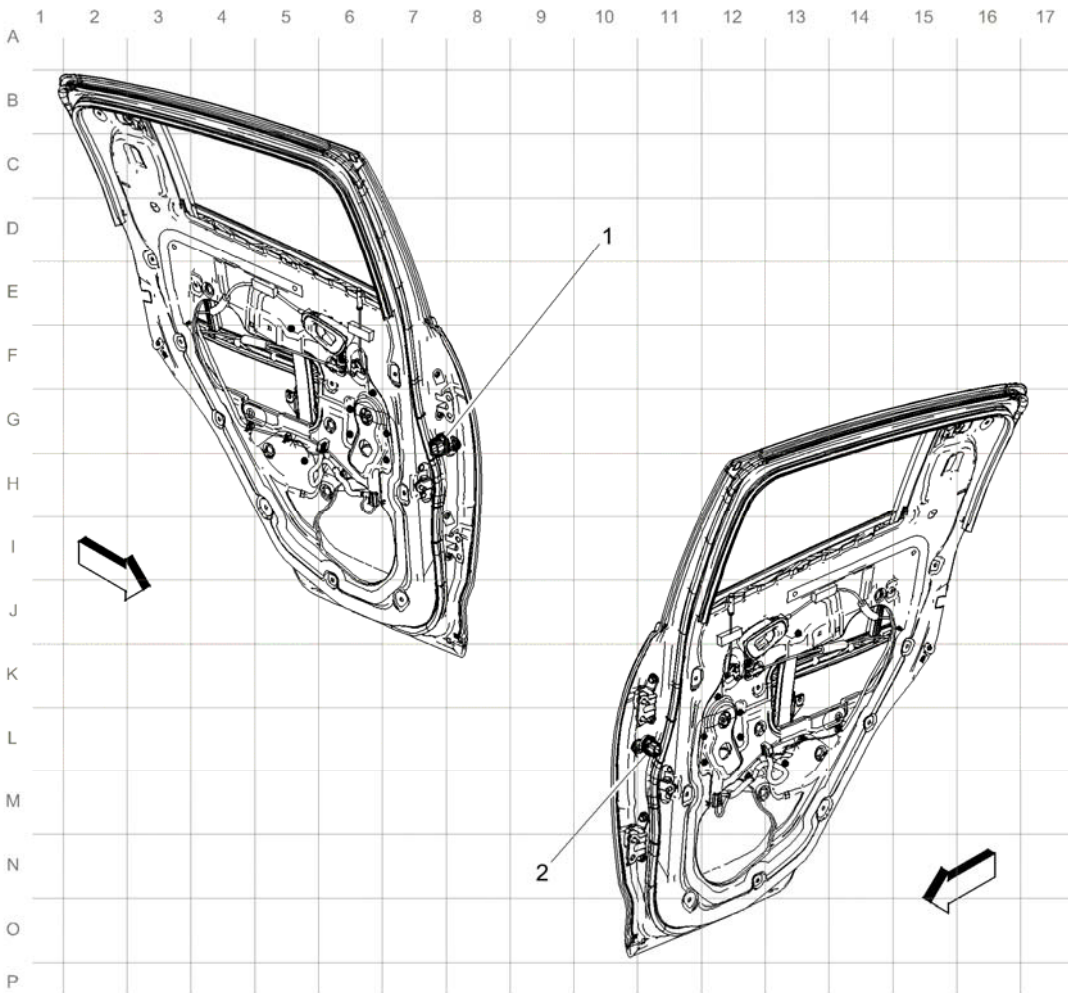


Fig. 9: Applying Adhesive Primer To Windshield Frame
 Courtesy of GENERAL MOTORS COMPANY

WARNING: Insufficient curing of urethane adhesive may allow unrestrained occupants to be ejected from the vehicle resulting in personal injury.

- For the moisture-curing type of urethane adhesive, allow a minimum of 6 hours at 21°C (70°F) or greater and with at least 30 percent relative humidity. Allow at least 24 hours for the complete curing of the urethane adhesive.
- For the chemical-curing type of urethane adhesive, allow a minimum of 1 hour.

Do NOT physically disturb the repair area until after these minimum times have elapsed.

4. Apply glass adhesive to the windshield frame.

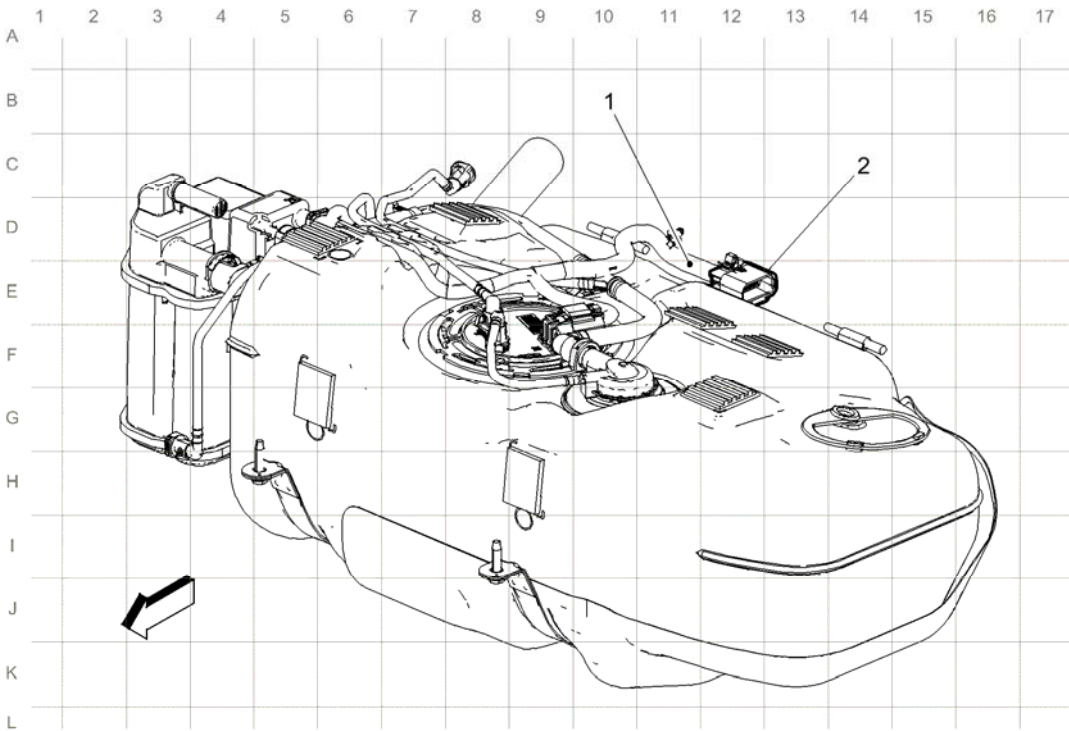


Fig. 10: Windshield And Windshield Frame
Courtesy of GENERAL MOTORS COMPANY

5. Install the windshield into the windshield frame.
6. Reposition the tape over the weatherstrip, the windshield and the windshield frame to hold the windshield in place.
7. Let the adhesive dry for 24 hours.
8. Remove the tape.

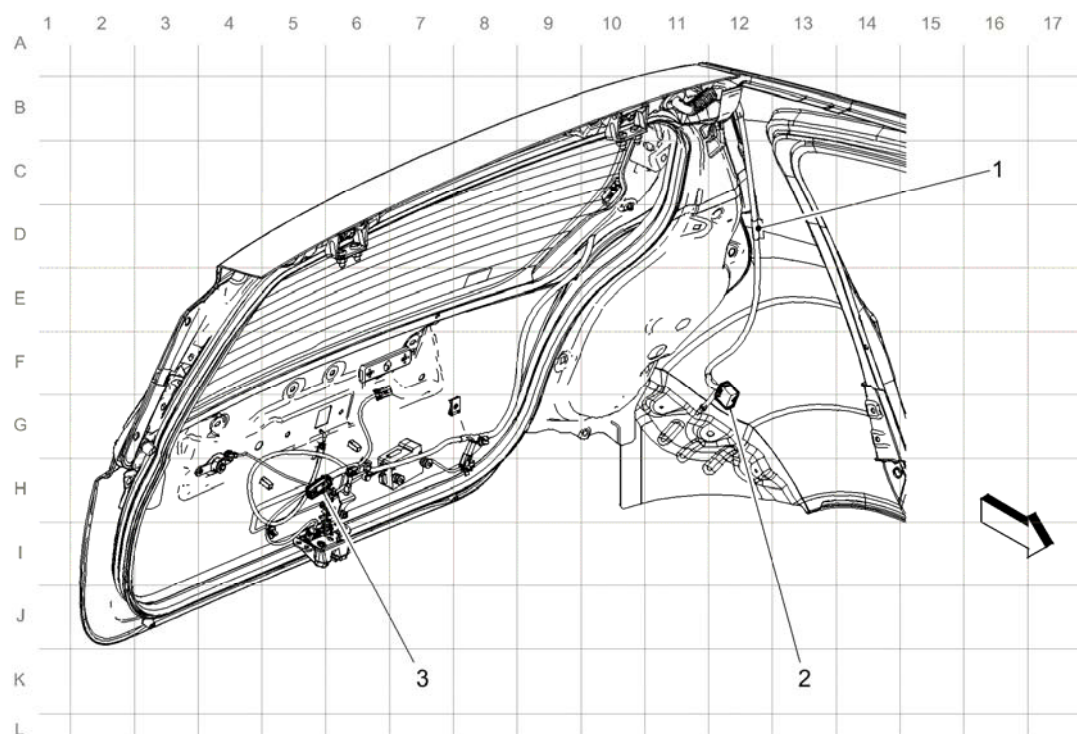


Fig. 11: Inspecting For Water Leaks

Courtesy of GENERAL MOTORS COMPANY

9. Inspect for water leaks by pouring water on the windshield. If a leak is found, dry the windshield and fill the area that leaks with adhesive. If the leak persists, remove the windshield and repeat the entire procedure.
10. Install the inside rearview mirror. Refer to **Inside Rearview Mirror Replacement** .
11. Install the air inlet grille. Refer to **Air Inlet Grille Panel Replacement** .

FRONT SIDE DOOR WINDOW REPLACEMENT

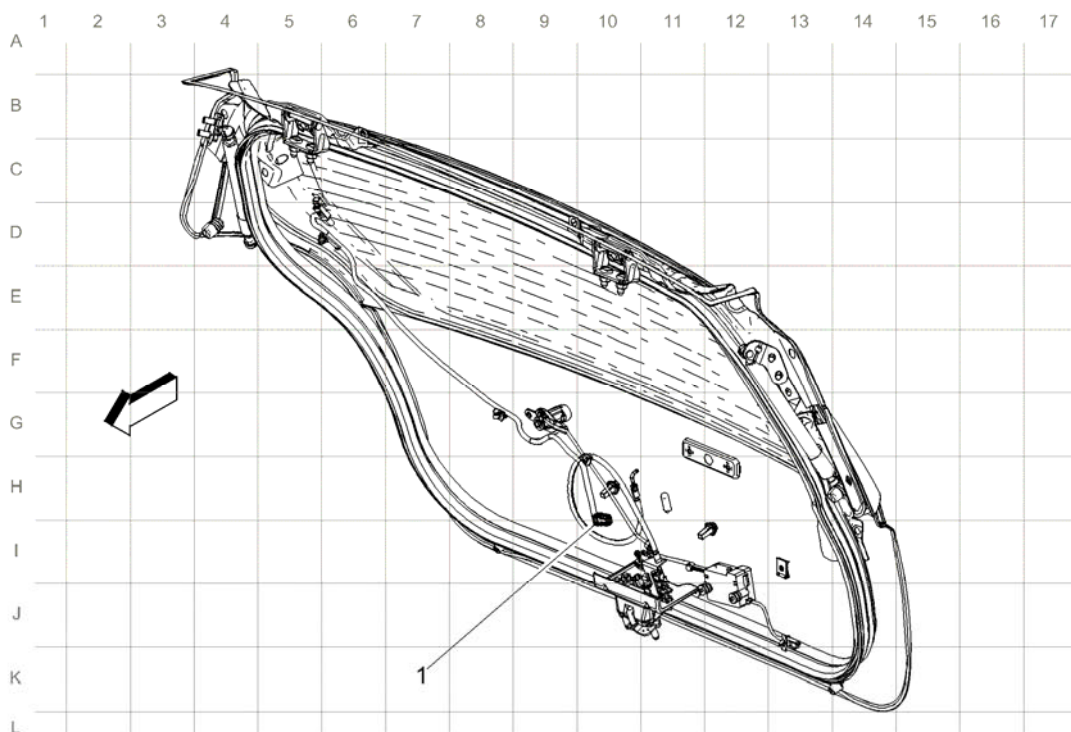


Fig. 12: Front Side Door Window
 Courtesy of GENERAL MOTORS COMPANY

Front Side Door Window Replacement

Callout	Component Name
Preliminary Procedure 1. Position the window approximately half way down in the door. 2. Remove the front side door trim panel. Refer to . 3. Remove the water deflector.	
1	Front Side Door Window Regulator Sash Screw (Qty 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2 (18 lb in)
2	Front Side Door Window Procedure 1. Remove the window regulator sash screws and then move the window to full down position using the window switch and regulator.

2. Rotate the front door window as necessary to remove it from the door.

REAR SIDE DOOR WINDOW REPLACEMENT

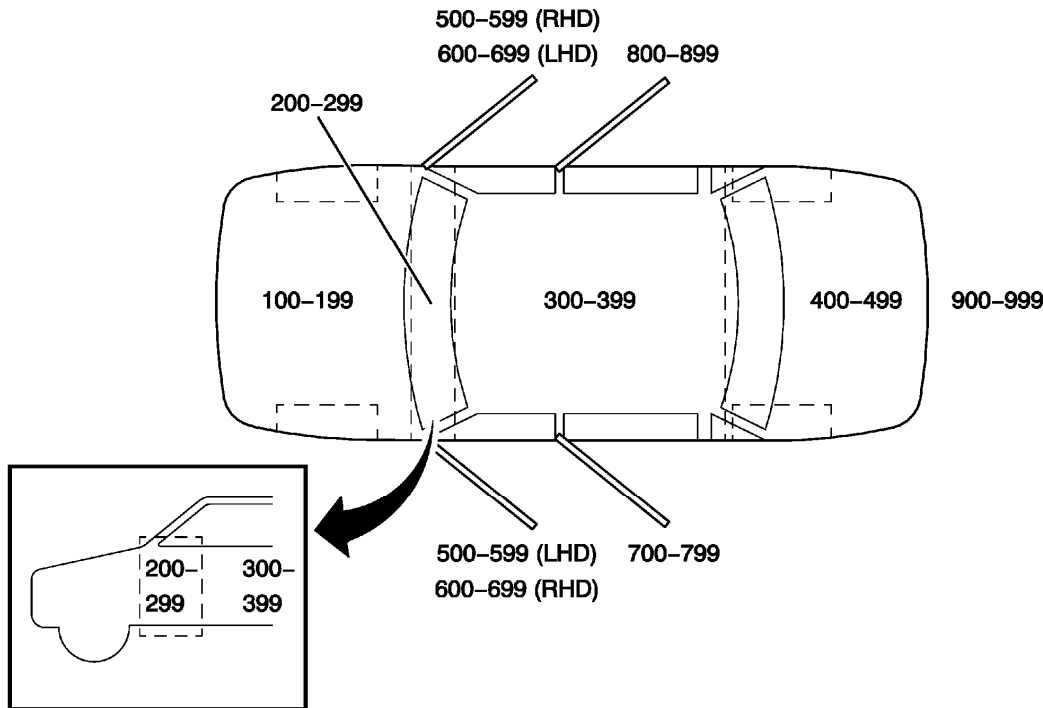


Fig. 13: Rear Side Door Window
Courtesy of GENERAL MOTORS COMPANY

Rear Side Door Window Replacement

Callout	Component Name
Preliminary Procedure	
1. Position the window approximately half way down in the door. 2. Remove the rear side door trim panel. Refer to <u>Rear Side Door Trim Panel Replacement</u> . 3. Remove the rear side door window regulator. Refer to <u>Rear Side Door Window Regulator Replacement</u>. 4. Remove the outer sealing strip. Refer to <u>Front Side Door Window Outer Sealing Strip Replacement</u>.	
1	Rear Side Door Window Regulator Sash Screw (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten

	2 (18 lb in)
	Rear Side Door Window
2	Procedure 1. After removing the window regulator detach the window from the window frame and lower the window into the door panel. 2. Remove the rear side door window channel. Refer to <u>Rear Side Door Window Channel Replacement</u>. 3. Rotate the rear door window as necessary to remove it from the door.

REAR WINDOW REPLACEMENT

Special Tools

J-24402 Glass Sealant Remover

Removal Procedure

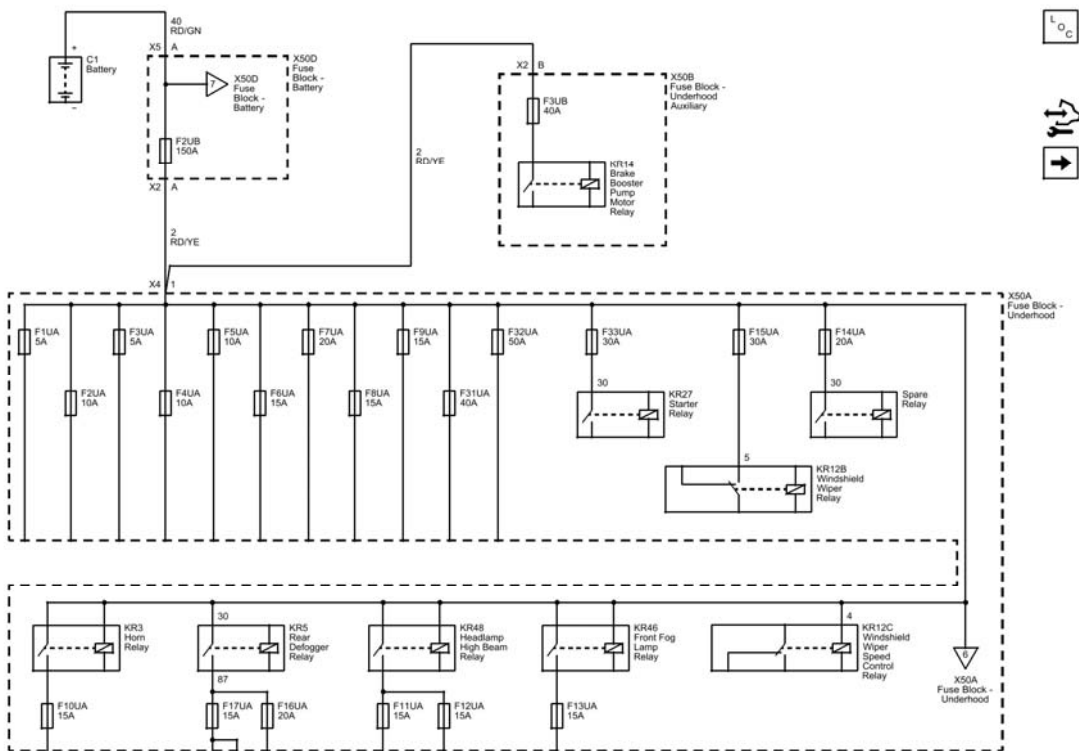


Fig. 14: Negative Battery Cable
Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to Defroster Outlet Warning .

1. Disconnect the negative battery cable.
2. Disconnect the rear window defogger electrical connectors.

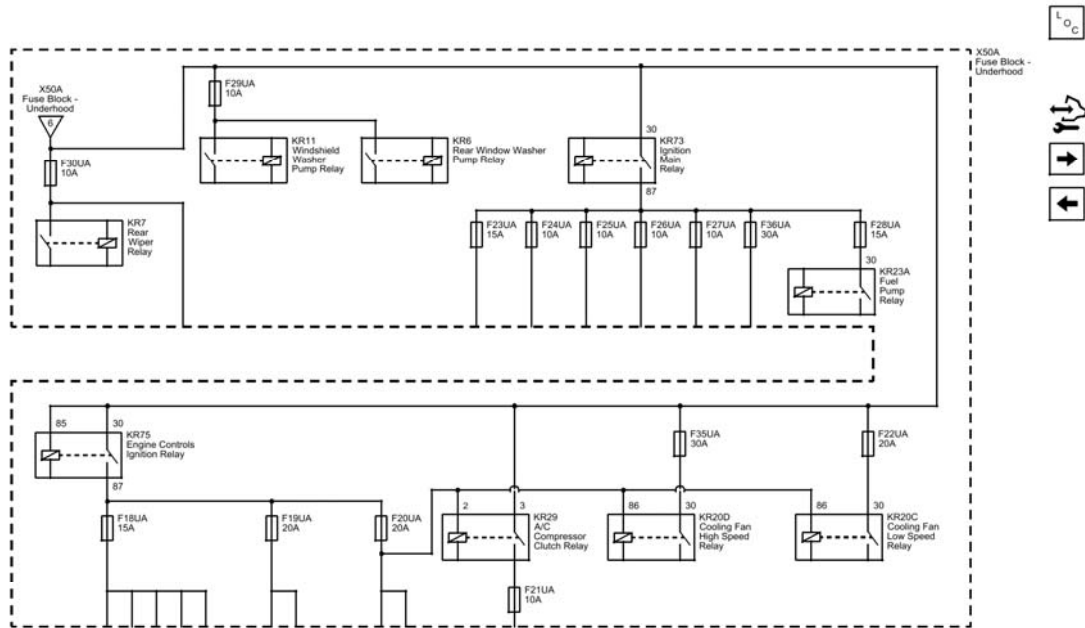


Fig. 15: Cutting Adhesive Around Rear Window Glass
Courtesy of GENERAL MOTORS COMPANY

3. Using the J-24402 glass sealant remover (1), cut the adhesive around the rear window glass.

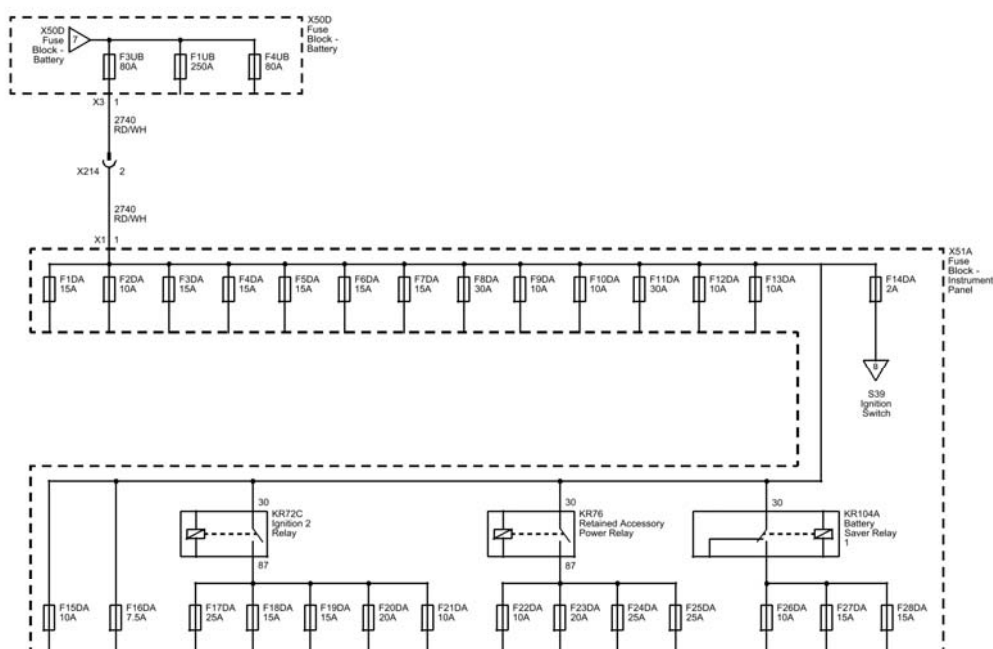


Fig. 16: Removing Windshield From Vehicle
Courtesy of GENERAL MOTORS COMPANY

4. Remove the rear window glass from the vehicle.
5. Using a knife, remove the adhesive from the rear window glass.

Installation Procedure

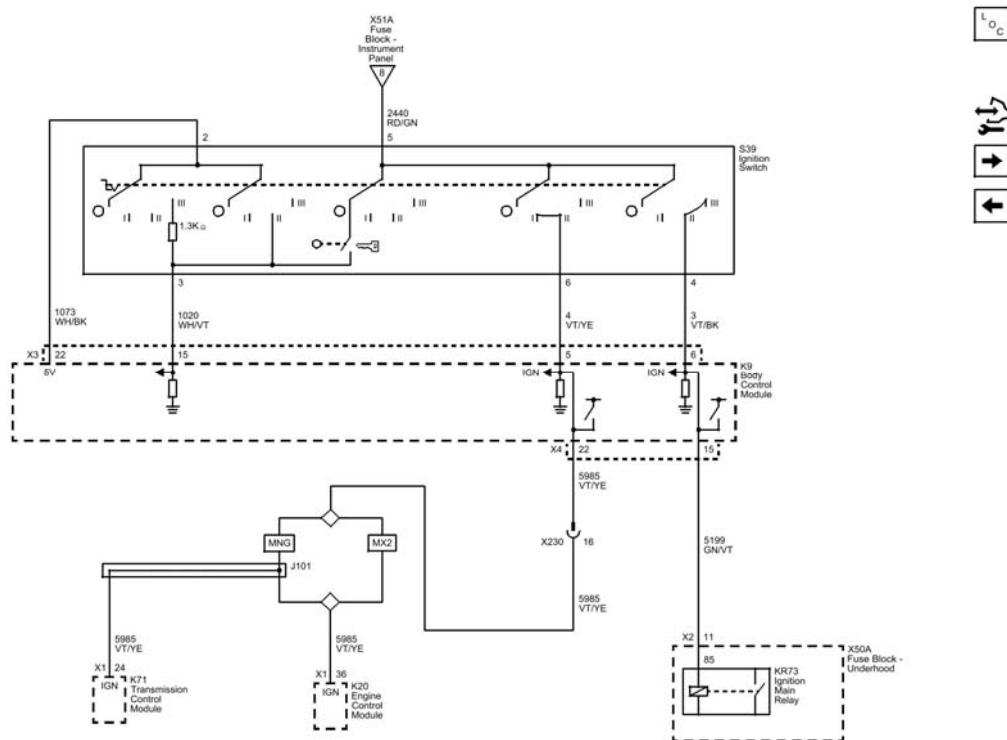


Fig. 17: Applying Tape To New Weatherstrip
Courtesy of GENERAL MOTORS COMPANY

1. Apply tape to the new weatherstrip and the rear window to hold the weatherstrip in place.
2. Apply adhesive primer to the rear window frame and the perimeter of the rear window.

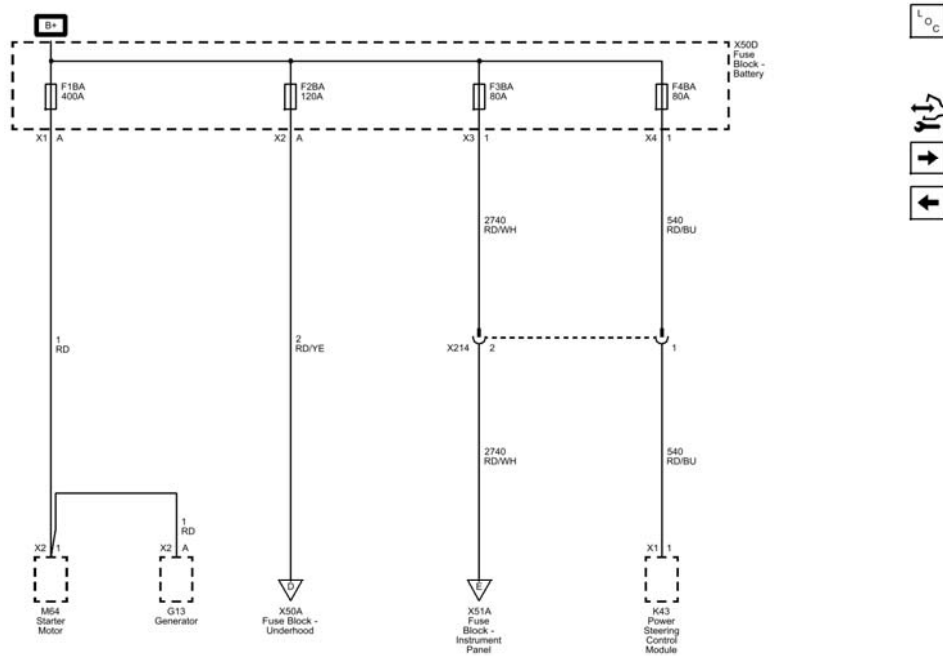


Fig. 18: Applying Adhesive Primer To Rear Window Frame
 Courtesy of GENERAL MOTORS COMPANY

WARNING: Insufficient curing of urethane adhesive may allow unrestrained occupants to be ejected from the vehicle resulting in personal injury.

- For the moisture-curing type of urethane adhesive, allow a minimum of 6 hours at 21°C (70°F) or greater and with at least 30 percent relative humidity. Allow at least 24 hours for the complete curing of the urethane adhesive.
- For the chemical-curing type of urethane adhesive, allow a minimum of 1 hour.

Do NOT physically disturb the repair area until after these minimum times have elapsed.

3. Apply glass adhesive to the rear window frame.

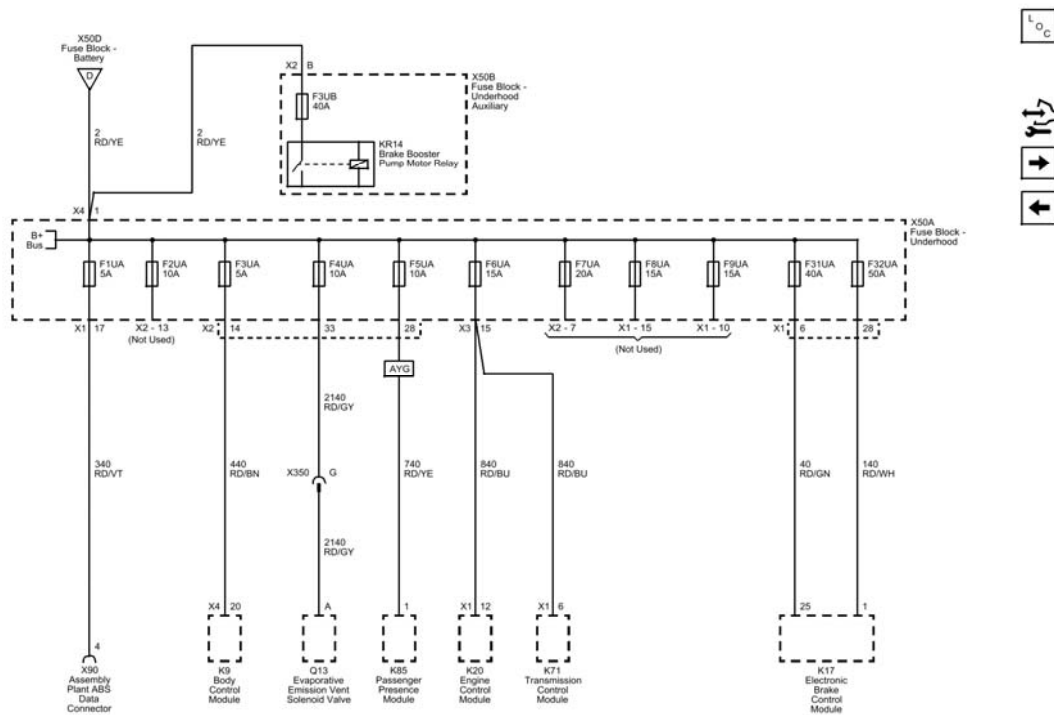


Fig. 19: Rear Window Frame
Courtesy of GENERAL MOTORS COMPANY

4. Install the rear window into the rear window frame.
5. Reposition the tape over the weatherstrip, the rear window and the rear window frame to hold the rear window in place.
6. Let the adhesive dry for 24 hours.
7. Remove the tape.

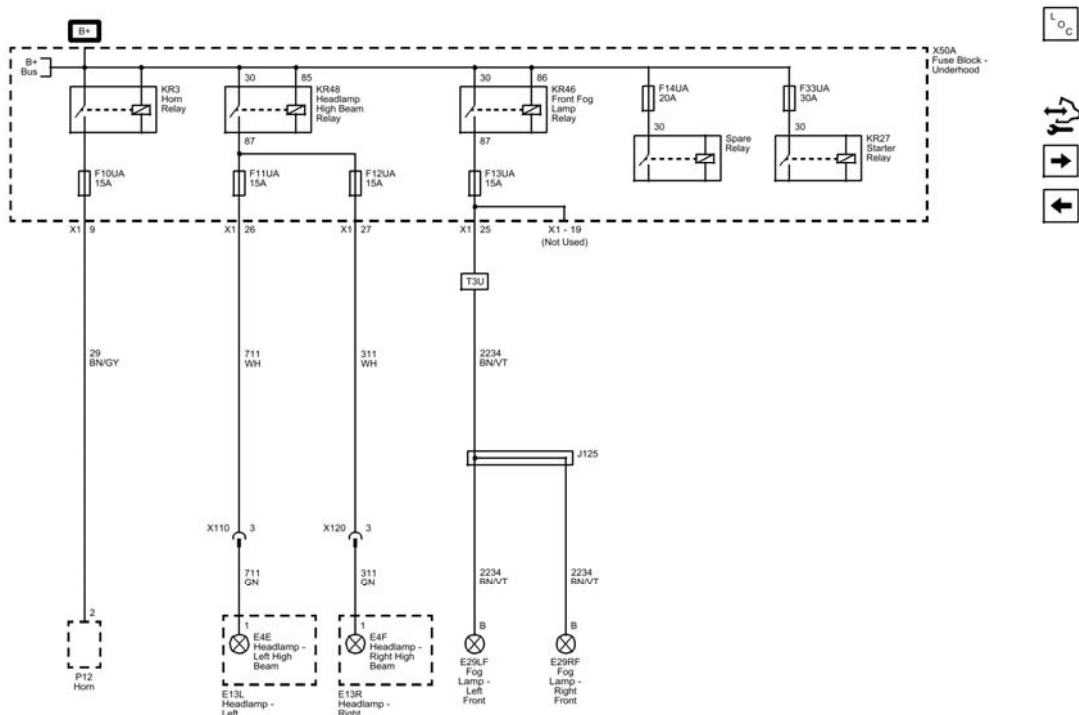


Fig. 20: Inspecting water leaks

Courtesy of GENERAL MOTORS COMPANY

8. Inspect for water leaks by pouring water on the rear window. If a leak is found, dry the window and fill the area that leaks with adhesive. If the leak persists, remove the rear window and repeat the entire procedure.
9. Connect the rear window defogger electrical connector.
10. Connect the negative battery cable.

LIFTGATE WINDOW STRUT REPLACEMENT

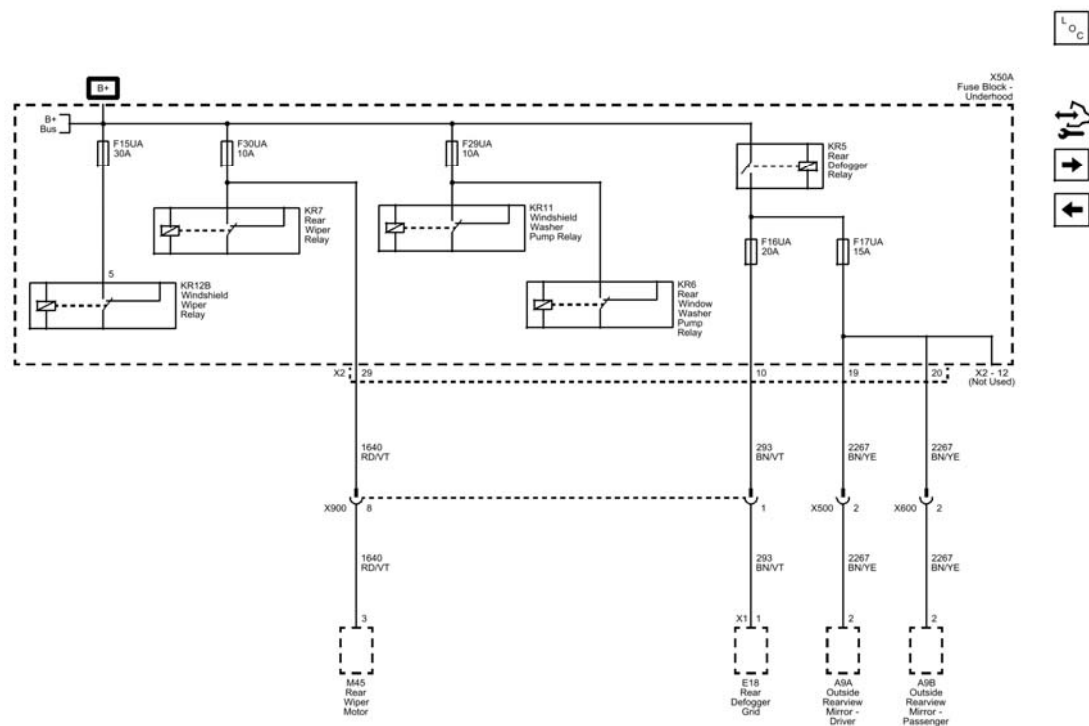


Fig. 21: Liftgate Window Strut
 Courtesy of GENERAL MOTORS COMPANY

Liftgate Window Strut Replacement

Callout	Component Name
WARNING: When a lift gate hold open device is being removed or installed, provide alternate support to avoid the possibility of damage to the vehicle or personal injury.	
1	Liftgate Window Strut Bolt (Body) (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 25 N.m (18 lb ft)
2	Liftgate Window Strut
3	Liftgate Window Strut Securing Bolt (Door) (Qty: 1) Tighten 22 N.m (16 lb ft)

FRONT SIDE DOOR WINDOW CHANNEL REPLACEMENT

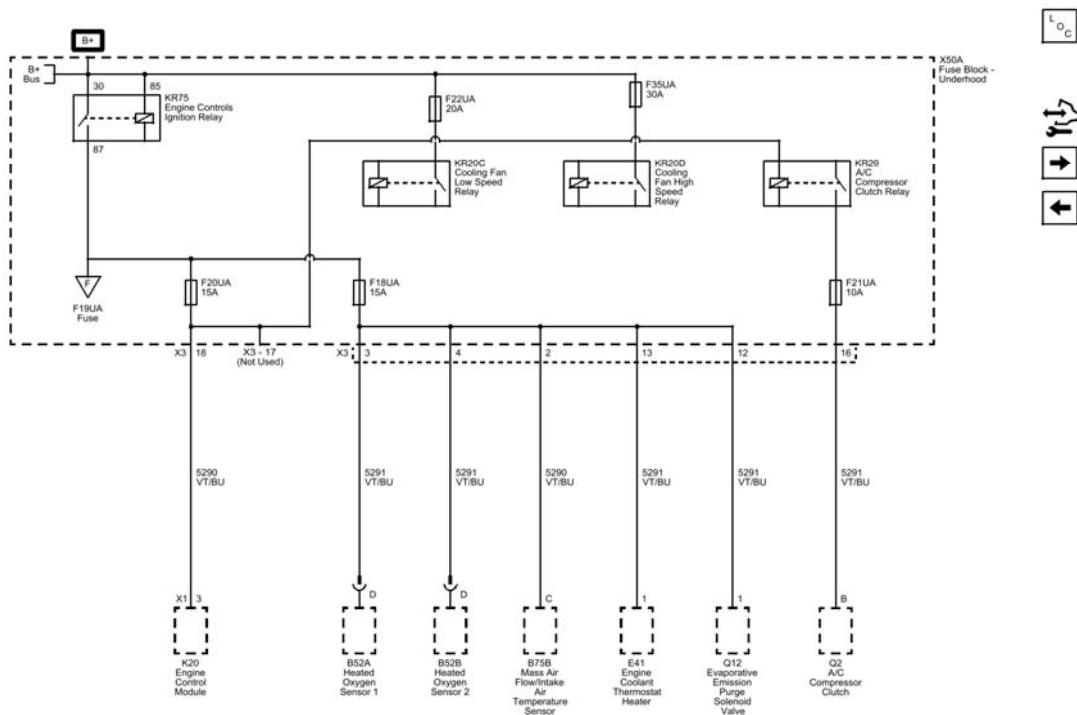


Fig. 22: Front Side Door Window Channel
 Courtesy of GENERAL MOTORS COMPANY

Front Side Door Window Channel Replacement

Callout	Component Name
Preliminary Procedure	
Remove the front side door window. Refer to Front Side Door Window Replacement .	
1	Front Side Door Window Channel Screw (Qty: 1) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 1.3 N.m (12 lb in)
2	Front Side Door Window Channel Bolt (Qty: 2) Tighten 8 N.m (71 lb in)
3	Front Side Door Window Channel Assembly

REAR SIDE DOOR WINDOW CHANNEL REPLACEMENT

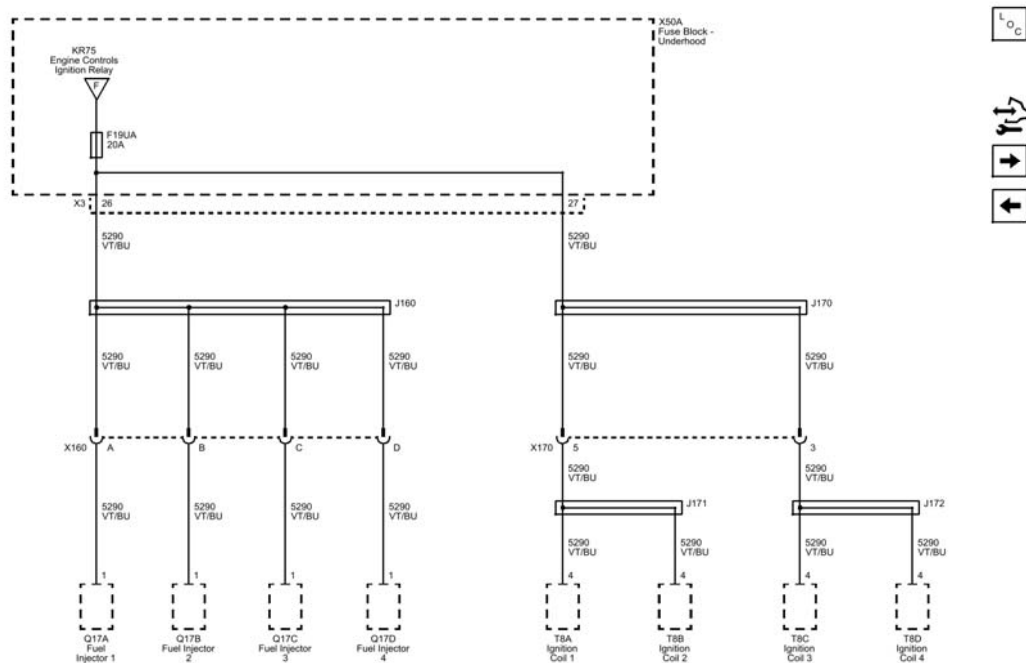


Fig. 23: Rear Side Door Window Channel
Courtesy of GENERAL MOTORS COMPANY

Rear Side Door Window Channel Replacement

Callout	Component Name
Preliminary Procedure 1. Detach the rear side door window from rear side door regulator and then put it down in side door panel. Refer to <u>Rear Side Door Window Replacement</u>. 2. Partially peel off the rear side door window weatherstrip from the door window opening. Refer to <u>Rear Side Door Window Weatherstrip Replacement</u>.	
1	Rear Side Door Window Channel Screw (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 8 (71 lb in)
2	Rear Side Door Window Channel Assembly

FRONT SIDE DOOR STATIONARY WINDOW REPLACEMENT

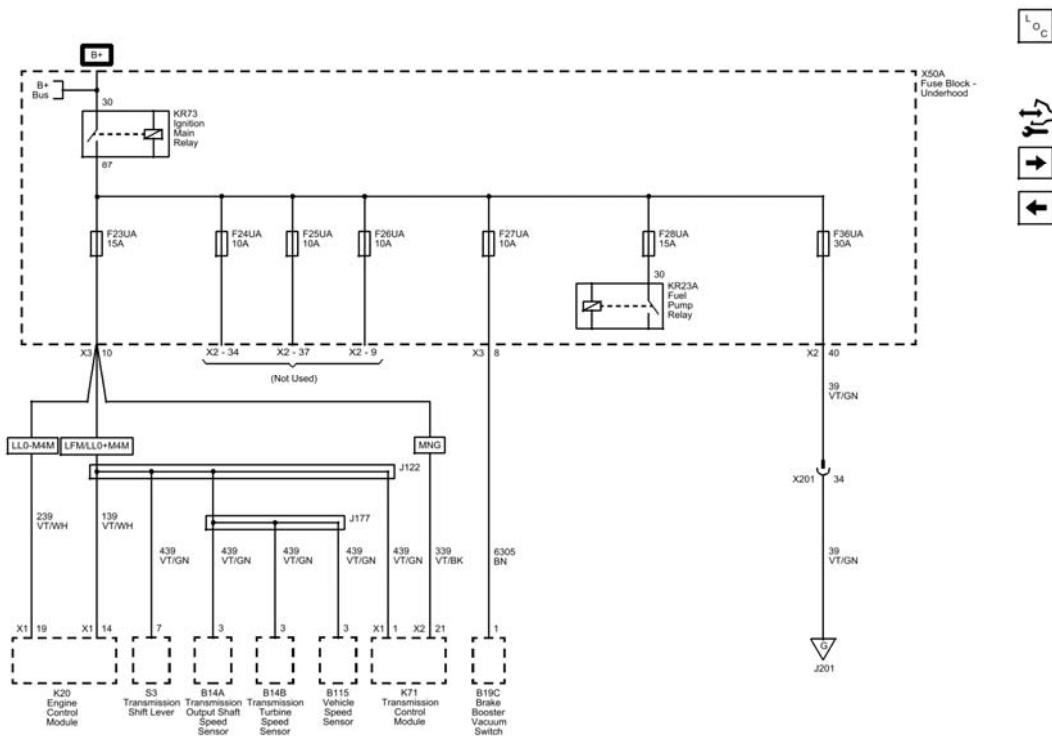


Fig. 24: Front Side Door Stationary Window
 Courtesy of GENERAL MOTORS COMPANY

Front Side Door Stationary Window Replacement

Callout	Component Name
Preliminary Procedure	
1. Remove the front side door window channel. Refer to Front Side Door Window Channel Replacement . 2. Remove the outside rearview mirror. Refer to Outside Rearview Mirror Replacement .	
1	Front Side Door Stationary Window Assembly

REAR SIDE DOOR WINDOW FRAME FRONT APPLIQUE REPLACEMENT

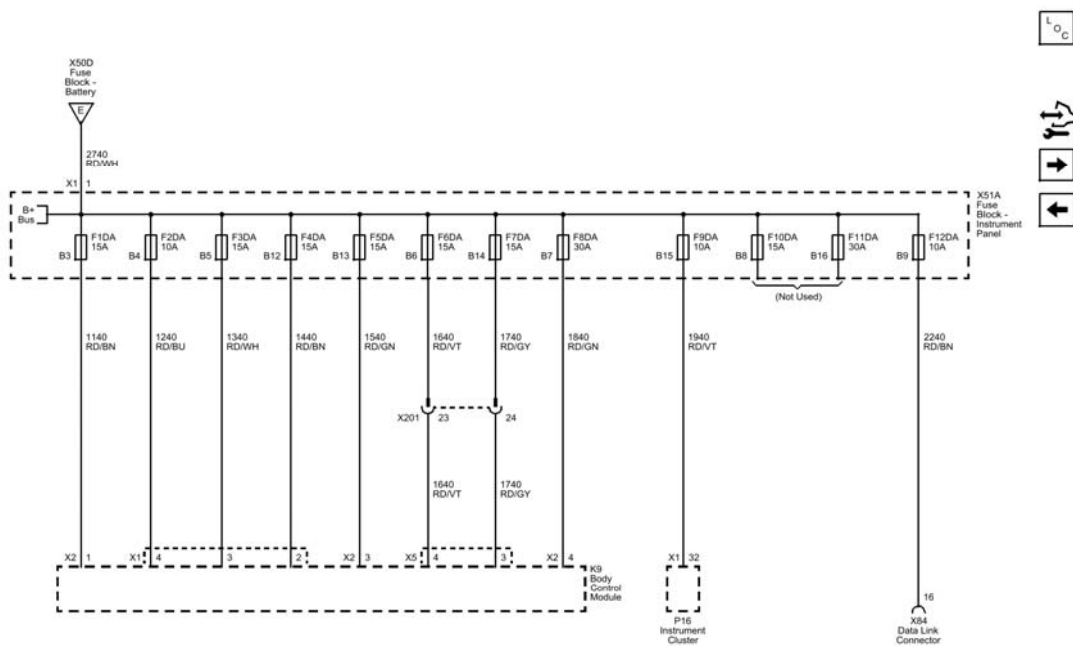


Fig. 25: Rear Side Door Window Frame Front Applique Tape
 Courtesy of GENERAL MOTORS COMPANY

Rear Side Door Window Frame Front Applique Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the rear side door window outer sealing strip. Refer to <u>Rear Side Door Window Outer Sealing Strip Replacement</u>. 2. Grasp upper corner of the window weatherstrip, pull downward releasing the assembly from the door frame. NOTE: Do not need to remove the weatherstrip assembly. Just partially peel off the weatherstrip to attach the tape.	
	Rear Side Door Window Frame Front Applique Procedure 1. Fit the tape pre-mask line to the panel character line. 2. Peel off the inside paper. 3. Attach the tape to the door panel.

1

4. Press the tape by using a squeegee or equivalent.
5. Peel off the outside paper.
6. Wrap the corner areas of the tape.
7. Inspect the tape is properly attached.

NOTE:

This applique is an adhesive tape.

FRONT SIDE DOOR WINDOW SWITCH REPLACEMENT - RIGHT SIDE

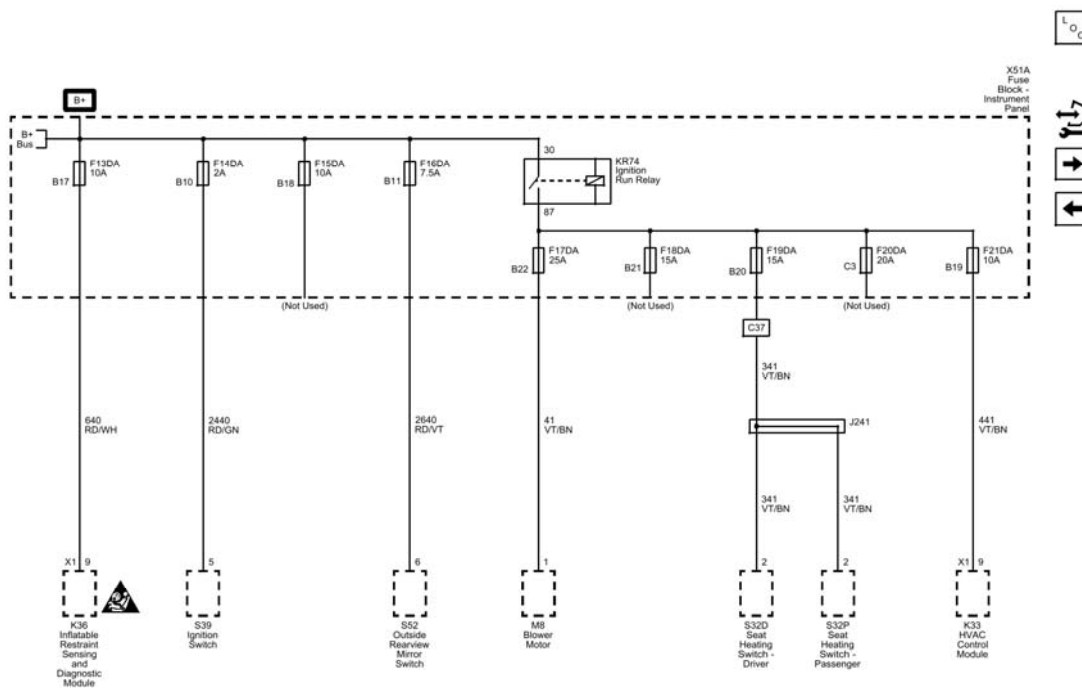


Fig. 26: Front Side Door Window Switch -- Right Side
 Courtesy of GENERAL MOTORS COMPANY

Front Side Door Window Switch Replacement - Right Side

Callout	Component Name
1	Front Side Door Window Switch Bezel Refer to Front Side Door Window Switch Bezel Replacement .
2	Front Side Door Window Switch Assembly Procedure Disconnect electrical connector.

FRONT SIDE DOOR WINDOW SWITCH REPLACEMENT - LEFT SIDE

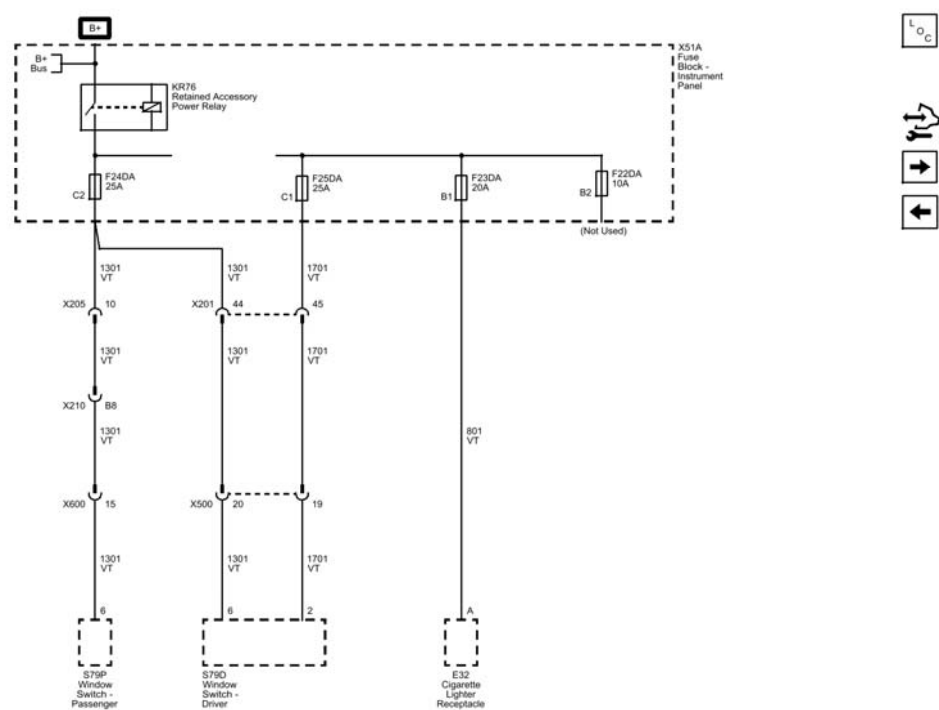


Fig. 27: Front Side Door Window Switch - Left Side
Courtesy of GENERAL MOTORS COMPANY

Front Side Door Window Switch Replacement - Left Side

Callout	Component Name
1	Front Side Door Window Switch Bezel Refer to Front Side Door Window Switch Bezel Replacement .
2	Front and Rear Side Door Window Switch Assembly Procedure Disconnect electrical connector.

REAR SIDE DOOR WINDOW SWITCH REPLACEMENT

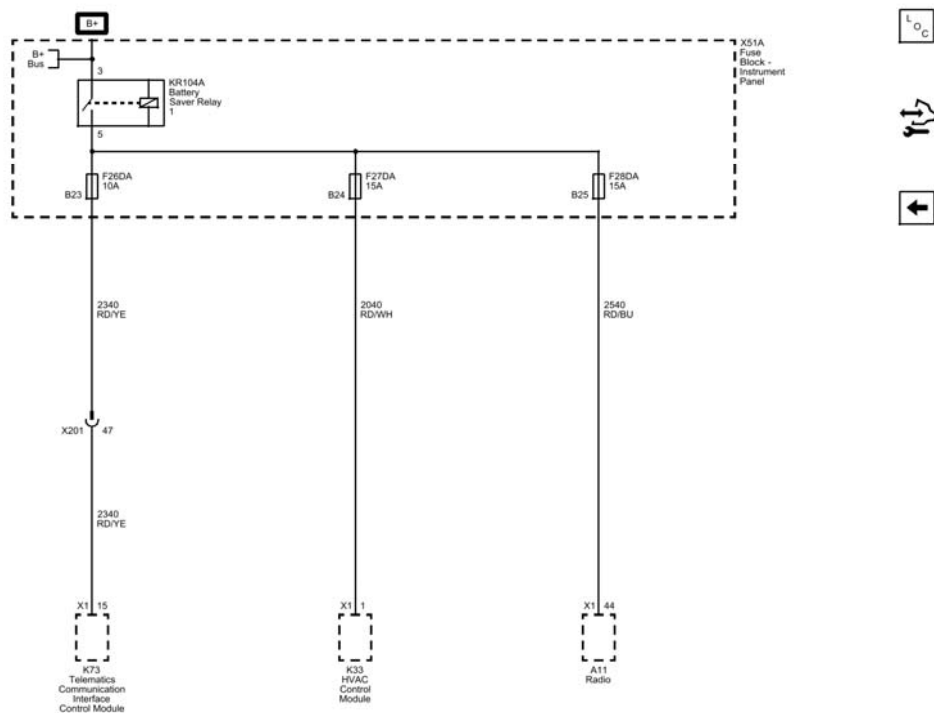


Fig. 28: Rear Side Door Window Switch
 Courtesy of GENERAL MOTORS COMPANY

Rear Side Door Window Switch Replacement

Callout	Component Name
1	Rear Side Door Window Switch Bezel Refer to Front Side Door Trim Panel Replacement .
2	Rear Side Door Window Switch Assembly Procedure Disconnect electrical connector.

FRONT SIDE DOOR WINDOW REGULATOR REPLACEMENT

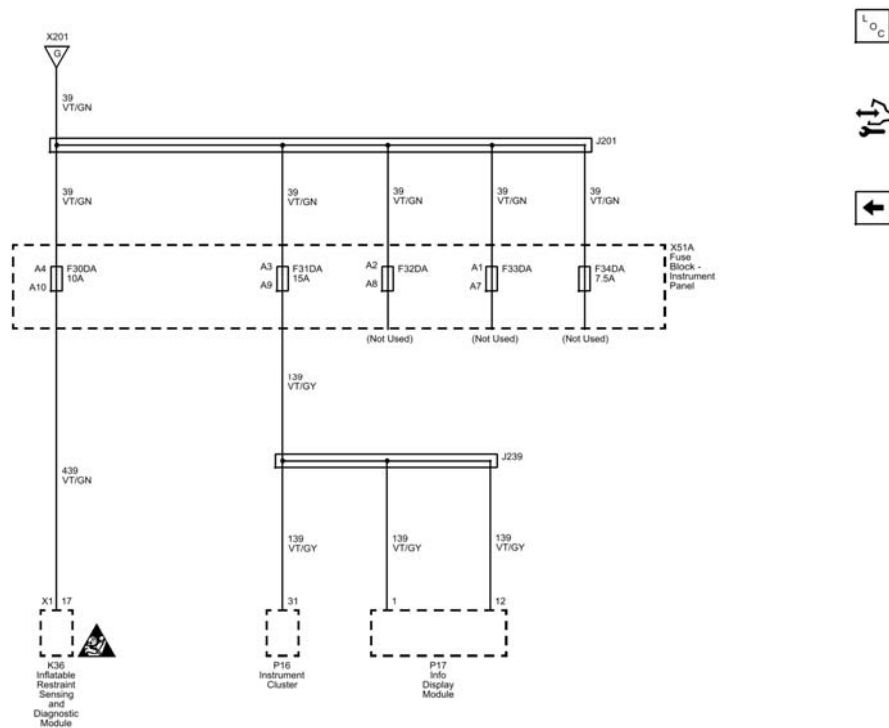


Fig. 29: Front Side Door Window Regulator
 Courtesy of GENERAL MOTORS COMPANY

Front Side Door Window Regulator Replacement

Callout	Component Name
Preliminary Procedure 1. Remove the front side door window regulator sash screw. Refer to Front Side Door Window Replacement. 2. After detaching window from regulator manually move glass to full up position and securely type off to window frame.	
1	Front Side Door Window Regulator Nut (Qty: 6) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 8 (71 lb in)
2	Front Side Door Window Regulator Assembly

REAR SIDE DOOR WINDOW REGULATOR REPLACEMENT

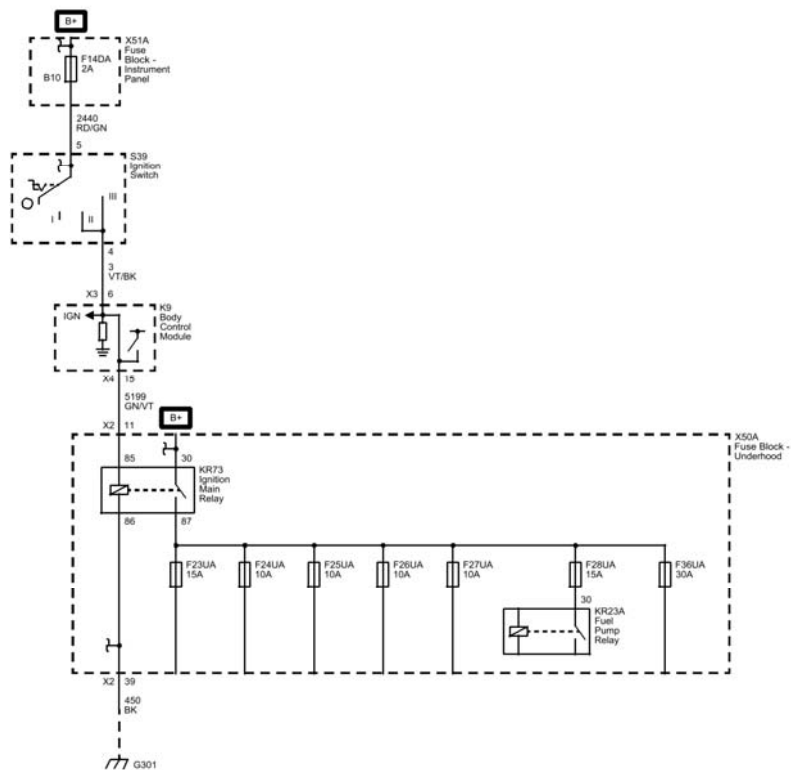


Fig. 30: Rear Side Door Window Regulator
Courtesy of GENERAL MOTORS COMPANY

Rear Side Door Window Regulator Replacement

Callout	Component Name
Preliminary Procedure 1. Remove the rear side door window regulator sash screws. Refer to <u>Rear Side Door Window Replacement</u>. 2. After detaching window from regulator manually move glass to full up position and securely type off to window frame.	
1	Rear Side Door Window Regulator Nut (Qty: 5) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 8 (71 lb in)
2	Rear Side Door Window Regulator Assembly

REAR SIDE DOOR WINDOW REGULATOR HANDLE REPLACEMENT

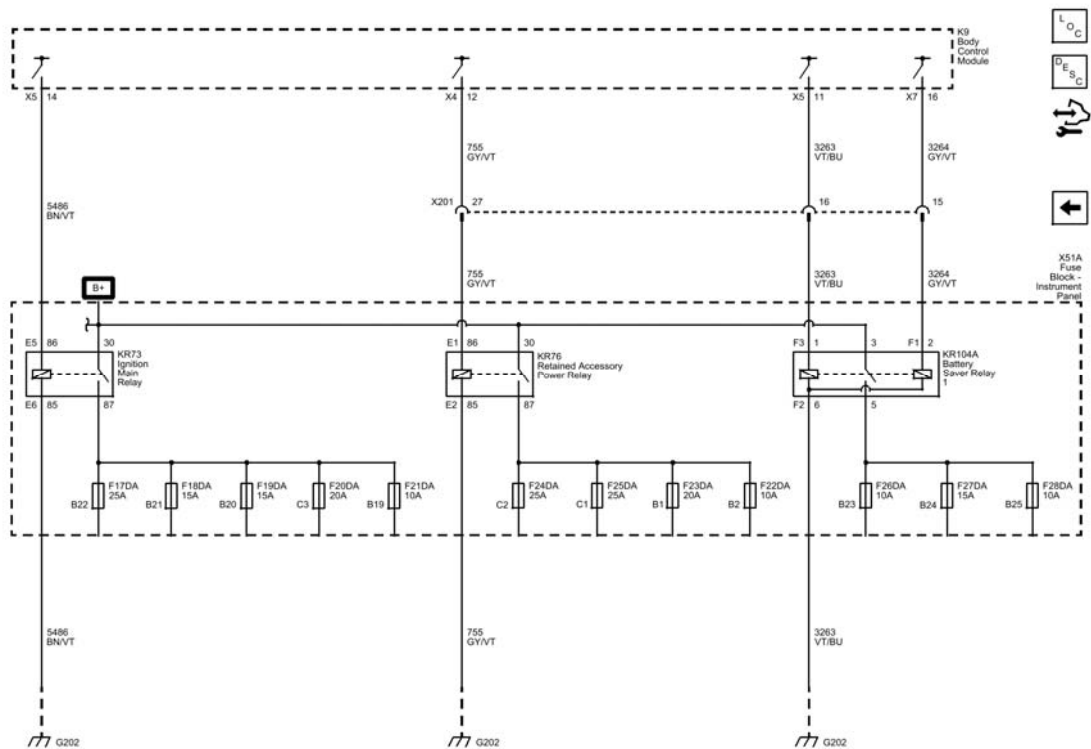


Fig. 31: Rear Side Door Window Regulator Handle
Courtesy of GENERAL MOTORS COMPANY

Rear Side Door Window Regulator Handle Replacement

Callout	Component Name
1	Rear Side Door Crank Clamp Procedure Use a proper tool aid in the removal of the rear side door crank.
2	Rear Side Door Window Regulator Handle

FRONT SIDE DOOR WINDOW OUTER SEALING STRIP REPLACEMENT

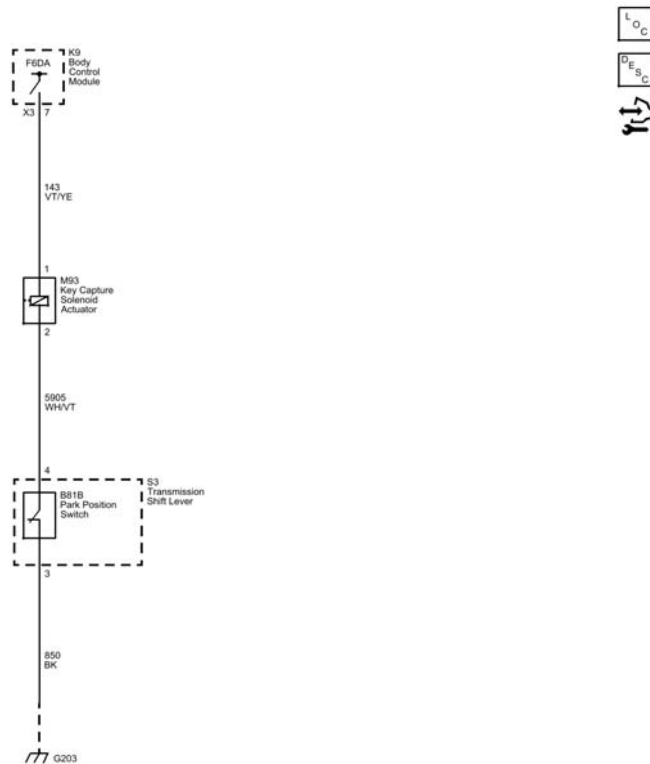


Fig. 32: Front Side Door Window Outer Sealing Strip
Courtesy of GENERAL MOTORS COMPANY

Front Side Door Window Outer Sealing Strip Replacement

Callout	Component Name
1	Front Side Door Window Outer Sealing Strip Screw (Qty: 1) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2 N.m (18 lb in)
2	Front Side Door Window Outer Sealing Strip Assembly

REAR SIDE DOOR WINDOW OUTER SEALING STRIP REPLACEMENT

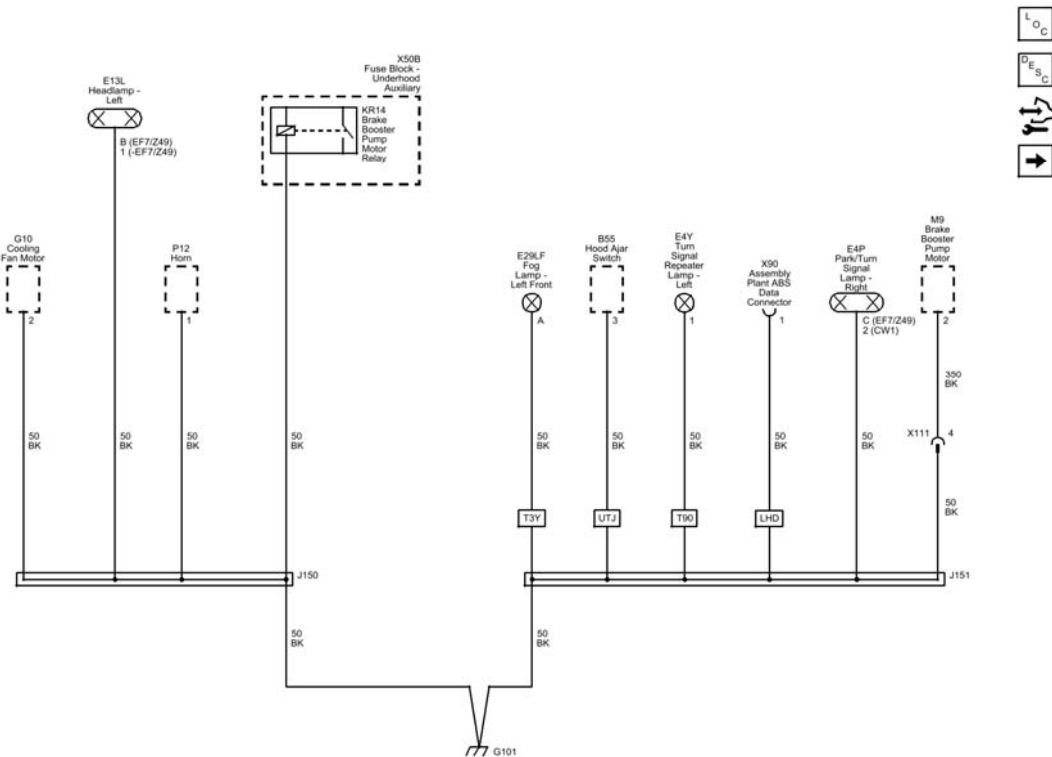


Fig. 33: Rear Side Door Window Outer Sealing Strip (Hatchback)
 Courtesy of GENERAL MOTORS COMPANY

Rear Side Door Window Outer Sealing Strip Replacement

Callout	Component Name
1	Rear Side Door Window Outer Sealing Strip Screw CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2 (18 lb in) NOTE: Open the rear door to the full open position to expose the rear side door window outer sealing strip screw that is located on the front inner edge of the door.
2	Rear Side Door Window Outer Sealing Strip Procedure 1. Use the appropriate tool, lift the front corner of the sealing strip and pull upward and away from the door flange.

- ## FRONT SIDE DOOR WINDOW WEATHERSTRIP REPLACEMENT



Callout	Component Name
Preliminary Procedures	
1. Remove the front side door trim panel. Refer to <u>Front Side Door Trim Panel Replacement</u> . 2. Remove the front side door window. Refer to <u>Front Side Door Window Replacement</u> 3. Remove the outer sealing strip. Refer to <u>Front Side Door Window Outer Sealing Strip Replacement</u>.	
	Front Side Door Window Weatherstrip Procedure 1. Grasp both upper corners of the window weatherstrip, pull downward releasing the assembly from the door frame.

1

2. Insert the weatherstrip downward in the front and rear channel until fully seated.
3. Position the window weatherstrip in the upper rear corner of the frame, work the weatherstrip around the door frame.
4. Carefully move the regulator upward for short slow intervals, while ensuring that the window remains in the channels.
5. Inspect the door window for proper operation before installing the door trim panel.

REAR SIDE DOOR WINDOW WEATHERSTRIP REPLACEMENT

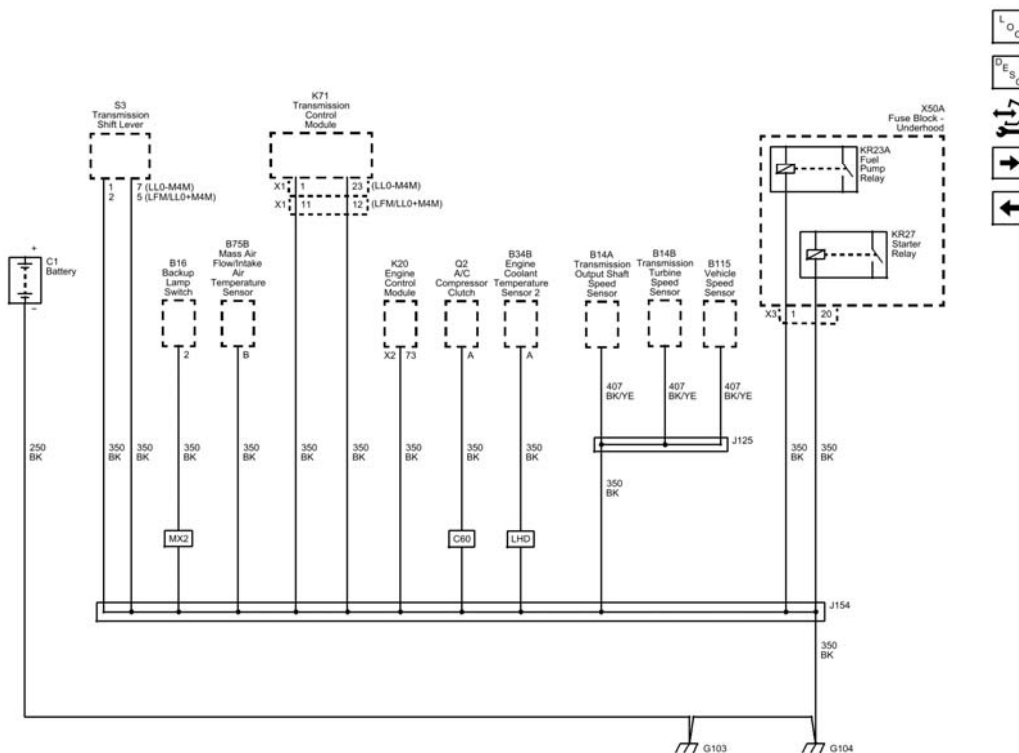


Fig. 35: Rear Side Door Window Weatherstrip (Hatchback)
Courtesy of GENERAL MOTORS COMPANY

Rear Side Door Window Weatherstrip Replacement

Callout	Component Name
Preliminary Procedures	
1.	Remove the rear side door window regulator. Refer to <u>Rear Side Door Window Regulator Replacement</u> .
2.	After removing the rear side door window regulator, gently lower the window into the door panel.
	Rear Side Door Window Weatherstrip
	Procedure

1	1. Remove the weatherstrip from the front and rear lower window guides. 2. Grasp both upper corners, pull downward releasing the weatherstrip from the door frame. 3. Insert the weatherstrip downward in the window guides until fully seated. 4. Carefully move the regulator upward for short slow intervals, while ensuring that the window remains in the guides. 5. Inspect the door window for proper operation before installing the door trim panel.
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DESCRIPTION AND OPERATION

POWER WINDOWS DESCRIPTION AND OPERATION

Power Window System Components

The power window system consists of the following components:

- Driver window switch
- Front passenger window switch
- Left rear window switch
- Right rear window switch
- Window regulator motors in each of the doors
- 30 amp fuse
- 25 amp fuse

14 Power Windows A55-A33-A66 Block Diagram

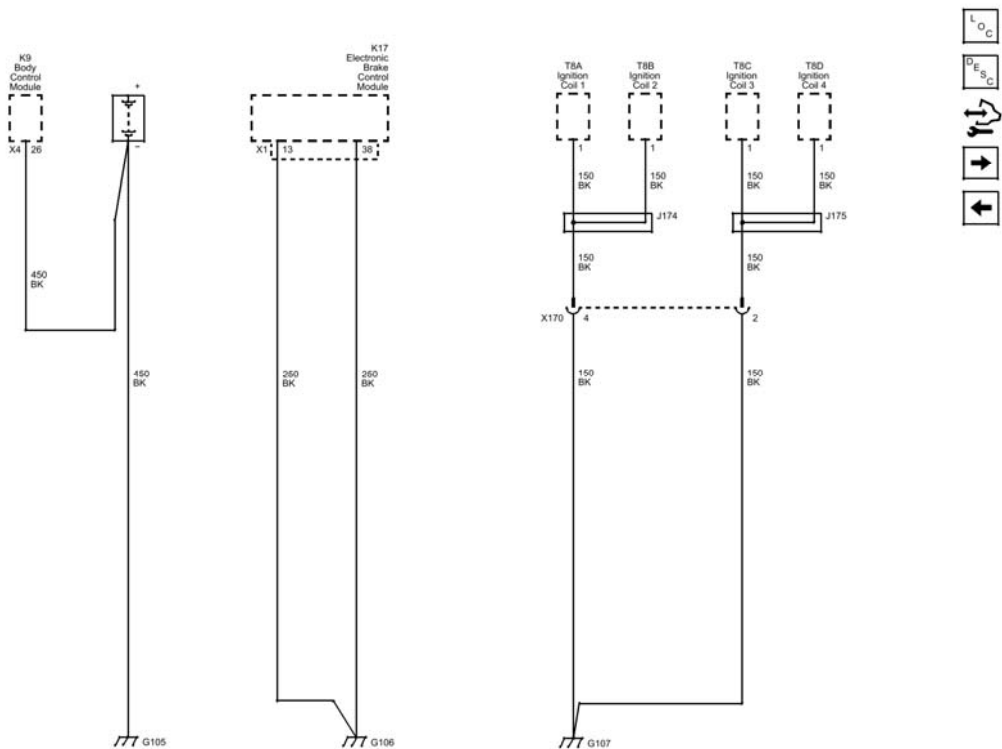


Fig. 36: Power Windows Block Diagram
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
HW	Hard-Wired
HW	Hard-Wired
HW	Hard-Wired
HW	Hard-Wired
HW	Hard-Wired
HW	Hard-Wired
HW	Hard-Wired
S79D	S79D Window Switch - Driver
M74D	M74D Window Motor - Driver
S79P	S79P Window Switch - Passenger
S79LR	S79LR Window Switch - Left Rear
S79RR	S79RR Window Switch - Right Rear
M74P	M74P Window Motor - Passenger
M74LR	M74LR Window Motor - Left Rear
M74RR	M74RR Window Motor - Right Rear

Power Window System Controls

The power window system can be controlled by a power window up or down switch activation.

Window Operation and the Driver Window Switch

When the ignition switch is in the RUN or ACCY position or Retained Accessory Power (RAP) is enabled, battery positive voltage is supplied to the driver window switch. Ground for the switch is provided by a ground circuit connected to a ground stake. When the driver window switch is pressed in the down position, the voltage is applied to the driver window motor down circuit and ground is applied to the driver window motor up circuit causing the window to open. When the driver window switch is pressed in the up position, the polarity is reversed, voltage and ground are applied to the opposite circuits and the window closes. In order to control the passenger windows from the driver door, the driver window switch assembly contains a separate window switch for each passenger door window. These window switches operate in the same way as the driver window switch, except that the applied voltage and ground must also pass through the local passenger, left rear or right rear window switch in order to command the respective window motor.

The driver window switch also provides power and ground for the local rear window switches. Battery positive voltage is supplied, through the power window master switch lockout signal circuit, to each local rear window switch. The local front passenger door window switch has a separate battery positive voltage circuit, however, this circuit is spliced into the driver window switch voltage supply circuit within the IP Fuse Block. Ground for all three of the passenger door switches, is also supplied by the driver window switch.

Lockout Switch Feature

The driver window switch contains a rear window lockout switch which disconnects the battery positive voltage supply to the remote rear passenger door window switches, disabling them. The local front passenger door window switch cannot be locked out.

Window Operation and the Passenger Window Switches

When the ignition switch is in the RUN or ACCY position or Retained Accessory Power (RAP) is enabled, battery positive voltage is supplied to each of the remote passenger door window switches. When a local window switch is pressed in the down position, voltage is applied to the window motor down circuit and ground is applied to the window motor up circuit, causing the window to open. When the window switch is pressed in the up position, the polarity is reversed, voltage and ground are applied to the opposite circuits and the window closes.

REAR WINDOW DEFOGGER DESCRIPTION AND OPERATION

Rear Window Defogger System Components

The rear window defogger system consist of the following components:

- The HVAC control module
- The body control module (BCM)
- The rear defogger relay
- The rear window grid
- Driver outside rearview mirror

- Passenger outside rearview mirror
- 30A fuse

K33-K9-X50A Defogger Block Diagram

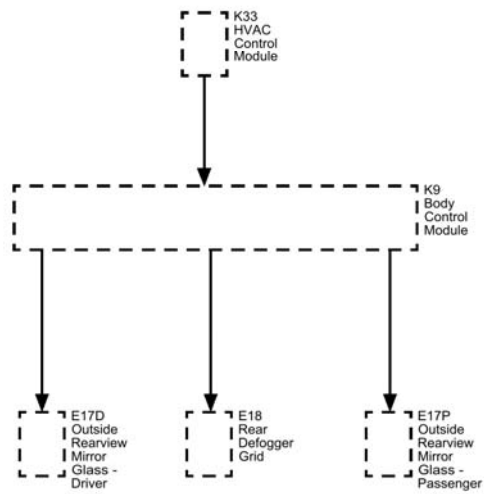


Fig. 37: K33-K9-X50A Defogger Block Diagram
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
HW	Hard-Wired
HW	Hard-Wired
HW	Hard-Wired
HW	Hard-Wired
E17D	E17D Outside Rearview Mirror Glass - Driver
E18	E18 Rear Defogger Grid
E17P	E17P Outside Rearview Mirror Glass - Passenger

K33	K33 HVAC Control Module
K9	K9 Body Control Module

Rear Window Defogger Operation

The BCM supplies 12 V signal to the rear window defogger switch signal circuit to the HVAC control module. When you depress the rear window defogger switch, the rear window defogger switch pulls the signal circuit low. The BCM interprets as a request for the rear window defogger system. The BCM enables the rear window defogger system by supplying voltage to the rear defogger relay coil. The relay coil supply voltage is also spliced off internally in the BCM to the supply voltage circuit of the rear window defogger indicator. The rear defogger relay is energized and the rear window defogger indicator is illuminated. With the relay energized, battery positive voltage is allowed from the relay switched input through the switch contacts and out the relay switched output to the rear window defogger grid.

When you start the engine and press the rear window defogger switch for the first time, the defogger cycle lasts for 15 minutes. Further operation results in 7.5 minute defogger cycles. The rear defogger feature will not time out if vehicle speed is above 80 km/h (50 mph). The defogger cycle resets to 15 minutes when you cycle the ignition to the OFF position and then to the ON position.

Heated Mirrors

The heated mirrors are also controlled through the rear defogger relay. Whenever the rear window defogger is turned on battery voltage is supplied to the mirror heater elements through the left and right mirror heater element control circuits.

STATIONARY WINDOW DESCRIPTION

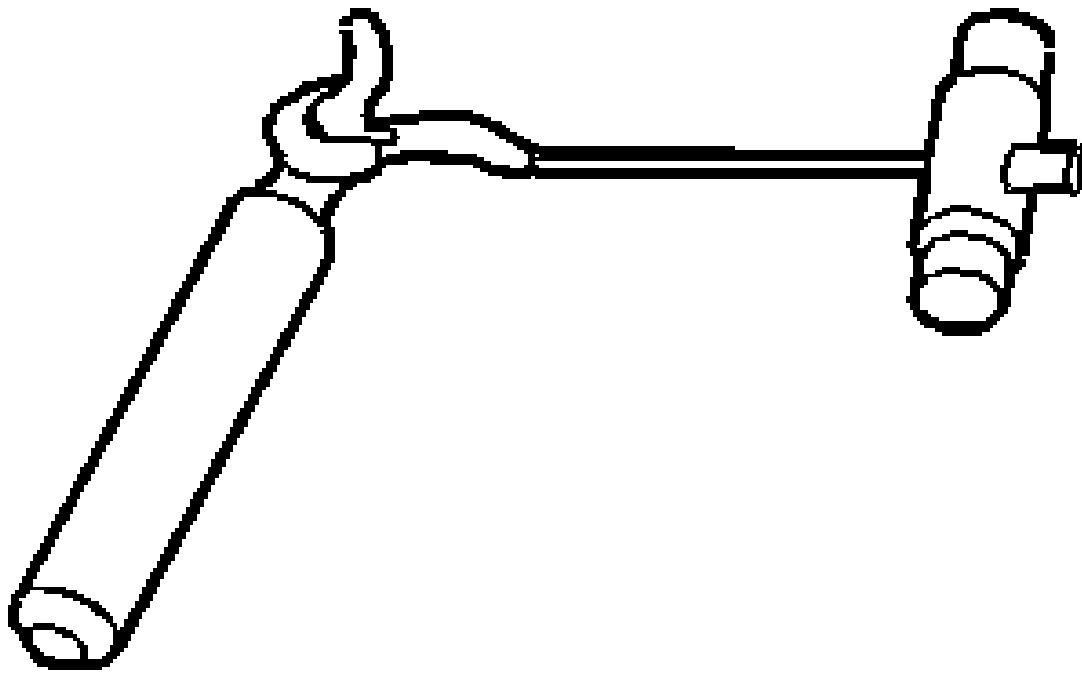
WARNING: Refer to Cracked Window Warning .

Stationary windows consist of all the windows on the vehicle which are immovable within its frame, such as the windshield, the rear window and the inside rearview mirror.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description



J-24402
Glass
Sealant
Remover

ACCESSORIES & EQUIPMENT

Floor Coverings and Headlinings - Spark

REPAIR INSTRUCTIONS

FLOOR CARPET DRYING

If the carpet or the pad or insulator is wet, use the following criteria for drying or for replacing the components:

- For a 1-piece carpet assembly bonded to a cotton or a fiber padding, replace the entire assembly.
- For a 2-piece carpet assembly with a cotton or a fiber padding, replace the padding only. While the carpet is out of the vehicle, dry the carpet using the method described below.
- For a 1-piece carpet assembly bonded to a foam padding or attached to a synthetic padding, dry the carpet using the method described below.
- For a 2-piece carpet assembly with a synthetic padding, dry the assembly using the method described below.

Drying Method

1. If you observe puddles of liquid on the carpet face, use a wet vacuum to remove the excess moisture.
2. Blot the face of the carpet with a towel in order to absorb as much moisture as possible.
3. Point a fan at the affected area and air dry the carpet.

FLOOR PANEL CARPET REPLACEMENT

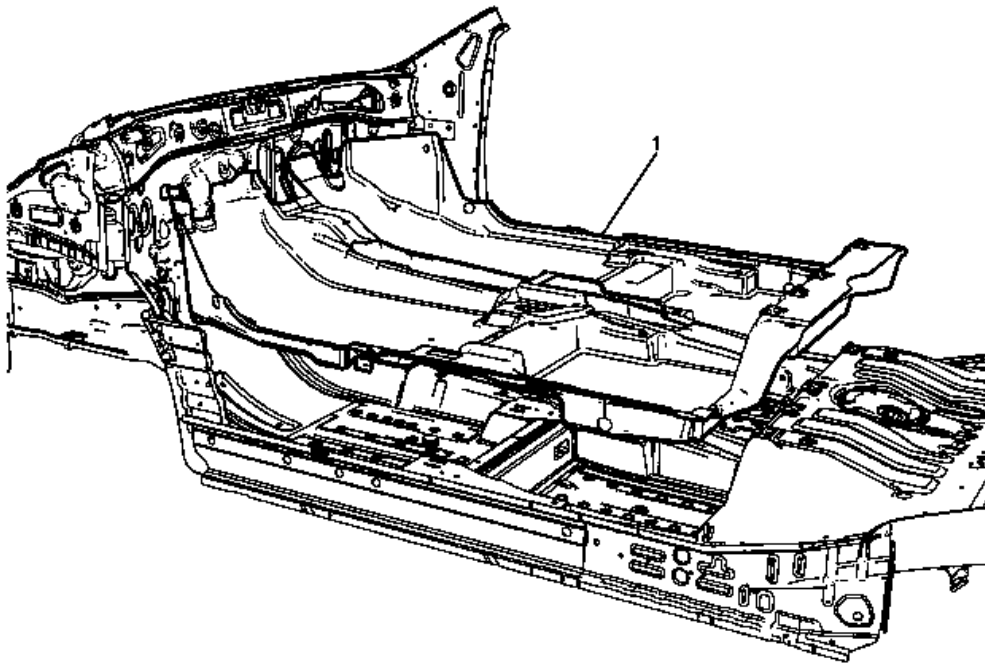


Fig. 1: Floor Panel Carpet
 Courtesy of GENERAL MOTORS COMPANY

Floor Panel Carpet Replacement

Callout	Component Name
Preliminary Procedures	
1. Remove front seats. Refer to <u>Driver or Passenger Seat Removal and Installation</u> . 2. Remove rear seat cushion. Refer to <u>Rear Seat Cushion Removal and Installation</u> . 3. Remove the front floor console. Refer to <u>Front Floor Console Replacement</u> . 4. Remove the front side door sill trim plate. Refer to <u>Front Side Door Sill Trim Plate Replacement</u> . 5. Remove the rear side door sill trim plate. Refer to <u>Rear Side Door Sill Trim Plate Replacement</u> . 6. Remove the center pillar lower trim panels. Refer to <u>Center Pillar Lower Trim Panel Replacement</u> .	
1	Front Floor Panel Carpet Assembly Procedure Loosen the transmission control.

HEADLINING TRIM PANEL REPLACEMENT

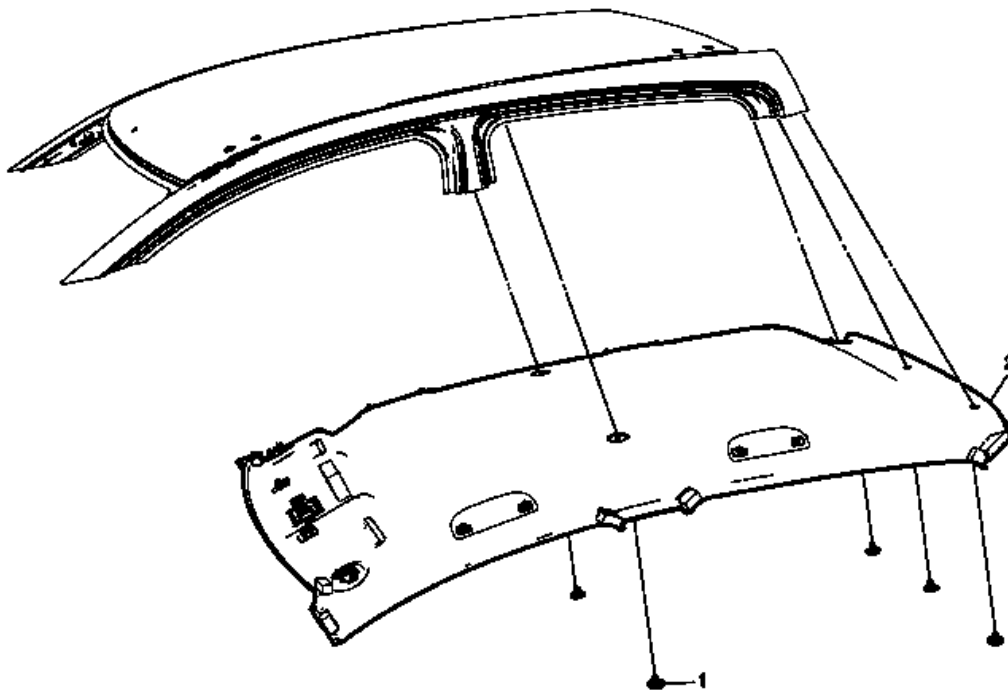


Fig. 2: Headlining Trim Panel

Courtesy of GENERAL MOTORS COMPANY

Headlining Trim Panel Replacement

Callout	Component Name
WARNING: Do not attempt to repair or alter the head impact energy-absorbing material glued to the headliner or to the garnish trims. If the material is damaged, replace the headliner and/or the garnish trim. Failure to do so could result in personal injury. CAUTION: If a vehicle is equipped with a head curtain inflator module ensure that the inflator module and tether are undamaged. If tether or curtain airbag are damaged in any way, they must be replaced. CAUTION: Use care when working around the head curtain inflator module. Sharp tools may puncture the curtain airbag. If the head curtain inflator module is damaged in any way, it must be replaced. Preliminary Procedures 1. Disable the SIR system. Refer to <u>SIR Disabling and Enabling</u> . 2. Remove the sunshade. Refer to <u>Sunshade Replacement</u> . 3. Remove the assist handles. Refer to <u>Assist Handle Replacement</u> . 4. Remove the windshield garnish moldings. Refer to <u>Windshield Garnish Molding Replacement</u> .	

5. Remove the center pillar upper trim panels. Refer to **Center Pillar Upper Trim Panel Replacement** .
6. Remove the quarter window garnish moldings. Refer to **Quarter Window Garnish Molding Replacement** .
7. Remove the center courtesy lamp assembly. Refer to **Center Courtesy Lamp Replacement** .
8. Move the front seat fully forward and recline.

1	Headliner Trim Panel Retainer (Qty: 5)
2	Headliner Trim Panel Assembly Procedure Disconnect the electrical connectors.

ACCESSORIES & EQUIPMENT

Frame and Underbody - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Frame to Body Retaining Bolt	170	125 lb ft
Front Compartment Splash Shield Bolt	9	80 lb in
Front Wheelhouse Liner Screw	1.5	13 lb in
Rear Wheelhouse Liner Screw	2.5	22 lb in
Torque Strut to Frame Retaining Bolt	100	74 lb ft
Torque Strut to Transmission Mounting Bracket Retaining	80	59 lb ft

REPAIR INSTRUCTIONS

FRONT COMPARTMENT SPLASH SHIELD REPLACEMENT

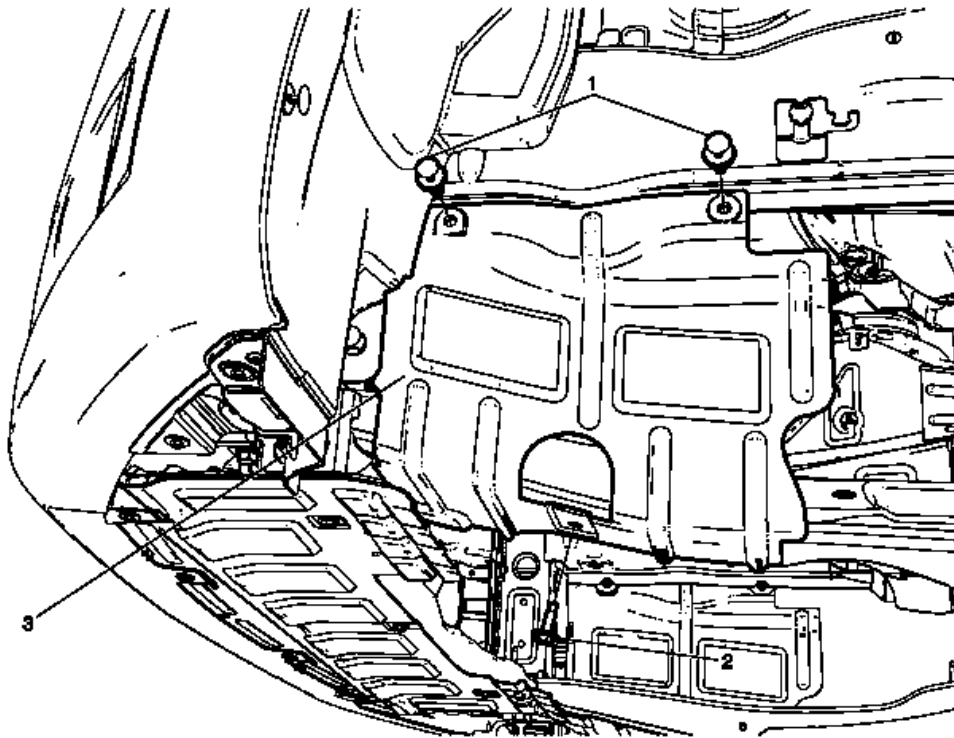


Fig. 1: Front Compartment Splash Shield
Courtesy of GENERAL MOTORS COMPANY

Front Compartment Splash Shield Replacement

Callout	Component Name
1	Front Compartment Splash Shield Retainer (Qty 2)
2	Front Compartment Splash Shield Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 9 N.m (80 lb in)
3	Front Compartment Splash Shield

DRIVETRAIN AND FRONT SUSPENSION FRAME REPLACEMENT (WITH EN-49802)

Special Tools

EN-49802 Cradle Supporter

For equivalent regional tools refer to Special Tools.

Removal Procedure

CAUTION: Refer to Vehicle Lifting and Jacking Caution .

1. Raise and support the vehicle.
2. Remove the front wheel and wheel assemblies. Refer to Tire and Wheel Removal and Installation .
3. Remove both front compartment splash shields. Refer to Front Compartment Splash Shield Replacement.
4. Remove the front under cover.
5. Remove both of the front wheel house linings.
6. Remove the front bumper fascia. Refer to Front Bumper Fascia Replacement .
7. Remove the lower wind guard.

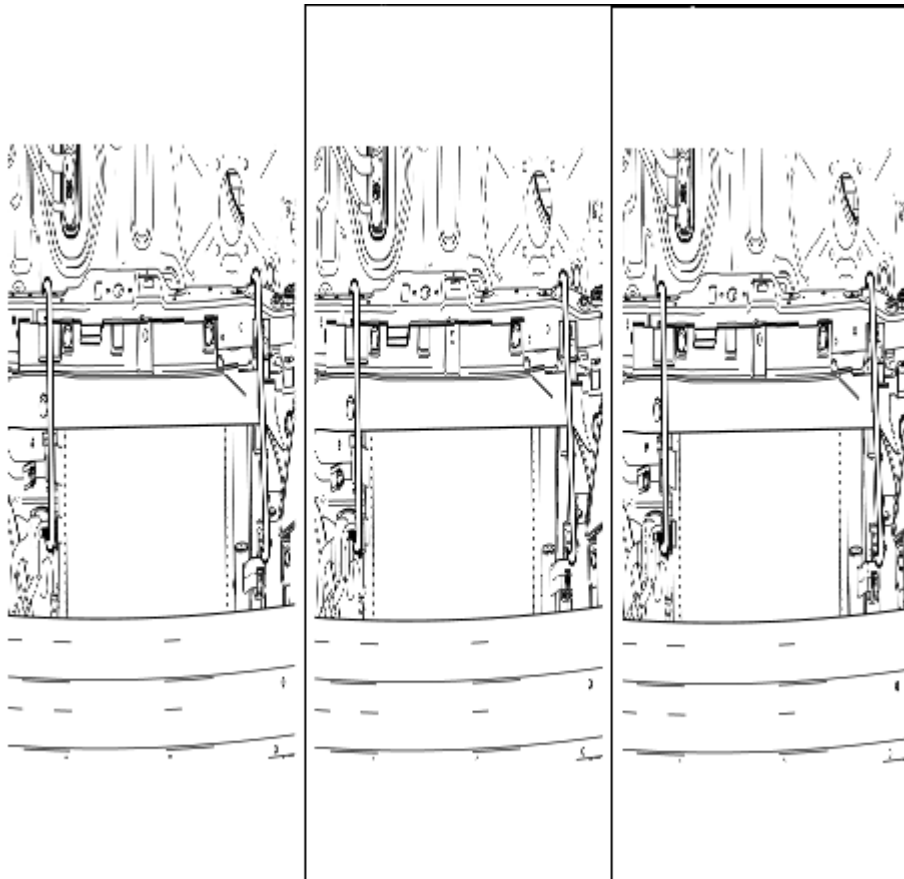


Fig. 2: Securing Cooling Module To Left And Right Of Upper Body Structure With A Wire
 Courtesy of GENERAL MOTORS COMPANY

8. Secure the cooling module to the left and right of the upper body structure with a wire.
9. Separate both of the control arm ball joints from the steering knuckles. Refer to **Lower Control Arm Replacement** .
10. Remove both of the upper stabilizer shaft link nuts and separate the left and right stabilizer shaft link from the strut. Refer to **Stabilizer Shaft Link Replacement** .
11. Remove the exhaust pipe. Refer to **Exhaust Front Pipe Replacement (LL0)** .

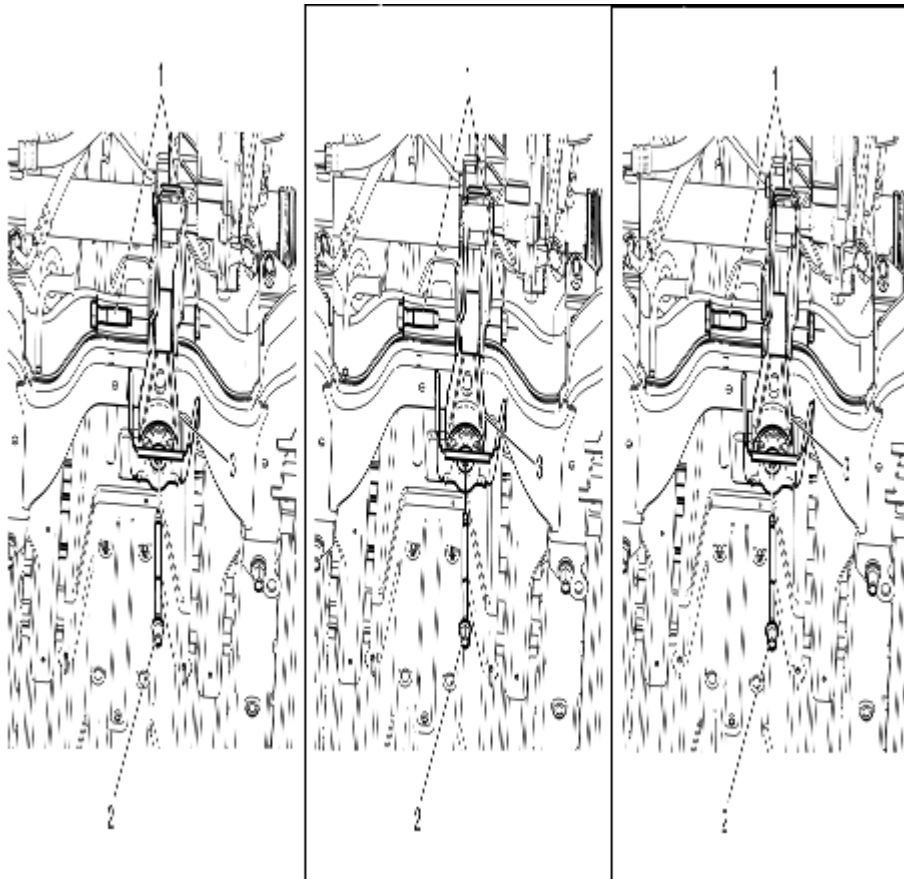


Fig. 3: Transmission Mounting Bracket Bolt And Nut And Torque Strut
Courtesy of GENERAL MOTORS COMPANY

12. Remove the torque strut to transmission mounting bracket bolt and nut (1) and the torque strut to frame bolt (2).
13. Remove the torque strut (3) from the frame.

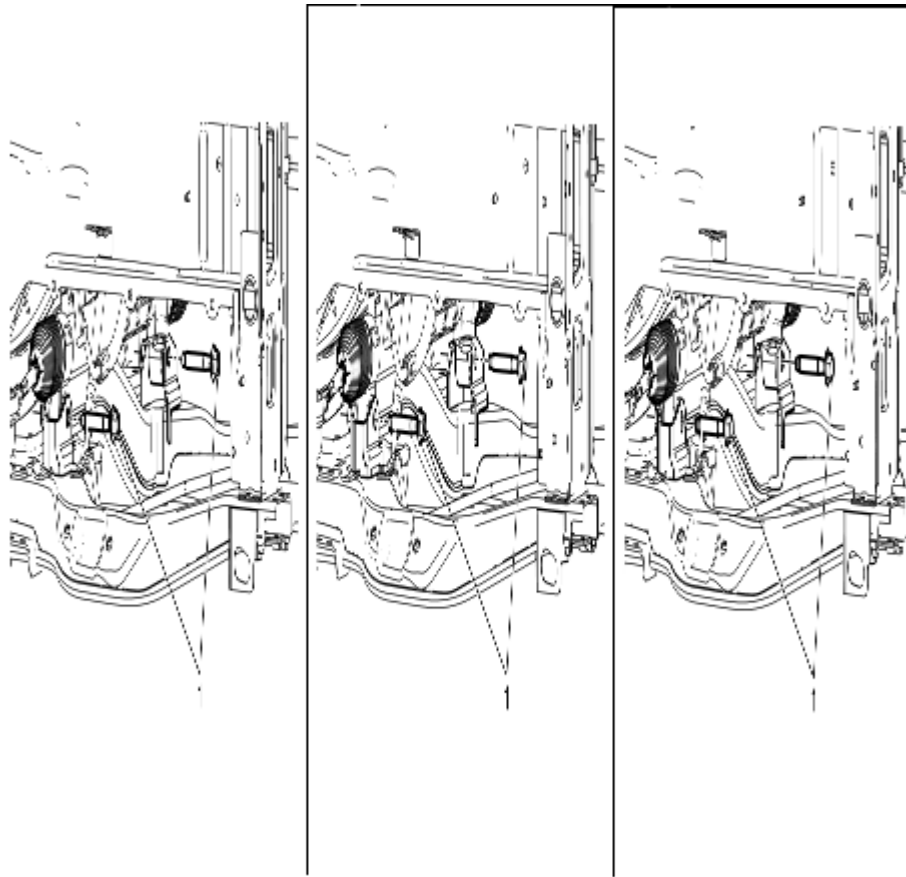


Fig. 4: Steering Gear Assembly And Frame Retaining Bolts
Courtesy of GENERAL MOTORS COMPANY

14. Remove the steering gear assembly to the frame retaining bolts (1) and separate the steering gear assembly from the frame. Refer to **Steering Gear Replacement (Electric Power Steering)** .

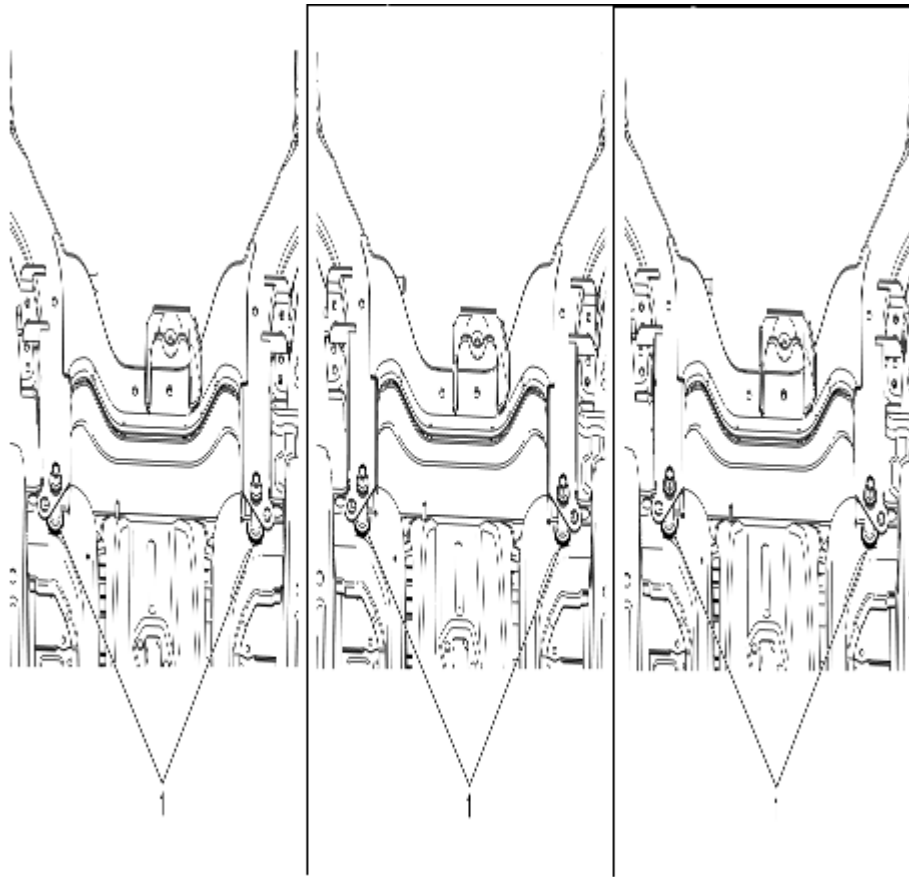


Fig. 5: Marking Frame To Body Positions
Courtesy of GENERAL MOTORS COMPANY

15. Mark the frame to body positions (1) with a paint pen or permanent marker.

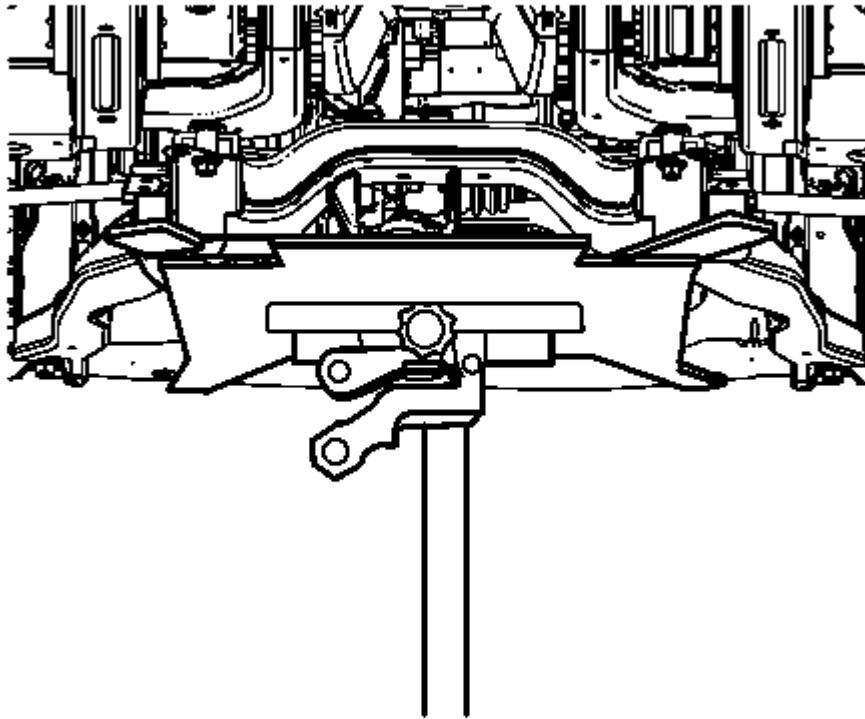


Fig. 6: Installing En-49802 Cradle Supporter To Hydraulic Jack Stand
Courtesy of GENERAL MOTORS COMPANY

16. Install the **EN-49802** cradle supporter to a hydraulic jack stand and support the frame.

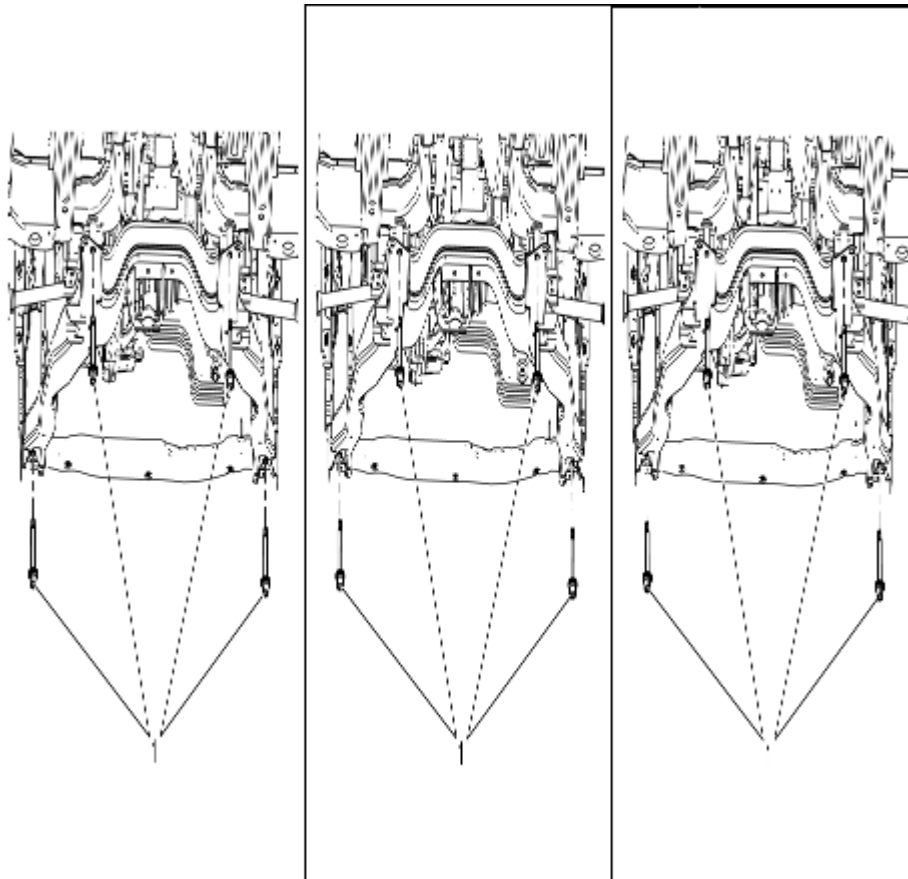


Fig. 7: Body Bolts

Courtesy of GENERAL MOTORS COMPANY

17. Remove the frame to body bolts (1).
18. Slowly lower the jack stand and remove the frame from the vehicle.
19. Remove the following components if replacing the frame:
 1. Remove the stabilizer shaft from the frame. Refer to **Stabilizer Shaft Replacement** .
 2. Remove the control arms from the frame. Refer to **Lower Control Arm Replacement** .
 3. Remove the radiator brackets from the frame.
 4. Remove the front lower impact bar.

Installation Procedure

1. Install the following components to the frame if removed:
 1. Install the front lower impact bar to the frame.
 2. Install the radiator brackets to the frame.
 3. Install the control arms to the frame. Refer to **Lower Control Arm Replacement** .
 4. Install the stabilizer shaft to the frame. Refer to **Stabilizer Shaft Replacement** .

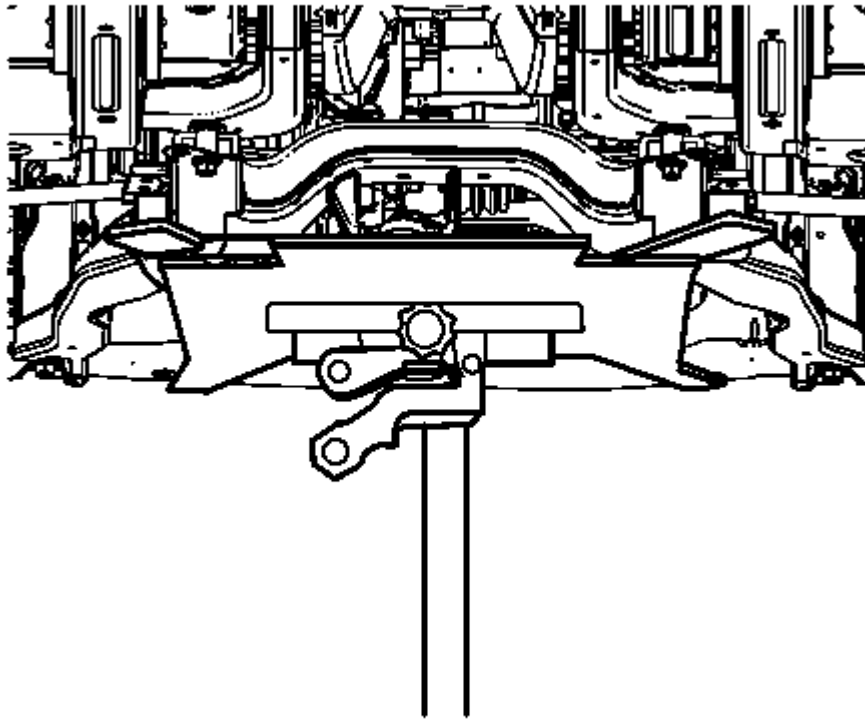


Fig. 8: Installing En-49802 Cradle Supporter To Hydraulic Jack Stand
Courtesy of GENERAL MOTORS COMPANY

2. With the frame on the **EN-49802** cradle supporter and hydraulic jack stand, raise the frame to the vehicle.

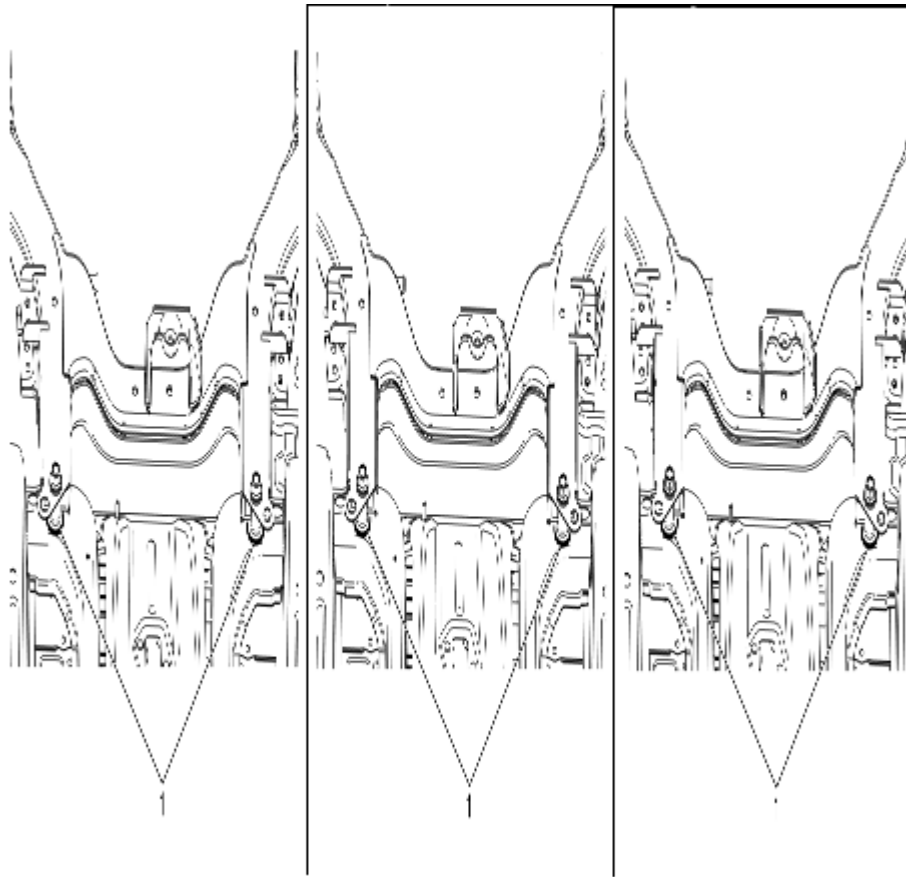


Fig. 9: Marking Frame To Body Positions
Courtesy of GENERAL MOTORS COMPANY

3. Hand start all the frame to body retaining bolts while aligning the frame to the paint marks (1).

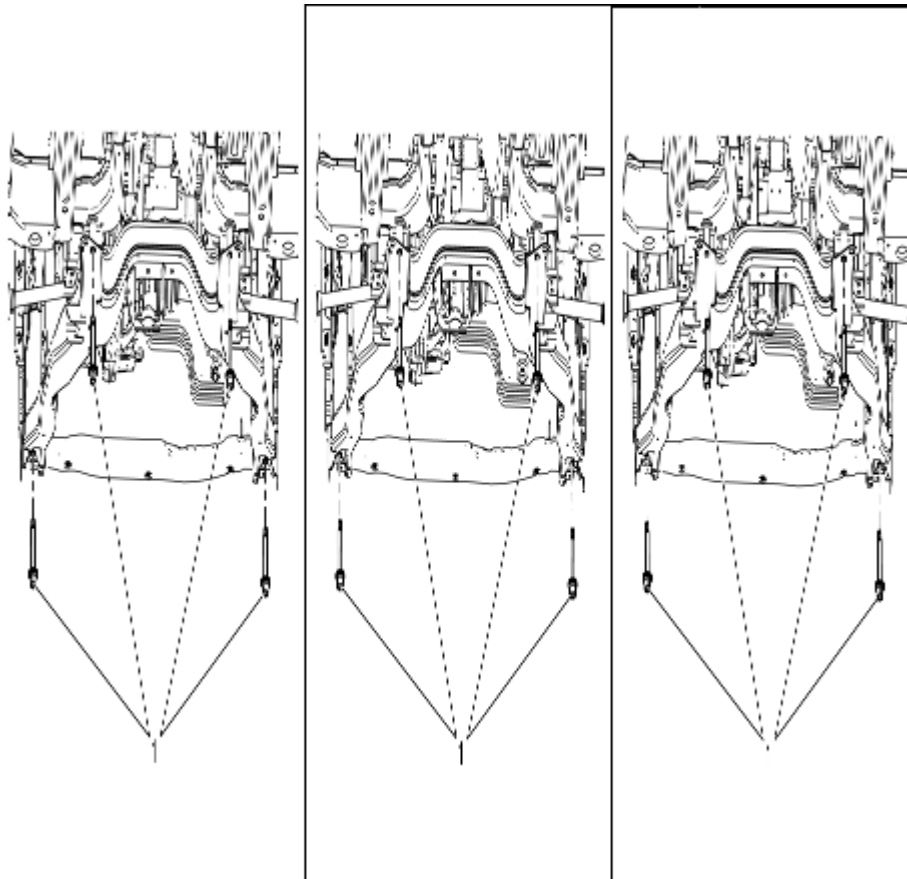


Fig. 10: Body Bolts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

4. Tighten the frame to body retaining bolts (1) to 170 (125 lb ft).
5. Lower the jack stand and remove the **EN-49802** cradle supporter.
6. Install the steering gear assembly to the frame retaining bolts. Refer to **Steering Gear Replacement (Electric Power Steering)** .

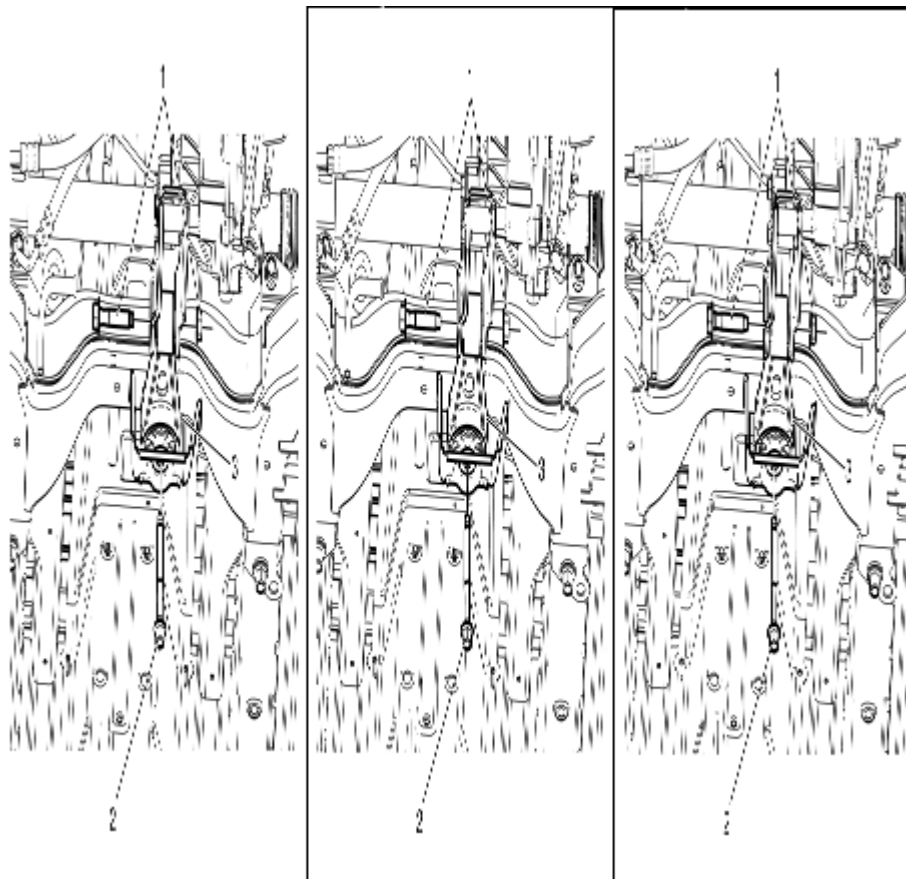


Fig. 11: Transmission Mounting Bracket Bolt And Nut And Torque Strut
Courtesy of GENERAL MOTORS COMPANY

7. Install the torque strut (3) from the frame.
8. Install the torque strut to the frame bolt (2) and tighten to 100 (74 lb ft).
9. Install the torque strut to the transmission mounting bracket bolt and nut (1) and tighten to 80 (59 lb ft).
10. Install the exhaust pipe. Refer to **Exhaust Front Pipe Replacement (LL0)** .
11. Connect both of the stabilizer shaft links to the struts and tighten the upper stabilizer shaft link nuts. Refer to **Stabilizer Shaft Link Replacement** .
12. Install both of the control arm ball joints to the steering knuckles. Refer to **Lower Control Arm Replacement** .
13. Remove the wires which secure the cooling module to the upper body structure.
14. Install the lower wind guard.
15. Install the front bumper fascia. Refer to **Front Bumper Fascia Replacement** .
16. Install both of the front wheel house linings.
17. Install the front under cover.
18. Install both of the front compartment splash shields. Refer to **Front Compartment Splash Shield Replacement**.
19. Install the front wheel and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** .
20. Lower the vehicle.

21. Road test the vehicle in order to test for the following conditions:

- Steering leads or pulls-Refer to **Wheel Alignment Measurement** .
- Abnormal powertrain noise or vibration at idle-Inspect the engine and transmission mounts for proper alignment and torque.

DRIVETRAIN AND FRONT SUSPENSION FRAME REPLACEMENT (WITH CH-49289)

Special Tools

- **CH-904** Base Frame
- **CH-49289** Centering Frame

For equivalent regional tools refer to **Special Tools**.

Removal Procedure

CAUTION: Refer to **Vehicle Lifting and Jacking Caution** .

1. Raise and support the vehicle.
2. Remove the front wheel and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** .
3. Remove both front compartment splash shields. Refer to **Front Compartment Splash Shield Replacement**.
4. Remove the front under cover.
5. Remove both of the front wheel house linings.
6. Remove the front bumper fascia. Refer to **Front Bumper Fascia Replacement** .
7. Remove the lower wind guard.

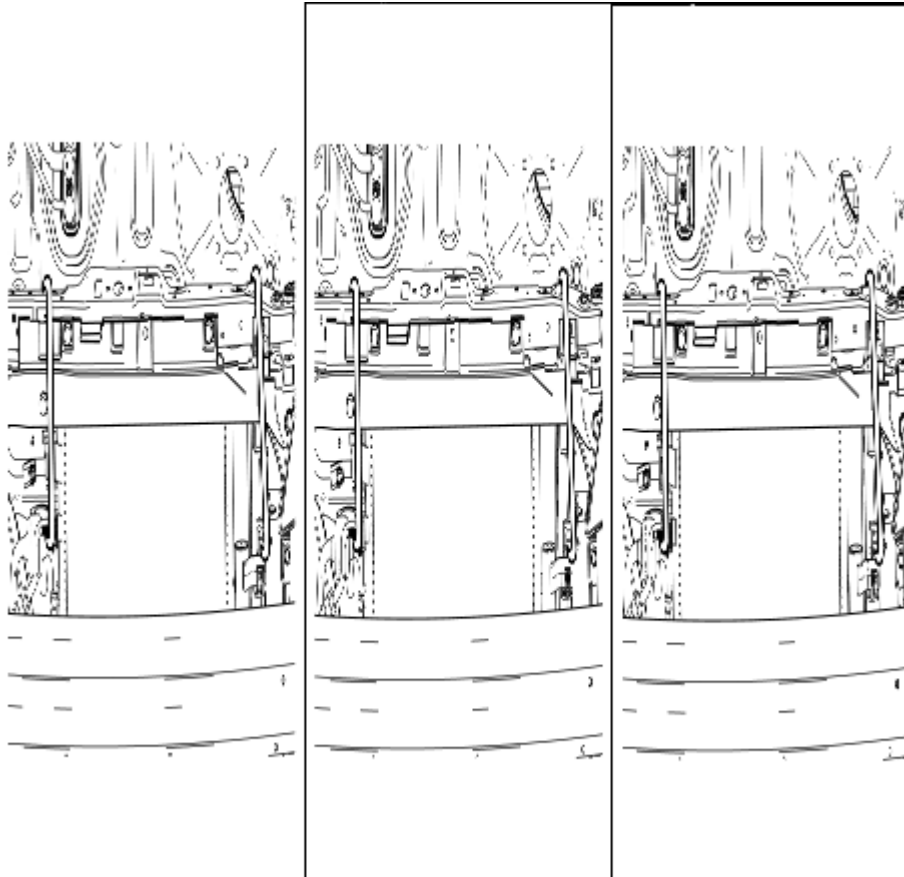


Fig. 12: Securing Cooling Module To Left And Right Of Upper Body Structure With A Wire
 Courtesy of GENERAL MOTORS COMPANY

8. Secure the cooling module to the left and right of the upper body structure with a wire.
9. Separate both of the control arm ball joints from the steering knuckles. Refer to **Lower Control Arm Replacement** .
10. Remove both of the upper stabilizer shaft link nuts and separate the left and right stabilizer shaft link from the strut. Refer to **Stabilizer Shaft Link Replacement** .
11. Remove the exhaust pipe. Refer to **Exhaust Front Pipe Replacement (LL0)** .

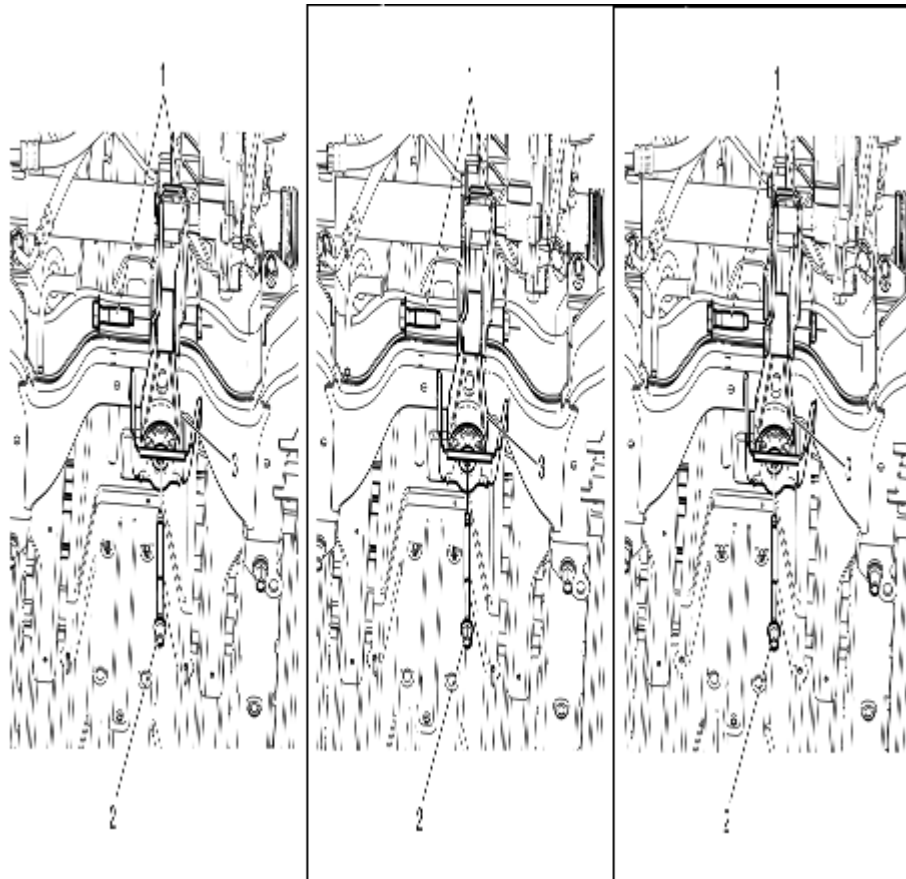


Fig. 13: Transmission Mounting Bracket Bolt And Nut And Torque Strut
Courtesy of GENERAL MOTORS COMPANY

12. Remove the torque strut to transmission mounting bracket bolt and nut (1) and the torque strut to frame bolt (2).
13. Remove the torque strut (3) from the frame.

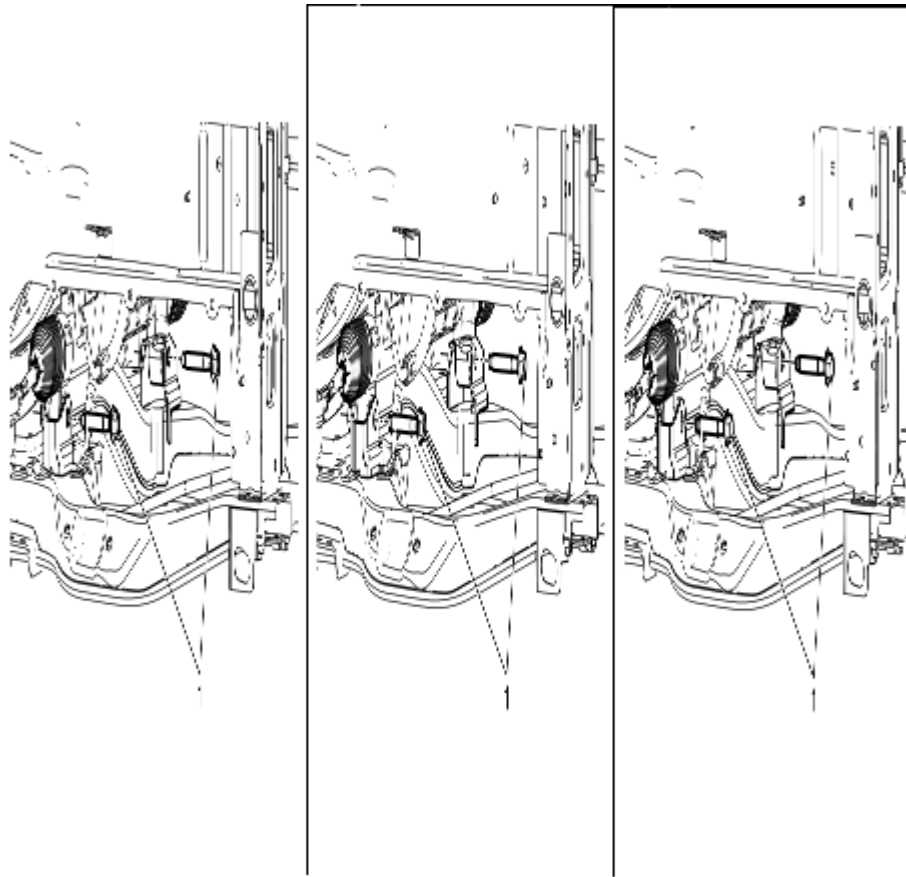


Fig. 14: Steering Gear Assembly And Frame Retaining Bolts
Courtesy of GENERAL MOTORS COMPANY

14. Remove the steering gear assembly to the frame retaining bolts (1) and separate the steering gear assembly from the frame. Refer to **Steering Gear Replacement (Electric Power Steering)** .

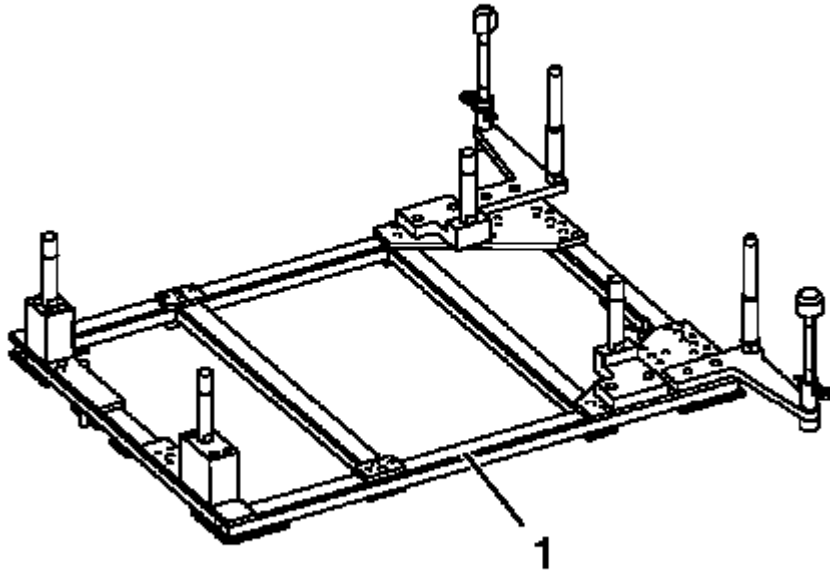


Fig. 15: Centering Frame

Courtesy of GENERAL MOTORS COMPANY

NOTE: The SPX installation manual is supplied with the special tool and is also available online from SPX directly. Go to www.spxtools-shop.com.

15. Assemble the **CH-49289** centering frame (1) according to the details provided in the SPX installation manual.
16. Support the **CH-904** base frame on a jack.
17. Support the **CH-49289** centering frame on the **CH-904** base frame.

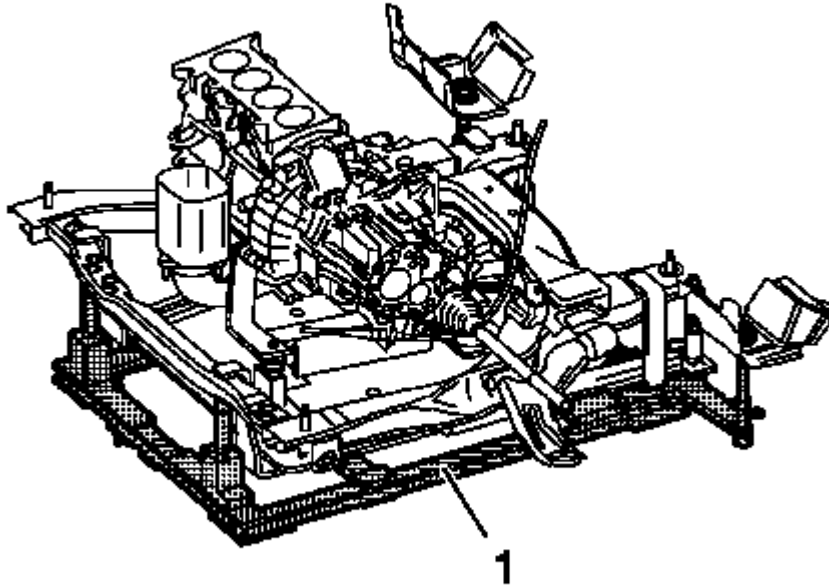


Fig. 16: Centering Frame

Courtesy of GENERAL MOTORS COMPANY

NOTE: The SPX installation manual is supplied with the special tool and is also available online from SPX directly.

18. Install the **CH-49289** centering frame (1) according to the details provided in the SPX installation manual.

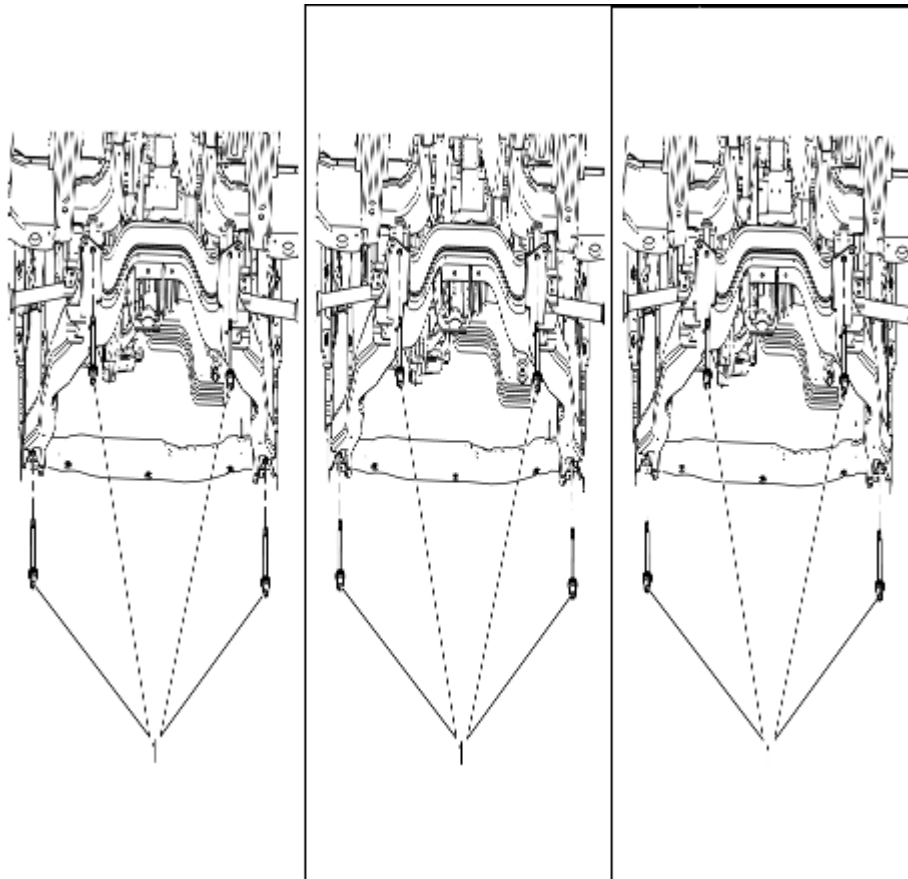


Fig. 17: Body Bolts

Courtesy of GENERAL MOTORS COMPANY

19. Remove the frame to body bolts (1).
20. Slowly lower the jack stand and remove the frame from the vehicle.
21. Remove the following components if replacing the frame:
 1. Remove the stabilizer shaft from the frame. Refer to **Stabilizer Shaft Replacement** .
 2. Remove the control arms from the frame. Refer to **Lower Control Arm Replacement** .
 3. Remove the radiator brackets from the frame.
 4. Remove the front lower impact bar.

Installation Procedure

1. Install the following components to the frame if removed:
 1. Install the front lower impact bar to the frame.
 2. Install the radiator brackets to the frame.
 3. Install the control arms to the frame. Refer to **Lower Control Arm Replacement** .
 4. Install the stabilizer shaft to the frame. Refer to **Stabilizer Shaft Replacement** .

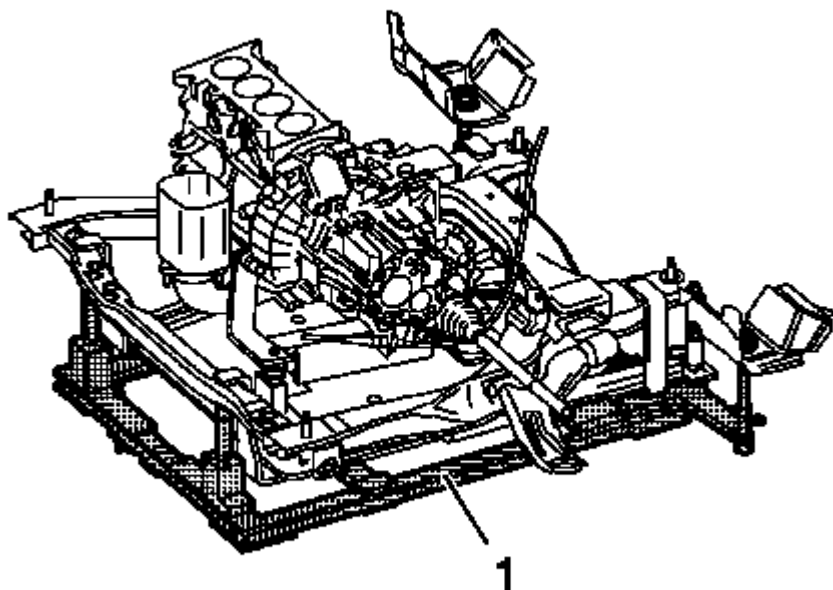


Fig. 18: Centering Frame

Courtesy of GENERAL MOTORS COMPANY

2. With the frame on the **CH-49289** centering frame (1) and hydraulic jack stand, raise the frame to the vehicle.

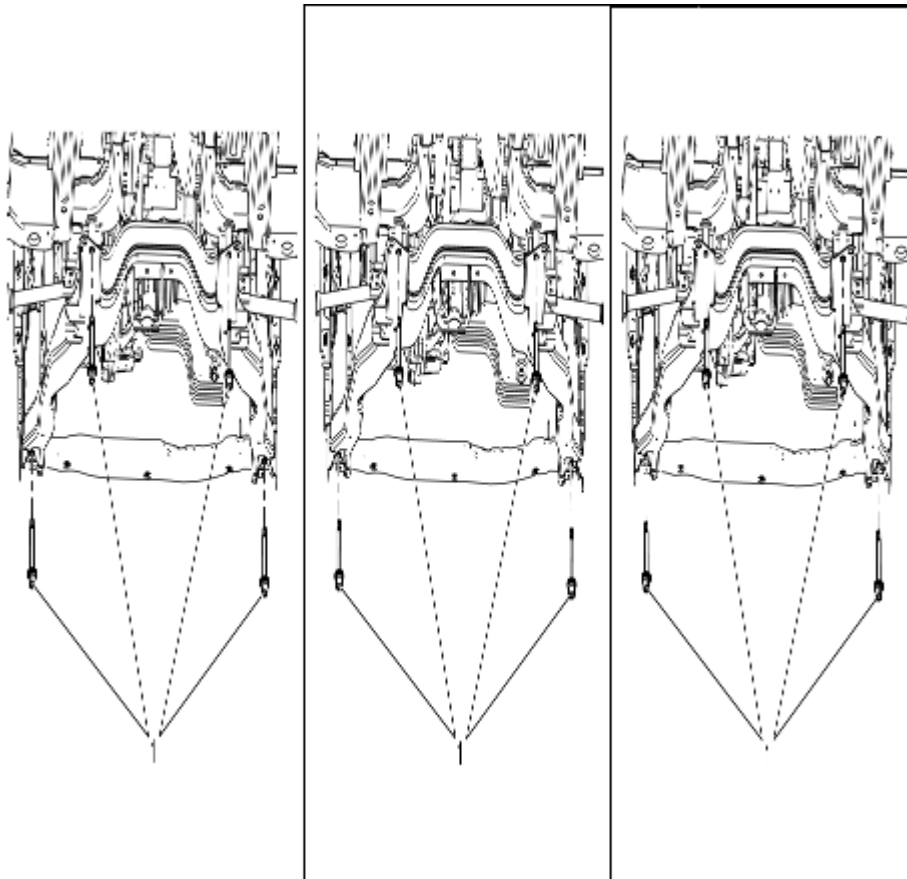


Fig. 19: Body Bolts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

3. Install and tighten the frame to body retaining bolts (1) to 170 (125 lb ft).
4. Lower the jack stand and remove the **CH-49289** centering frame.
5. Install the steering gear assembly to the frame retaining bolts. Refer to **Steering Gear Replacement (Electric Power Steering)** .

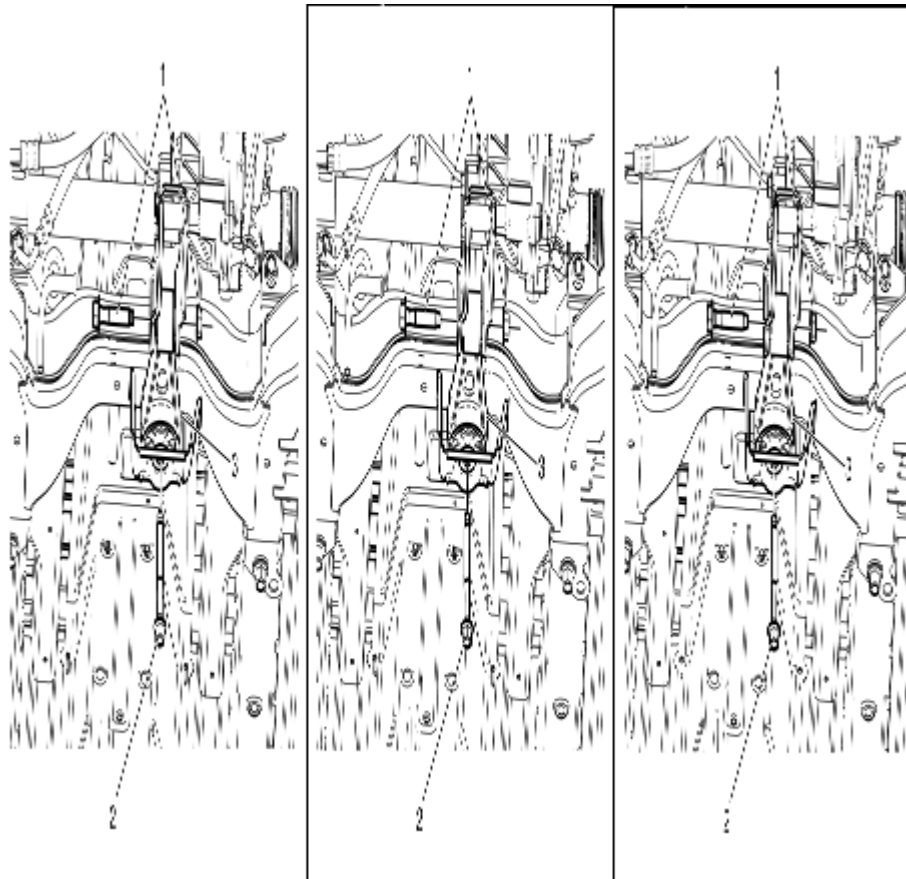


Fig. 20: Transmission Mounting Bracket Bolt And Nut And Torque Strut
Courtesy of GENERAL MOTORS COMPANY

6. Install the torque strut (3) from the frame.
7. Install the torque strut to the frame bolt (2) and tighten to 100 (74 lb ft).
8. Install the torque strut to the transmission mounting bracket bolt and nut (1) and tighten to 80 (59 lb ft).
9. Install the exhaust pipe. Refer to **Exhaust Front Pipe Replacement (LL0)** .
10. Connect both of the stabilizer shaft links to the struts and tighten the upper stabilizer shaft link nuts. Refer to **Stabilizer Shaft Link Replacement** .
11. Install both of the control arm ball joints to the steering knuckles. Refer to **Lower Control Arm Replacement** .
12. Remove the wires which secure the cooling module to the upper body structure.
13. Install the lower wind guard.
14. Install the front bumper fascia. Refer to **Front Bumper Fascia Replacement** .
15. Install both of the front wheel house linings.
16. Install the front under cover.
17. Install both of the front compartment splash shields. Refer to **Front Compartment Splash Shield Replacement**.
18. Install the front wheel and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** .
19. Lower the vehicle.

20. Road test the vehicle in order to test for the following conditions:

- Steering leads or pulls-Refer to **Wheel Alignment Measurement** .
- Abnormal powertrain noise or vibration at idle-Inspect the engine and transmission mounts for proper alignment and torque.

FRONT WHEELHOUSE LINER REPLACEMENT

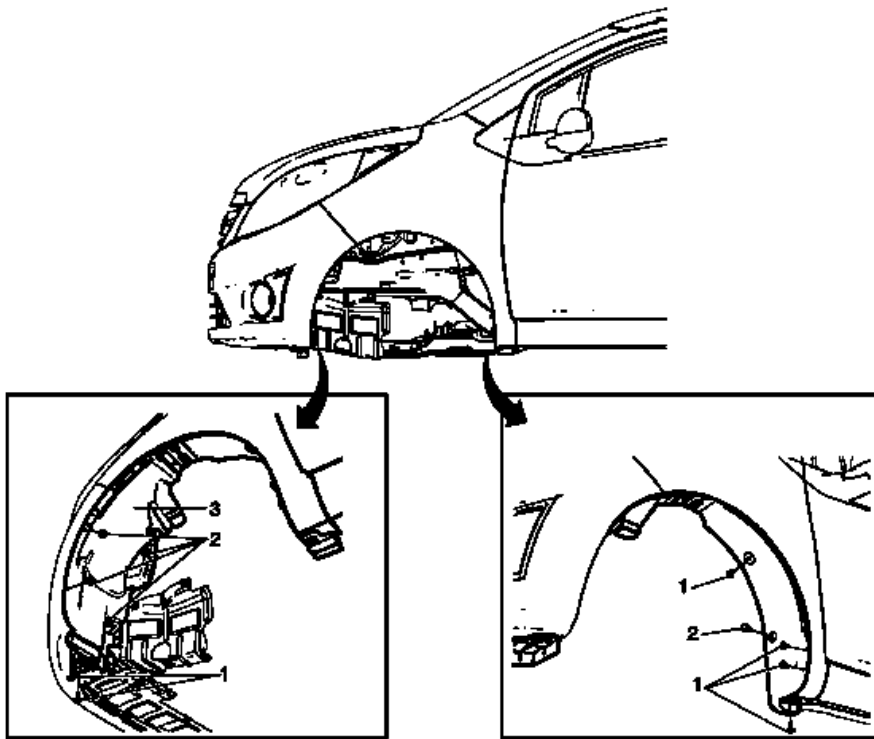


Fig. 21: Front Wheelhouse Liner
Courtesy of GENERAL MOTORS COMPANY

Front Wheelhouse Liner Replacement

Callout	Component Name
Preliminary Procedure Remove the tire and wheel assembly. Refer to <u>Tire and Wheel Removal and Installation</u> .	
1	Front Wheelhouse Liner Screw (Qty: 6) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 1.5 N.m (13 lb in)
2	Front Wheelhouse Liner Plastic Retainer (Qty: 5)
3	Front Wheelhouse Liner

REAR WHEELHOUSE LINER REPLACEMENT

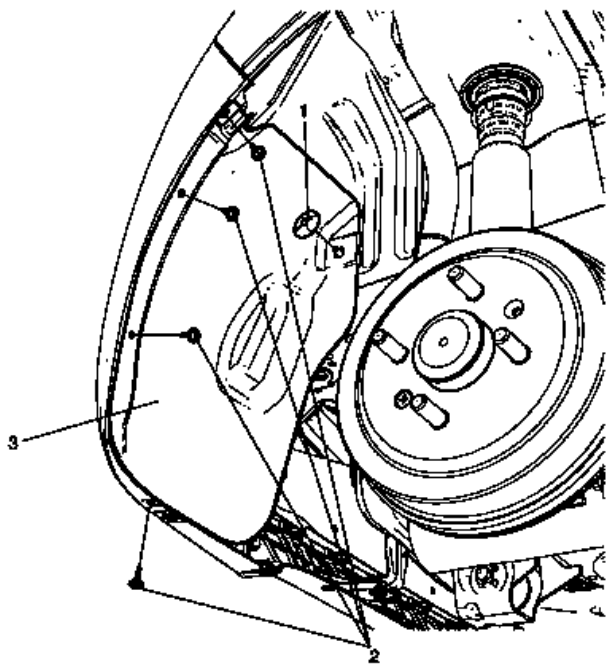


Fig. 22: Rear Wheelhouse Liner
Courtesy of GENERAL MOTORS COMPANY

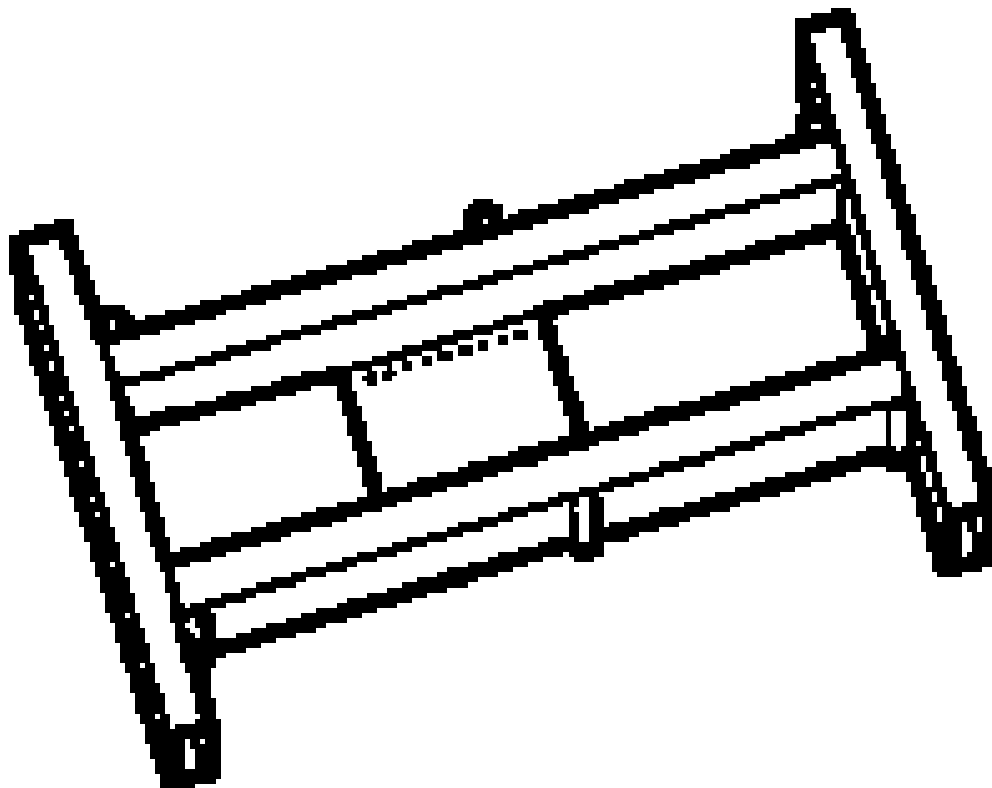
Rear Wheelhouse Liner Replacement

Callout	Component Name
1	Rear Wheelhouse Liner Retainer (Qty: 1)
2	Rear Wheelhouse Liner Screw (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2.5 (22 lb in)
3	Rear Wheelhouse Liner

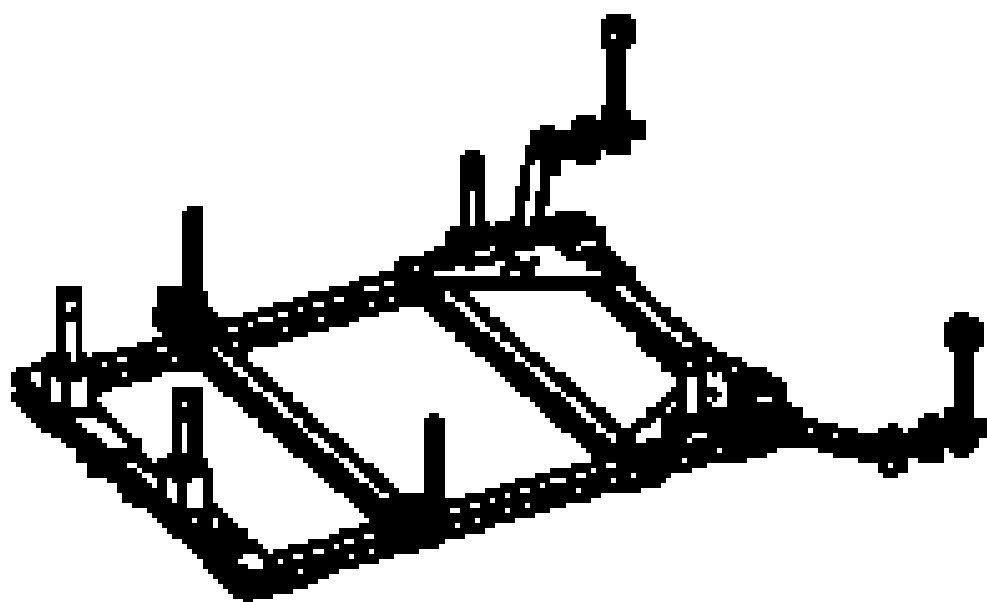
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

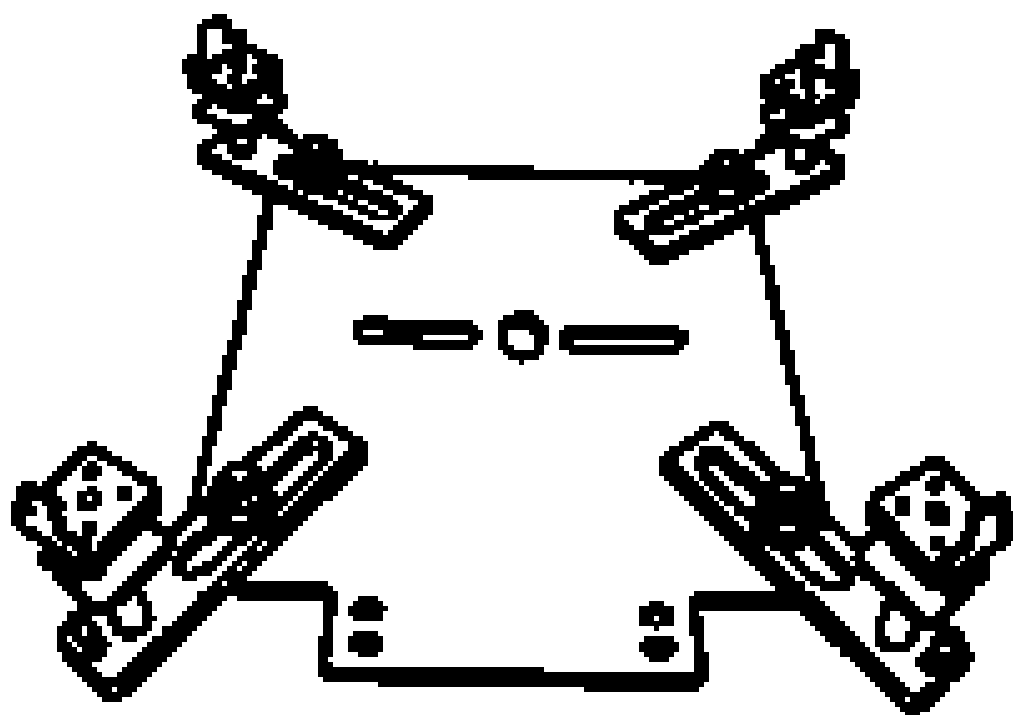
Illustration	Tool Number/ Description



CH-904
KM-904
Base Frame



CH-49289
Centering
Frame



EN-49802
Cradle
Supporter

SUSPENSION

Front Suspension - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Front Stabilizer Shaft Clamp Bolts	25	18 lb ft
Front Stabilizer Shaft Link to Stabilizer Bar Retaining Nuts	43	32 lb ft
Front Stabilizer Shaft Link to Strut Retaining Nuts	43	32 lb ft
Lower Control Arm Ball Joint to Steering Knuckle Retaining Bolt	65	48 lb ft
Lower Control Arm Rear Bushing Nut	110 + 53°	81 lb ft + 53°
Lower Control Arm to Cradle Retaining Bolts - Front	110	81 lb ft
Lower Control Arm to Cradle Retaining Bolts and Nuts - Rear	110	81 lb ft
Strut Nut	65	48 lb ft
Strut to Steering Knuckle Retaining Bolts and Nuts		
• First Pass	80	59 lb ft
• Final Pass	38 degrees	
Strut Upper Mounting Nut	65	48 lb ft

REPAIR INSTRUCTIONS

STABILIZER SHAFT REPLACEMENT

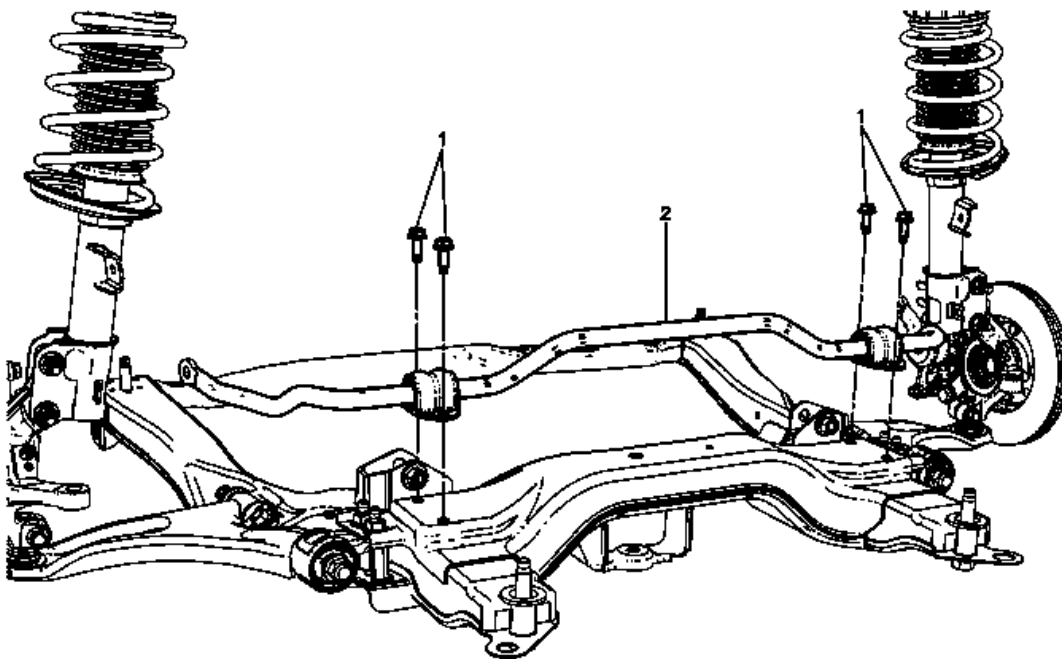


Fig. 1: Stabilizer Shaft
 Courtesy of GENERAL MOTORS COMPANY

Stabilizer Shaft Replacement

Callout	Component Name
Preliminary Procedure 1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Remove the front tire and wheel assemblies. Refer to <u>Tire and Wheel Removal and Installation</u> . 3. Separate both of the outer tie rod ends. Refer to <u>Steering Linkage Outer Tie Rod Replacement</u> . 4. Remove both of the stabilizer shaft links. Refer to <u>Stabilizer Shaft Link Replacement</u>.	
1	Front Stabilizer Shaft Clamp Bolt (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 25 N.m (18 lb ft)
2	Front Stabilizer Shaft

STABILIZER SHAFT LINK REPLACEMENT

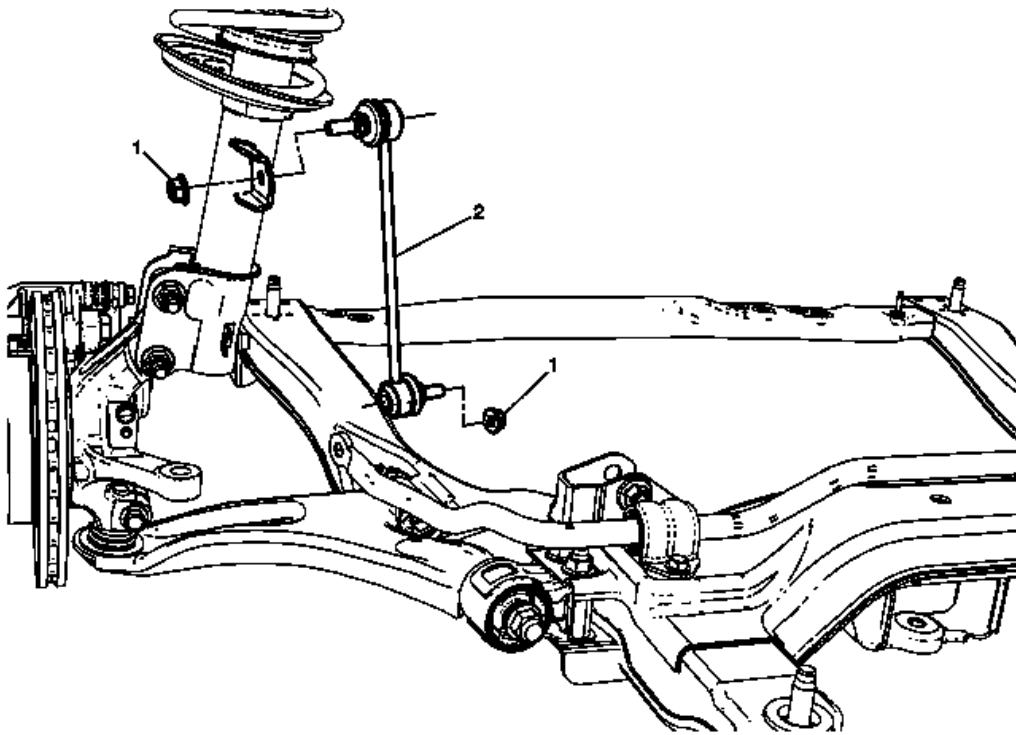


Fig. 2: Stabilizer Shaft Link
 Courtesy of GENERAL MOTORS COMPANY

Stabilizer Shaft Link Replacement

Callout	Component Name
Preliminary Procedure	
1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Remove the front tire and wheel assemblies. Refer to <u>Tire and Wheel Removal and Installation</u> .	
1	Front Stabilizer Shaft Link Nut (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . NOTE: 1. When removing the stabilizer shaft link nuts, remove both of the upper nuts first and then lift up the stabilizer bar ends in order to get the tool access to lower nuts. 2. When removing and installing nut, fix the rotational pivot bolt with the appropriate tool. Tighten 43 (32 lb ft)

STABILIZER SHAFT INSULATOR REPLACEMENT

The stabilizer shaft insulator is not serviced separately. If the stabilizer shaft insulator is defective, it will have to be replaced as the stabilizer shaft assembly. Refer to **Stabilizer Shaft Replacement**.

FRONT WHEEL BEARING AND HUB REPLACEMENT

Special Tools

- **CH-46560-04** Thread Rod (Component of DT-50178)
- **CH-46560-05** Hex Nut (Component of DT-50178)
- **DT-47540** Wheel Hub Spacer (Hub Removal & Installation Adapter, Component of DT-50178)
- **DT-47541** Wheel Bearing Spacer (Wheel Bearing Removal Adapter, Component of DT-50178)
- **DT-47542** Wheel Bearing Spacer (Hub & Bearing Installation Plate, Component of DT-50178)
- **DT-47543** Wheel Bearing Spacer (Wheel Bearing Installation Adapter, Component of DT-50178)
- **DT-50178** Hub/Bearing Remover/Installer Kit
- **DT-50178-01** Bridge Support (Component of DT-50178)

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the front wheel and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
3. Remove the brake rotor. Refer to **Front Brake Rotor Replacement** .
4. Remove the steering knuckle assembly. Refer to **Steering Knuckle Replacement**.
5. Use a vice in order to hold the steering knuckle assembly.

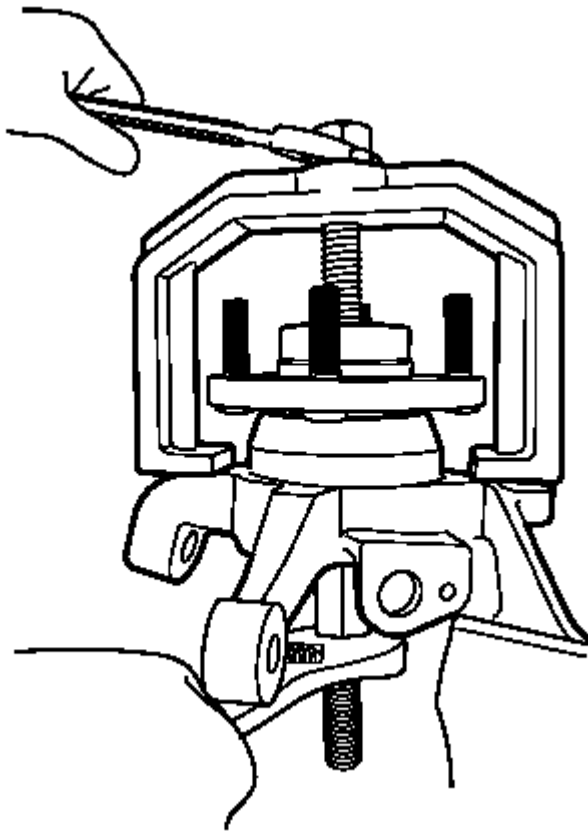


Fig. 3: Removing Wheel Hub From Steering Knuckle Using Tools
Courtesy of GENERAL MOTORS COMPANY

6. Using the **DT-50178-01** bridge support, **CH-46560-04** thread rod, **CH-46560-05** hex nut, and **DT-47540** wheel hub spacer, remove the wheel hub from the steering knuckle.

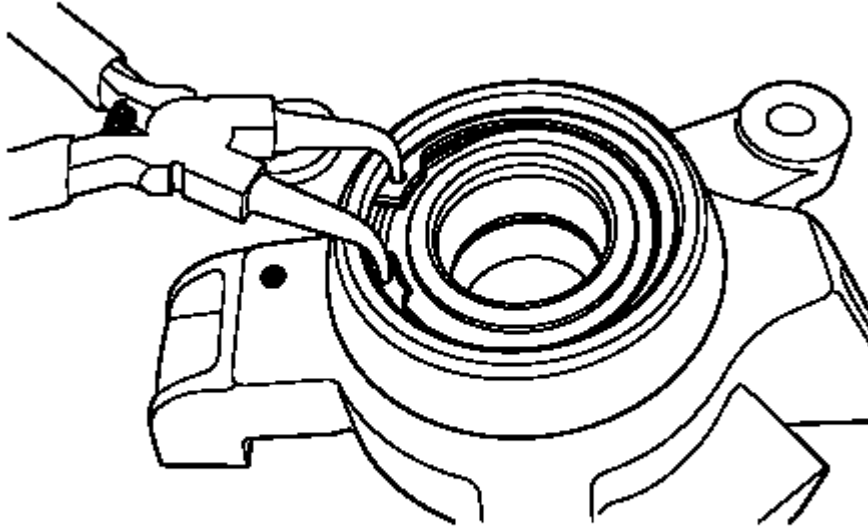


Fig. 4: Wheel Bearing Retaining Ring And Steering Knuckle
Courtesy of GENERAL MOTORS COMPANY

7. Remove the wheel bearing retaining ring from the steering knuckle.

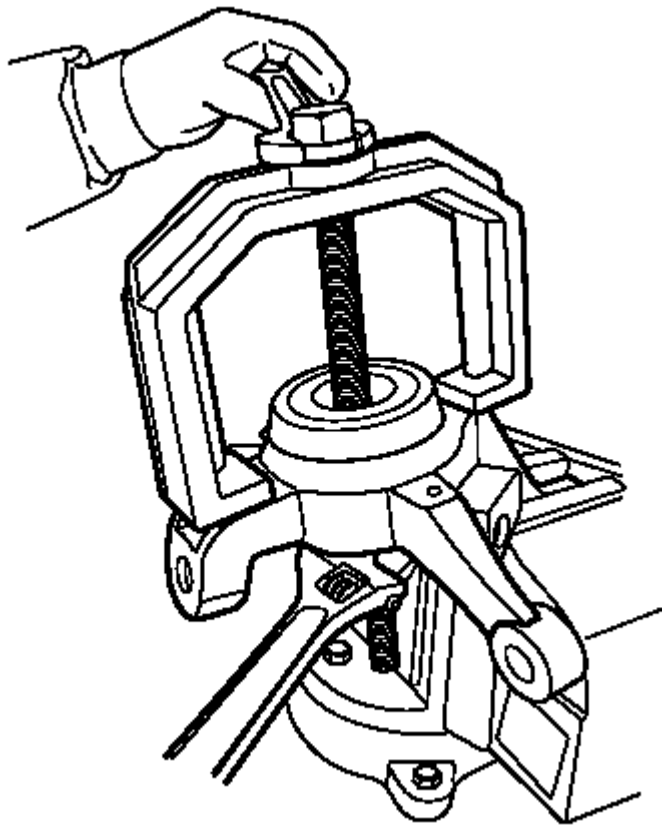


Fig. 5: Removing Wheel Bearing From Steering Knuckle
Courtesy of GENERAL MOTORS COMPANY

8. Using the **DT-50178-01** bridge support, **CH-46560-04** thread rod, **CH-46560-05** hex nut, and **DT-47541** wheel bearing spacer, remove the wheel bearing from the steering knuckle.

Discard the wheel bearing.

9. Clean the bore of the steering knuckle.

Installation Procedure

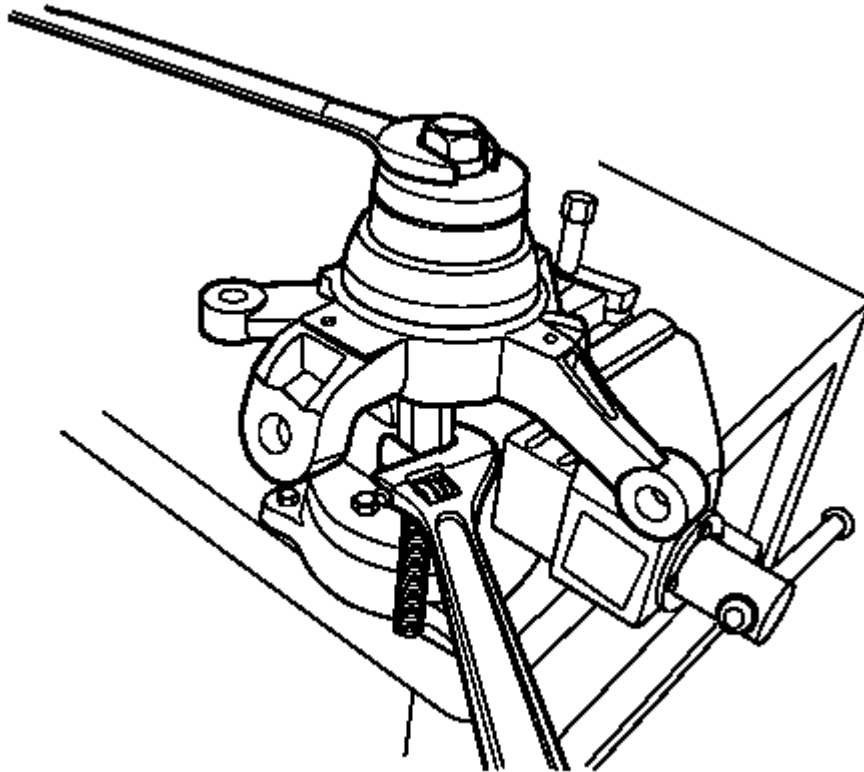


Fig. 6: Steering Knuckle And Wheel Bearing
Courtesy of GENERAL MOTORS COMPANY

1. Use a vice in order to hold the steering knuckle.
2. Using the **DT-47542** wheel bearing spacer, **CH-46560-04** thread rod, **CH-46560-05** hex nut, and **DT-47543** wheel bearing spacer, install the NEW wheel bearing to the steering knuckle.

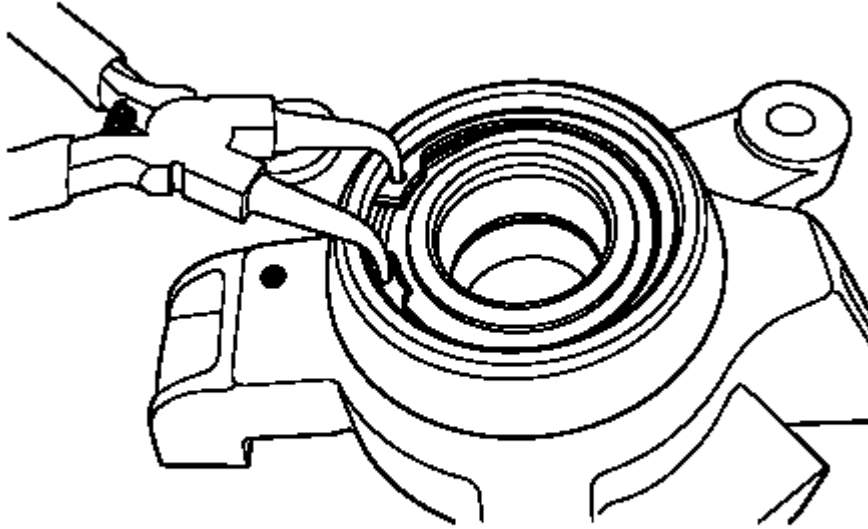


Fig. 7: Wheel Bearing Retaining Ring And Steering Knuckle
Courtesy of GENERAL MOTORS COMPANY

3. Install the wheel bearing retaining ring to the steering knuckle.

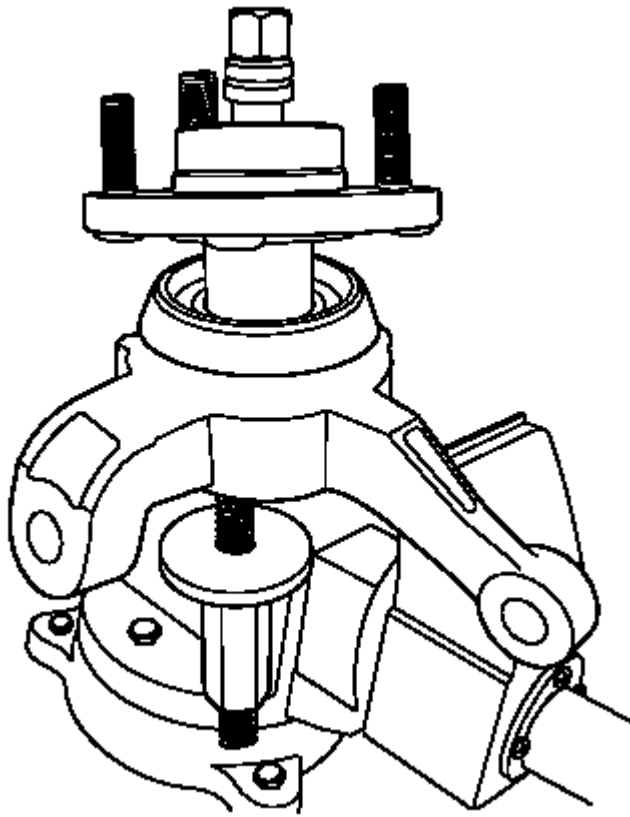


Fig. 8: Wheel Hub And Steering Knuckle
Courtesy of GENERAL MOTORS COMPANY

4. Using the **DT-47542** wheel bearing spacer, **CH-46560-04** thread rod, **CH-46560-05** hex nut, and **DT-47540** wheel hub spacer, install the wheel hub to the steering knuckle.
5. Verify that the wheel hub rotates smoothly.
6. Install the steering knuckle assembly. Refer to **Steering Knuckle Replacement**.
7. Install the brake rotor. Refer to **Front Brake Rotor Replacement**.
8. Install the front wheel and wheel assembly. Refer to **Tire and Wheel Removal and Installation**.
9. Lower the vehicle.

STEERING KNUCKLE REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**.
2. Remove the front tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation**.
3. Disconnect the outer tie rod end from the steering knuckle. Refer to **Steering Linkage Outer Tie Rod Replacement**.
4. Separate the control arm ball joint from the steering knuckle. Refer to **Lower Control Arm Replacement**.

5. Separate the wheel drive shaft from the steering knuckle. Refer to **Front Wheel Drive Shaft Replacement** .
6. Remove the brake rotor. Refer to **Front Brake Rotor Replacement** .
7. Remove the wheel speed sensor, if equipped with ABS. Refer to **Front Wheel Speed Sensor Replacement (Right Side)** , **Front Wheel Speed Sensor Replacement (Left Side)** .
8. Remove the brake rotor splash shield from the steering knuckle. Refer to **Front Brake Shield Replacement** .

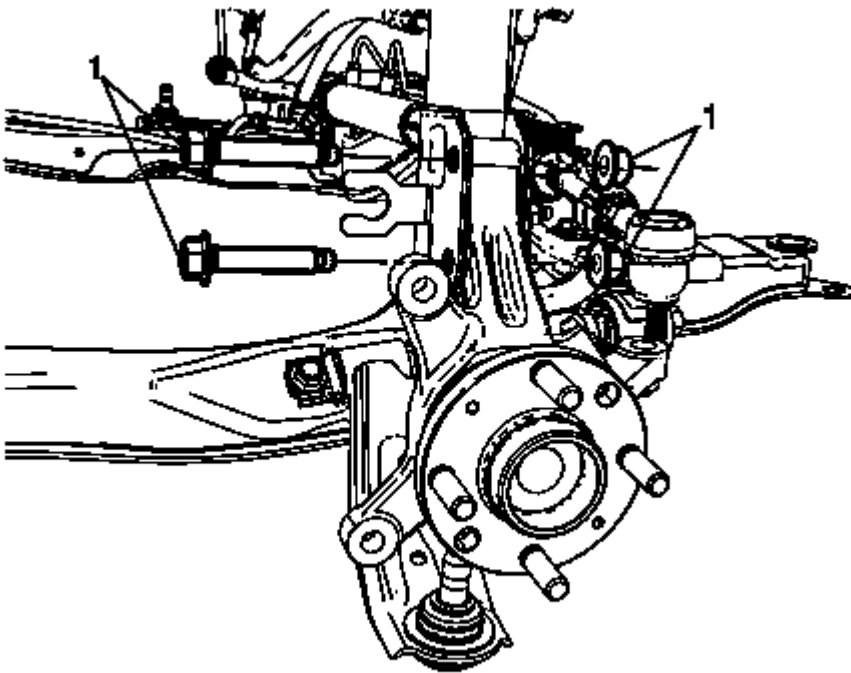


Fig. 9: Knuckle, Bolts And Nuts
Courtesy of GENERAL MOTORS COMPANY

9. Remove the bolts and nuts (1) attaching the strut to the knuckle.

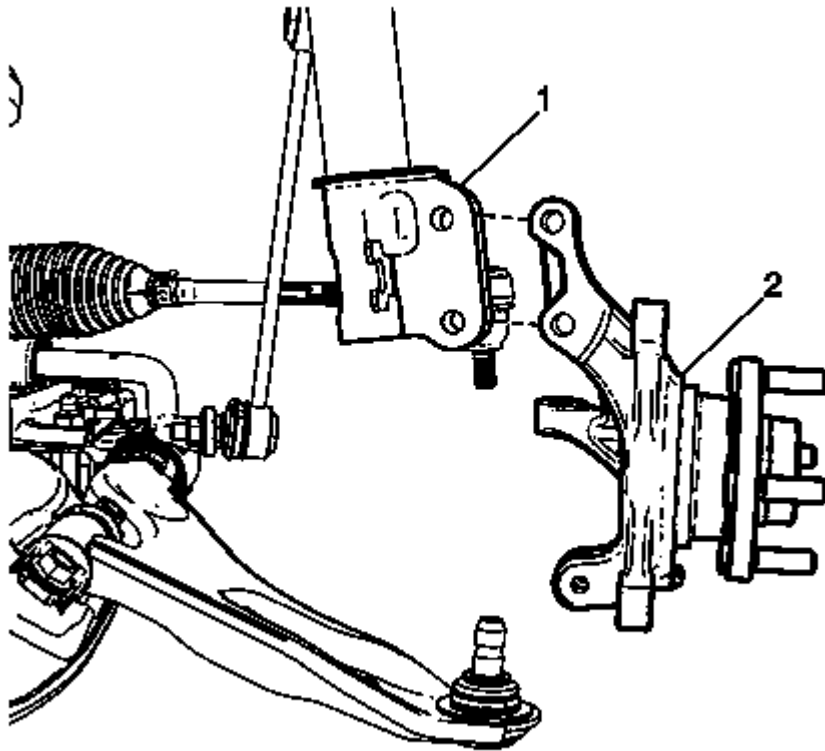


Fig. 10: Steering Knuckle Assembly
Courtesy of GENERAL MOTORS COMPANY

10. Remove the steering knuckle assembly (2) from the strut assembly (1).

Installation Procedure

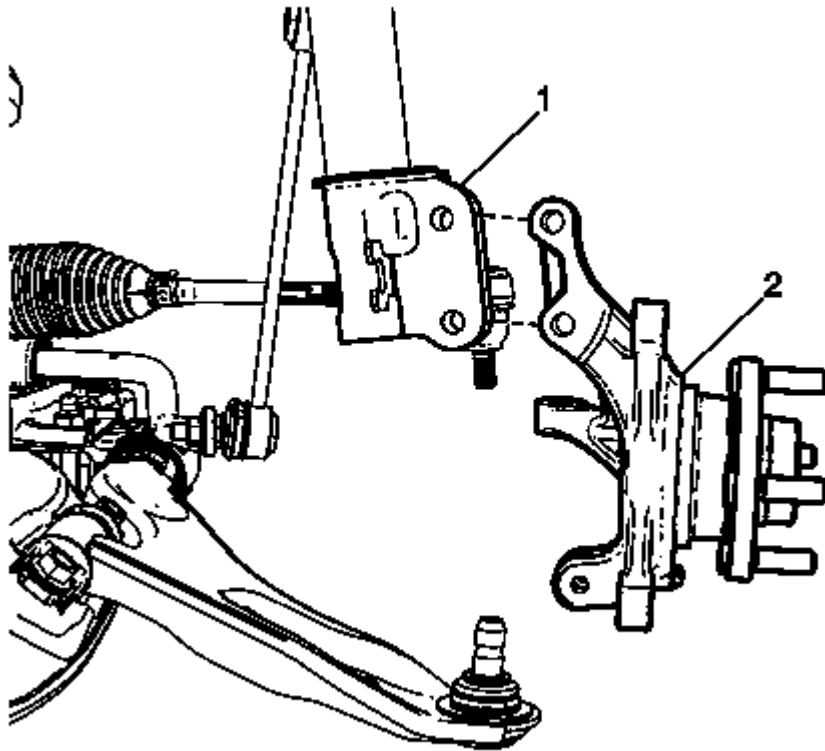


Fig. 11: Steering Knuckle Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Install the steering knuckle assembly (2) to the strut assembly (1).

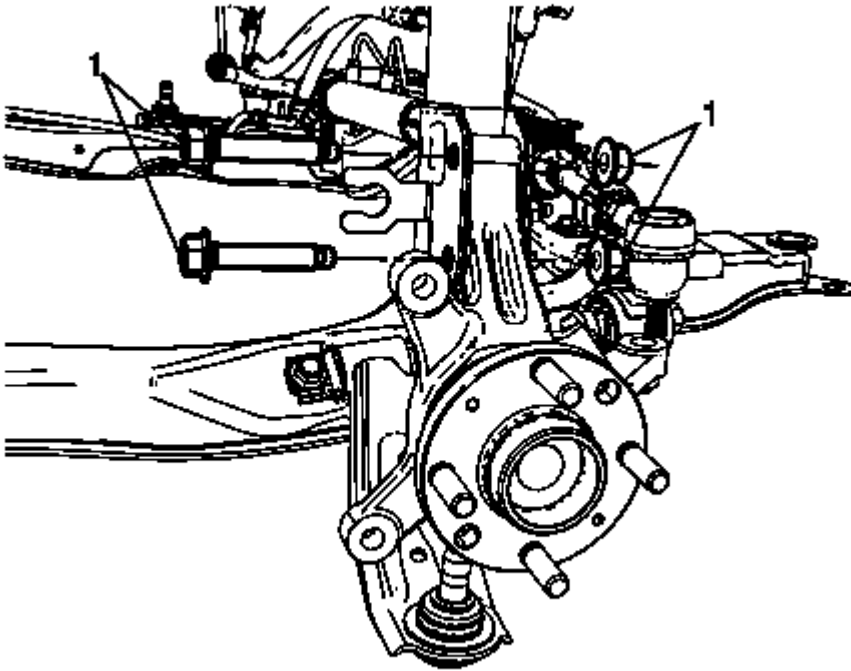


Fig. 12: Knuckle, Bolts And Nuts
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

2. Install the strut to knuckle retaining bolts and nuts (1) and tighten to 80 (59 lb ft).
3. Tighten the nuts at the final pass to an additional 38 degrees.
4. Install the brake rotor splash shield to the steering knuckle. Refer to **Front Brake Shield Replacement** .
5. Install the wheel speed sensor, if equipped with ABS. Refer to **Front Wheel Speed Sensor Replacement (Right Side)** , **Front Wheel Speed Sensor Replacement (Left Side)** .
6. Install the brake rotor. Refer to **Front Brake Rotor Replacement** .
7. Install the wheel drive shaft to the steering knuckle. Refer to **Front Wheel Drive Shaft Replacement** .
8. Install the control arm ball joint to the steering knuckle. Refer to **Lower Control Arm Replacement**.
9. Install the outer tie rod end to the steering knuckle. Refer to **Steering Linkage Outer Tie Rod Replacement** .
10. Install the front tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
11. Lower the vehicle.

LOWER CONTROL ARM REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
2. Remove the tire and wheel assembly. Refer to Tire and Wheel Removal and Installation .

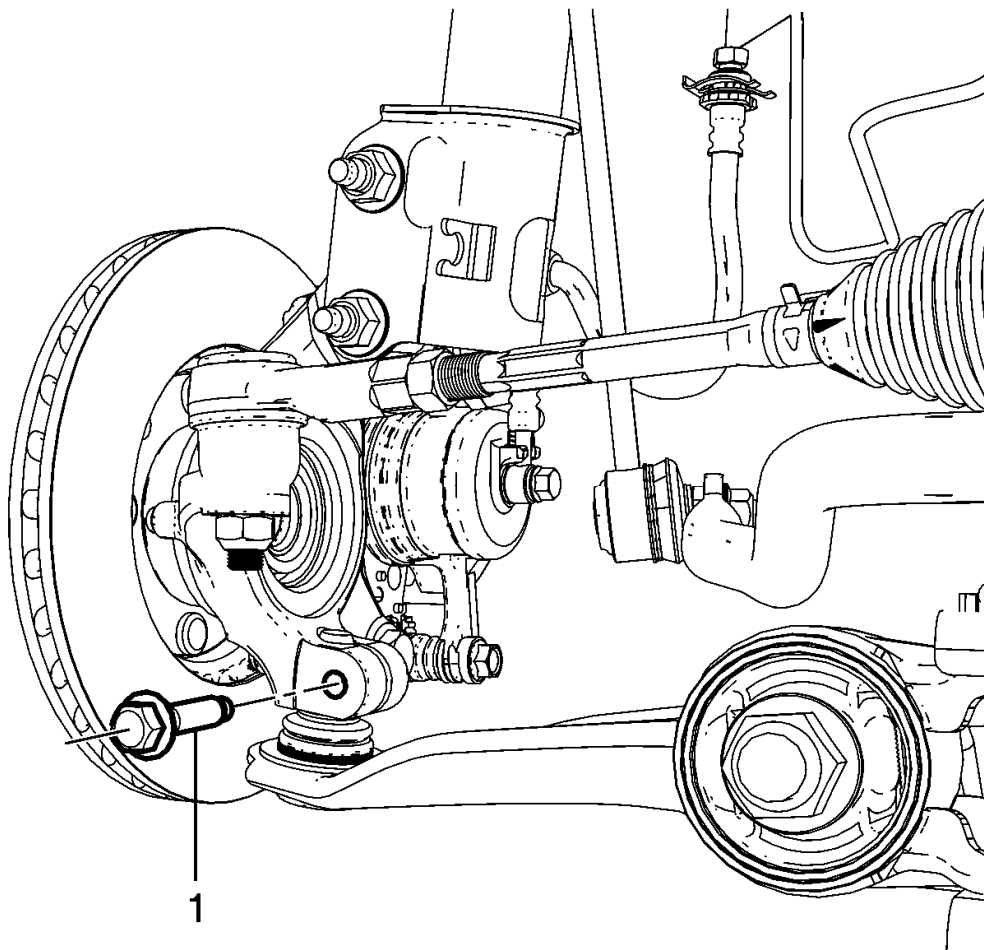


Fig. 13: Steering Knuckle Retaining Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Remove the lower control arm ball joint to steering knuckle retaining bolt (1) and separate the ball joint from the steering knuckle.

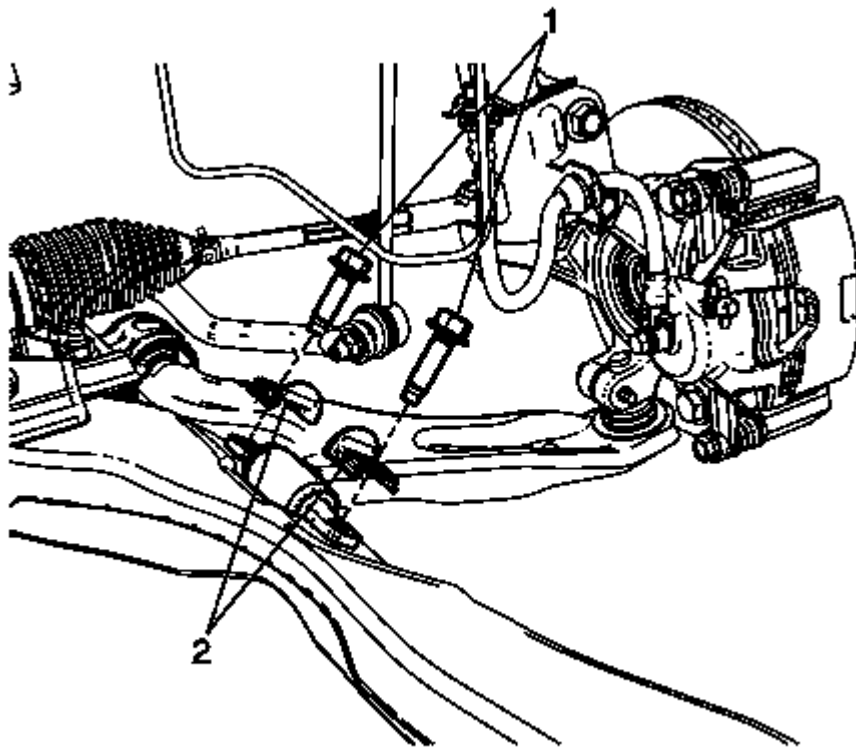


Fig. 14: Cradle Bolts And Front Lower Control Bushing Brackets
Courtesy of GENERAL MOTORS COMPANY

4. Remove the front lower control arm to cradle bolts (1) and the front lower control bushing brackets (2).

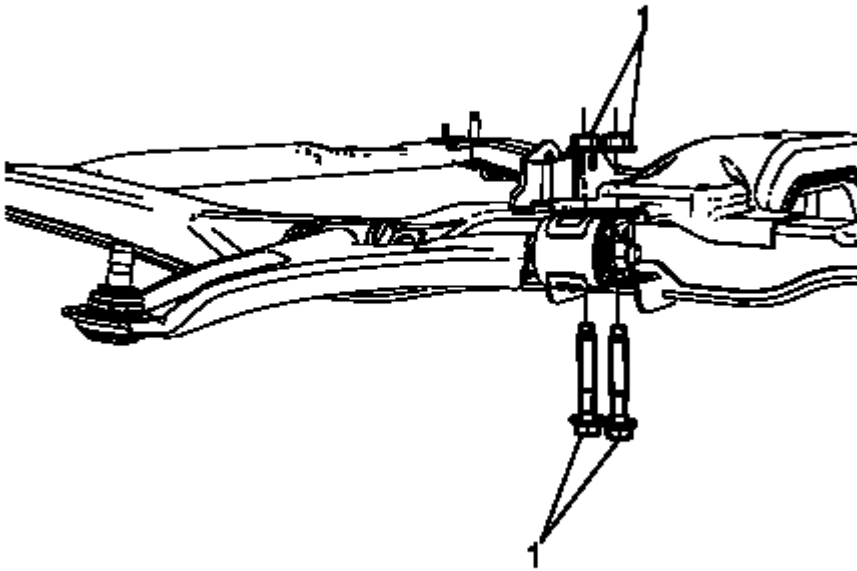


Fig. 15: Rear Lower Control Arm And Cradle Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the rear lower control arm to cradle bolts and nuts (1).

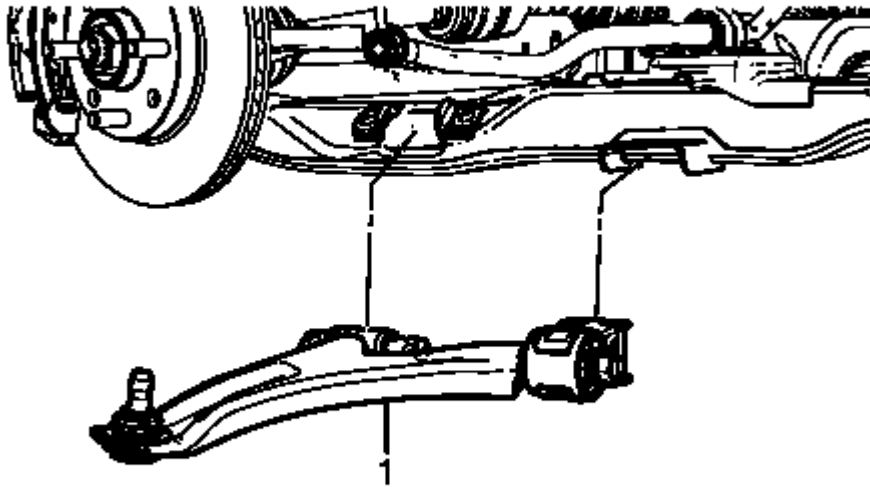


Fig. 16: Lower Control Arm

Courtesy of GENERAL MOTORS COMPANY

6. Remove the lower control arm (1) from the cradle.

Installation Procedure

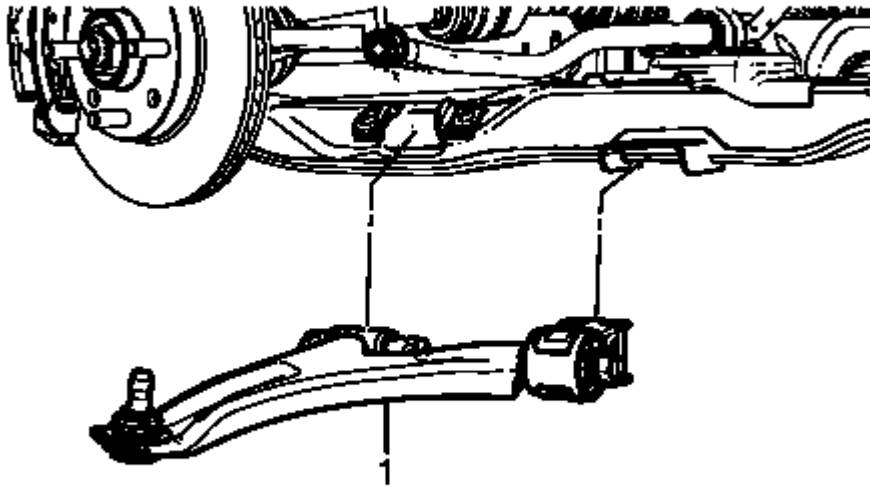


Fig. 17: Lower Control Arm

Courtesy of GENERAL MOTORS COMPANY

1. Position the lower control arm (1) in the vehicle.

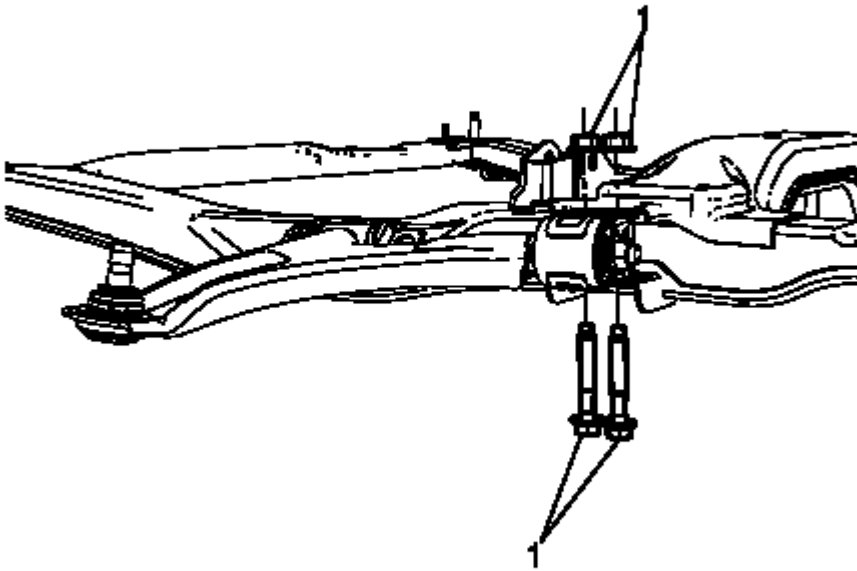


Fig. 18: Rear Lower Control Arm And Cradle Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

2. Install the rear lower control arm to cradle bolts and nuts (1) and tighten to 110 N.m (81 lb ft).

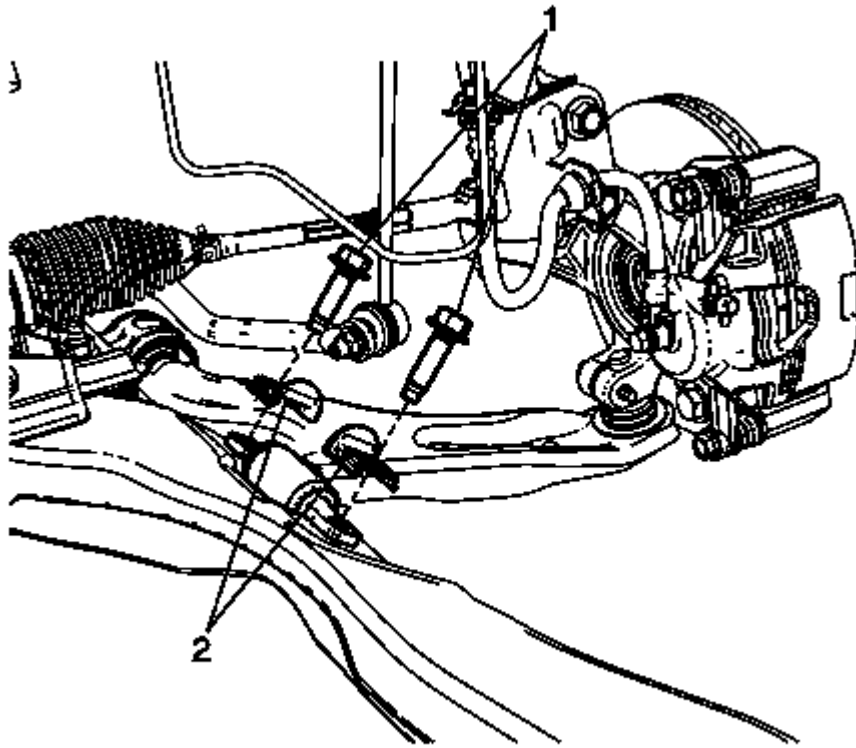


Fig. 19: Cradle Bolts And Front Lower Control Bushing Brackets
Courtesy of GENERAL MOTORS COMPANY

3. Install the front lower control arm bushing brackets (2) and the front lower control arm to cradle bolts (1) and tighten to 110 N.m (81 lb ft).

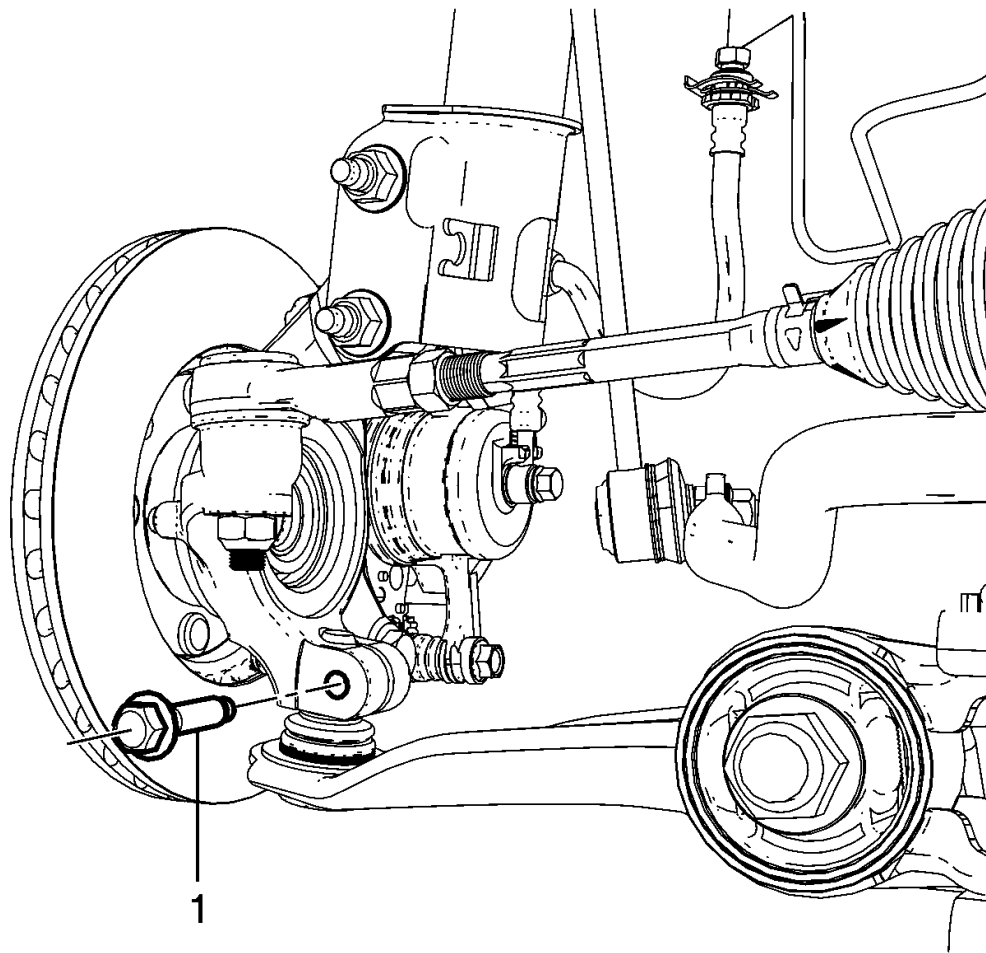


Fig. 20: Steering Knuckle Retaining Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Install the lower control arm ball joint to the steering knuckle.
5. Install the lower control arm ball joint to steering knuckle retaining bolt (1) and tighten to 65 N.m (48 lb ft).
6. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
7. Lower the vehicle to the ground.

FRONT LOWER CONTROL ARM BUSHING REPLACEMENT

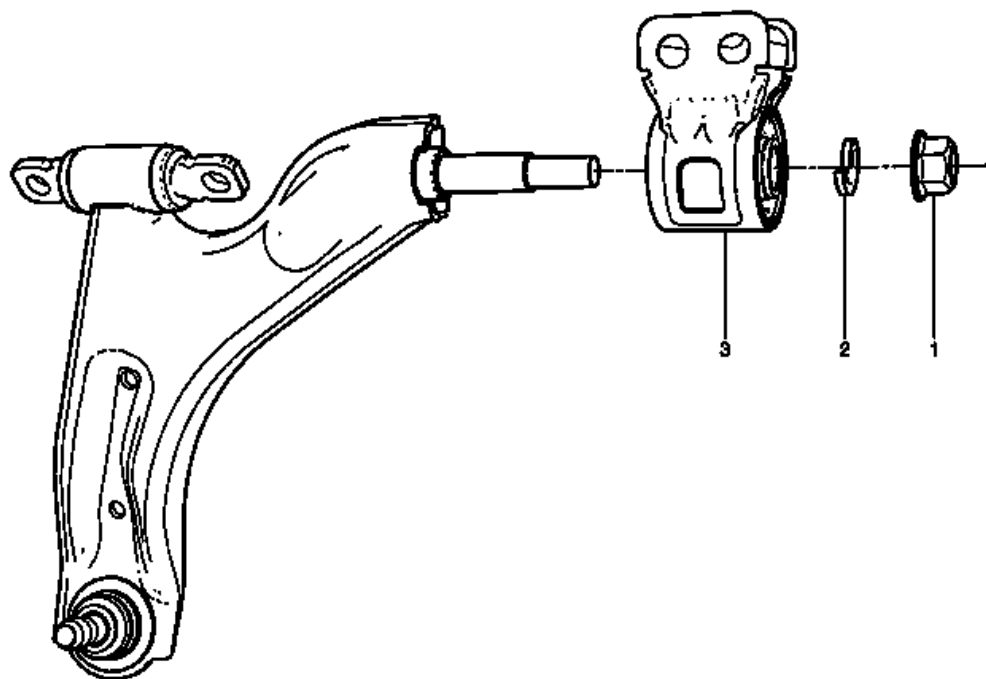


Fig. 21: Front Lower Control Arm Bushing
 Courtesy of GENERAL MOTORS COMPANY

Front Lower Control Arm Bushing Replacement

Callout	Component Name
Preliminary Procedure 1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Remove the front tire and wheel assemblies. Refer to <u>Tire and Wheel Removal and Installation</u> . 3. Remove the lower control arm. Refer to <u>Lower Control Arm Replacement</u>.	
1	Lower Control Arm Rear Bushing Nut CAUTION: Refer to <u>Fastener Caution</u> . TIP: Note the position of the bushing during removal. Tighten 110 N.m + 53° (81 lb ft + 53°)
2	Washer
3	Lower Control Arm Rear Bushing Procedure Hold the rear bushing when tightening the rear bushing bolt.

WHEEL STUD REPLACEMENT

Special Tools

CH-43631 Ball Joint Remover

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
3. Without disconnecting the hydraulic brake flex hose, remove and support the brake caliper and bracket as an assembly, and remove the brake rotor. Refer to **Front Brake Rotor Replacement** .
4. Remove the front wheel hub. Refer to **Front Wheel Bearing and Hub Replacement**.

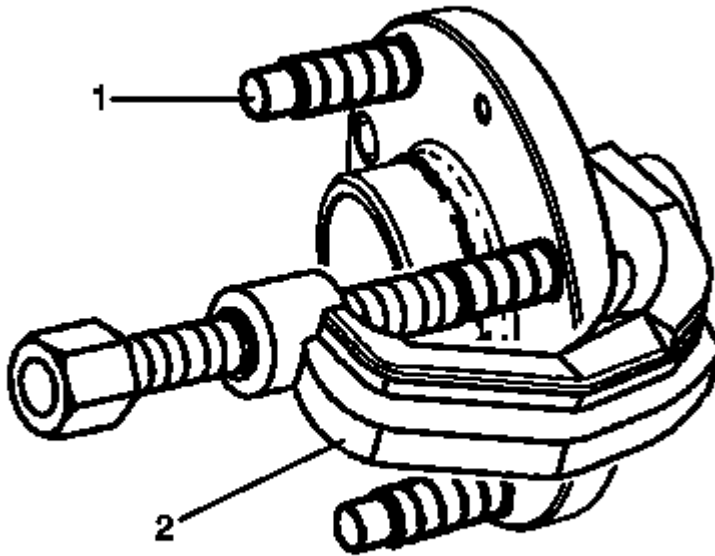


Fig. 22: Wheel Stud And Separator
Courtesy of GENERAL MOTORS COMPANY

5. Using the **CH-43631** ball joint remover (2), remove the wheel stud (1) from the hub and discard the stud.

Installation Procedure

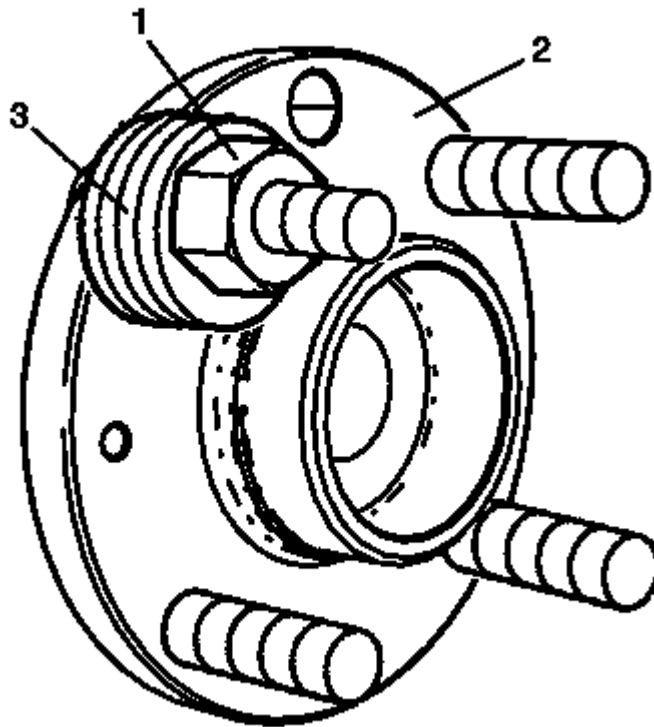


Fig. 23: Wheel Hub Flange, Lug Nut And Washers
Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW wheel stud to the wheel hub.
2. Add enough washers (3) in order to draw the stud into the hub.
3. Install the wheel nut (1).
4. Tighten the wheel nut until the head of the wheel stud is fully seated against the back of the wheel hub flange (2).
5. Remove the wheel nut (1) and the washers (3).
6. Install the front wheel hub. Refer to **Front Wheel Bearing and Hub Replacement**.
7. Install the brake rotor, and install the brake caliper and bracket as an assembly. Refer to **Front Brake Rotor Replacement** .
8. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
9. Lower the vehicle.

STRUT ASSEMBLY REMOVAL AND INSTALLATION

Special Tools

CH-49375 Wrench

For equivalent regional tools, refer to **Special Tools**.

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .

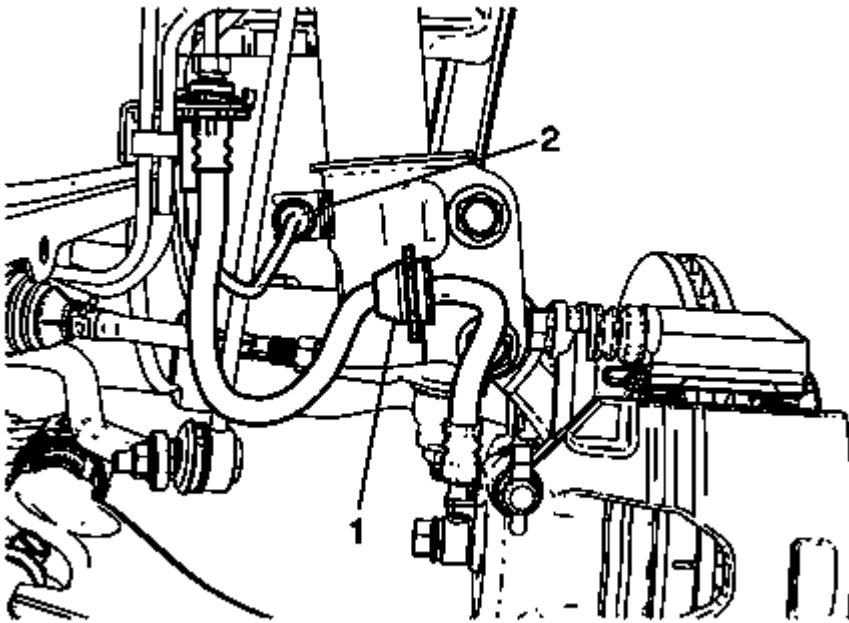


Fig. 24: Brake Hose Grommet

Courtesy of GENERAL MOTORS COMPANY

3. Detach the brake hose grommet (1) from the strut bracket.
4. Detach the wheel speed sensor wiring harness grommet (2) from the strut bracket, if equipped with ABS.

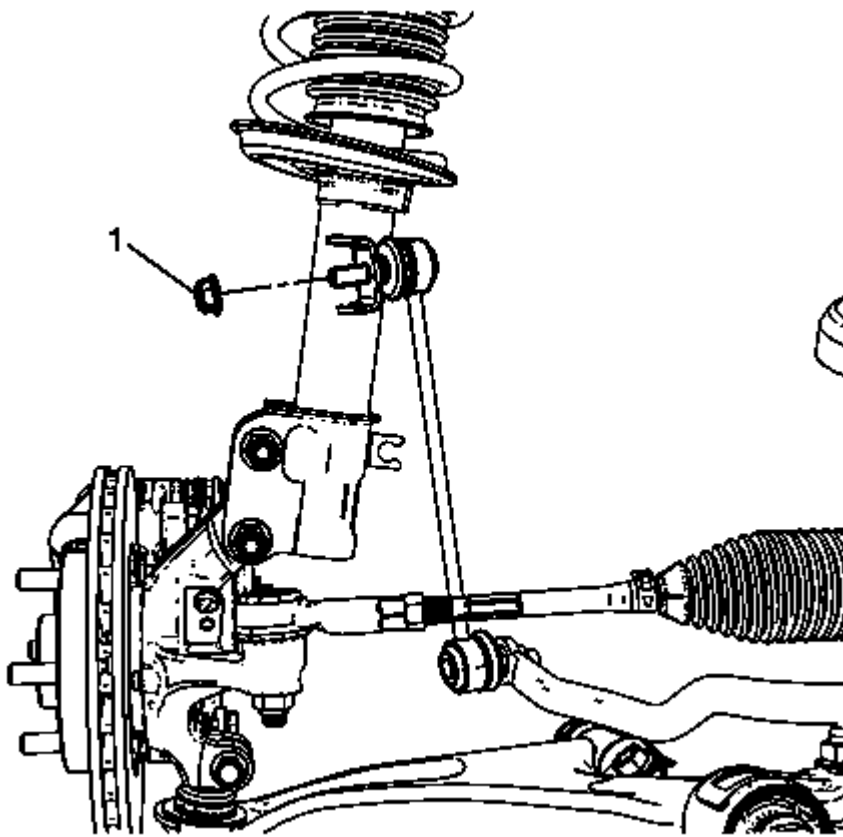


Fig. 25: Stabilizer Shaft Link And Strut Retaining Nut
Courtesy of GENERAL MOTORS COMPANY

5. Remove the stabilizer shaft link to strut retaining nut (1) and separate the stabilizer link from the strut.

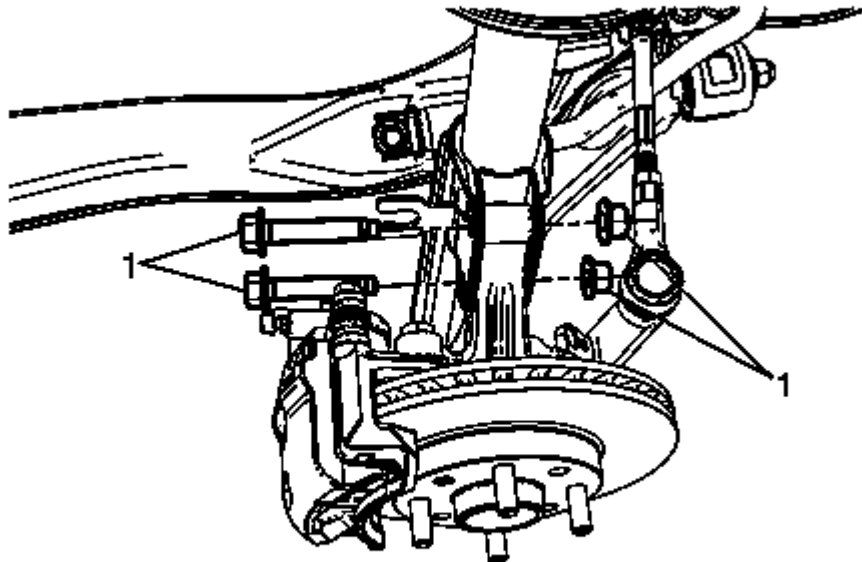


Fig. 26: Steering Knuckle To Strut Bolts And Nuts
Courtesy of GENERAL MOTORS COMPANY

6. Remove the steering knuckle to strut bolts and nuts (1).
7. Lower the vehicle.
8. Remove the plenum lower panel. Refer to **Plenum Lower Panel Replacement** .

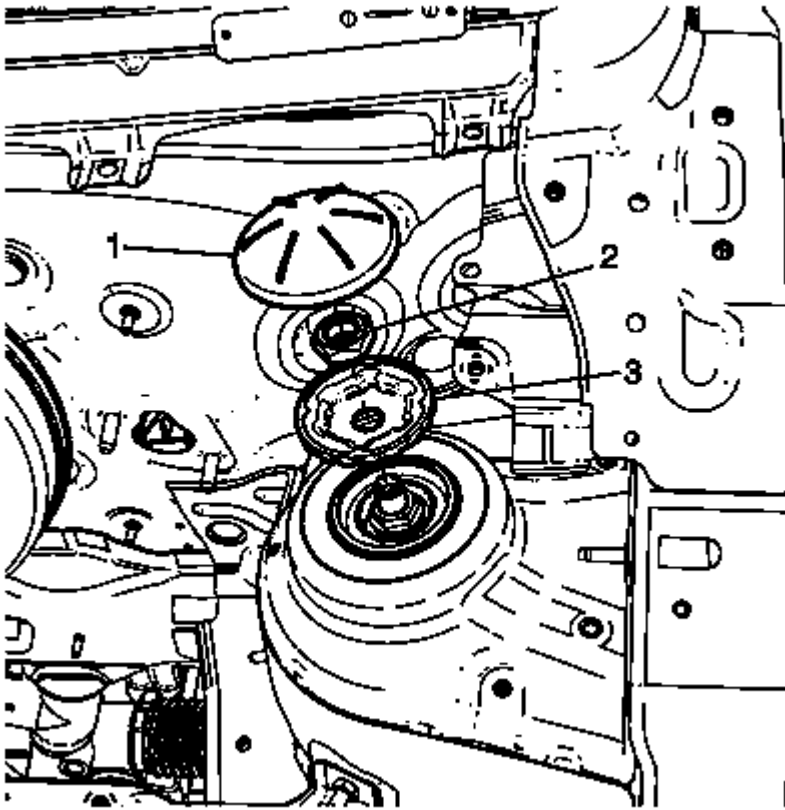


Fig. 27: Strut Cover

Courtesy of GENERAL MOTORS COMPANY

9. Remove the strut cover (1).

CAUTION: Completely fix the strut pivot with the special tool not to rotate when removing the strut upper mounting nut. Failure to do this could cause damage to the vehicle or component.

10. Using the **CH-49375** wrench, remove the strut upper mounting nut (2).
11. Remove the strut mounting plate (3).
12. Separate the front strut from the steering knuckle.
13. Remove the front strut assembly from the vehicle.

Installation Procedure

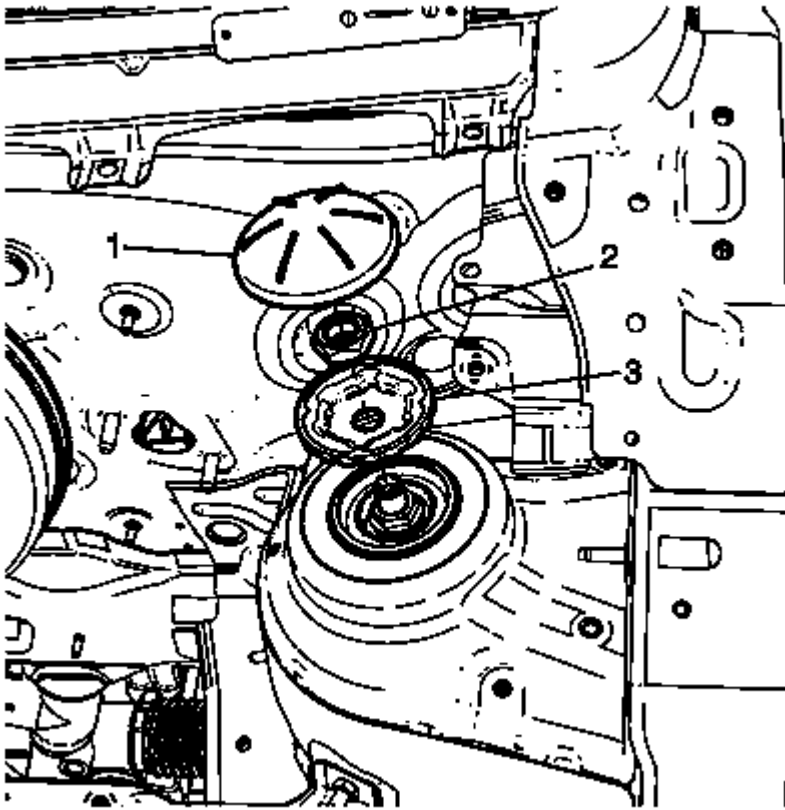


Fig. 28: Strut Cover

Courtesy of GENERAL MOTORS COMPANY

1. Install the front strut assembly to the vehicle.
2. Install the strut mounting plate (3).

CAUTION: Refer to Fastener Caution .

CAUTION: Completely fix the strut pivot with the special tool not to rotate when removing the strut upper mounting nut. Failure to do this could cause damage to the vehicle or component.

3. Using the **CH-49375** wrench, install the strut upper mounting nut (2) and tighten to 65 (48 lb ft).
4. Install the strut cover (1).
5. Install the plenum lower panel. Refer to Plenum Lower Panel Replacement .

CAUTION: Refer to Vehicle Lifting and Jacking Caution .

6. Raise and support the vehicle.

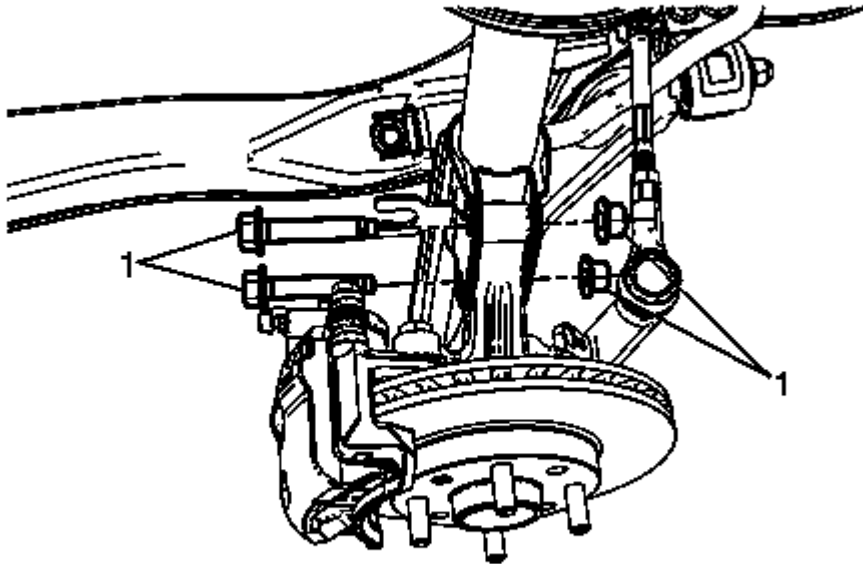


Fig. 29: Steering Knuckle To Strut Bolts And Nuts
Courtesy of GENERAL MOTORS COMPANY

7. Install the front strut to the steering knuckle.
8. Install the steering knuckle to strut retaining bolts and nuts (1) and tighten to 80 (59 lb ft).
9. Tighten the nuts at the final pass to an additional 38 degrees.

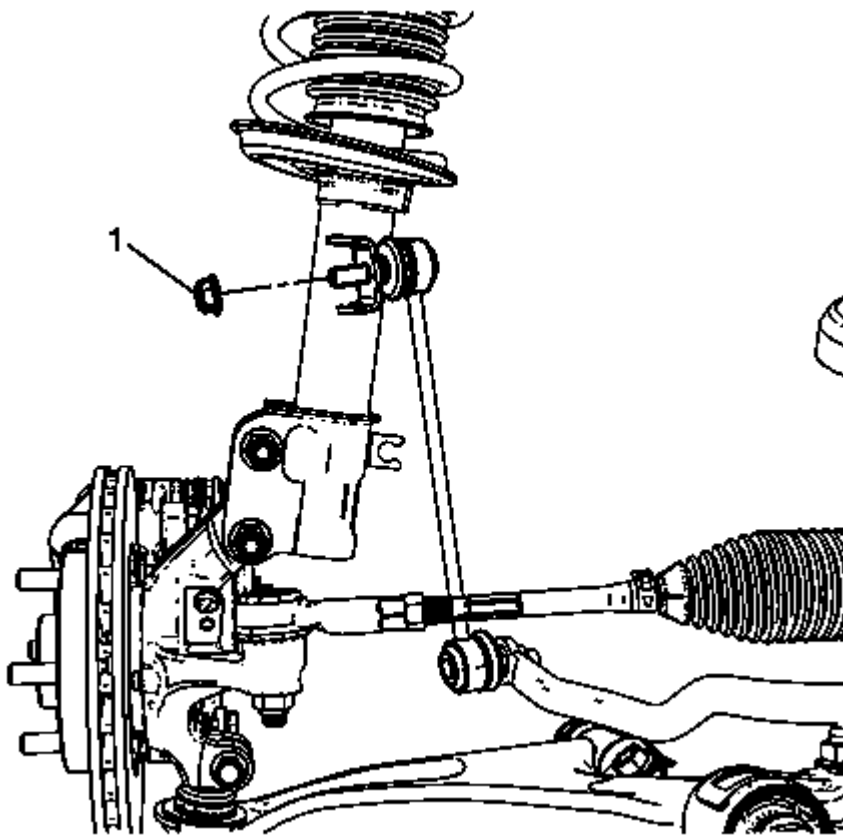


Fig. 30: Stabilizer Shaft Link And Strut Retaining Nut
Courtesy of GENERAL MOTORS COMPANY

10. Install the stabilizer link to the strut and install the stabilizer shaft link to strut retaining nut (1) and tighten to 43 (32 lb ft).

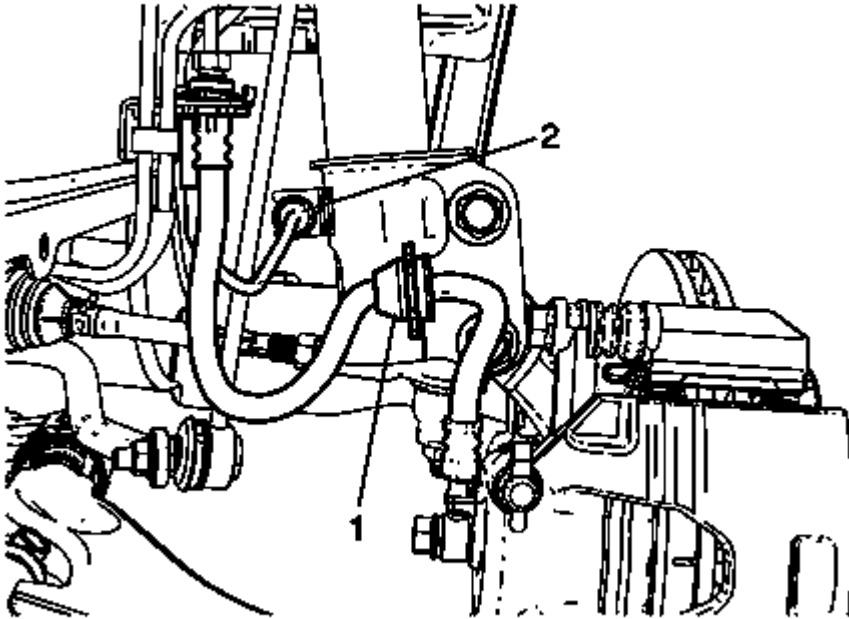


Fig. 31: Brake Hose Grommet

Courtesy of GENERAL MOTORS COMPANY

11. Install the wheel speed sensor wiring harness grommet (2) to the strut bracket, if equipped with ABS.
12. Install the brake hose grommet (1) to the strut bracket.
13. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
14. Lower the vehicle.
15. Check the front wheel alignment. Refer to **Wheel Alignment Specifications** .

SHOCK ABSORBER DISPOSAL

WARNING: Use the proper eye protection when drilling to prevent metal chips from causing physical injury.

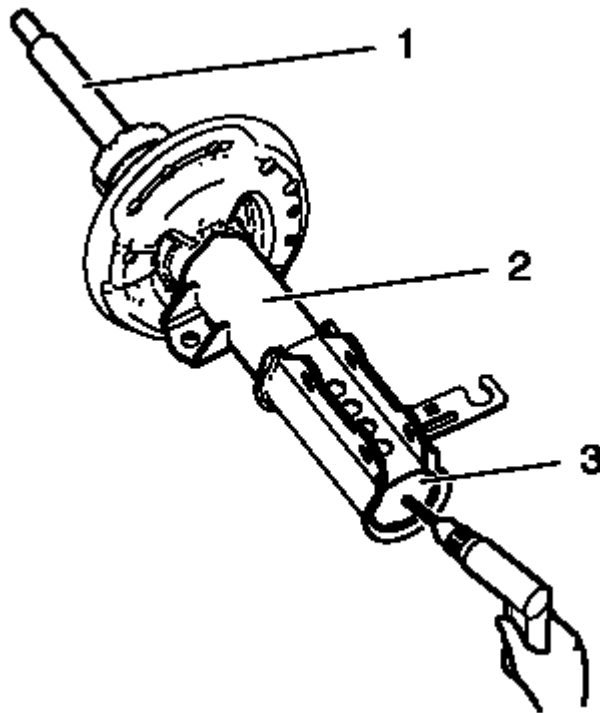


Fig. 32: Drilling A Hole In Strut At Center Of End Cap Using Drill Bit
Courtesy of GENERAL MOTORS COMPANY

1. Clamp the strut in a vise horizontally with the rod (1) completely extended.
2. Drill a hole in the strut at the center of the end cap (3) using a 5 mm (3/16 in) drill bit. Gas or a gas/oil mixture will exhaust when the drill bit penetrates the strut. Use shop towels in order to contain the escaping oil.
3. Remove the strut from the vise.
4. Hold the strut over a drain pan vertically with the hole down.
5. Move the rod (1) in and out of the tube (2) to completely drain the oil from the strut.

STRUT, STRUT COMPONENT, OR SPRING REPLACEMENT

Special Tools

CH-46558 Front Spring Compressor

For equivalent regional tools, refer to **Special Tools**.

Disassembly Procedure

1. Remove the strut assembly. Refer to **Strut Assembly Removal and Installation**.

2. Install the strut assembly to the vise.

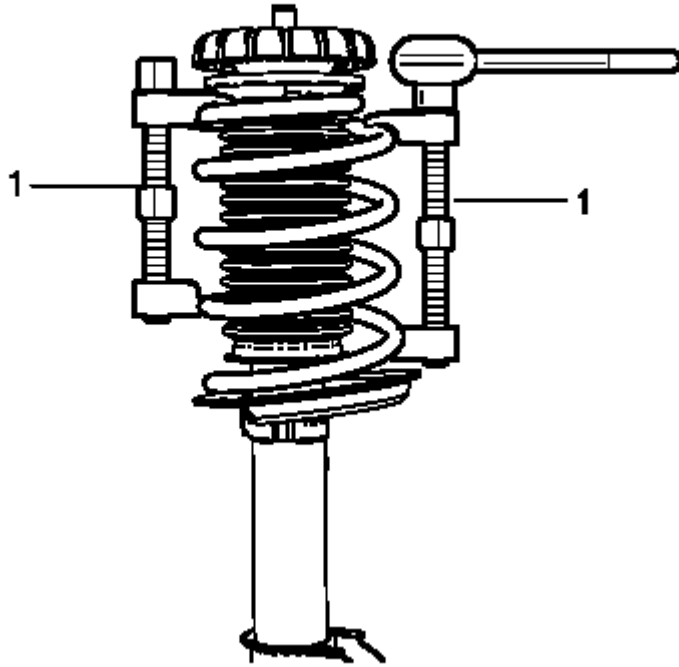


Fig. 33: View Of CH-46558 Front Spring Compressor
Courtesy of GENERAL MOTORS COMPANY

3. Install the **CH-46558** front spring compressor (1) to the coil spring.
4. Compress the coil spring using the **CH-46558** front spring compressor (1).

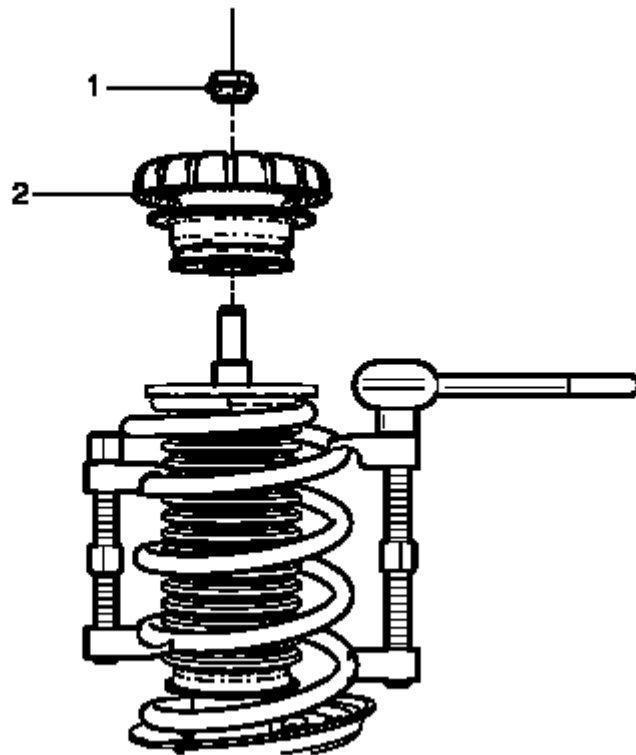


Fig. 34: Strut Nut And Strut

Courtesy of GENERAL MOTORS COMPANY

5. Remove the strut nut (1) from the strut.
6. Remove the upper strut mount (2) from the strut.

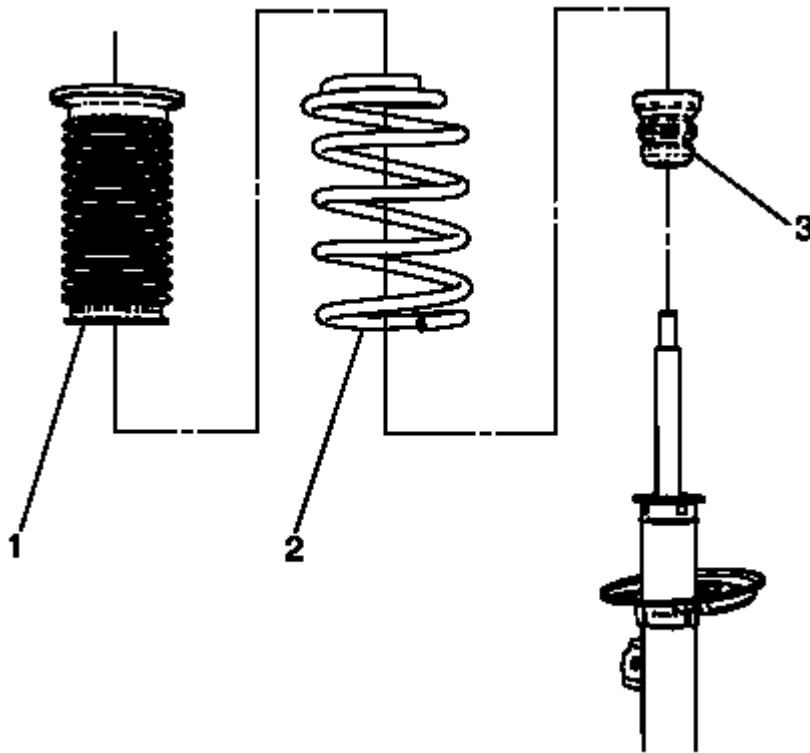


Fig. 35: Cartridge Upper Cover

Courtesy of GENERAL MOTORS COMPANY

7. Remove the cartridge upper cover (1) from the strut.
8. Remove the **CH-46558** front spring compressor from the coil spring.
9. Remove the coil spring (2) from the strut.
10. Remove the strut bumper (3) from the strut.
11. Remove the strut from the vise.

Assembly Procedure

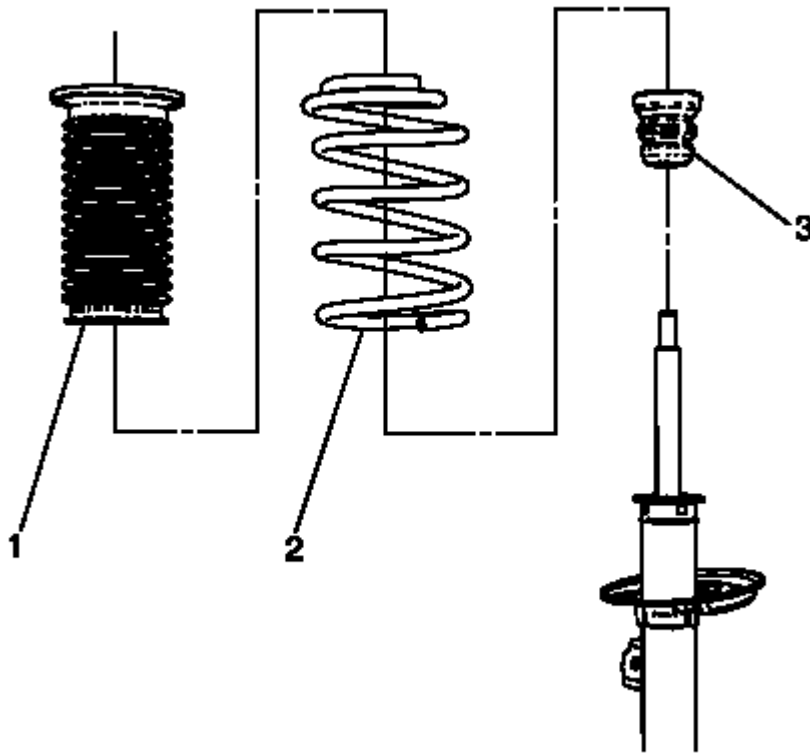


Fig. 36: Cartridge Upper Cover
Courtesy of GENERAL MOTORS COMPANY

1. Install the strut to the vise.
2. Install the strut bumper (3) to the strut.
3. Install the coil spring (2) to the strut.
4. Install the **CH-46558** front spring compressor to the coil spring.
5. Compress the coil spring using the **CH-46558** front spring compressor.
6. Install the cartridge upper cover (1) to the strut.

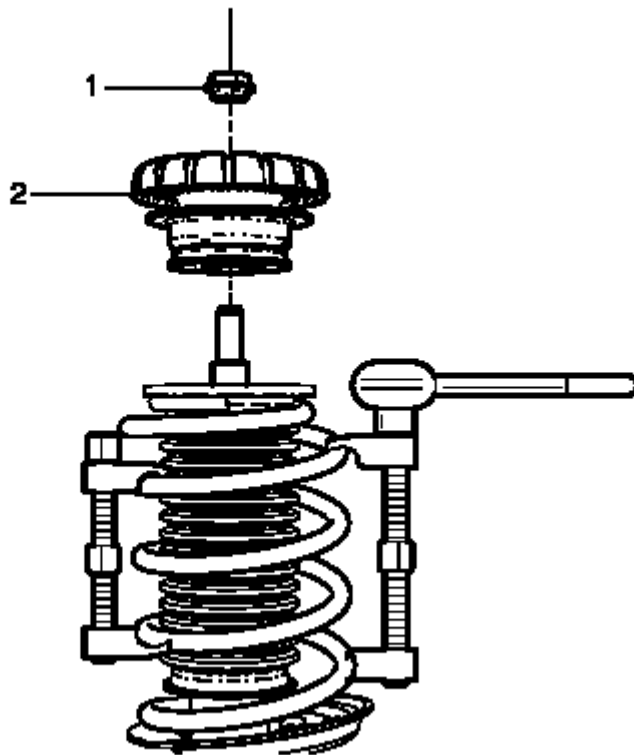


Fig. 37: Strut Nut And Strut

Courtesy of GENERAL MOTORS COMPANY

7. Install the upper strut mount (2) to the strut.

CAUTION: Refer to Fastener Caution .

8. Install the strut nut (1) to the strut and tighten to 65 N.m (48 lb ft).
9. Remove the **CH-46558** front spring compressor (1) from the coil spring.
10. Remove the strut assembly from the vise.
11. Install the strut assembly to the vehicle. Refer to Strut Assembly Removal and Installation.

DESCRIPTION AND OPERATION

FRONT SUSPENSION DESCRIPTION AND OPERATION

The front suspension has 2 primary purposes:

- Isolate the driver from irregularities in the road surface.
- Define the ride and handling characteristics of the vehicle.

The front suspension absorbs the impact of the tires traveling over irregular road surfaces and dissipates this energy throughout the suspension system. This process isolates the vehicle occupants from the road surface. The rate at which the suspension dissipates the energy and the amount of energy that is absorbed is how the suspension defines the vehicles ride characteristics.

Ride characteristics are designed into the suspension system and are not adjustable. The ride characteristics are mentioned in this description in order to aid in the understanding of the functions of the suspension system. The suspension system must allow for the vertical movement of the tire and wheel assembly as the vehicle travels over irregular road surfaces while maintaining the tire's horizontal relationship to the road.

This requires that the steering knuckle be suspended between a lower control arm and a strut assembly. The lower control arm attaches from the steering knuckle at the outermost point of the control arm. The attachment is through a ball and socket type joint. The innermost end of the control arm attached at 2 points to the vehicle frame through semi-rigid bushings. The upper portion of the steering knuckle is attached to a strut assembly. The strut assembly then connects to the vehicle body by way of an upper bearing. The steering knuckle is allowed to travel up and down independent of the vehicle body structure and frame.

This up and down motion of the steering knuckle as the vehicle travels over bumps is absorbed predominantly by the coil spring. This spring is retained under tension over the strut assembly. A strut is used in conjunction with this system in order to dampen out the oscillations of the coil spring. A strut is a basic hydraulic cylinder.

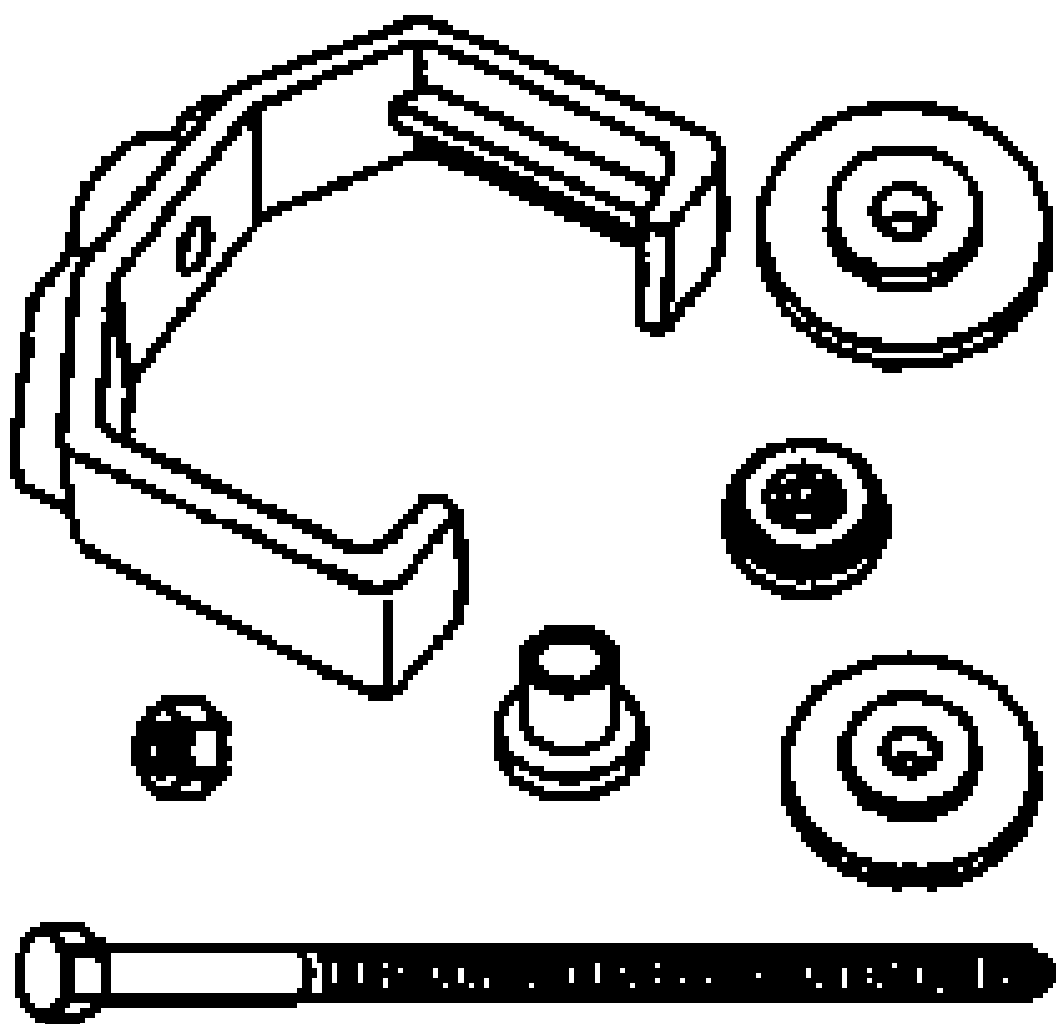
The strut is filled with oil and has a moveable shaft that connects to a piston inside the strut. Valves inside the shock absorber offer resistance to oil flow and consequently inhibit rapid movement of the piston and shaft. Each end of the shock absorber is connected in such a fashion to utilize this recoil action of a spring alone. Each end of the strut is designed as the connection point of the suspension system to the vehicle and acts as the coil spring seat. This allows the strut to utilize the dampening action to reduce the recoil of a spring alone. The lower control arm is allowed to pivot at the vehicle frame in a vertical fashion. The ball joint allows the steering knuckle to maintain the perpendicular relationship to the road surface.

Front suspensions systems utilize a stabilizer shaft. The stabilizer bar connects between the left and right lower control arm assemblies through the stabilizer link and stabilizer shaft insulators. This bar controls the amount of independent movement of the suspension when the vehicle turns. Limiting the independent movement defines the vehicles handling characteristics on turns.

SPECIAL TOOLS AND EQUIPMENT

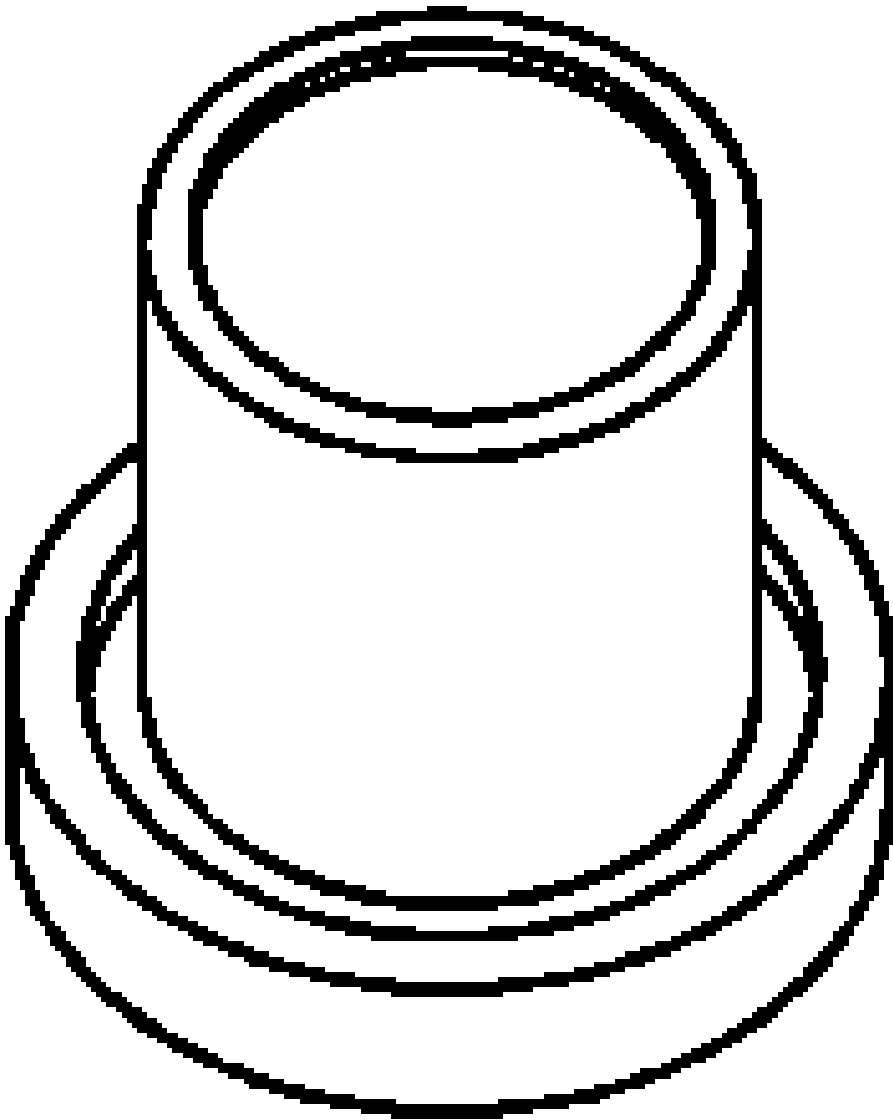
SPECIAL TOOLS

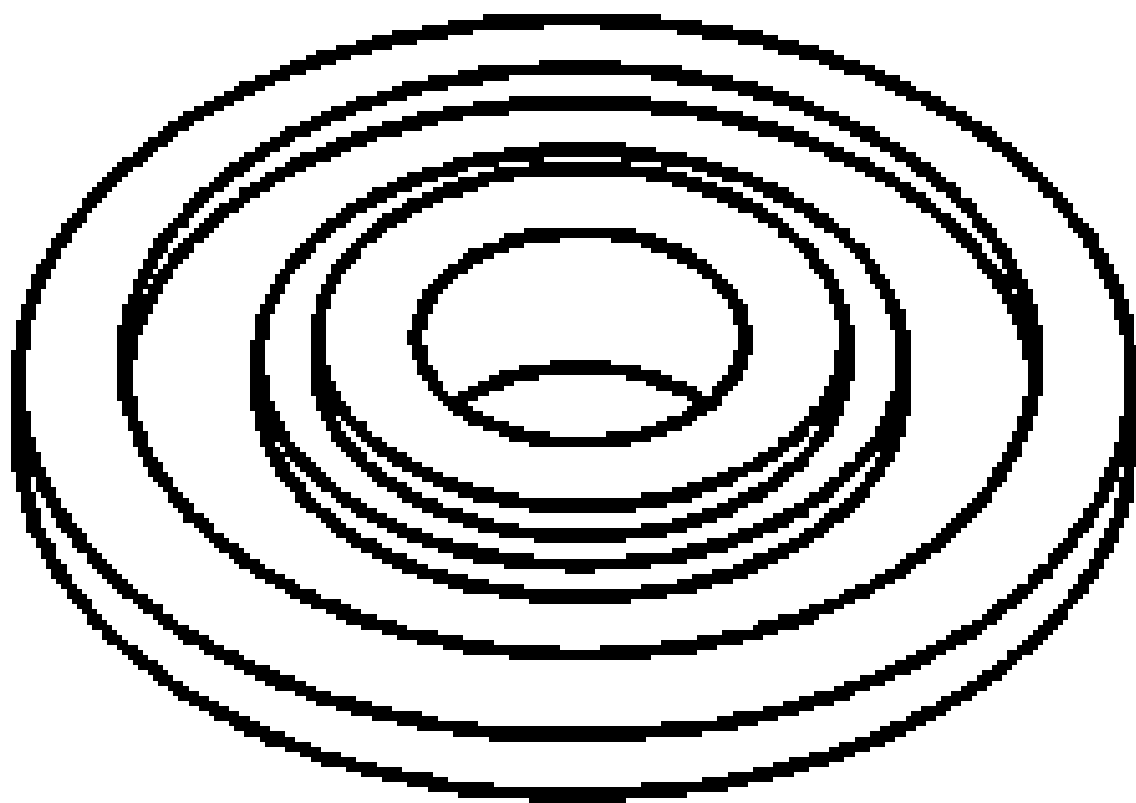
Illustration	Tool Number/ Description



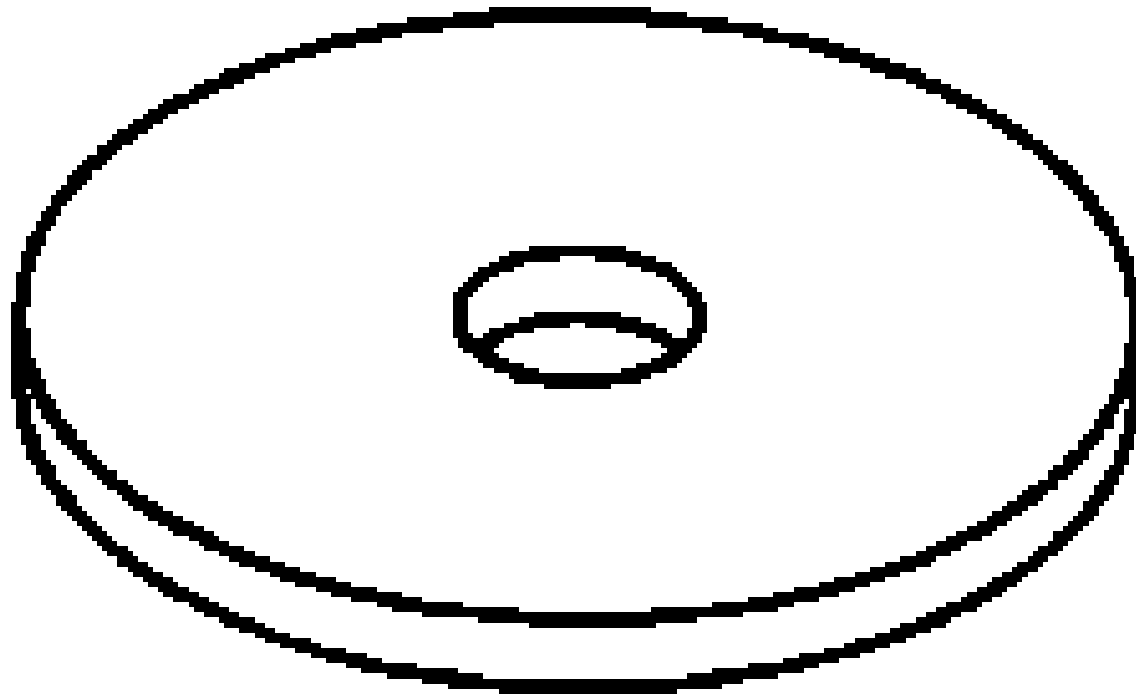
DT-50178
Wheel Hub
Bearing
Remover/Installer
Kit

Wheel Hub
Spacer (Hub
Removal and
Installation
Adapter,
Component of
DT-50178)



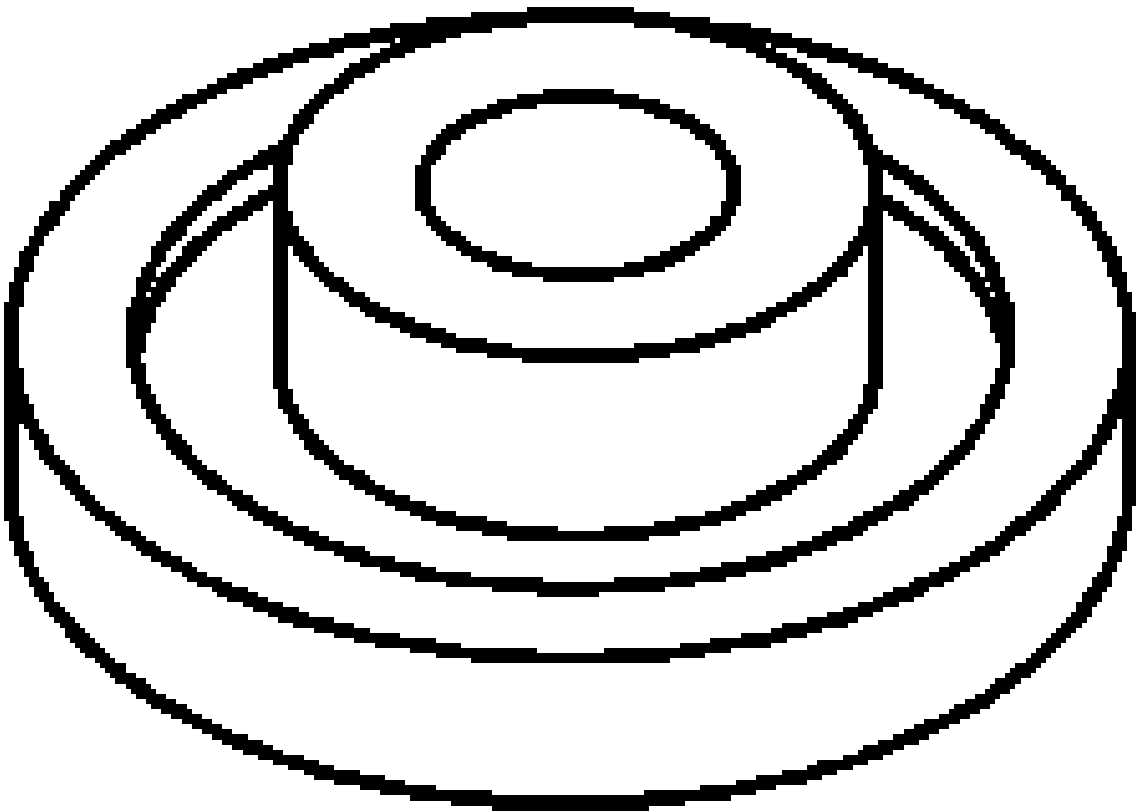


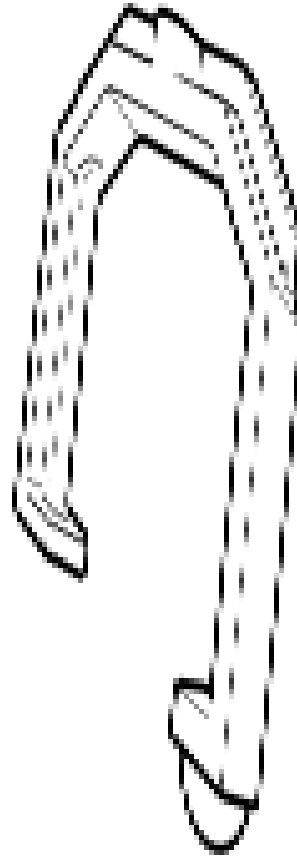
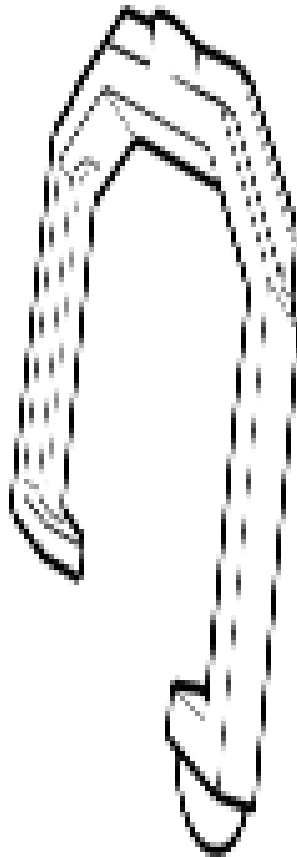
DT-47541
Wheel Bearing
Spacer (Wheel
Bearing Removal
Adapter,
Component of
DT-50178)



DT-47542
Wheel Bearing
Spacer (Hub and
Bearing
Installation Plate,
Component of
DT-50178)

Wheel Bearing
Spacer (Wheel
Bearing
Installation
Adapter,
Component of
DT-50178)

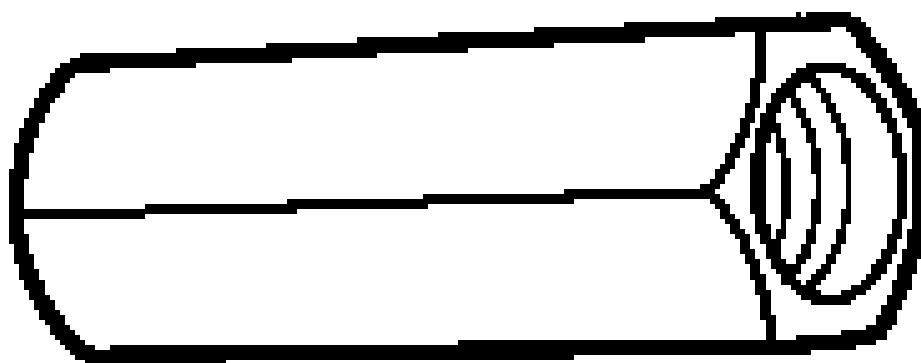




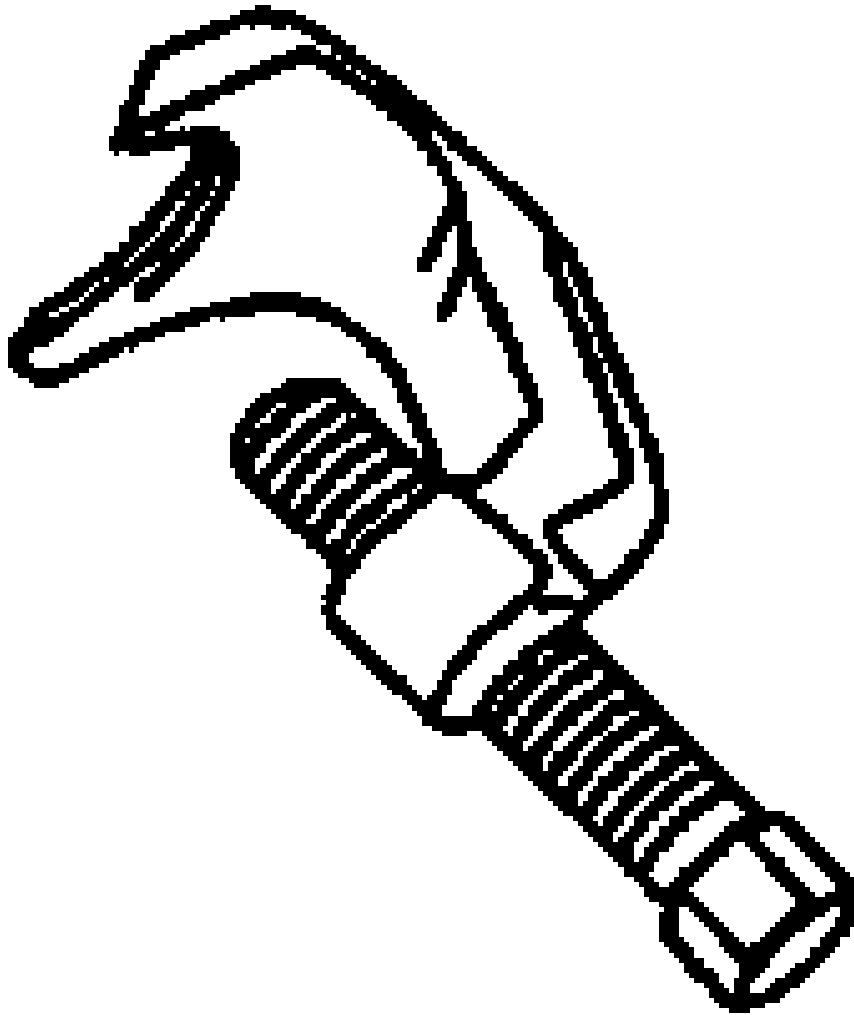
DT-50178-01
Bridge Support
(Component of
DT-50178)



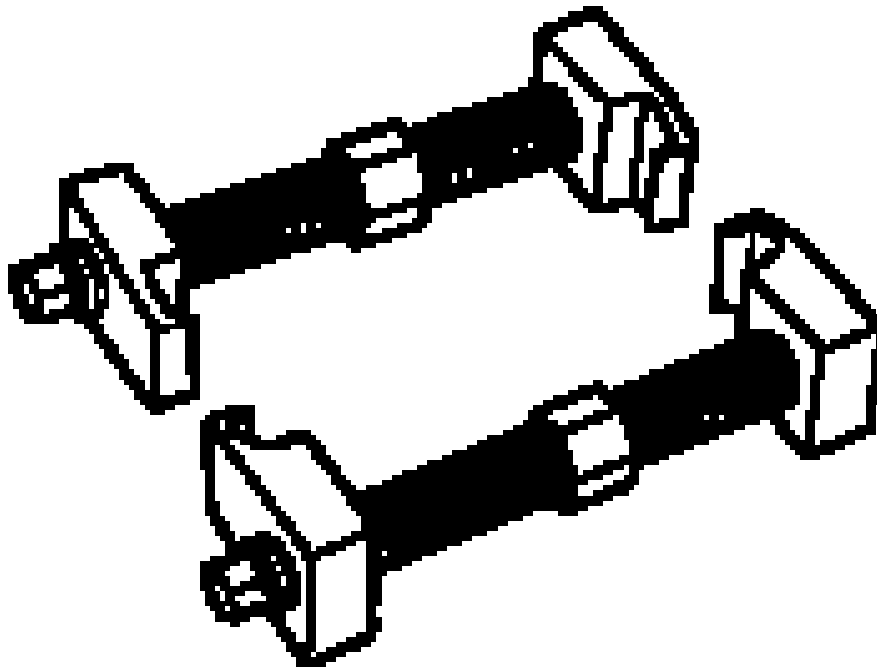
CH-46560-04
Thread Rod
(Component of
DT-50178)



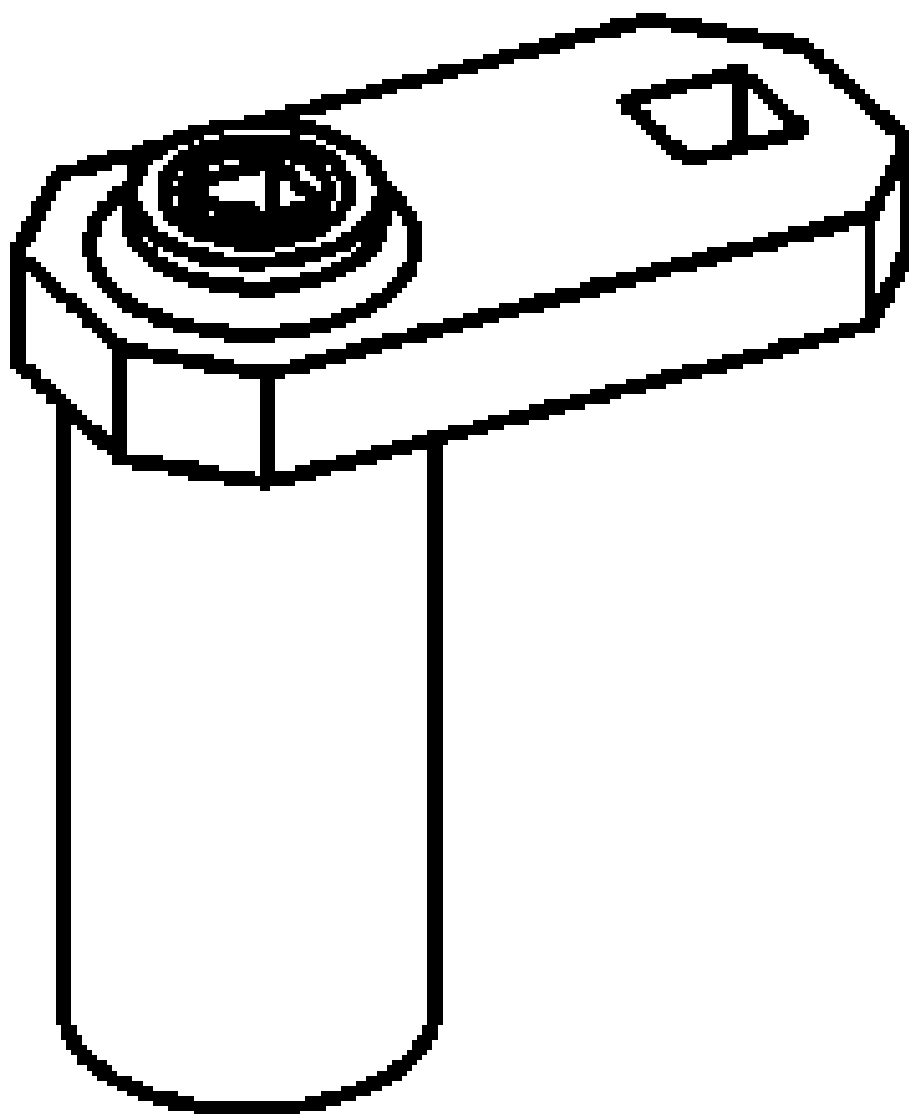
CH-46560-05
Hex Nut
(Component of
DT-50178)



CH-43631
Ball Joint
Remover



CH-46558
J-45400
Front Spring
Compressor



CH-49375
Wrench

GENERAL INFORMATION

General Information - Spark

INTRODUCTION

ARROWS AND SYMBOLS

This service information uses various symbols in order to describe different service operations.

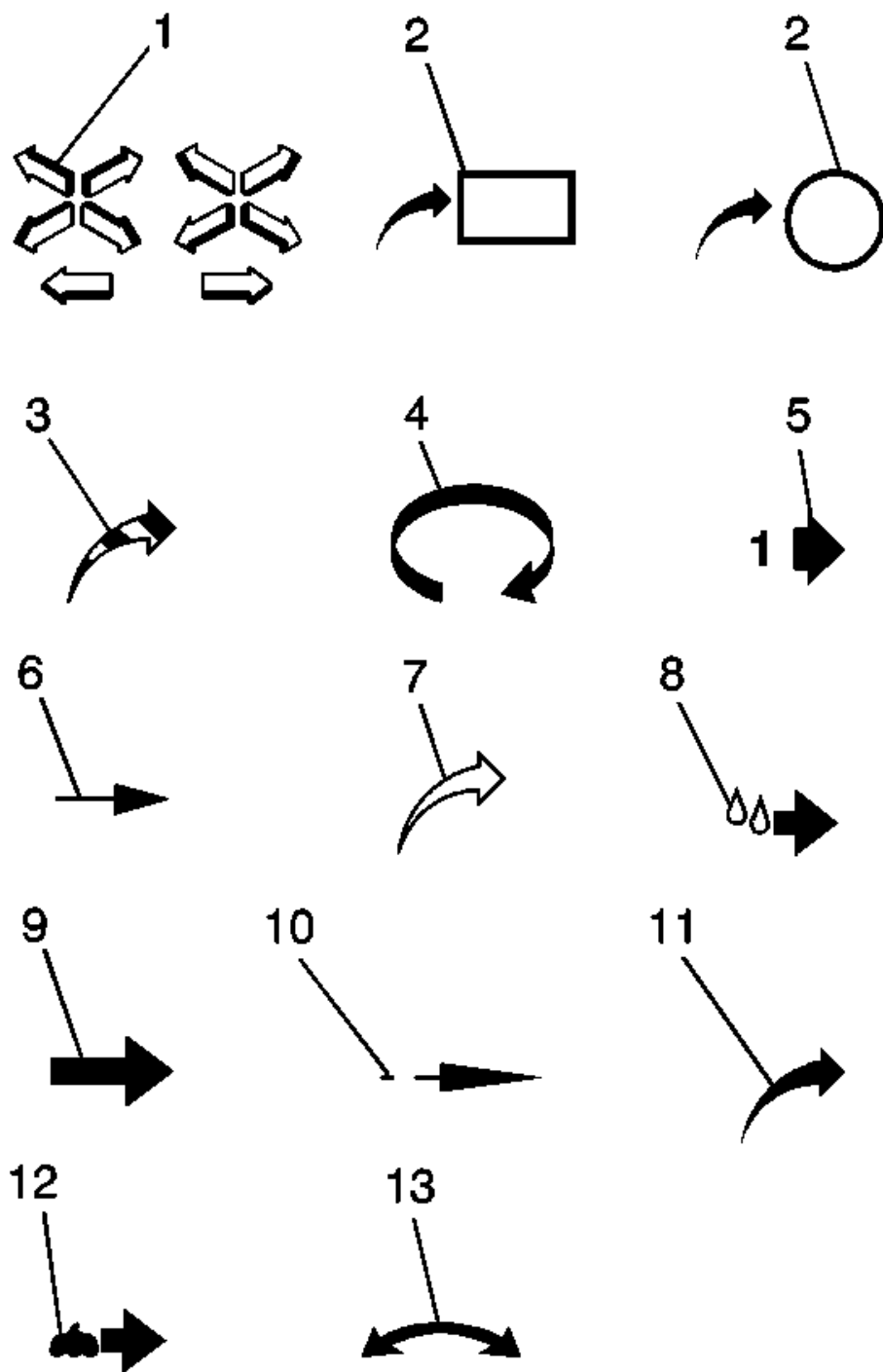


Fig. 1: Identifying Different Service Operations Symbols
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
---------	----------------

1	Front of Vehicle
2	View Detail
2	View Detail
3	Ambient Air Mixed with Another Gas or Indicate Temperature Change
4	Motion or Direction
5	View Angle
6	Dimension (1:2)
7	Ambient/Clean Air Flow or Cool Air Flow
8	Lubrication Point- Oil or Fluid
9	Task Related
10	Sectioning (1:3)
11	Gas Other Than Ambient Air or Hot Air Flow
12	Lubrication Point- Grease or Jelly
13	Multidirectional Arrow

ACRONYMS AND UNITS

Acronyms

Acronym	Meaning	Definition
2WD	Two-Wheel Drive	Indicates that a vehicle has 2 driven wheels OR that a 4WD vehicle uses only 2 wheels for propulsion. So it can be the description of a vehicle configuration OR the operational mode of the drivetrain.
4WD	Four-Wheel Drive	Four-wheeled vehicle with a drivetrain that allows all four wheels to receive power from the engine simultaneously which provides better control on various surfaces. Can be used to describe the configuration of the vehicle OR as the operational mode of the drivetrain. 4WD vehicles usually can turn 2 wheels off to be in a 2WD mode. See also AWD.
A/C	Air Conditioning	The cooling and dehumidification of indoor air for thermal comfort.
A/D	Analog to Digital	Used in context of converting electrical analog signals to digital signals.
ABS	Antilock Braking System	System on motor vehicles which prevents the wheels from locking while braking which helps the driver maintain control in heavy braking conditions.
AC	Alternating Current	An electrical current whose magnitude and direction vary cyclically.
AM	Amplitude Modulation	Method of impressing data onto an alternating-current (AC) carrier waveform.
APP	Accelerator Pedal Position	A pedal that controls the throttle valve.
		All-wheel-drive systems are designed to function on

AWD	All-Wheel Drive	all types of surfaces, both on- and off-road, and most of them cannot be switched off. This can also be called full-time four wheel drive. See also 4WD.
AWG	American Wire Gauge	American wire gauge is a standardized wire gauge system used since 1857 predominantly in the United States for the diameters of round, solid, nonferrous, electrically conducting wire. E.g. a wire of AWG10 has a diameter of 2.588mm, AWG20 corresponds to a diameter of 0.812mm.
B+	Battery Positive Voltage	The electrical potential on the positive terminal of the battery.
BARO	Barometric Pressure	Atmospheric pressure as measured by a barometer.
BCM	Body Control Module	This module supplies vehicle occupants with visual and audible information and controls various vehicle functions,
BECM	Battery Energy Control Module	Control module used to regulate the battery voltage.
BPP	Brake Pedal Position	Position of the foot pedal that moves a piston in the master brake cylinder.
CAN	Controller Area Network	Serial data connection between control modules by Bosch
CCM	Chassis Control Module	The module that controls various vehicle functions on the Chassis, like Engine/Trans Mount, Active Grille Air Shutter, Load Leveling, etc...
CD	Compact Disc	A small optical disk on which data such as music, text, or graphic images is digitally encoded.
CNG	Compressed Natural Gas	This a substitute for gasoline or diesel fuel. It is made by compressing natural gas (which is mainly composed by methane (CH ₄), in a percentage range of 70% to 98%)
CO	Carbon Monoxide	This is a product of the incomplete combustion of carbon-containing compounds, at room temperature this is a gas. It consists of one carbon atom covalently bonded to one oxygen atom.
CO ₂	Carbon Dioxide	Chemical compound composed of two oxygen atoms covalently bonded to a single carbon atom.
CPA	Connector Position Assurance	Part of an electrical connector that prevents the connector from moving out of its socket. Usually needs to be pressed to unlock the connector when disconnecting it.
CPP	Clutch Pedal Position	A lever operated with the foot that controls the coupling that connects or disconnects driving and driven parts of a driving mechanism.
CV	Constant Velocity	Used in conjunction with CV joints, which connect two shafts at an angle while both shafts always have the same rotational speed without variations.

CVT	Continuously Variable Transmission	A transmission in which the ratio of the rotational speeds of two shafts, as the input shaft and output shaft of a vehicle or other machine, can be varied continuously within a given range, providing an infinite number of possible ratios which improves fuel economy.
D	Drive	D on the transmission gear selector lever.
DAB	Digital Audio Broadcast	Technology for broadcasting of audio using digital radio (carries information via digital signal) transmission.
DC	Direct Current	Continuous current, constant flow of electric charge.
DLC	Data Link Connector	This is an electronic connector typically located underneath the driver's side dashboard, just above the pedals. The connector has 16 pins.
DMM	Digital Multimeter	Electronic measuring instrument that combines several functions in one unit. The most basic instruments include an ammeter, voltmeter, and ohmmeter.
DOHC	Dual Overhead Camshaft	Dual overhead camshafts (DOHC) are higher performance engines, they produce more power, and can run at higher speeds because they allow an engine to have four valves per cylinder. Each camshaft operates two of the valves, one camshaft handles the intake valves, and one handles the exhaust valves
DPF	Diesel Particulate Filter	Device designed to remove diesel particulate matter or soot from the exhaust gas of a diesel engine.
DRL	Daytime Running Lamps	White lights mounted on the front of an automobile that automatically switch on when the key is turned and are intended for daytime use, to increase the visibility of the automobile.
DSCC	Distance Sensing Cruise Control	A type of cruise control that automatically maintains the distance between vehicles.
DSP	Digital Signal Processor	A specialized microprocessor designed specifically for digital signal processing, generally in real-time computing.
DTC	Diagnostic Trouble Code	An electronic signal stored in an automotive computer, indicating the presence of a fault detected by that computer.
DVD	DVD	A popular optical disc storage media format the size of a CD. Used mainly for movies but also for data. DVD has no spelled out version (officially it does not mean Digital Video Disc or Digital Versatile Disc, it just means DVD).
EBCM	Electronic Brake Control Module	This module contains a microprocessor and software for antilock braking system operation.

ECM	Engine Control Module	This electronic module works with a vehicle's sensors and engine control devices to insure that the engine operates at maximum efficiency and performance. It performs three vital functions. Receives electronic signals from engine sensors. Analyzes the data and makes an engine performance decision (based on the pre-set parameters within the unit). Sends an "output command" to an actuator that adjusts engine performance.
ECT	Engine Coolant Temperature	A measure of how hot or cold the fluid which flows through the engine in order to prevent its overheating, transferring the heat produced by the device to other devices that utilize or dissipate it.
EEPROM	Electrically Erasable Programmable Read-Only Memory	A non-volatile storage chip used in computers and other devices to store small amounts of volatile data, e.g. calibration tables or device configuration.
EGR	Exhaust Gas Recirculation	Is an NO _x (nitrogen oxide and nitrogen dioxide) reduction technique used in most gasoline and diesel engines. EGR works by recirculating a portion of an engine's exhaust gas back to the engine cylinders.
EMI	Electromagnetic Interference	Electromagnetic interference (also called radio frequency interference) is a disturbance that affects an electrical circuit due to either electromagnetic conduction or electromagnetic radiation emitted from an external source.
ESD	Electrostatic Discharge	The sudden and momentary electric current that flows between two objects at different electrical potentials.
EV	Electric Vehicle	A category of vehicles that only have an electric drive system.
EVAP	Evaporative Emission	A system that controls the fuel fumes in the fuel tank.
FM	Frequency Modulation	In telecommunication this is a way to convey information over a carrier wave by varying its frequency.
FWD	Front-Wheel Drive	A form of engine/transmission layout used in motor vehicles, where the engine drives the front wheels only.
GMLAN	General Motors Local Area Network	A local-area network is a computer network covering a small geographic area, like a home or vehicle. This specific type of LAN connects several controllers inside the vehicle and was developed by General Motors.
GPS	Global Positioning System	Satellite-based navigation system made up of a network of 24 satellites placed into orbit by the U.S. Department of Defense.
GSM	Global System for Mobile Communications	Globally accepted standard for digital cellular communication.

GVW	Gross Vehicle Weight	Maximum total weight of a road vehicle or trailer that is loaded, including the weight of the vehicle itself plus fuel, passengers, cargo, and trailer tongue weight.
HD	Heavy Duty	Robust design to accommodate large work loads.
HID	High Intensity Discharge	A type of light that produces a bright light by using gas filled bulbs. (gas is usually mercury, metal halide, and high-pressure sodium) Uses very little battery power and is a very "cool" light.
HO2S	Heated Oxygen Sensor	Heated oxygen sensors have an internal heater circuit that brings the sensor up to operating temperature more quickly than an unheated sensor. An oxygen sensor must be hot (about 600-650°F) before it will generate a voltage signal. The hot exhaust from the engine will provide enough heat to bring an O2 sensor up to operating temperature.
HVAC	Heating Ventilation Air Conditioning	This system is sometimes referred to as climate control. Ventilation air ducts installed throughout a vehicle that supply conditioned air to a room through rectangular or round outlet vents.
I ² C	Inter-Integrated Circuit	Serial data connection between Integrated Circuits (microchips) inside a control module invented by Phillips
IAT	Intake Air Temperature	Temperature of the air entering intake air flow system of the engine.
ICE	Internal Combustion Engine	An engine in which the combustion of fuel and an oxidizer (typically air) occurs in a confined space called a combustion chamber.
ID	Identification	Number or Code that identifies a component or control module. Can be written on the part or be transmitted on a bus or via radio.
ISP	Internet Service Provider	A company that furnishes corporations and individual consumers with various services, mainly access to the Internet.
ISS	Input Shaft Speed	Rotational speed of the input shaft of a transmission.
LAN	Local Area Network	Standard network connection PC's.
LCD	Liquid Crystal Display	A thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector.
LED	Light Emitting Diode	Small light bulbs that fit easily into an electrical circuit they do not have a filament that will burn out, and they do not get especially hot. They are illuminated solely by the movement of electrons in a semiconductor material.
LIN	Local Interconnect Network	Computer networking bus system used within automotive network architectures. Similar to CAN,

		but cheaper and less powerful.
LPG	Liquefied Petroleum Gas	A mixture of mainly propane and butane, produced commercially and stored under pressure to keep it in a liquid state.
MAF	Mass Air Flow	The amount of air drawn into the engine
MAP	Manifold Absolute Pressure	Pressure in the engine intake system after the throttle valve referenced to a perfect vacuum.
MDI	Multiple Diagnostics Interface	A device used by GM dealers that enables a PC to communicate with the control modules in a vehicle.
MIL	Malfunction Indicator Lamp	An indicator of the internal status of a car engine.
MOST	Media Oriented Systems Transport	Serial communication bus to transmit audio and video information.
N	Neutral	A state of the transmission in which it is not engaged.
NiMH	Nickel Metal Hydride	A type of rechargeable battery that uses a hydrogen absorbing alloy for the negative electrode.
NOx	Nitrogen Oxides	Refers to any of the following oxygen compounds of nitrogen or a mixture of them. Nitric Oxide, Nitrogen dioxide, Nitrous Oxide, Dinitrogen trioxide, Dinitrogen tetroxide, Dinitrogen pentoxide.
O2	Oxygen	A colorless, odorless, tasteless, gaseous chemical element with the chemical symbol O and atomic number 8.
O2S	Oxygen Sensor	An electronic device that measures the proportion of oxygen (O2) in the gas or liquid being analyzed.
OBD	On-Board Diagnostic	A generic term referring to a vehicle's self-diagnostic and reporting capability.
OEM	Original Equipment Manufacturer	A producer that provides a product to its customers, who proceed to modify or bundle it before distributing it to their customers.
OSS	Output Shaft Speed	Rotational speed of the output shaft of a transmission.
P	Park	A state in which the transmission is set so one can leave the vehicle.
PCB	Printed Circuit Board	A thin plate on which chips and other electronic components are placed.
PCM	Powertrain Control Module	A control module that features the functions of both, the engine and the transmission control module.
PCMCIA	Personal Computer Memory Card Industry Association	An international standards body and trade association with over 100 member companies that was founded in 1989 to establish standards for Integrated Circuit cards and to promote interchangeability among mobile computers where ruggedness, low power, and small size were critical.
PIN	Personal Identification Number	A secret numeric password shared between a user and a system that can be used to authenticate the user to the system.

PPE	Personal Protective Equipment	Protective clothing, helmets, goggles, or other garment designed to protect the wearer's body from injury.
PRNDL	Park, Reverse, Neutral, Drive, Low	Park, Reverse, Neutral, Drive, Low (automatic transmission positions).
PTC	Positive Temperature Coefficient	Refers to materials that experience an increase in electrical resistance when their temperature is raised.
PTO	Power Take-Off	A splined driveshaft, usually on a tractor or truck that can be used to provide power to an attachment or separate machine. This mechanism allows implements to draw energy from the tractor's engine.
PVC	Polyvinyl Chloride	A thermoplastic copolymer.
PWM	Pulse Width Modulation	Square shaped type of signal that carries the information in the ratio between on and off times.
R	Reverse	Rearward: directed or moving toward the rear;
RAM	Random Access Memory	A type of computer data storage. It today takes the form of integrated circuits that allow the stored data to be accessed in any order.
RCT	Radiator Coolant Temperature	This is the heat intensity of the radiator coolant measured in degrees. The radiator is a part of the cooling system that removes the engine heat. Coolant is a mixture of water and antifreeze (ethylene glycol) which lowers the freezing point of the water in the coolant system, this fluid also picks up heat from the engine and transfers it to the air.
RDS	Radio Data System	A standard from the European Broadcasting Union for sending small amounts of digital information using conventional FM radio broadcasts.
RF	Radio Frequency	A frequency or rate of oscillation within the range of about 3 Hz and 300 GHz. This range corresponds to frequency of alternating current electrical signals used to produce and detect radio waves.
ROM	Read-Only Memory	A class of storage media used in computers and other electronic devices. Data stored in ROM cannot be modified.
RPO	Regular Production Option	A three digit/letter code given to parts, assemblies, and systems originally installed on the vehicle. These RPO codes designate options and are assigned by General Motors.
RSA	Rear Seat Audio	An auxiliary set of controls that operate the main audio system from the rear seat. Rear passengers can also operate a different media source than the front passengers.
RWD	Rear-Wheel Drive	A common engine/transmission layout in which the engine is in the front of the vehicle, but the front mid-engine, rear mid-engine and rear engine layouts are

		also used.
SCV	Speed Controlled Volume	The volume control is set for a desired sound level in the vehicle as the vehicle increases its speed, the sound level is adjusted.
SDM	Sensing and Diagnostic Module	The name given to air bag modules used in General Motors vehicles.
SIM	Subscriber Identity Module	Part of a removable smart card Integrated Circuit Card. This is used for mobile cellular telephone devices such as mobile computers and mobile phones. SIM cards securely store the service-subscriber key used to identify a subscriber. The SIM card allows users to change phones by simply removing the SIM card from one mobile phone and inserting it into another mobile phone or broadband telephony device.
SIR	Supplemental Inflatable Restraint	Technical term for the air bag. Air bag is a stretchable membrane, which inflates during an automobile accident to provide cushioning to the passenger's head and torso to prevent injury to the passengers.
SPI	Serial Peripheral Interface	This is an interface that enables the serial (one bit at a time) exchange of data between two devices. An SPI operates in full duplex mode. This means that data can be transferred in both directions at the same time. It is a standard bus technology like CAN or I2C.
SPS	Service Programming System	System that enables repair facilities to update the software in control modules.
SUV	Sport Utility Vehicle	A passenger vehicle which combines the towing capacity of a pickup truck with the passenger-carrying space of a minivan.
SVS	Service Vehicle Soon	Indicator lamp or symbol for a malfunction related to a vehicle component or system.
TA	Traffic Announcement	Message spoken on radio regarding the movement of vehicles or pedestrians through an area or along a route. The buttons on radios that enable this announcements are also often labeled TA.
TAC	Throttle Actuator Control	A motor which moves the engine throttle plate or valve, controlled by the engine control module. A throttle plate limits the amount of air entering a internal combustion gasoline engine.
TAP	Transmission Adaptive Pressure	The transmission control module learns each component's characteristics and adjusts fluid pressure accordingly.
TCC	Torque Converter Clutch	Resides in a torque converter to connect an engine to an automatic transmission. The clutch is applied when conditions are correct to achieve a 1:1 ratio of engine crankshaft to transmission input shaft.
		A module that controls electronic automatic

TCM	Transmission Control Module	transmissions. It uses sensors from the vehicle as well as data provided by the Engine Control Module to calculate how and when to change gears in the vehicle for optimum performance, fuel economy and shift quality.
TDC	Top Dead Center	The piston is in its highest position relative to the combustion chamber.
TIS	Techline Information System	The PC-based global dealership diagnostic software that provides the technician the ability to reference the most recent service information via the service department's computer.
TPA	Terminal Position Assurance	An additional locking mechanism inside an electric connector that holds the pins in place.
TV	Television	A telecommunication system for broadcasting and receiving moving pictures and sound over a distance.
USB	Universal Serial Bus	A type of communication bus connection between a computer and a peripheral device.
VCI	Vehicle Communications Interface	A diagnostic tool that communicates to modules of multiple communication protocols in a vehicle by converting vehicle serial data into PC serial data communication.
VIN	Vehicle Identification Number	Used by manufacturers to uniquely identify motor vehicles using 17 characters.
VSCM	Vehicle Stability Control Module	This module uses information from several sensors to detect a loss of vehicle traction, then works with the antilock brake system to apply individual brakes to help keep the vehicle on its intended path.
VSS	Vehicle Speed Sensor	Sends data regarding how fast the car is traveling at the moment of driving. It is designed to be able to record the rate at which the vehicle's crankshaft is spinning.
WOT	Wide Open Throttle	When the throttle blade or valve is at its maximum open position, allowing maximum air to enter an internal combustion gasoline engine.
WLAN	Wireless Local Area Network	Standard to transmit digital data via radio frequency.
XM	XM (Satellite Radio)	XM Satellite Radio Holdings (XM) is one of two satellite radio services in the United States and Canada. XM provides pay-for-service radio, analogous to cable television. Its service includes 73 different music channels, 39 news, sports, talk, and entertainment channels, 21 regional traffic and weather channels and 23 play-by-play sports channels (2008).
XML	Extensible Markup Language	A markup language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable.

Units

Unit	Meaning	Definition
m ²	Square Meter	Area
A	Ampere	Electrical
Ah	Ampere Hour	Electrical
C	Coulomb	Electrical
dBm	Decibel Meter	Electrical
dBmV	Decibel Millivolt	Electrical
mV/DIV	Millivolts per Division	Electrical
mV/s	Millivolts per Second	Electrical
ohms	Ohm	Electrical
V	Volt	Electrical
V/DIV	Volts per Division	Electrical
V/ms	Volts per Millisecond	Electrical
W	Watt	Electrical
mm ³ /stroke	Cubic Millimeters per Stroke	Flow
gal/h	Gallons per Hour	Flow
g/s	grams per second	Flow
g/stroke	Grams per Stroke	Flow
kg/100km	Kilograms per 100 Kilometer	Flow
kg/h	Kilograms per Hour	Flow
km/L	kilometer/liter	Flow
L/100km	Liters per 100 Kilometers	Flow
L/h	Liters per Hour	Flow
L/min	Liters per Minute	Flow
MPG	Miles per Gallon	Flow
mg/s	Milligrams per Second	Flow
mg/stroke	Milligrams per stroke	Flow
ft	feet	Length
in	Inch	Length
m	Meter	Length
mi	Mile	Length
bar	Bar	Mechanical
bar/min	Bars per Minute	Mechanical
in. H2O	Inches of Water	Mechanical
in. H2O/s	Inches of Water per second	Mechanical
kPa/s	Kilopascals per Second	Mechanical
N	Newton	Mechanical
	Newton Meter	Mechanical
Pa	Pascal	Mechanical
Pa/s	Pascals per Second	Mechanical

lb ft	Pound Foot	Mechanical
PSI	Pound-Force per Square Inch	Mechanical
Counts	Counts	Misc.
Cycles	Cycles	Misc.
dB	Decibel	Misc.
°	Degree	Misc.
°C	Degree Centigrade	Misc.
°CA	Degree Crankshaft Angle	Misc.
°F	Degree Fahrenheit	Misc.
°/s	Degree per Second	Misc.
Hz	Hertz	Misc.
kbit/s	Kilobit per second	Misc.
lx	Lux	Misc.
ppm	Parts per Million	Misc.
%	Percent	Misc.
%/min	Percents per Minute	Misc.
%/sec	Percents per Second	Misc.
Pulses	Pulses	Misc.
:1	Ratio	Misc.
RPM	Revolutions per Minute	Misc.
Steps	Steps	Misc.
W/m ²	Watts per Square Meter	Misc.
g	g (Acceleration)	Movement
km/h	Kilometers per Hour	Movement
m/s	Meters per Second	Movement
m/s ³	Meters per Second Cubed	Movement
m/s ²	Meters per Second Squared	Movement
MPH	Miles per Hour	Movement
mm/s	Millimeters per Second	Movement
d	Day	Time
h	Hour	Time
hh:mm:ss	Hour:Minute:Second	Time
ms/DIV	Milliseconds per Division	Time
min	Minute	Time
s	Second	Time
s/DIV	Seconds per Division	Time
yy-mm-dd	Year-Month-Day (2 digits)	Time
yyyy-mm-dd	Year-Month-Day (4 digits, preferred)	Time
m ³	Cubic Meter	Volume
gal	Gallon	Volume

L	Liter	Volume
mL	milliliters	Volume
US gal	US Gallon	Volume
US pt	US Pint	Volume
US qt	US Quart	Volume
kg	Kilogram	Weight

CUSTOMER CONCERN VERIFICATION SHEETS

The GM Customer Concern Verification Sheets have been designed to improve communications between the service customer and the technician. The more clearly the technician understands the concern and its symptoms, the more likely the concern will be fixed right the first time.

VEHICLE, ENGINE AND TRANSMISSION ID AND VIN LOCATION, DERIVATIVE AND USAGE

VIN Plate (Some Countries)

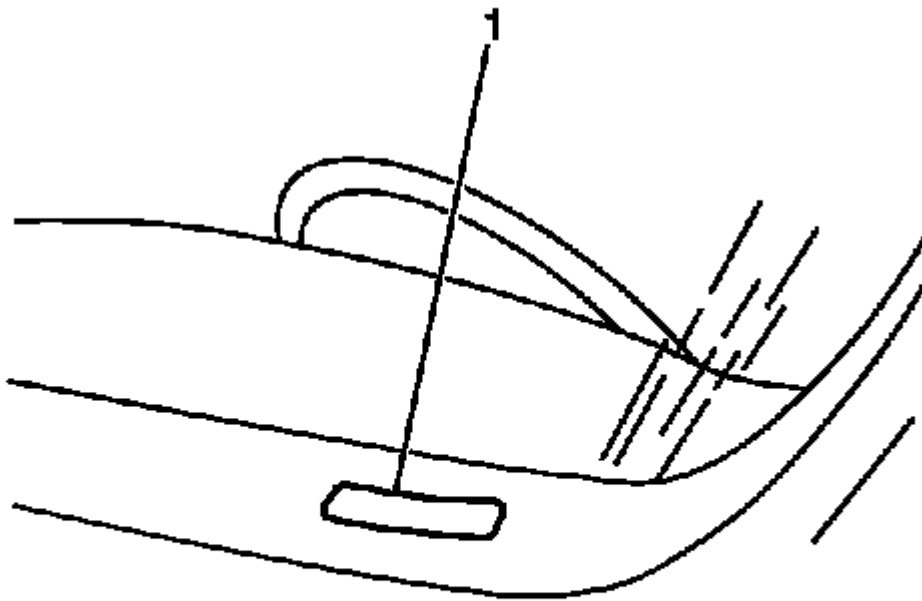


Fig. 2: View Of VIN Plate Location
Courtesy of GENERAL MOTORS COMPANY

The vehicle identification number (VIN) plate (1) is the legal identifier of the vehicle. The VIN plate is located on the upper left corner of the instrument panel (I/P) and can be seen through the windshield from the outside of the vehicle.

VIN Body Stamping

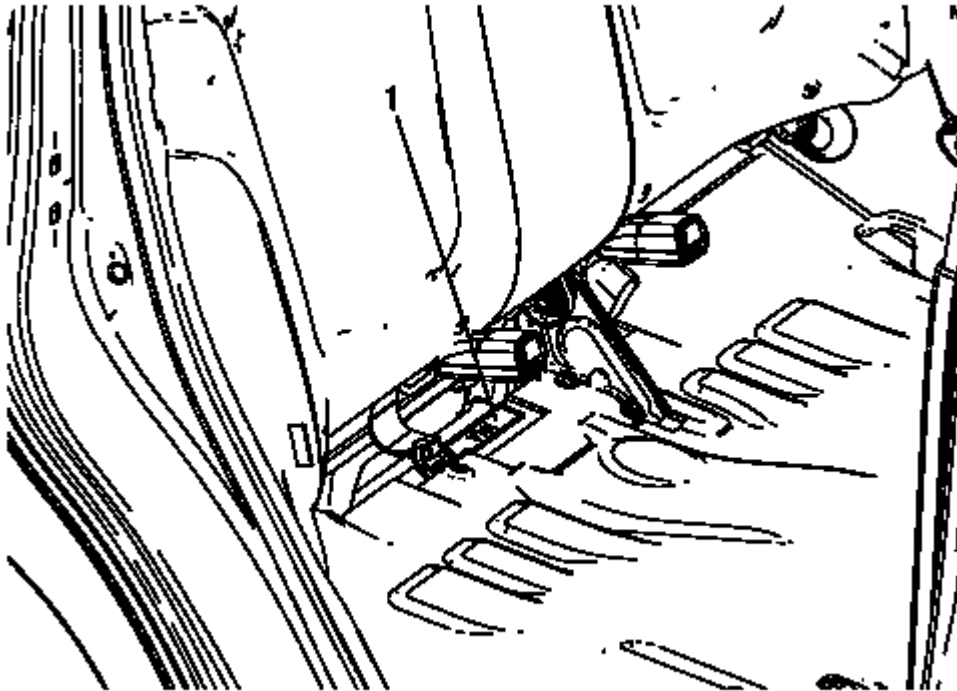


Fig. 3: Rear Floor Panel

Courtesy of GENERAL MOTORS COMPANY

Stamping in the rear floor panel (1) under the center of rear seat.

Vehicle Identification Number (VIN) System Type

Position	Definition	Character	Description
1	Country of Origin	K	Korea
2	Manufacturer	L	General Motors Daewoo Auto and Technology Company
3	Trade Name	A	Daewoo
		1	Chevrolet
		2	Pontiac
		3	Holden
		4	Buick
		5	Suzuki

4	Car Line	M	M300
5	Transmission	F A	FWD, MT FWD, AT
6-7	Body Style	48	4-Door Hatchback, 4 Windows
8	Engine Type	1 V H Z X 9	1.0L DOHC 1.19L DOHC 1.0L DOHC Diesel 1.0L DOHC LPG 1.0L DOHC Diesel (India) 1.2L DOHC
9	VIN Check Digit	Varies	Calculated Check Digit
10	Model Year	A B C D E F G	2010 2011 2012 2013 2014 2015 2016
11	Plant Location	K	Kunsan, South Korea
12-17	Production Sequence Number	-	Production Sequence Number

Engine Identification

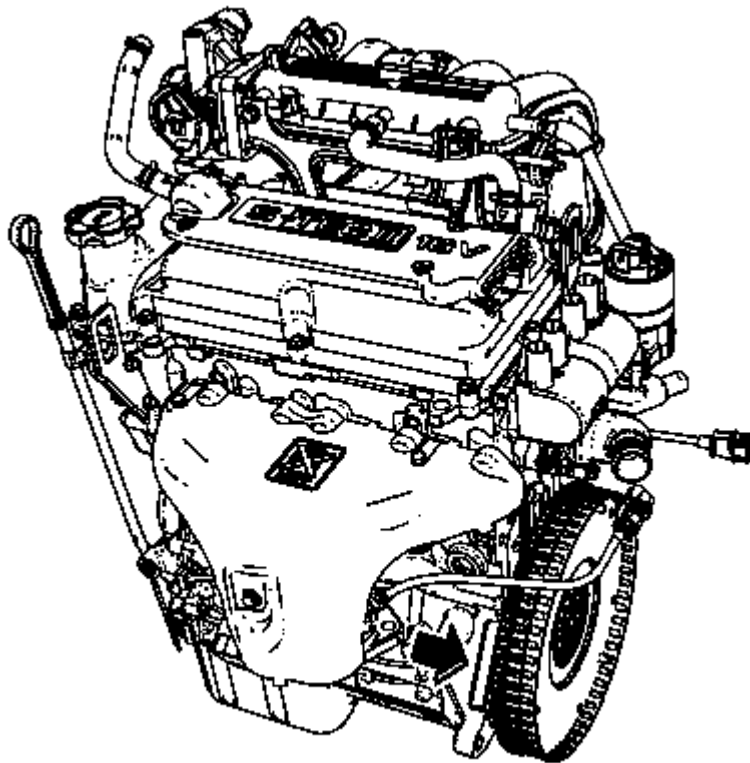


Fig. 4: Location Of Engine Number
 Courtesy of GENERAL MOTORS COMPANY

The engine number is stamped on the block under the number 4 exhaust manifold.

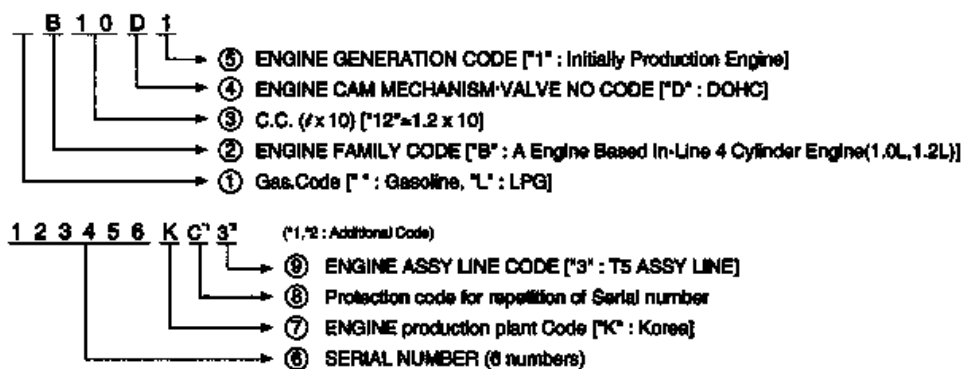


Fig. 5: Engine Identification
 Courtesy of GENERAL MOTORS COMPANY

VEHICLE CERTIFICATION, TIRE PLACARD, ANTI-THEFT, AND SERVICE PARTS ID LABEL

Certification Plate Location

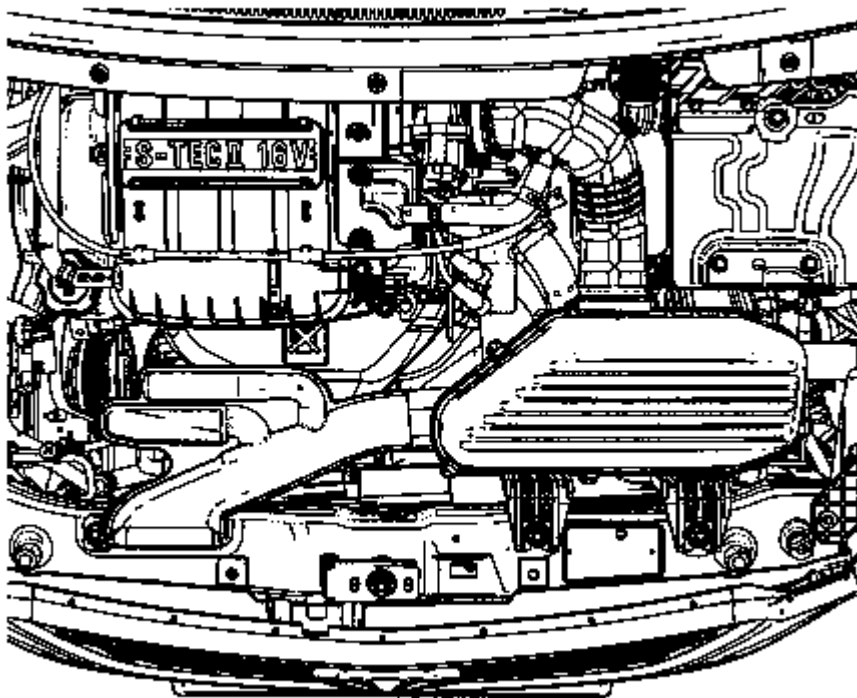


Fig. 6: Certification Plate Location

Courtesy of GENERAL MOTORS COMPANY

The vehicle identification number (VIN) plate is attached to the top of the front panel support.

Identification Plate Location

		GM DAEWOO Auto & Technology Company		①
		[②]		
		[③]		
○ Body Color [⑧]		[④]	KG	○
		[⑤]	KG	
	1 -	[⑥]	KG	
	2 -	[⑦]	KG	

Fig. 7: Identification Plate Location
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Manufacturer Name
2	Whole Vehicle Type Approval Number
3	VIN (Vehicle Identification Number)
4	GVW
5	Combination Weight (GVW + Braked Trailer Weight)
6	Maximum Permissible Axle Weight - Front
7	Maximum Permissible Axle Weight - Rear
8	Body Color

Tire Placard

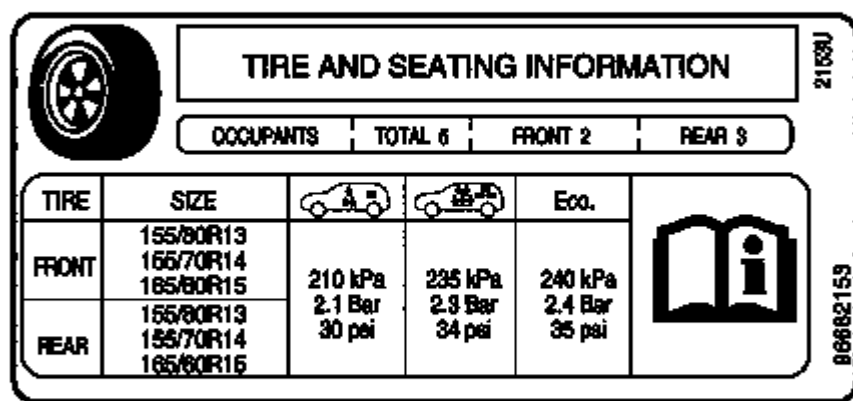


Fig. 8: Tire Placard
 Courtesy of GENERAL MOTORS COMPANY

The tire placard label is located on the driver door and displays the following assessments:

- Tire size

- Tire pressure
 - Front
 - Rear
 - Various loading conditions

RPO CODE LIST

The following table provides the description of the Regular Production Option (RPO) codes that are available on the vehicle. The vehicle's RPO list is printed on the Service Parts Identification Label.

RPO	Description
01C	Trim Color Seat - Light Titanium
01O	Trim Color Seat - V DK Pewter
01R	Trim Color Seat - Moroccan Blue
02Q	Trim Color Seat - Rose
1AQ	Trim Color Door Panel - V DK Pewter
2BH	Molding Door Interior - Jade Black
2BI	Molding Door Interior - Super Red
2BJ	Molding Door Interior - Moroccan Blue
2BK	Molding Door Interior - V DK Pewter
2BV	Molding Door Interior - Switchblade Silver Metallic
2GB	Radio - AM/FM Stereo, Seek, CD, ETR, Fader, MP3, USB
30F	Steering Wheel Color - Jet Black
37F	Steering Wheel Color - Polar Silver
4AQ	Interior Trim - V DK Pewter
5MB	Panel - Trim, Right Rear Compartment, Side
5MC	Panel - Trim, Load Compartment, Side
A32	Window - Power Operated, Front Door
A50	Seat - Front Bucket
A60	Lock Control Right Rear Compartment - Lid, Tailgate, Key Activated
A91	Lock Control Right Rear Compartment - Tailgate, Remote Controlled Electronic Open/Close
AAR	Restraint - Knee, Bolster, Foam Type
AE3	Window - Power Operated, Front and Rear Door
AFA	Interior Trim Config - 1
AFB	Interior Trim Config - 2
AFC	Interior Trim Config - 3
AFD	Interior Trim Config - 4
AFE	Interior Trim Config - 5
AFF	Interior Trim Config - 6
AFG	Interior Trim Config - 7
AFH	Interior Trim Config - 8

AFI	Interior Trim Config - 9
AFJ	Interior Trim Config - 10
AH9	Adjuster Front Seat - Manual, 2 Way, Driver
AIA	Restraint - Seat, Passenger, RETR, 3 Point
AIB	Restraint - Seat, Passenger, RETR, 3 Point, Load Limit
AID	Restraint - Seat, Passenger, RETR, 3 Point, Deluxe
AIF	Restraint - Seat, Driver, RETR, 3 Point, Load Limit
AIG	Restraint - Seat, Driver, RETR, 3 Point
AJ3	Restraint System - Seat, Inflatable, Driver, Front
AJ7	Restraint System - Seat, Inflatable, Driver and Passenger, Front and Seat Side
AK5	Restraint System - Seat, Inflatable, Driver and Passenger Front
AM4	Seat Rear - Split Back, Folding, Custom
AM7	Seat Rear - Folding
AM9	Seat Rear - Split Back, Folding
AMA	Seat Rear - Split Back, Folding, Headrest
AME	Lock Control - Side Door, Emergency Unlock, Automatic
APW	Window - Power, Not Desired
AQ2	Net - Convenience, Package
AQ4	Seat Right Rear -
AR1	Restraint System - (- Delete)
AT3	Restraint Provisions - Child, Rear Seat, Anchorage, Reinforced
AT7	Restraint System Rear - Seat, SHLDR, RETR, 3 Point, 3 SHLDR
ATZ	Seat Rear - Not Installed
AU3	Lock Control - Side Door, Electronic
AU4	Lock Control - Side Door, Electronic, Automatic
AV5	Seat - Front Bucket, High Back
AWB	Restraint System Rear - Seat, LH and RH/ELR and CTR/2 Point
AWS	Restraint - Seat Belt Tensioner, Passenger
AWT	Restraint - Seat Belt Tensioner, Driver
AY0	Restraint System - Seat, Inflatable, Driver and Passenger Front, Seat Side, Roof Side
AYF	Restraint System - Seat, Inflatable, Driver and Passenger Front, Front Seat Side & RR Seat side, Roof Side, Knee
B30	Covering Floor - Carpet
B37	Covering - Floor Mat, Front and Rear, Auxiliary
B56	Molding Rocker - Body Color
B7S	Tray - Interior, Rear, Parcel, Pull String
BA8	Compartment - Stowage, Front Seat, Passenger
DLU	Mirror I/S Front Van - Sunshade, Driver, without Mirror, Passenger, with Mirror and Cover
DLV	Mirror I/S Front Van - Sunshade, Driver and Passenger, with Mirror and Cover
DLW	Mirror O/S - LH and RH, Remote Control, Electric, Manual Folding, Heated

DP5	Mirror Provisions - Housing, Molded with Color
DQ9	Mirror Provisions - Color
DQB	Mirror I/S R/V - without Tilt
DT4	Ashtray - Cigarette Lighter
DVD	Cluster Color - INST, Polar Silver
DVE	Cluster Color - INST, Jet Black
E17	Bumper - 2.5 mph
E22	Handle - Assist, Rear
E27	Handle - Assist, Passenger
E2U	Ornamentation - Lettering, "LS"
E7Y	Fire Extinguisher - 2 kg
E91	Pocket - Front Seat Back, Passenger
EBN	Trim Seat - Cloth, Bonn
EBO	Trim Seat - Cloth, Curve
EBP	Trim Seat - PU Leather, Purisme-Embo
ELH	Pocket - Front Seat, Passenger, Side
ERI	Equipment - Battery Saver
F81	Ratio - Transaxle Final Drive 4.71
FCP	Trim Door - Polypropylene
FE4	Suspension System - Special Ride and Handling
FV5	Ratio - Transaxle Final Drive 4.19
FX2	Ratio - Transaxle Final Drive 3.91
FX3	Ride And Handling - Automatic Electronic Controlled
GAN	Primary Color - Exterior, Switchblade Silver Met (G) 636R
GAR	Primary Color - Exterior, Carbon Flash Met (G) 501Q
GAZ	Primary Color - Exterior, Olympic White (G) 8624
GBA	Primary Color - Exterior, Black (G) 8555
GCT	Primary Color - Exterior, Moroccan Blue Met (G)
GCW	Primary Color - Exterior, Misty Lake Met (G)
GEL	Primary Color - Exterior, Dynamic Orange Met 728R
GGE	Primary Color - Exterior, Super Red (G) 717R
GJS	Primary Color - Exterior, Ice Teal Met (729R)
GJT	Primary Color - Exterior, Green Cocktail Met (726R)
GJU	Primary Color - Exterior, Coconut Champagne Met (727R)
GKE	Primary Color - Linen Beige Met
GME	Ornamentation - Exterior, "GM" Mark of Excellence
GYJ	Parts Package - Van
HDN	Ornamentation - Emblem, "Holden"
J41	Brake System - Power, Front Disc, Rear Drum, Cast Iron
JM0	Booster - Brake, Single
JM4	Brake System - Power, Front Disc, Rear Drum, Cast Iron, Antilock, Front and

	Right Rear Wheel
JM7	Booster - Brake, Hydraulic, HI Performance
K06	Fan - Electric Cooling
K12	Filter - Air, Pollutant
K97	Generator - 80 Amp
KL7	Conversion - Propane Gas (LP Gas)
KRB	Fuel Rating - Octane No. 83
KRC	Fuel Rating - Octane No. 87
KRD	Fuel Rating - Octane No. 91
KRE	Fuel Rating - Octane No. 95
LC5	Engine - Gas, 4 CYL, 1.19 L, MFI, L4, DOHC
LCP	Engine - Propane Gas, 4 CYL, 1.0 L, MFI, DOHC
LHD	Vehicle Drive - Left Hand Drive
LMT	Engine - Gas, 4 CYL, L4, 1.0 L, MFI, DOHC, Iron, GMDAT
LMU	Engine - Gas, 4 CYL, L4, 1.2 L, MFI, DOHC, GMDAT
LEB	Engine - Diesel, 3 CYL, 1.0 L, CRI, DOHC, FGT, 39KW, INDIA
LL0	Engine - Gas, 4 CYL, L4, 1.2 L, MFI, DOHC, FAM A/B, DCVCP, GEN2
MFL	Transmission - Automatic 4 Speed, Jatco, JF405E
MNG	Transmission - Automatic 4 Speed, Aisin, 80-40LE
MFM	Transmission - Manual 5 Speed, Y4M HD, 1ST 3.539, 5th 0.781
MX2	Transmission - Manual 5 Speed, Y4M HD, 1ST 3.539, 5th 0.756
N33	Steering Column - Tilt Type
N40	Steering - Power, Non-Variable Ratio
N45	Steering Wheel - 3 Spokes
N51	Steering - Manual
NE9	Emission System - EEC 09
NQ5	Cap - Transmission Controlled Lever, Cap Console, Polar Silver
NQB	Control - Steering Wheel, Leather Wrapped (GMDAT)
NQT	Emission System - Open Loop, Leaded (GMDAT)
NQU	Emission System - Korean, ULEV
NT3	Emission System - EEC 00
NT4	Emission System - EEC 05
NWU	Tailpipe - Downward Deflecting
Q8E	Jack - Mechanical, with Tools
QI0	Model Conversion - Interior, Trim Level 0
QI1	Model Conversion - Interior, Trim Level 1
QI2	Model Conversion - Interior, Trim Level 2
RHD	Vehicle Drive - Right Hand Drive
SMR	Ornamentation - Lettering "Groove"
SMS	Ornamentation - Lettering "Jazz"
SMT	Ornamentation - Lettering "Pop"
TCY	

	Provisions - Seat, Child
T3U	Lamp - Front Fog
T3X	Lamp System - Daytime Running, Regular Intensity Low Beam
T3Y	Lamp - Front Fog, Projection Type
T44	Alarm - Overspeed Warning, Acoustical
T56	Spoiler - Rear, Roof, Sport
T79	Lamp - Fog, Rear
T89	Lamp - Tail and Stop, Export
T90	Lamp - Signaling and Marker, Export
T94	Headlamps Control - LH Rule of the Road
TB1	Lamp - Tail and Stop, Korea
TB8	Headlamps Control - RH Rule of the Road
TBI	Plant Code - Talegaon, India
TD1	Reflector - Safety Triangle
TDY	Ornamentation - Lettering, "Chevrolet"
TFC	Alarm - Seat Belt Warning, Passenger
TH5	Height Adjustment - Safety Belt, Front Seat
TL6	Grille - Radiator, Black
TN9	Battery - LN1, FLA, 12V, 50AH, 375 ENCCA
TR6	Headlamps Control - Leveling System, Manual
TS6	Lamp - Stop, High Level
TTQ	Spoiler - Rear, Roof, Sport, Enlarged
TUQ	Lighter - Cigarette, without Illumination
TYS	Sales Package - Korea Electric Power
U04	Horn - Single Note
U05	Horn - Dual
U18	Speedometer - Instrument, Kilometer
U25	Lamp - Interior, Rear Compartment, Courtesy
U71	Antenna - Roof, Radio
U74	Antenna - Radio - Delete
U92	Antenna - Roof, Radio, GPS, Phone
UAD	Speaker System - 2, Front, Base
UAL	Audio Control - Data System, Mode
UC1	Speedometer - Instrument, Miles
UCH	Radio - AM/FM Stereo, Seek, CD, ETR, Fader, MP3
UD7	Sensor Indicator - Rear Parking Assist
UDB	Display Instrument - Driver Info Enhanced (Segmented)
UDG	Display Instrument - Trip Odometer (Segmented)
UDZ	Display - Trip Computer
UH0	Indicator - Seat Belt Warning, LH
UH1	Indicator - Seat Belt Warning, RH
UXX	

	Indicator - Seat Belt Warning, Rear Seat
UK3	Control - Steering Wheel, Accessory
UK5	Radio - AM/FM Stereo, Seek/Scan, Automatic Reverse Cassette, ETR
UM7	Radio - AM/FM Stereo, Seek/Scan, Clock, ETR
UQ4	Speaker System - 4, Base
UQ9	Speaker System - (- Delete)
UTJ	Theft Deterrent - Electrical, Unauthorized Entry
UV8	Telephone - Provisions for Mobile
UW6	Speaker System - 6, Custom
UY0	Battery - LN0, FLA, 12V, 40AH, 300 ENCCA
UZM	Radio - AM/FM Stereo, CD-ROM, MP3/WMA, Navigator, RDS, SD Slot, USB, Wireless Interface
V22	Grille - Radiator, Chrome
V48	Coolant - Engine Maximum Protection
V54	Luggage Carrier - Roof, Painted
V87	Vehicle Statement - Gulf States Organization
VA8	Language Label - Spanish
VD8	Provisions - First Aid Kit
VEE	Bumper Front - Body Color, Front and Rear
VH4	Mud Flaps -
VHU	Bumper Front - Sport
VHY	Protector - Body Sheet Metal, High Corrosion Preventive
VIX	Plate - Vehicle Identification - Visual (GMDAT)
VIY	Plate - Vehicle Identification - Asterisk (*) Mark (GMDAT)
VJY	Protector - Body Sheet Metal, Low Corrosion Preventive
VK8	Holder - Eyeglasses
VL4	License Plate Front - Front Mounting Package, EEC
VMA	License Plate Front - Front Mounting Package, Korea
VNU	VIN Format - U.S. Type
VNV	VIN Format - Korea Type
VNW	VIN Format - EU (ISO) Type
VXP	Panel Center - Instrument, V DK Pewter, Acrylic Paint
VXQ	Panel Center - Instrument, Dark Argent, Metallic Paint
VXR	Panel Center - Instrument, Cyclone, Aqua Graphic Film
W2V	Ornamentation - Lettering, VAR - Delete
WAM	Ornamentation - Name Plate "Matiz"
WAS	Ornamentation - Name Plate "Spark"
WCM	Ornamentation - Lettering "LT"
WF7	Ornamentation - Name Plate "Barina Spark"
WG3	Ornamentation - Name Plate "Spark 300"
WU5	Switch - I/P LP Dimmer

XA6	Label - EEC Compliance
XL4	Chassis - Protection Kit, Engine Compartment
XX7	Radio - Provisions, Installation, VAR 3
Y9Y	Ornamentation - Decal "Chevrolet"
ZY0	Warranty - 50, 000 km, 2 N.mears
ZY9	Warranty - 100, 000 km, 3 N.mears

FASTENERS

Metric Fasteners

This vehicle provides fastener dimensions using the metric system. Most metric fasteners are approximate in diameter to equivalent English fasteners. Make replacements using fasteners of the same nominal diameter, thread pitch, and strength.

A number marking identifies the OE metric fasteners except cross-recess head screws. The number also indicates the strength of the fastener material. A Posidrive® or Type 1A cross-recess identifies a metric cross-recess screw. For best results, use a Type 1A cross-recess screwdriver, or equivalent, in Posidrive® recess head screws.

GM Engineering Standards and North American Industries have adopted a portion of the ISO-defined standard metric fastener sizes. The purpose was to reduce the number of fastener sizes used while retaining the best thread qualities in each thread size. For example, the metric M6.0 X 1 screw, with nearly the same diameter and 25.4 threads per inch replaced the English 1/4-20 and 1/4-28 screws. The thread pitch is midway between the English coarse and fine thread pitches.

Fastener Strength Identification

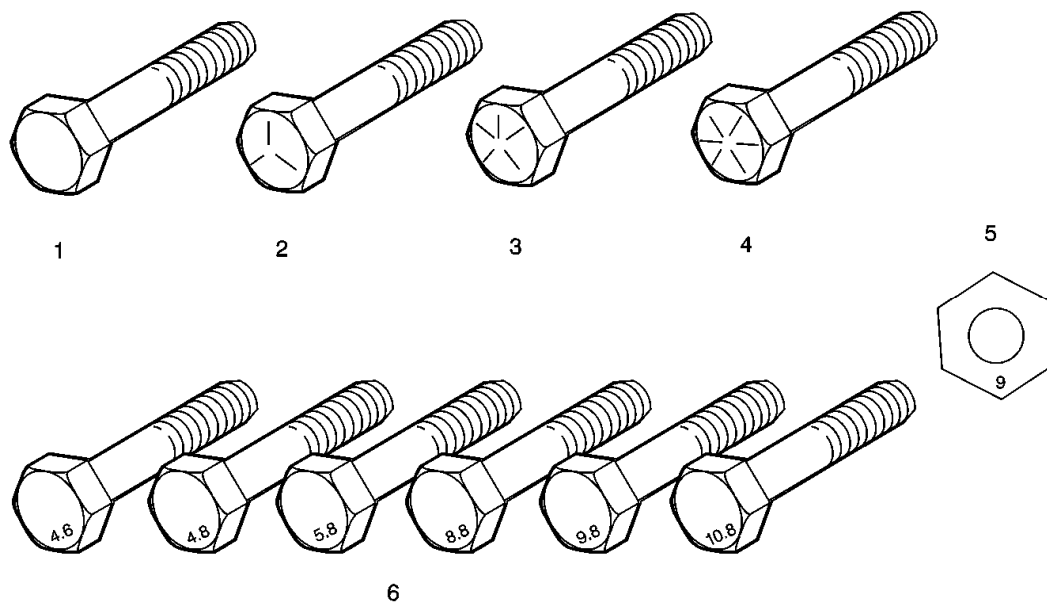


Fig. 9: Identifying Fastener Strength Marks
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	English Bolt, Grade 2 (Strength Class)
2	English Bolt, Grade 5 (Strength Class)
3	English Bolt, Grade 7 (Strength Class)
4	English Bolt, Grade 8 (Strength Class)
5	Metric Nut, Strength Class 9
6	Metric Bolts, Strength Class Increases as Numbers Increase

The most commonly used metric fastener strength property classes are 9.8 and 10.9. The class identification is embossed on the head of each bolt. The English, inch strength classes range from grade 2 to grade 8. Radial lines are embossed on the head of each bolt in order to identify the strength class. The number of lines on the head of the bolt is 2 lines less than the actual grade. For example, a grade 8 bolt will have 6 radial lines on the bolt head. Some metric nuts are marked with a single digit strength identification number on the nut face.

The correct fasteners are available through GM SPO. Many metric fasteners available in the aftermarket parts channels are designed to metric standards of countries other than the United States, and may exhibit the following:

- Lower strength
- No numbered head marking system
- Wrong thread pitch

The metric fasteners on GM products are designed to new, international standards. The following are the common sizes and pitches, except for special applications:

- M6.0 X 1
- M8 X 1.25
- M10 X 1.5
- M12 X 1.75
- M14 X 2.00
- M16 X 2.00

Prevailing Torque Fasteners

Prevailing torque fasteners create a thread interface between the fastener and the fastener counterpart in order to prevent the fastener from loosening.

All Metal Prevailing Torque Fasteners

These fasteners accomplish the thread interface by a designed distortion or deformation in the fastener.

Nylon Interface Prevailing Torque Fasteners

These fasteners accomplish the thread interface by the presence of a nylon material on the fastener threads.

Adhesive Coated Fasteners

These fasteners accomplish the thread interface by the presence of a thread-locking compound on the fastener threads. Refer to the appropriate repair procedure in order to determine if the fastener may be reused and the applicable thread-locking compound to apply to the fastener.



1



2



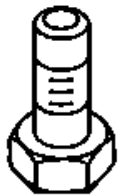
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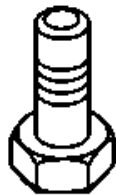
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5



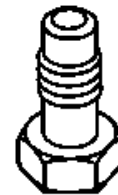
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7



8



9

Fig. 10: Identifying Adhesive Coated Fasteners
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Prevailing Torque Nut, Center Lock Type
2	Prevailing Torque Nut, Top Lock Type
3	Prevailing Torque Nut, Nylon Patch Type
4	Prevailing Torque Nut, Nylon Washer Insert Type
5	Prevailing Torque Nut, Nylon Insert Type
6	Prevailing Torque Bolt, Dry Adhesive Coating Type
7	Prevailing Torque Bolt, Thread Profile Deformed Type
8	Prevailing Torque Bolt, Nylon Strip Type
9	Prevailing Torque Bolt, Out-of-Round Thread Area Type

A prevailing torque fastener may be reused ONLY if:

- The fastener and the fastener counterpart are clean and not damaged
- There is no rust on the fastener
- The fastener develops the specified minimum torque against its counterpart prior to the fastener seating

Metric Prevailing Torque Fastener Minimum Torque Development

Application	Specification	
	Metric	English
All Metal Prevailing Torque Fasteners		
• 6 mm	0.4 N.m	4 lb in
• 8 mm	0.8 N.m	7 lb in
• 10 mm	1.4 N.m	12 lb in
• 12 mm	2.1 N.m	19 lb in
• 14 mm	3 N.m	27 lb in
• 16 mm	4.2 N.m	37 lb in
• 20 mm	7 N.m	62 lb in
• 24 mm	10.5 N.m	93 lb in
Nylon Interface Prevailing Torque Fasteners		
• 6 mm	0.3 N.m	3 lb in
• 8 mm	0.6 N.m	5 lb in
• 10 mm	1.1 N.m	10 lb in
• 12 mm	1.5 N.m	13 lb in
• 14 mm	2.3 N.m	20 lb in
• 16 mm	3.4 N.m	30 lb in
• 20 mm	5.5 N.m	49 lb in
• 24 mm	8.5 N.m	75 lb in

English Prevailing Torque Fastener Minimum Torque Development

Application	Specification	
	Metric	English
All Metal Prevailing Torque Fasteners		
• 1/4 in	0.5 N.m	4.5 lb in
• 5/16 in	0.8 N.m	7.5 lb in
• 3/8 in	1.3 N.m	11.5 lb in
• 7/16 in	1.8 N.m	16 lb in
• 1/2 in	2.3 N.m	20 lb in
• 9/16 in	3.2 N.m	28 lb in

• 5/8 in	4 N.m	36 lb in
• 3/4 in	7 N.m	54 lb in
Nylon Interface Prevailing Torque Fasteners		
• 1/4 in	0.3 N.m	3 lb in
• 5/16 in	0.6 N.m	5 lb in
• 3/8 in	1 N.m	9 lb in
• 7/16 in	1.3 N.m	12 lb in
• 1/2 in	1.8 N.m	16 lb in
• 9/16 in	2.5 N.m	22 lb in
• 5/8 in	3.4 N.m	30 lb in
• 3/4 in	5 N.m	45 lb in

THREAD INSERTS

General Purpose Thread Repair Kits.

These kits are available commercially.

Repair Procedure

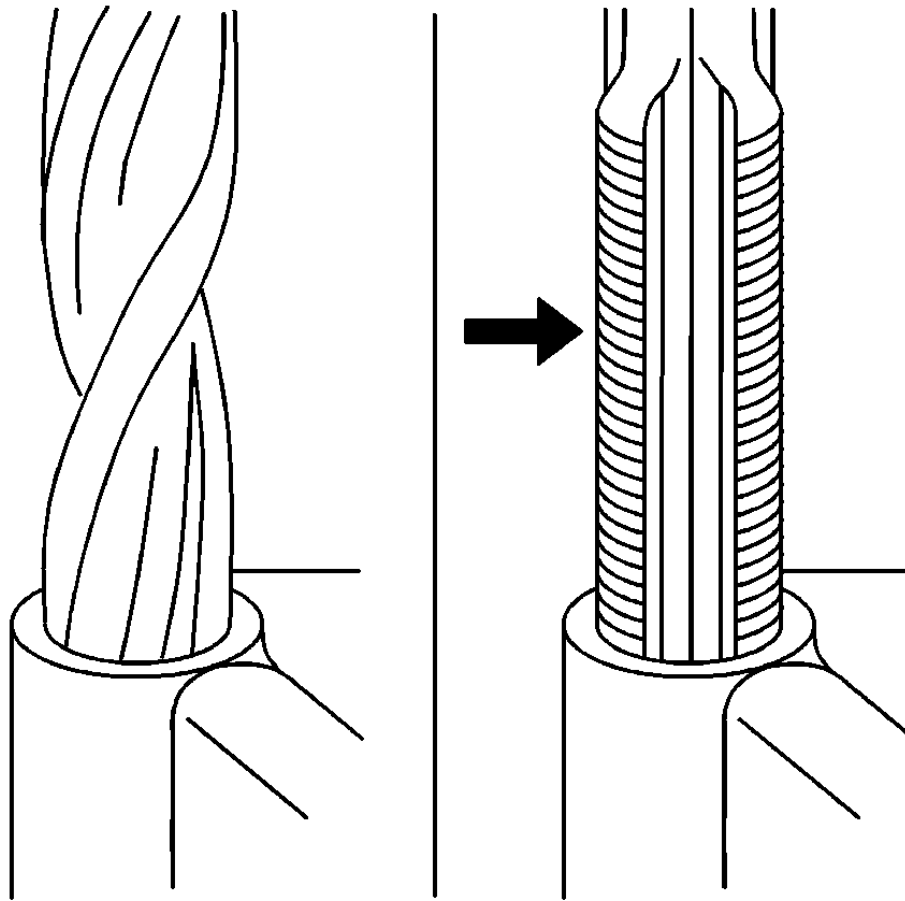


Fig. 11: Drilling & Tapping Damaged Threads
Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to Safety Glasses Warning .

NOTE: Refer to the thread repair kit manufacturer instructions regarding the size of the drill and tap to use.

Avoid any buildup of chips. Back out the tap every few turns and remove the chips.

1. Determine the size, the pitch, and the depth of the damaged thread. If necessary, adjust the stop collars on the cutting tool and tap to the required depth.
2. Drill out the damaged threads. Clean out any chips.
3. Lubricate the tap with light engine oil. Tap the hole. Clean the threads.

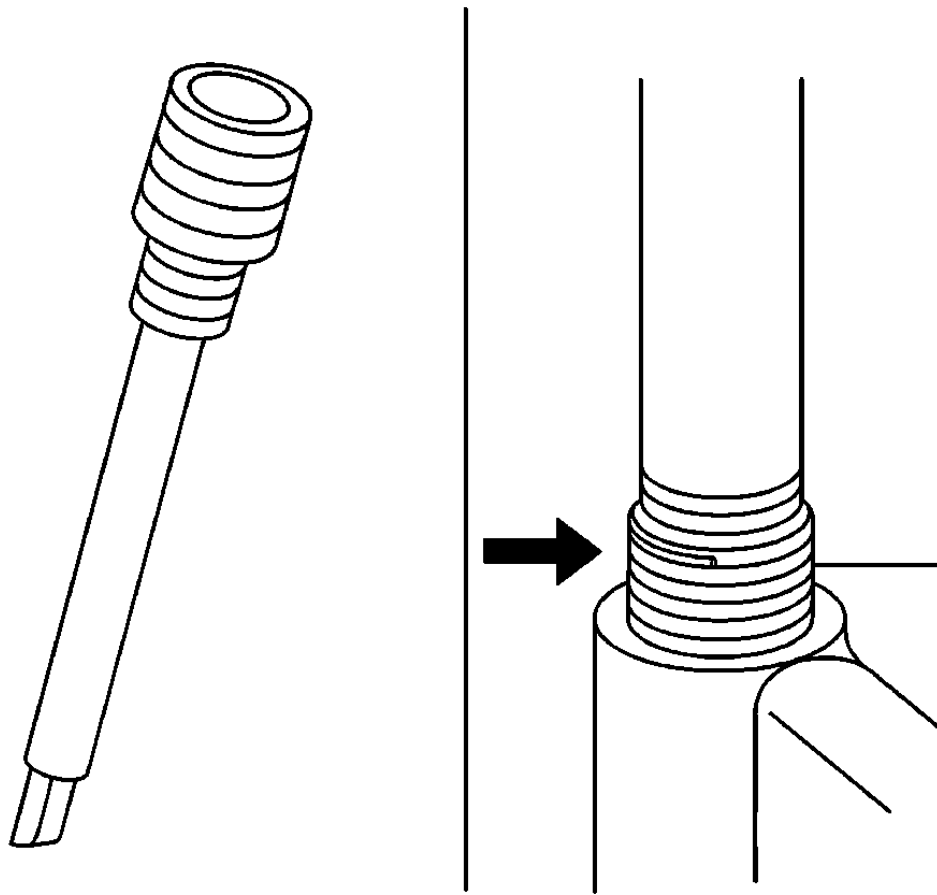


Fig. 12: View Of Thread Insert

Courtesy of GENERAL MOTORS COMPANY

4. Thread the thread insert onto the mandrel of the installer. Engage the tang of the insert onto the end of the mandrel.

NOTE: **The insert should be flush to one turn below the surface.**

5. Lubricate the insert with light engine oil, except when installing in aluminum and install the insert.
6. If the tang of the insert does not break off when backing out the installer, break the tang off with a drift.

DOOR LOCK AND IGNITION LOCK FOLDING AND NON-FOLDING KEY CUTTING

High Security keys are available from the service parts system.

Obtain the key code from the security card or from the GM Dealer World, Parts, Key Code Look Up system.

If you have the key code and access to a Triax-E., BD Laser or other code key cutting machine from the GM Dealer Equipment Catalog, you may cut a new key.

If you have the original key and access to a Matrix S, BD Laser or other key duplicating machine, you may duplicate the key.

If you do not have a high security key cutting machine, order the side cut key from the service parts system. Include the key code in the NOTE field. Indicate the timing and the method of the shipment.

Inspect the new key operation in the lock cylinder. Ensure the new key operates effectively.

KEY AND LOCK CYLINDER CODING

Ignition Lock Cylinder

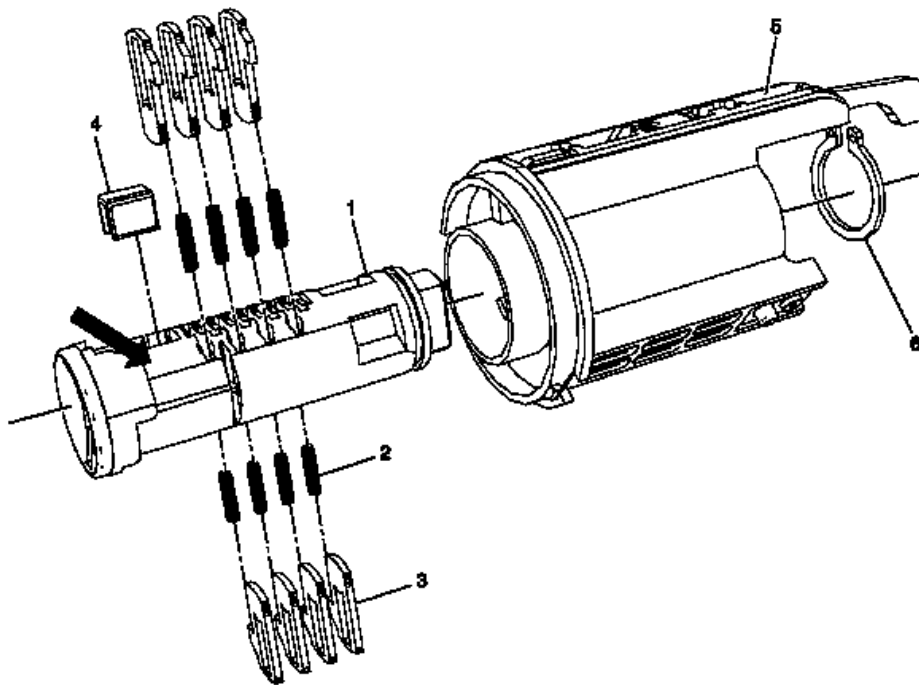


Fig. 13: Ignition Lock Cylinder
Courtesy of GENERAL MOTORS COMPANY

1. Tumbler spring (2) and tumbler (3) to be assembled into cylinder (1)-In this case start with the tumbler near the cylinder head and work through until the last tumbler at the cylinder ground. Use the key as tool by pushing it in step by step to hold the already assembled tumblers in place.
2. Slide piece (4) to be assembled into the pocket in cylinder (1).
3. Apply grease on the cylinder diameter.
4. Assemble the rotor case (5) and sub-assembly.
5. Remove the key.

6. Install the C-ring (6) to the bottom of the cylinder.

Front Side Door Lock Cylinder

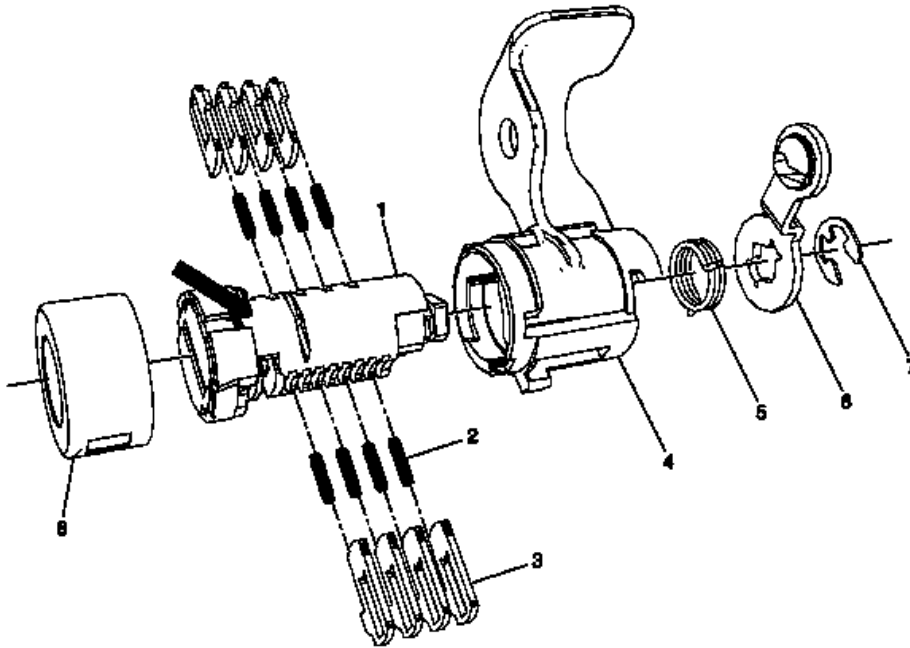


Fig. 14: Front Side Door Lock Cylinder
Courtesy of GENERAL MOTORS COMPANY

1. Tumbler spring (2) and tumbler (3) to be assembled into cylinder (1)-In this case start with the tumbler near the cylinder head and work through until the last tumbler at the cylinder ground. Use the key as tool by pushing it in step by step to hold the already assembled tumblers in place.
2. Apply grease on the cylinder diameter.
3. Assemble the rotor case (5) and sub-assembly.
4. Remove the key.
5. Install the return spring (5) and lever (6).
6. Install the E-ring (6) to the bottom of the cylinder.
7. Install and stake the rotor case cover (8) onto the head of the rotor case (5) by crimping the cover material in 2 places into the pockets around the head of the rotor case.

Liftgate Lock Cylinder

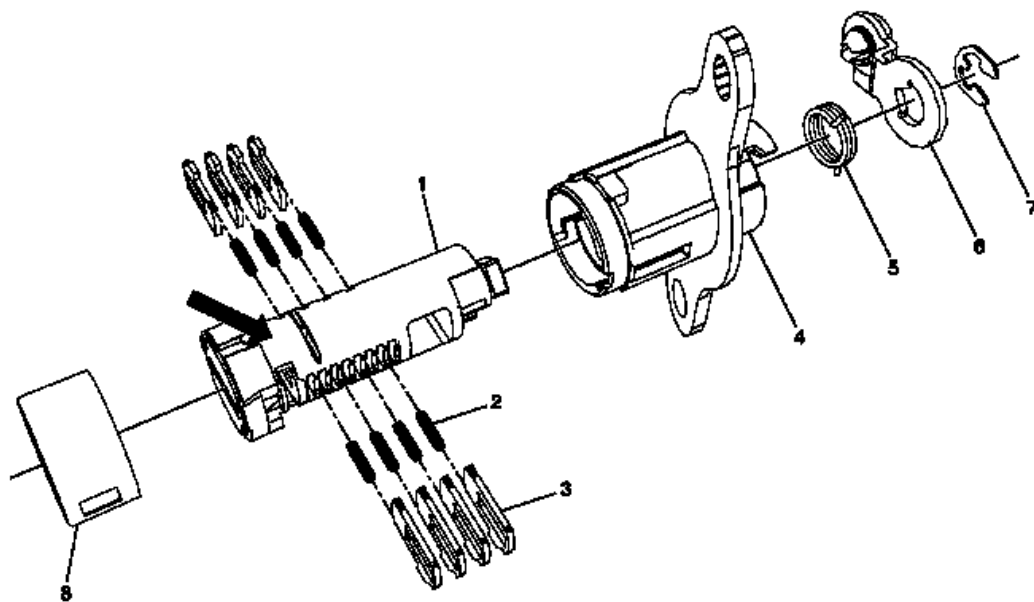


Fig. 15: Liftgate Lock Cylinder

Courtesy of GENERAL MOTORS COMPANY

1. Tumbler spring (2) and tumbler (3) to be assembled into cylinder (1)-In this case start with the tumbler near the cylinder head and work through until the last tumbler at the cylinder ground. Use the key as tool by pushing it in step by step to hold the already assembled tumblers in place.
2. Apply grease on the cylinder diameter.
3. Assemble the rotor case (5) and sub-assembly.
4. Remove the key.
5. Install the return spring (5) and lever (6).
6. Install the E-ring (6) to the bottom of the cylinder.
7. Install and stake the rotor case cover (8) onto the head of the rotor case (5) by crimping the cover material in 2 places into the pockets around the head of the rotor case.

LIFTING AND JACKING THE VEHICLE

NOTE: The use of a **LOW PROFILE LIFT ARMS SYSTEM** may be required to avoid unwanted contact with the vehicle body and structure depending on lifting equipment used. Refer to the manufacturer recommendation for their applications of low profile lift arms system for their lifting equipment.

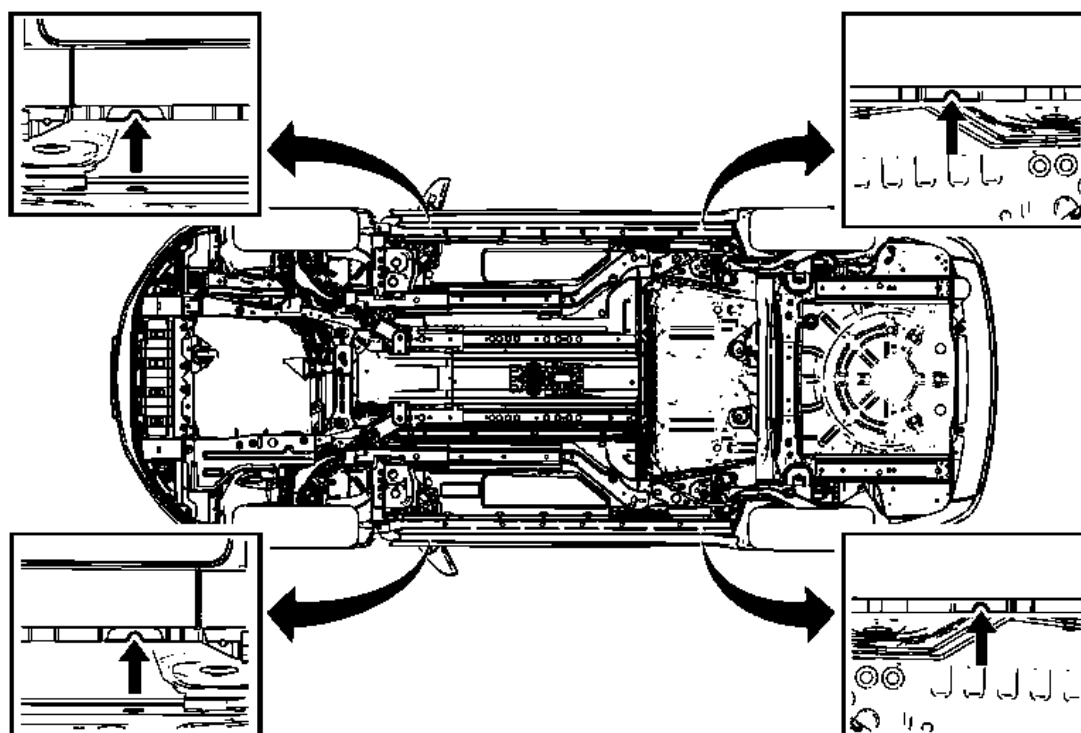


Fig. 16: Vehicle Lifting Points

Courtesy of GENERAL MOTORS COMPANY

WARNING: To avoid any vehicle damage, serious personal injury or death when major components are removed from the vehicle and the vehicle is supported by a hoist, support the vehicle with jack stands at the opposite end from which the components are being removed and strap the vehicle to the hoist.

WARNING: To avoid any vehicle damage, serious personal injury or death, always use the jackstands to support the vehicle when lifting the vehicle with a jack.

CAUTION: Perform the following steps before beginning any vehicle lifting or jacking procedure:

- Remove or secure all of the vehicle contents in order to avoid any shifting or any movement that may occur during the vehicle lifting or jacking procedure.
- The lifting equipment or the jacking equipment weight rating must meet or exceed the weight of the vehicle and any vehicle contents.
- The lifting equipment or the jacking equipment must meet the operational standards of the lifting equipment or jacking equipment manufacturer.

- Perform the vehicle lifting or jacking procedure on a clean, hard, dry, level surface.
- Perform the vehicle lifting or jacking procedure only at the identified lift points. DO NOT allow the lifting equipment or jacking equipment to contact any other vehicle components.

Failure to perform the previous steps could result in damage to the lifting equipment or the jacking equipment, the vehicle, and/or the vehicle contents.

Vehicle Lifting- Frame Contact Lift

Front Lift Pads

When lifting the vehicle with a frame-contact lift, place the front lift pads on the rocker outer panel weld flange, as shown.

Rear Lift Pads

When lifting the vehicle with a frame-contact lift, place the rear lift pads on the rocker outer panel weld flange, as shown.

Vehicle Jacking

CAUTION: When you are jacking the vehicle at the front locations, be certain that the jack or the jack lift pad does not contact the front fascia, front fascia air dam, or the front fenders. If such contact occurs, vehicle damage may result. When jacking at selected front locations additional clearance may be required for the jacking points.

NOTE: When you are lifting a vehicle with a service jack, block the wheels at the opposite end from which you are lifting. Use jack stands to provide additional support.

When using a service jack under the front of the vehicle use one of the following locations:

Front of Vehicle

Place the service jack pad in the same location as shown for the front lift pads.

Rear of Vehicle

NOTE: Place jackstands **ONLY** under strong and stable vehicle structures.

Place the service jack pad in the same location as shown for the rear lift pads.

HVAC

Heating, Ventilation, and Air Conditioning - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS (1.0L LMT, 1.19L LC5, AND 1.2L LMU)

Fastener Tightening Specifications (1.0L LMT, 1.19L LC5, and 1.2L LMU)

Application	Specification	
	Metric	English
Air Conditioning Compressor and Condenser Hose Bolt to Air Conditioning Compressor	22 N.m	16 lb ft
Air Conditioning Compressor and Condenser Hose Nut to Air Conditioning Condenser	10 N.m	89 lb in
Air Conditioning Compressor Bolts	22 N.m	16 lb ft
Air Conditioning Evaporator Hose Assembly Bolt to Air Conditioning Compressor	22 N.m	16 lb ft
Air Conditioning Evaporator Hose Assembly Mounting Bracket Nuts	10 N.m	89 lb in
Air Conditioning Evaporator Hose Assembly Nut to Air Conditioning Condenser	10 N.m	89 lb in
Air Conditioning Evaporator Hose Assembly Nut to Air Conditioning Evaporator Thermal Expansion Valve	20 N.m	15 lb ft
Air Conditioning Evaporator Thermal Expansion Valve Bolts	3.5 N.m	31 lb in
Air Conditioning Refrigerant Pressure Sensor	1.2 N.m	11 lb in
Blower Motor Resistor Screws	1.2 N.m	11 lb in
Blower Motor Screws	1.2 N.m	11 lb in
Compressor Clutch Plate Bolt	14 N.m	10 lb ft
Evaporator Rear Cover Screws	1.2 N.m	11 lb in
Heater and Air Conditioning Evaporator Case Screws	1.2 N.m	11 lb in
Heater Core Cover Screws	1.2 N.m	11 lb in
Heater Core Pipe Side Cover Screws	1.2 N.m	11 lb in
Heater Core Pipe Under Cover Screw	1.2 N.m	11 lb in
HVAC Module Assembly to Dash Panel Bolts	6 N.m	53 lb in
Instrument Panel Outer Air Outlet Duct Screw	1.3 N.m	12 lb in
Left Floor Air Outlet Duct Screw	1.2 N.m	11 lb in
Right Floor Air Outlet Duct Screw	1.2 N.m	11 lb in
Service Port Valve Core	0.4 N.m	4 lb in
Windshield Defroster Nozzle Screw	1.3 N.m	12 lb in

FASTENER TIGHTENING SPECIFICATIONS (1.0L DIESEL LEB)

Fastener Tightening Specifications (1.0L Diesel LEB)

Application	Specification	
	Metric	English
Air Conditioning Compressor and Condenser Hose Bolt to Air Conditioning Compressor	22 N.m	16 lb ft
Air Conditioning Compressor and Condenser Hose Nut to Air Conditioning Condenser LSF	10 N.m	89 lb in
Air Conditioning Compressor and Condenser Hose Nut to Air Conditioning Condenser LEB	9 N.m	80 lb in
Air Conditioning Compressor Bolts	22 N.m	16 lb ft
Air Conditioning Compressor Bracket Bolts	22 N.m	16 lb ft
Air Conditioning Compressor Hose Bolt to Air Conditioning Compressor LEB	22 N.m	16 lb ft
Air Conditioning Compressor Hose Nut to Air Conditioning Evaporator Hose Assembly LEB	9 N.m	80 lb in
Air Conditioning Evaporator Hose Assembly Bolt to Air Conditioning Compressor LSF	22 N.m	16 lb ft
Air Conditioning Evaporator Hose Bracket Bolt to Front Compartment Front Inner Side Rail LEB	9 N.m	80 lb in
Air Conditioning Evaporator Hose Bracket Nut to Front Compartment Front Inner Side Rail LEB	9 N.m	80 lb in
Air Conditioning Evaporator Hose Bracket Nut to Dash Panel LEB	9 N.m	80 lb in
Air Conditioning Evaporator Hose Assembly Mounting Bracket Nuts LSF	10 N.m	89 lb in
Air Conditioning Evaporator Hose Assembly Nut to Air Conditioning Condenser LSF	10 N.m	89 lb in
Air Conditioning Evaporator Hose Assembly Nut to Air Conditioning Compressor Hose LEB	22 N.m	16 lb ft
Air Conditioning Evaporator Hose Assembly Nut to Air Conditioning Evaporator Thermal Expansion Valve LSF	20 N.m	15 lb ft
Air Conditioning Evaporator Hose Assembly Nut to Air Conditioning Evaporator Thermal Expansion Valve LEB	22 N.m	16 lb ft
Air Conditioning Evaporator Thermal Expansion Valve Bolts	3.5 N.m	31 lb in
Air Conditioning Refrigerant Pressure Sensor	1.2 N.m	11 lb in
Blower Motor Resistor Screws	1.2 N.m	11 lb in
Blower Motor Screws	1.2 N.m	11 lb in
Compressor Clutch Plate Bolt	14 N.m	10 lb ft
Condenser Outlet Tube Nut to Air Conditioning Condenser LEB	9 N.m	80 lb in
Evaporator Rear Cover Screws	1.2 N.m	11 lb in
Heater and Air Conditioning Evaporator Case Screws	1.2 N.m	11 lb in
Heater Core Cover Screws	1.2 N.m	11 lb in

Heater Core Pipe Side Cover Screws	1.2 N.m	11 lb in
Heater Core Pipe Under Cover Screw	1.2 N.m	11 lb in
HVAC Module Assembly to Dash Panel Bolts	6 N.m	53 lb in
Instrument Panel Outer Air Outlet Duct Screw	1.3 N.m	12 lb in
Left Floor Air Outlet Duct Screw	1.2 N.m	11 lb in
Right Floor Air Outlet Duct Screw	1.2 N.m	11 lb in
Service Port Valve Core	0.4 N.m	4 lb in
Windshield Defroster Nozzle Screw	1.3 N.m	12 lb in

REFRIGERANT SYSTEM SPECIFICATIONS (1.2L LL0, 1.0L LFM)

Refrigerant System Specifications (1.2L LL0, 1.0L LFM)

Application	Specification	
	Metric	English
PAG Oil ISU 105		
Compressor Replacement The service compressor is precharged with 41 ml (1.4 oz) of PAG oil.		
Condenser Replacement	15-20 ml	0.5-0.7 oz
Evaporator Replacement	15-20 ml	0.5-0.7 oz
Total System PAG Oil Capacity	50 ml	1.7 oz
R-134a		
• Refrigerant Charge	430 g	15 oz

DIAGNOSTIC INFORMATION AND PROCEDURES

LEAK TESTING

Special Tools

- **BO-42220** Universal 12V Leak Detection Lamp
- **GE-39400-A** Halogen Leak Detector
- **GE-41447** R-134A A/C Tracer Dye-Box of 24
- **GE-43872** Fluorescent Dye Cleaner
- **GE-46297** A/C Dye Injector Kit
- **GE-46297-12** Replacement Dye Cartridges

For equivalent regional tools, refer to **Special Tools**.

Refrigerant Leak Testing

NOTE: These vehicles are not now manufactured with fluorescent dye installed directly into the air conditioning (A/C) system. Therefore, if refrigerant leak testing is

required, add florescent dye into the air conditioning (A/C) system.

The fluorescent dye mixes and flows with the polyalkylene glycol (PAG) oil throughout the refrigerant system.

Verifying some passive leaks may require using the **GE-39400-A** detector, even though the A/C system contains fluorescent dye.

Fluorescent Leak Detector

Fluorescent dye will assist in locating any leaks in the A/C system.

NOTE: PAG oil is water soluble.

- Condensation on the evaporator core or the refrigerant lines may wash the PAG oil and fluorescent dye away from the actual leak. Condensation may also carry dye through the HVAC module drain.
- Leaks in the A/C system will be indicated in a light green or yellow color when using the leak detection lamp.

Use the leak detection lamp in the following areas:

- All fittings or connections that use seal washers or O-rings
- All of the A/C components
- The A/C compressor shaft seal
- The A/C hoses and pressure switches
- The HVAC module drain tube, if the evaporator core is suspected of leaking
- The service port sealing caps
- The sealing cap is the primary seal for the service ports.
- Follow the instructions supplied with the **BO-42220** lamp.
- To prevent false diagnosis in the future, thoroughly clean the residual dye from any area where leaks were found. Use a rag and the approved **GE-43872** cleaner.

Fluorescent Dye Injection

NOTE: Use only fluorescent dye approved by General Motors.

NOTE: Do NOT overcharge the A/C system with dye.

- **GE-41447** dye can be poured directly into a removed A/C component.
- **GE-46297-12** dye cartridge is injected into the low side port using **GE-46297** injector kit.
- Not all of the fluorescent dyes are compatible with PAG oil. Some types of dye decrease the oil viscosity or may chemically react with the oil.
- R-134A leak detection dye requires time to work. Depending upon the leak rate, a leak may not become visible for between 15 minutes and 7 days.

- To prevent false diagnosis, thoroughly clean any residual dye from the service port with a rag and the approved fluorescent dye cleaner **GE-43872** dye cleaner.

Halogen Leak Detector

WARNING: Do not operate the detector in a combustible atmosphere since its sensor operates at high temperatures or personal injury and/or damage to the equipment may result.

Ensure that the vehicle has at least 0.45 kg (1 lb) of refrigerant in the A/C refrigeration system in order to perform a leak test. Refer to **Refrigerant Recovery and Recharging** for recharging the A/C system.

NOTE: Halogen leak detectors are sensitive to the following items:

- Windshield washing solutions
- Many solvents and cleaners
- Some adhesives used in the vehicle

Clean and dry all surfaces in order to prevent a false warning. Liquids will damage the detector.

NOTE: Follow a continuous path in order to ensure that you will not miss any possible leaks. Test all areas of the system for leaks.

Follow the instructions supplied with the **GE-39400-A** detector.

AIR CONDITIONING (A/C) SYSTEM PERFORMANCE TEST

This test measures the operating efficiency of the A/C system under the following conditions:

- The current ambient air temperature
- The current relative humidity
- The high side pressure of the A/C system
- The low side pressure of the A/C system
- The temperature of the air being discharged into the passenger compartment

Test Description

The numbers below refer to the step numbers on the diagnostic table.

1

This step determines if the A/C system has at least the minimum refrigerant charge required to operate the system without damage.

2

This step measures the performance of the A/C system.

3

This step is to allow for vehicle variations as well as high ambient temperatures.

Air Conditioning (A/C) System Performance Test

Step	Action	Values	Yes	No
NOTE: • The ambient air temperature must be at least 16°C (60°F). • Do not induce additional air flow across the front of the vehicle during the test. • If you were sent here from a DTC diagnostic table, clear the DTC upon completion of this test.				
1	1. Park the vehicle inside or in the shade. 2. Open the windows in order to ventilate the interior of the vehicle. 3. If the A/C system was operating, allow the A/C system to equalize for about 2 minutes. 4. Turn OFF the ignition. 5. Install the J-43600 ACR 2000 Air Conditioning Service Center or GE-48800 CoolTech A/C Recharge Machine. 6. Record the ambient air temperature and humidity. 7. Record the low and high side STATIC pressure readings. Are both the low side and high side pressures within the specified value?	More than 16°C (60°F) - 345 kPa (50 psi) More than 24°C (75°F) - 483 kPa (70 psi) More than 33°C (90°F) - 690 kPa (100 psi)	Go to Step 2	Go to <u>Leak Testing</u>
	NOTE: Record the relative humidity and the ambient air temperature at the time of the test. 1. Close the vehicle doors and windows. 2. Open the drivers door window 12.7-15.2 cm (5-6 in). 3. Select the following HVAC control settings: • The A/C is ON. • The coldest temperature setting			

2	• The maximum blower speed • Recirculation mode • The instrument panel (I/P) outlet mode • All I/P outlets are OPEN. 4. Install thermometers in the left and right center panel air outlets. 5. Apply the parking brake. 6. Place the transaxle/transmission in one of the following positions: • PARK (Automatic) • NEUTRAL (Manual) 7. Start the engine and warm to operating temperature. 8. Operate the A/C system for 5 minutes. 9. Inspect A/C components for the following conditions: • Abnormal frost areas • Unusual noises 10. Record the following information: • The panel outlet air temperatures • The low-side pressure • The high-side pressure 11. Compare the low and high side pressures and the panel output temperatures to the A/C Performance Table below. Does all the data recorded fall within the specified ranges of the A/C Performance Table below?	-	Go to Step 5	Go to Step 3
3	If the pressures and temperatures recorded do not fall within the specified ranges: 1. Continue to operate the A/C system for an additional 5 minutes. 2. Record the pressures and temperatures again. 3. Compare the low and high side pressures and the panel output temperature to the A/C Performance Table below.	-		

	Does all the data recorded fall within the specified ranges of the A/C Performance Table below?		Go to Step 5	Go to Step 4
4	Perform the necessary repairs. Refer to <u>A/C Diagnostics Chart</u> . Is the action complete?	-	Go to Step 5	-
5	Operate the system in order to verify the test results. Did you find the same results?	-	System OK	Go to <u>Symptoms - HVAC Systems - Manual</u>

A/C Performance Table

Ambient Temperature	Relative Humidity	Low Side Service Port Pressure	High Side Service Port Pressure	Maximum Left Center Discharge Air Temperature
13-18°C (55-65°F)	0-100%	206-282 kPa (30-41 psi)	1350-1660 kPa (196-241 psi)	17°C (61°F)
19-24°C (66-75°F)	Below 40%	206-296 kPa (30-43 psi)	1398-1708 kPa (203-248 psi)	14°C (57°F)
	Above 40%	227-316 kPa (35-46 psi)	1481-1832 kPa (215-266 psi)	18°C (63°F)
25-29°C (76-85°F)	Below 35%	241-316 kPa (36-47 psi)	1550-1818 kPa (225-264 psi)	15°C (59°F)
	35-50%	248-323 kPa (36-47 psi)	1619-1867 kPa (235-271 psi)	17°C (61°F)
	Above 50%	261-337 kPa (38-49 psi)	1660-1977 kPa (241-287 psi)	18°C (64°F)
30-35°C (86-95°F)	Below 30%	268-337 kPa (39-49 psi)	1667-1949 kPa (242-283 psi)	18°C (63°F)
	30-50%	275-351 kPa (40-51 psi)	1772-2032 kPa (250-295 psi)	19°C (64°F)
	Above 50%	282-358 kPa (41-52 psi)	1791-2149 kPa (260-312 psi)	19°C (66°F)
36-41°C (96-105°F)	Below 20%	296-365 kPa (43-53 psi)	1791-2053 kPa (260-298 psi)	19°C (66°F)
	20-40%	296-372 kPa (43-54 psi)	1832-2412 kPa (266-311 psi)	19°C (66°F)
	Above 40%	303-378 kPa (44-55 psi)	1908-2232 kPa (277-324 psi)	20°C (68°F)
42-46°C (106-115°F)	Below 20%	323-392 kPa (47-57 psi)	1922-3156 kPa (279-313 psi)	22°C (70°F)
	Above 20%	330-392 kPa (48-57 psi)	1970-2256 kPa (286-329 psi)	22°C (70°F)
47-49°C (116-120°F)	Below 30%	351-420 kPa (51-61 psi)	1832-2060 kPa (266-299 psi)	23°C (73°F)

A/C DIAGNOSTICS CHART

A/C Diagnostics Chart

Low Side Gauge Reading	High Side Gauge Reading	Potential Causes
Low	Low	Low Refrigerant Charge
		Restriction between Compressor and High Side port
	Low/Normal	Evaporator Freezing
	High	Restriction between the Low Side and High Side ports or Restricted TXV/Orifice Tube
		Compressor Stuck at Maximum Displacement
High	Low	Compressor has Low Displacement or Internal Malfunction
		Malfunctioning Cooling Fans
	High	Refrigerant Overcharge
		Restriction between the Low Side Port and Compressor Inlet
		Restricted Condenser Air Flow
		Expansion Device Stuck Open
		Air in A/C System
Normal/High	Normal/High	Refrigerant Contamination
		PAG or POE Oil Overcharge

NOISE DIAGNOSIS - BLOWER MOTOR

Noise Diagnosis - Blower Motor

Step	Action	Yes	No
DEFINITION: Noise originating from the blower motor.			
1	Were you sent here from Symptoms or another diagnostic table?	Go to Step 2	Go to <u>Symptoms - HVAC Systems - Manual</u>
2	Inspect the air inlet grille for debris. Is debris present?	Go to Step 8	Go to Step 3
3	1. Sit inside the vehicle. 2. Close the vehicle doors and windows. 3. Turn ON the ignition, with the engine OFF. 4. Cycle the blower motor through all of the speeds and modes in order to determine where and when the noise occurs.		
	Is a noise evident during the blower operation?	Go to Step 4	Go to Step 11
	Inspect for excessive vibration at each blower motor		

4	speed by feeling the blower case. Is excess vibration present?	Go to Step 6	Go to Step 5
5	Listen to the blower motor at each speed. Is the blower motor making a squeaking or chirping noise?	Go to Step 9	Go to Step 11
6	1. Remove the blower motor. Refer to <u>Blower Motor Replacement</u>. 2. Inspect the blower motor impeller for deposits of foreign material. 3. Inspect the blower motor for deposits of foreign material. Did you find any foreign material on the blower motor or blower motor impeller?	Go to Step 8	Go to Step 7
7	Inspect the blower motor for the following conditions: • Cracked blades • A loose impeller retainer • Improper impeller alignment Did you find any of these conditions?	Go to Step 9	Go to Step 10
8	Remove the foreign material. Is the action complete?	Go to Step 10	-
9	Replace the blower motor. Refer to <u>Blower Motor Replacement</u> . Is the repair complete?	Go to Step 11	-
10	Install the blower motor. Refer to <u>Blower Motor Replacement</u> . Is the action complete?	Go to Step 11	-
11	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to Step 2

AIR CONDITIONING COMPRESSOR OIL DIAGNOSIS

Air Conditioning Compressor Oil Diagnosis

Condition	Corrective Action
NOTE: To avoid repeat compressor failure, always inspect the condition of the refrigerant oil and take the appropriate corrective action before installing the replacement compressor.	
Clean oil no debris present	No corrective action necessary.
	• Replace the desiccant or component containing the desiccant.

Clean oil with debris present	• Replace the desiccant filter if applicable. • Remove and inspect the high pressure side filter (if applicable). • Remove, inspect, clean, or replace the orifice tube. • If the system has a front orifice tube and is equipped with a filter in the rear auxiliary line, remove, inspect, clean, or replace the filter.
Dark brown/black and/or pungent/unusual odor with no debris present	• Replace the desiccant or component containing the desiccant. • Replace the desiccant filter if applicable. • Flush the refrigerant system.
Dark brown/black and/or pungent/unusual odor with debris present	• Replace the desiccant or component containing the desiccant. • Replace the desiccant filter if applicable. • Flush the refrigerant system. • Remove and inspect the high pressure side filter if applicable. • Remove, inspect, clean, or replace the orifice tube. • If the system has a front orifice tube and is equipped with a filter in the rear auxiliary line, remove, inspect, clean or replace the filter.
Oil overcharge	Flush the refrigerant system.
Refrigerant contamination	Flush the refrigerant system.
Hybrid polyolester refrigerant oil (POE) contamination	• Flush the refrigerant system. • Replace the desiccant or component containing the desiccant. • Replace the desiccant filter if applicable.

NOISE DIAGNOSIS - AIR CONDITIONING (A/C) SYSTEM

Noise Diagnosis - Air Conditioning (A/C) System

Step	Action	Yes	No
DEFINITION: Noise originating from the A/C compressor, drive belt, or the A/C lines.			
1	Were you sent here from Symptoms or another diagnostic table?	Go to Step 2	Go to <u>Symptoms - HVAC Systems - Manual</u>
	1. A/C system noises can be generally categorized into 3 areas: • Screeching, squealing, chirping noises		

2	• Moaning noises • Vibration/rattle noises 2. Start the engine. 3. Ensure that the A/C is ON. Is a screeching, squealing noise heard when the A/C is engaged?	Go to Step 3	Go to Step 9
3	With the engine OFF, inspect the drive belt for excessive wear. Refer to <u>Drive Belt Falls Off and Excessive Wear Diagnosis</u> . Is the drive belt excessively worn?	Go to Step 18	Go to Step 4
4	Inspect the drive belt tension. Is the drive belt tension correct?	Go to Step 5	Go to Step 18
5	Inspect the drive belt for excessive oil coverage. Is the drive belt covered with oil?	Go to Step 17	Go to Step 6
6	1. Start the engine. 2. Ensure that the A/C is ON. 3. Inspect the compressor and the clutch. Is the A/C compressor locked up?	Go to Step 23	Go to Step 7
7	Is the A/C compressor clutch slipping?	Go to Step 22	Go to Step 8
8	WARNING: Refer to <u>Moving Parts and Hot Surfaces Warning</u> . Using a stethoscope, listen to the A/C compressor for any abnormal noises. Is the compressor causing an abnormal noise?	Go to Step 15	Go to Step 10
9	Does a moaning noise exist when the A/C clutch is engaged?	Go to Step 10	Go to Step 12
10	Listen to the A/C compressor components and mounting for noise concerns using a stethoscope. Are any of these components loose, damaged, or excessively worn?	Go to Step 19	Go to Step 11
11	1. Idle the engine. 2. Engage the A/C compressor clutch. 3. Using a stethoscope, move around the entire refrigerant plumbing system, listening for any abnormal noises caused by a component of the A/C system touching another component. Are any of the A/C components grounding out and causing a vibration noise?	Go to Step 21	Go to Step 13
	Does a vibration or rattle noise exist when the A/C		

12	clutch is engaged?	Go to Step 13	Go to Step 14
13	Does the noise stop when the A/C clutch is disengaged?	Go to Step 15	Go to Step 24
14	1. Idle the engine in PARK with the A/C compressor clutch engaged. 2. Using a stethoscope, move around the entire A/C system testing for any abnormal noises caused by a component. Do any of the A/C components cause an abnormal noise?	Go to Step 20	Go to Step 24
15	Verify that the A/C system is properly charged. Refer to <u>Refrigerant System Specifications (1.2L LL0, 1.0L LFM)</u>. Is the A/C system properly charged?	Go to Step 25	Go to Step 16
16	Recharge the A/C system to specification. Refer to <u>Refrigerant Recovery and Recharging</u>. Is the abnormal compressor noise still present?	Go to Step 23	Go to Step 25
17	Repair the oil leak. Refer to <u>Oil Leak Diagnosis</u> . Is the repair complete?	Go to Step 18	-
18	Replace the drive belt. Refer to <u>Air Conditioning Compressor Belt Replacement</u> . Is the replacement complete?	Go to Step 25	-
19	Repair or replace the A/C compressor mounting component. Is the repair complete?	Go to Step 25	-
20	Repair or replace the component which is causing the moaning concern as needed. Is the repair complete?	Go to Step 25	-
21	Correctly route or insulate the A/C component. Is the repair complete?	Go to Step 25	-
22	Replace the A/C compressor clutch. Refer to <u>Air Conditioning Clutch Replacement (1.2L LL0, 1.0L LFM)</u>. Is the repair complete?	Go to Step 25	-
23	Replace the A/C compressor. Refer to <u>Air Conditioning Compressor Replacement (1.2L LL0, 1.0L LFM)</u>. Is the repair complete?	Go to Step 25	-
24	The concern may be caused by an engine related component. Refer to <u>Vibration Analysis - Engine</u> . Did you find and correct the condition?	Go to Step 25	-
25	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to Step 2

NOISE DIAGNOSIS - HVAC MODULE

Noise Diagnosis - HVAC Module

Step	Action	Yes	No
DEFINITION: Noise originating from the HVAC module.			
1	Were you sent here from Symptoms or another diagnostic table?	Go to Step 2	Go to Symptoms - HVAC Systems - Manual
2	1. Start the engine. 2. Cycle through all of the following: • Blower motor speeds • HVAC modes • Temperature control settings 3. Determine the location of noise: • Recirculation door • Temperature door • Mode valve Is noise evident when selecting recirculation?	Go to Step 6	Go to Step 3
3	Is noise evident when selecting temperature?	Go to Step 6	Go to Step 4
4	Is noise evident when selecting mode ?	Go to Step 5	Go to Step 2
5	1. Remove the HVAC module. Refer to <u>Air Conditioning (A/C) Evaporator and Blower Module Assembly Replacement.</u> 2. Inspect the mode valve for dust, dirt or debris. Is dust, dirt or debris present?	Go to Step 11	Go to Step 12
6	Remove the HVAC module. Refer to <u>Air Conditioning (A/C) Evaporator and Blower Module Assembly Replacement.</u> Is action complete?	Go to Step 7	-
7	1. Inspect the air flow door for proper operation. 2. Inspect the ducts for obstructions or foreign materials. Were any of these conditions found?	Go to Step 10	Go to Step 8
8	Inspect air flow door for warping or cracking. Is air flow door in normal condition?	Go to Step 13	Go to Step 9
9	Replace air flow door. Is repair complete?	Go to Step 13	-
10	Remove any obstructions or foreign material found. Is action complete?	Go to Step 13	-
11	Vacuum and remove dust, dirt and debris. Is action complete?	Go to Step 14	-

12	Replace the upper evaporator case. Refer to <u>Air Conditioning Evaporator Core Replacement</u> . Is action complete?	Go to Step 14	-
13	Install the HVAC Module. Refer to <u>Air Conditioning (A/C) Evaporator and Blower Module Assembly Replacement</u> . Is action complete?	Go to Step 14	-
14	Operate the system to verify the repair. Did you find and correct the condition?	System OK	Go to Step 2

REPAIR INSTRUCTIONS

REFRIGERANT RECOVERY AND RECHARGING

Special Tools

GE-45037 A/C Oil Injector

For equivalent regional tools, refer to **Special Tools**.

WARNING: To prevent personal injury, avoid breathing A/C Refrigerant and lubricant vapor or mist. Work in a well ventilated area. To remove refrigerant from the A/C System, use service equipment designed for recovery that is certified to meet the requirements of the appropriate SAE Standards. If an accidental system discharge occurs, ventilate the work area before continuing service. Additional health and safety information may be obtained from the refrigerant, refrigerant recovery, and lubricant manufacturers.

WARNING: For personal protection, goggles and lint-free gloves should be worn and a clean cloth wrapped around fittings, valves, and connections when doing work that includes opening the refrigerant system. If refrigerant comes in contact with any part of the body severe frostbite and personal injury can result. The exposed area should be flushed immediately with cold water and prompt medical help should be obtained.

CAUTION: R-134a is the only approved refrigerant for use in this vehicle. The use of any other refrigerant may result in poor system performance or component failure.

CAUTION: To avoid system damage use only R-134a dedicated tools when servicing the A/C system.

CAUTION: Use only Polyalkylene Glycol Synthetic Refrigerant Oil (PAG) for internal circulation through the R-134a A/C system and only 525 viscosity mineral

oil on fitting threads and O-rings. If lubricants other than those specified are used, compressor failure and/or fitting seizure may result.

CAUTION: R-12 refrigerant and R-134a refrigerant must never be mixed, even in the smallest of amounts, as they are incompatible with each other. If the refrigerants are mixed, compressor failure is likely to occur. Refer to the manufacturer instructions included with the service equipment before servicing.

The air conditioning filling device service center is a complete air conditioning service center for R-134a. The ACR 2000 recovers, recycles, evacuates and recharges A/C refrigerant quickly, accurately and automatically. The unit has a display screen that contains the function controls and displays prompts that will lead the technician through the recover, recycle, evacuate and recharge operations. R-134a is recovered into and charged out of an internal storage vessel. The ACR 2000 automatically replenishes this vessel from an external source tank in order to maintain a constant 5.45-6.82 kg (12-15 lb) of A/C refrigerant.

The ACR 2000 has a built in A/C refrigerant identifier that will test for contamination, prior to recovery and will notify the technician if there are foreign gases present in the A/C system. If foreign gases are present, the ACR 2000 will not recover the refrigerant from the A/C system.

The ACR 2000 also features automatic air purge, single pass recycling and an automatic oil drain.

Refer to the air conditioning filling device service center manual for operation and setup instruction. Always recharge the A/C system with the proper amount of R-134a. Refer to **Refrigerant System Specifications (1.2L LL0, 1.0L LFM)** for the correct amount.

A/C Refrigerant System Oil Charge Replenishing

If oil was removed from the A/C system during the recovery process or due to component replacement, the oil must be replenished. Oil can be injected into a charged system using **GE-45037** injector. For the proper quantities of oil to add to the A/C refrigerant system, refer to **Refrigerant System Specifications (1.2L LL0, 1.0L LFM)**.

FLUSHING

Special Tools

- **J 41447** Leak Detection Dye
- **J 42220** Universal 12V Leak Detection Lamp
- **J 43600** ACR 2000 Refrigerant Station
- **J 45268** Flush Adapter Kit
- **J 45037** A/C Oil Injector

NOTE: Flushing is not intended to remove metal from the A/C system.

Flushing is intended to remove the following:

- Contaminated PAG oil
- Desiccant, following a desiccant bag failure
- Overcharge of PAG oil
- Refrigerant contamination

NOTE: Warmer engine or ambient temperature decreases the refrigerant recovery time during the A/C flush procedure.

1. Recover the refrigerant. Refer to **Refrigerant Recovery and Recharging**.
2. Remove the thermal expansion valve (TXV). Refer to **Air Conditioning Evaporator Thermal Expansion Valve Replacement**.
3. Install the stud for the **GE-45268** Flush Adapter Kit onto the J 45268-115.
4. Install the J 45268-115 in place of the TXV.

CAUTION: Refer to **Fastener Caution** .

5. Install the TXV mounting bolts and tighten to 3.5 (31 lb in).
6. Connect the evaporator line to the J 45268-115.
7. Install the TXV block fitting nut and tighten to 20 (15 lb ft).
8. Remove the A/C compressor. Refer to **Air Conditioning Compressor Replacement (1.2L LL0, 1.0L LFM)**.
9. Install J 45268-4 to the A/C compressor suction hose.
10. Install J 45268-5 to the A/C compressor discharge hose.

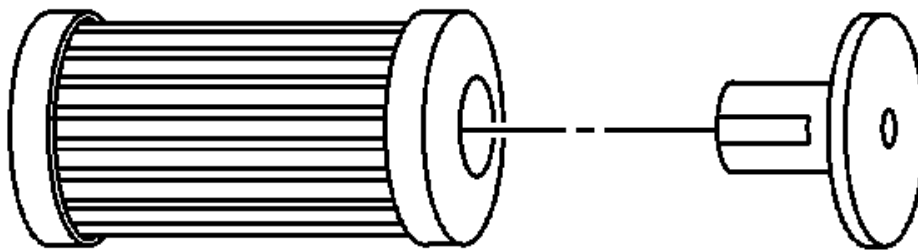


Fig. 1: View Of A/C Filter & Check Valve
Courtesy of GENERAL MOTORS COMPANY

NOTE: The filter inside the J 45268-1 is serviceable. Remove and discard the check valve from the filter.

11. Forward flow refrigerant flushing is recommended for contaminated refrigerant or PAG oil.

Perform the following procedure:

1. Service the filter with ACDelco P/N GF 470, before each flush.

Connect the J-45268-1 flush filter to the suction port of the J-45268-4 flush adapter.

2. Connect the blue hose from the **J-43600** air conditioning service center to the J-45268-1 flush filter adapter.
3. Connect the red hose from the **J-43600** air conditioning service center to the J-45268-5 flush adapter.

12. Reverse flow refrigerant flushing is recommended for desiccant bag failure. Perform the following procedure and replace the accumulator when the flush procedure is complete.

NOTE: **The filter inside the J 45268-1 is serviceable. Remove and discard the check valve from the filter.**

1. Service the filter with AC P/N GF 470, before each flush. Connect the J-45268-1 flush filter to the discharge port of the J-45268-5 flush adapter.
2. Connect the blue hose from the **J-43600** air conditioning service center to the J 45268-1 flush filter adapter.
3. Connect the red hose from the **J-43600** air conditioning service center to the suction port of the J-45268-4 flush adapter.

NOTE: **Close the valve on the external refrigerant tank, before starting the flush process.**

13. Flush the A/C system. Follow the instructions supplied with the **J-43600** air conditioning service center.
14. Disconnect the red hose on the **J-43600** ACR 2000 air conditioning service center from the J 45268-5.
15. Disconnect the blue hose on the **J-43600** ACR 2000 air conditioning service center from the J 45268-1.
16. Remove J 45268-1 from the J 45268-4.
17. Remove the J 45268-5 from the A/C compressor discharge hose.
18. Remove the J 45268-4 from the A/C compressor suction hose.

NOTE: **Flushing will remove all the PAG oil from the A/C system.**

The A/C system must be replenished with the correct amount of PAG oil.

19. If you will reinstall the removed A/C compressor, perform the following procedure:
 1. Remove the A/C compressor drain plug.
 2. Drain the PAG oil from the A/C compressor. Rotate the compressor input shaft to assist in draining the PAG oil from the compressor.
 3. Install the A/C compressor drain plug and tighten to 16 (12 lb ft).
 4. Add the total system capacity of PAG oil to the A/C compressor. Refer to **Refrigerant System Specifications (1.2L LL0, 1.0L LFM)**
20. If you will replace the A/C compressor after flushing the system, perform the following procedure:
 1. Determine if the new service compressor is shipped with PAG oil. Refer to **Refrigerant System Specifications (1.2L LL0, 1.0L LFM)**.
 2. If the service compressor is shipped with PAG oil, DO NOT drain the new PAG oil from the compressor.
 3. Deduct the amount of PAG oil shipped with the service compressor from the amount of PAG oil listed in the capacities table. Refer to **Refrigerant System Specifications (1.2L LL0, 1.0L LFM)**.
 4. Add the calculated amount to the compressor, as needed.

NOTE: Flushing will remove the fluorescent leak detection dye from the A/C system.

21. Add one bottle of **J 41447** Leak Detection Dye directly to the A/C compressor.
22. Install the A/C compressor. Refer to **Air Conditioning Compressor Replacement (1.2L LL0, 1.0L LFM)**.
23. Remove J 45268-115.
24. Inspect the TXV for debris. Clean or replace as needed.
25. Install the TXV. Refer to **Air Conditioning Evaporator Thermal Expansion Valve Replacement**.
26. Evacuate and recharge the A/C system. Refer to **Refrigerant System Specifications (1.2L LL0, 1.0L LFM)**.
27. Leak test the fittings using **J42220** Universal 12V Leak Detection Lamp.

After Flushing Is Complete

NOTE: Flushing will remove all the A/C system lubricant and leak detection dye from the A/C system.

After a compressor failure, it is extremely important to eliminate and/or contain the debris that may cause repeat repairs. The debris generated from a compressor failure will be discharged into the compressor suction line, discharge line, condenser and liquid line. A suction screen filter should be installed whenever possible, after a compressor failure, to protect the expansion device (orifice tube or TXV) in both the front and rear systems from debris.

1. Remove the suction hose from the A/C compressor. Refer to **Air Conditioning Compressor and Condenser Hose Replacement (1.2L LL0, 1.0L LFM)**.
2. Install the suction screen filter kit (P/N 95369523) to the suction port of A/C compressor.
3. Install the suction hose and suction screen filter mounting bolt and tighten the bolts to 22 (16 lb ft).
4. Install the proper amount of PAG oil, into the A/C system using the **J 45037** Oil Injector. Refer to **Refrigerant System Specifications (1.2L LL0, 1.0L LFM)**.
5. Evacuate and recharge the A/C system. Refer to **Refrigerant System Specifications (1.2L LL0, 1.0L LFM)**.
6. Verify proper A/C system operation.
7. Leak test all connections using the **J 44220** Universal 12V Leak Detection Lamp or equivalents. Remember that the A/C system must operate for several minutes before leak dye will show a leak if one is present.

AIR CONDITIONING COMPRESSOR OIL BALANCING (1.2L LL0, 1.0L LFM)

Draining Procedure

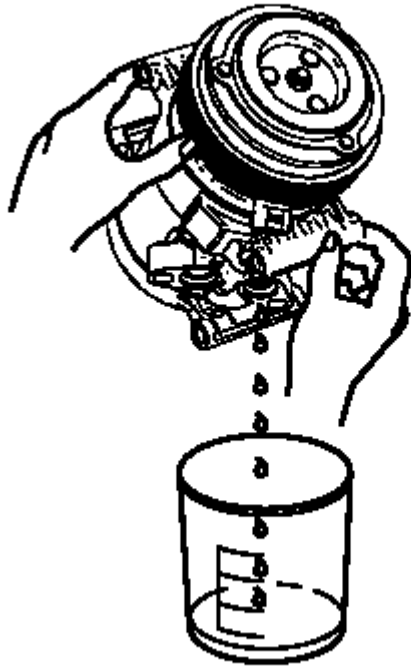


Fig. 2: Draining Refrigerant Oil From Air Conditioning Compressor
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Drain and measure as much of the refrigerant oil as possible from the removed compressor.**

1. Drain the oil from both the suction and discharge ports of the removed compressor into a clean, graduated container. Rotate the compressor shaft to assist in draining the compressor.
2. Measure and record the amount of oil drained from the removed compressor. This measurement will be used during installation of the replacement compressor.
3. Inspect the oil drained from removed compressor. Refer to **Air Conditioning Compressor Oil Diagnosis**.
4. Properly discard the used refrigerant oil.

Balancing Procedure

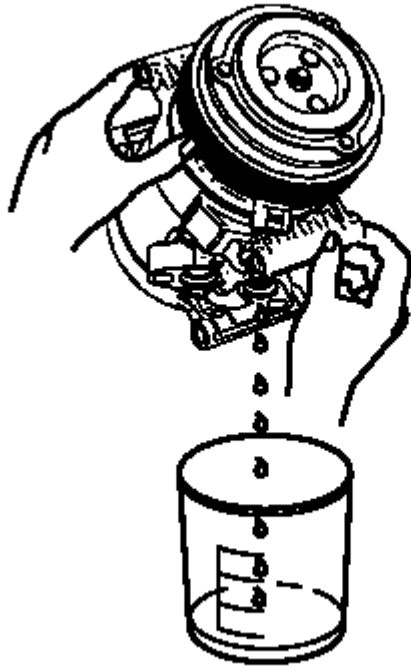


Fig. 3: Draining Refrigerant Oil From Air Conditioning Compressor
Courtesy of GENERAL MOTORS COMPANY

NOTE: **The refrigerant oil in the A/C system must be balanced during compressor replacement.**

1. Before installing the compressor, the refrigerant oil will have to be fully drained:
2. Add back the same quantity of polyalkylene glycol (PAG) oil as drained from the removed compressor.

Refer to the amount of refrigerant oil recorded during the compressor removal.

AIR CONDITIONING COMPRESSOR REPLACEMENT (1.2L LL0, 1.0L LFM)

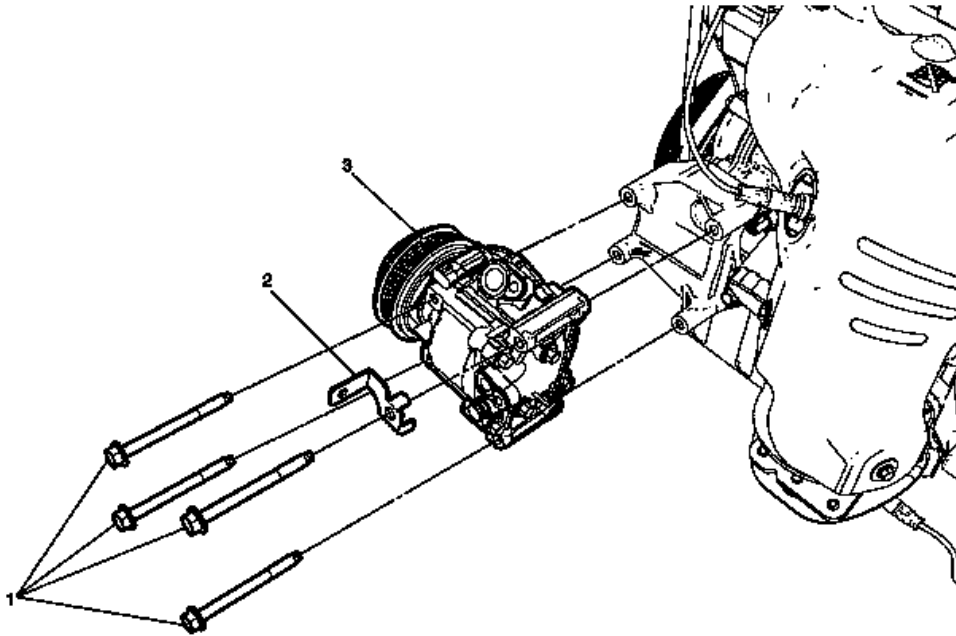


Fig. 4: Air Conditioning Compressor
Courtesy of GENERAL MOTORS COMPANY

Air Conditioning Compressor Replacement (1.2L LL0, 1.0L LFM)

Callout	Component Name
Preliminary Procedures 1. Recover the refrigerant. Refer to <u>Refrigerant Recovery and Recharging</u>. 2. Remove the air conditioning compressor belt. Refer to <u>Air Conditioning Compressor Belt Replacement</u>. 3. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u>. 4. Remove the front bumper fascia opening lower cover. Refer to <u>Front Bumper Fascia Opening Lower Cover Replacement</u>. 5. Disconnect the A/C compressor electrical connector. 6. Remove the compressor hose assembly from the compressor. Refer to <u>Air Conditioning Compressor and Condenser Hose Replacement (1.2L LL0, 1.0L LFM)</u>, and <u>Air Conditioning Evaporator Hose Assembly Replacement (1.2L LL0, 1.0L LFM)</u>.	
1	Air Conditioning Compressor Bolt (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 22 (16 lb ft)

2	Engine Wiring Harness Bracket
3	Air Conditioning Compressor Assembly Procedure 1. Use a low viscosity, poly-alkylene glycol (PAG) oil. Use of the incorrect oil can result in compressor failure. 2. When replacing the A/C compressor, balance the compressor oil. Refer to <u>Air Conditioning Compressor Oil Balancing (1.2L LL0, 1.0L LFM)</u> . 3. Using GE 39400-A leak detector test A/C compressor fittings. Special Tools GE 39400-A Electronic Halogen Leak Detector For equivalent regional tools, refer to <u>Special Tools</u> .

AIR CONDITIONING CLUTCH REPLACEMENT (1.2L LL0, 1.0L LFM)

Special Tools

- **GE-39400-A** Halogen Leak Detector
- **GE-48965** Clutch Plate Holder

For equivalent regional tools, refer to **Special Tools**.

Removal Procedure

1. Remove the compressor. Refer to **Air Conditioning Compressor Replacement (1.2L LL0, 1.0L LFM)**.

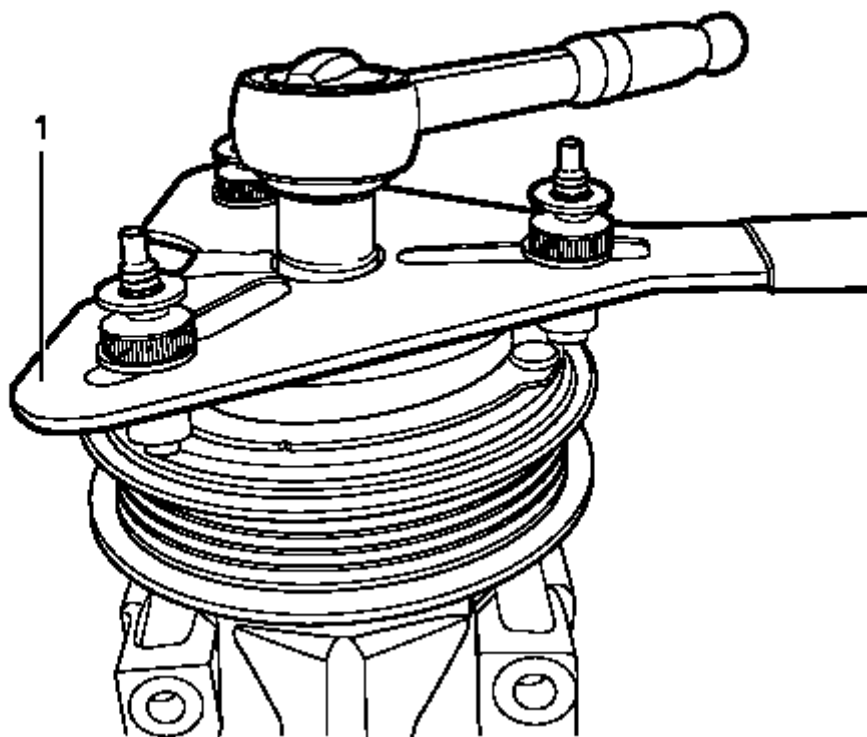


Fig. 5: Identifying GE-48965 Clutch Plate Holder
Courtesy of GENERAL MOTORS COMPANY

2. Use the **GE-48965** clutch plate holder (1) to hold the compressor clutch plate from turning.
3. Remove the compressor clutch plate nut from the compressor.

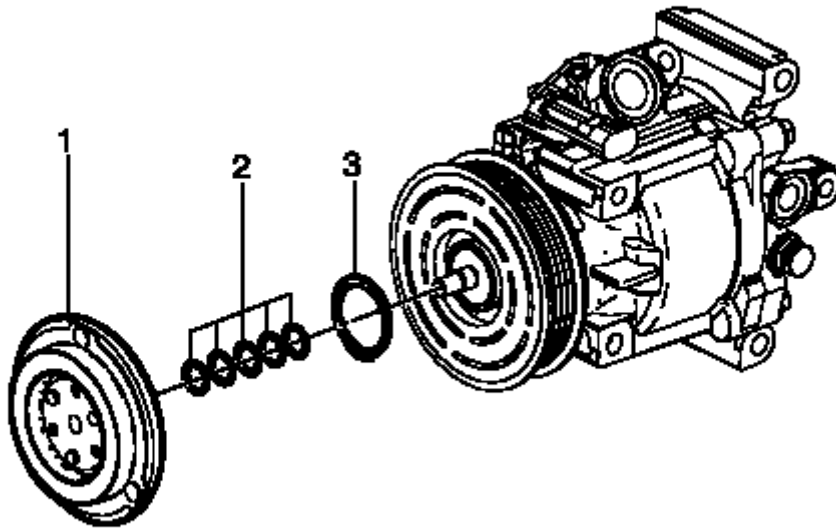


Fig. 6: Compressor Clutch Plate

Courtesy of GENERAL MOTORS COMPANY

4. Remove the compressor clutch plate (1).
5. Remove the compressor air gap shim (2).
6. Remove the compressor pulley snap ring (3) using a ring pryer.

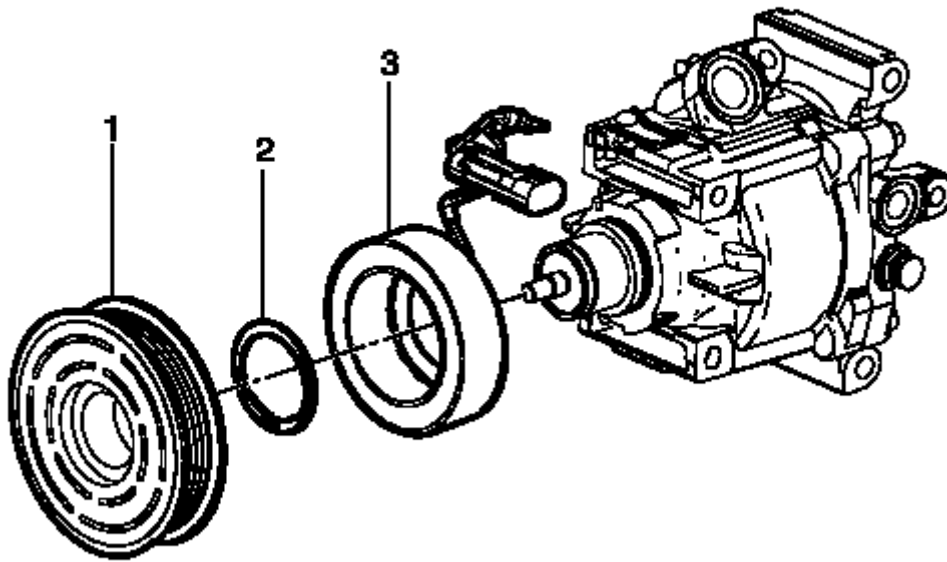


Fig. 7: Compressor Pulley And Compressor Clutch Coil
Courtesy of GENERAL MOTORS COMPANY

7. Remove the compressor pulley (1) from the compressor.
8. Remove the compressor pulley snap ring (2) using a ring pryer.
9. Remove the compressor clutch coil (3) from the compressor.

Installation Procedure

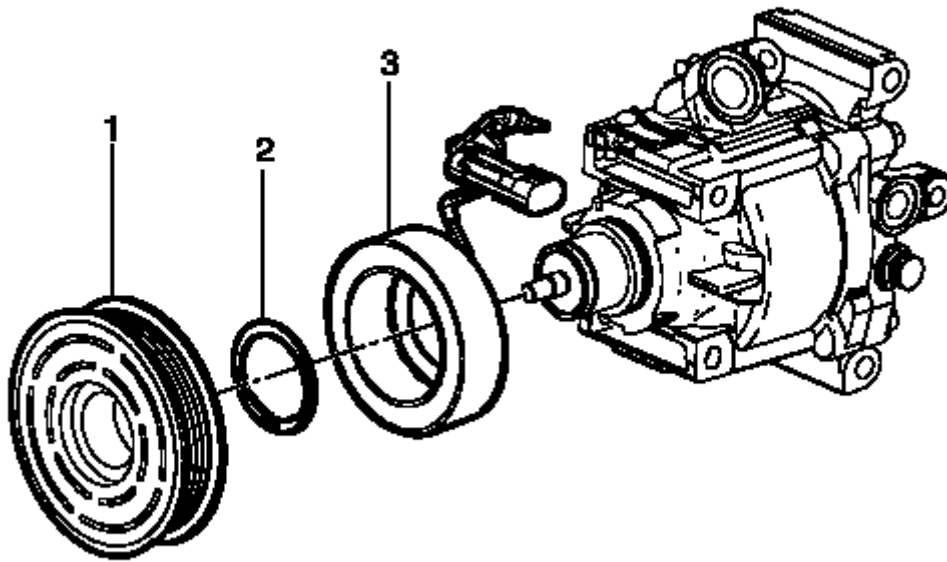


Fig. 8: Compressor Pulley And Compressor Clutch Coil
Courtesy of GENERAL MOTORS COMPANY

1. Install the compressor clutch coil (3) to the compressor.
2. Install the compressor pulley snap ring (2) using a ring pryer.
3. Install the compressor pulley (1) to the compressor.

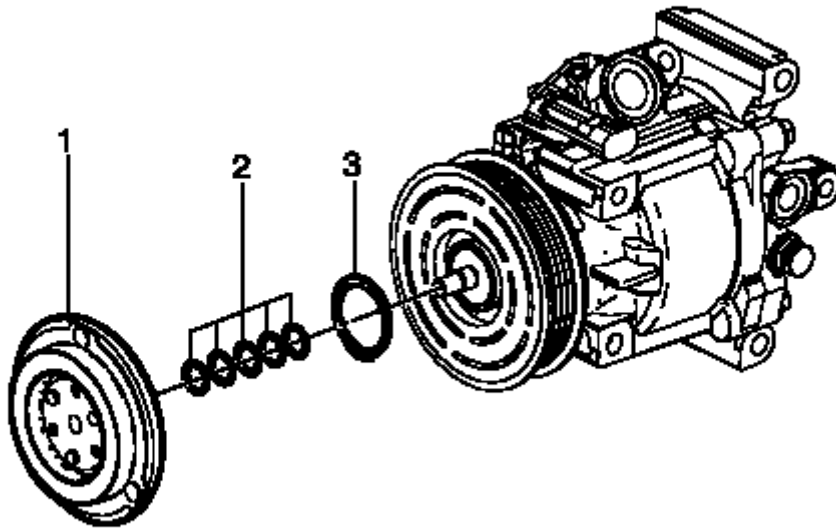


Fig. 9: Compressor Clutch Plate

Courtesy of GENERAL MOTORS COMPANY

4. Install the compressor pulley snap ring (3) using a ring pryer.
5. Install the compressor air gap shim (2).
6. Install the compressor clutch plate (1).

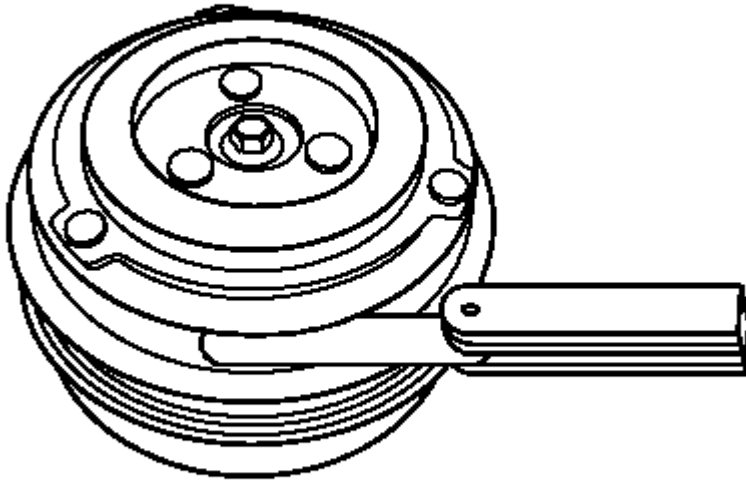


Fig. 10: Measuring Air Gap Between Pulley And Drive Plate
Courtesy of GENERAL MOTORS COMPANY

7. Measure the air gap between the pulley and the drive plate. Adjust the shims to achieve 0.25-0.45 mm (0.0098-0.0177 in) air gap.

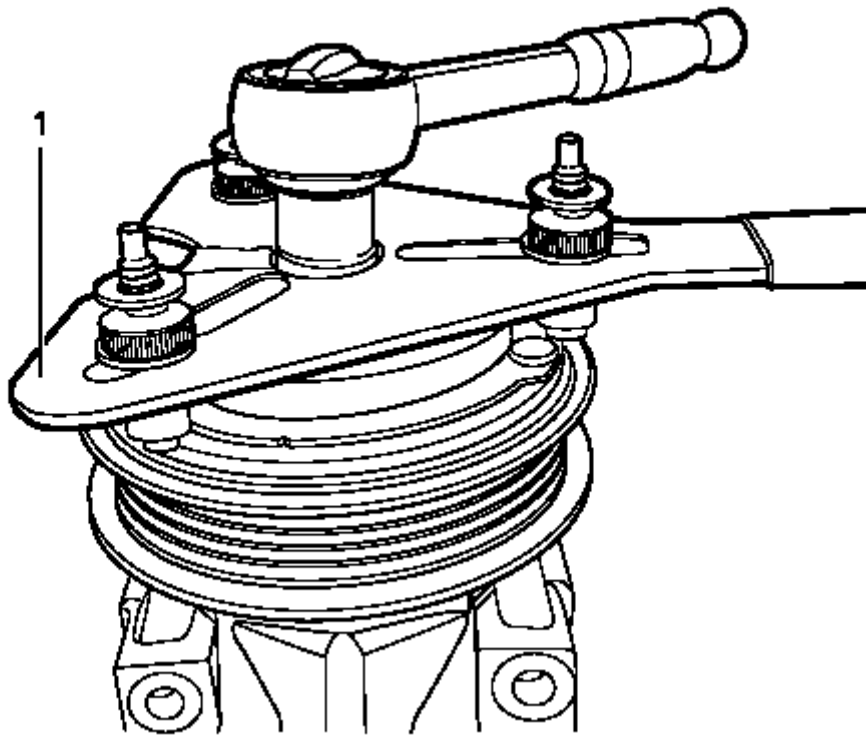


Fig. 11: Identifying GE-48965 Clutch Plate Holder
Courtesy of GENERAL MOTORS COMPANY

8. Use the **GE-48965** clutch plate holder (1) to hold the compressor clutch plate from turning.

CAUTION: Refer to Fastener Caution .

9. Install the compressor clutch plate bolt and tighten to 16 (12 lb ft).
10. Install the compressor. Refer to **Air Conditioning Compressor Replacement (1.2L LL0, 1.0L LFM)**.
11. Leak test the fittings using the **GE-39400-A** halogen leak detector.

AIR CONDITIONING COMPRESSOR BRACKET REPLACEMENT

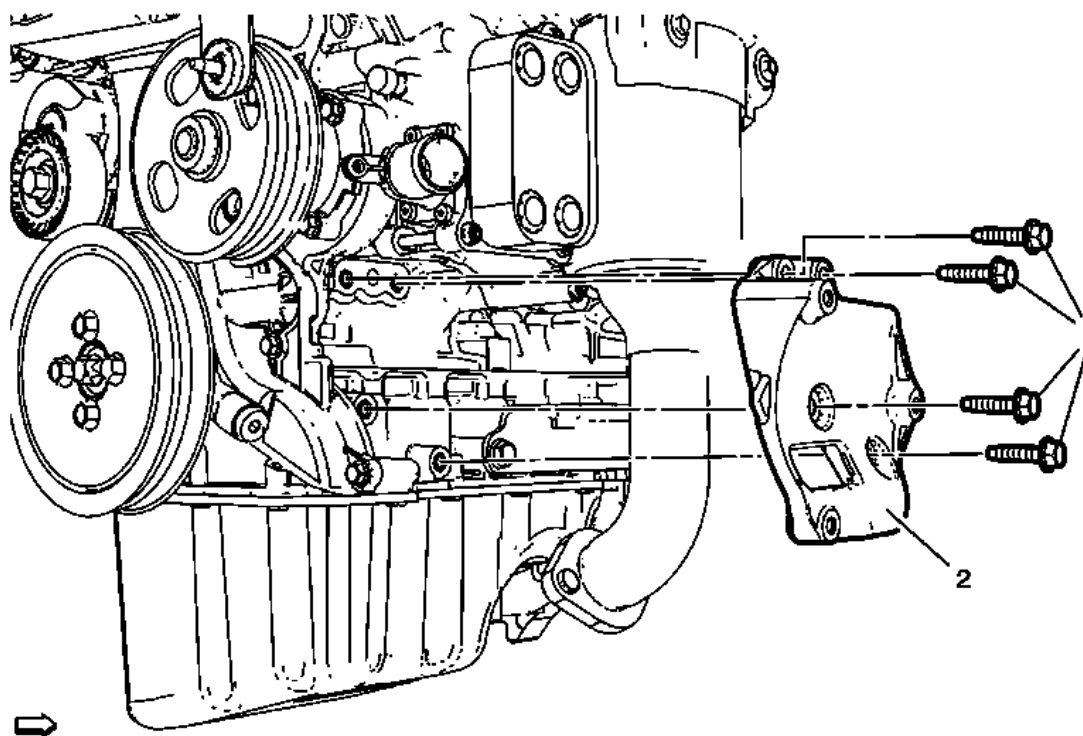


Fig. 12: Air Conditioning Compressor Bracket
Courtesy of GENERAL MOTORS COMPANY

Air Conditioning Compressor Bracket Replacement

Callout	Component Name
Preliminary Procedures Remove the air conditioning compressor. Refer to <u>Air Conditioning Compressor Replacement (1.2L LL0, 1.0L LFM)</u> .	
1	Air Conditioning Compressor Bracket Bolt (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 22 N.m (16 lb ft)
2	Air Conditioning Compressor Bracket

AIR CONDITIONING SYSTEM SEAL REPLACEMENT

Removal Procedure

1. Disassemble the A/C refrigerant components. Refer to the appropriate repair procedure.

NOTE: Cap or tape the open A/C refrigerant components immediately to prevent

system contamination.

2. Cap or tape the A/C refrigerant components.

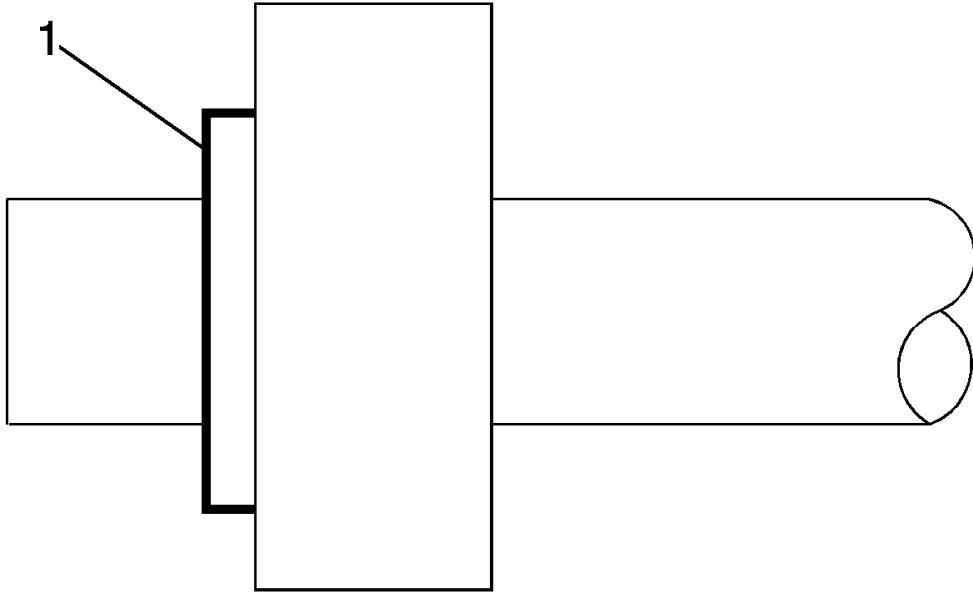


Fig. 13: Sealing Washer

Courtesy of GENERAL MOTORS COMPANY

3. Remove the sealing washer (1) from the A/C refrigerant component.
4. Inspect the seal washer for signs of damage to help determine the root cause of the failure.
5. Inspect the A/C refrigerant components for damage or burrs. Repair if necessary.

NOTE: DO NOT reuse sealing washer.

6. DISCARD the sealing washer.

Installation Procedure

NOTE: Flat washer type seals do not require lubrication.

1. Inspect the new sealing washer for any signs of cracks, cuts, or damage.

Do not use a damaged sealing washer.

2. Remove the cap or tape from the A/C refrigerant components.

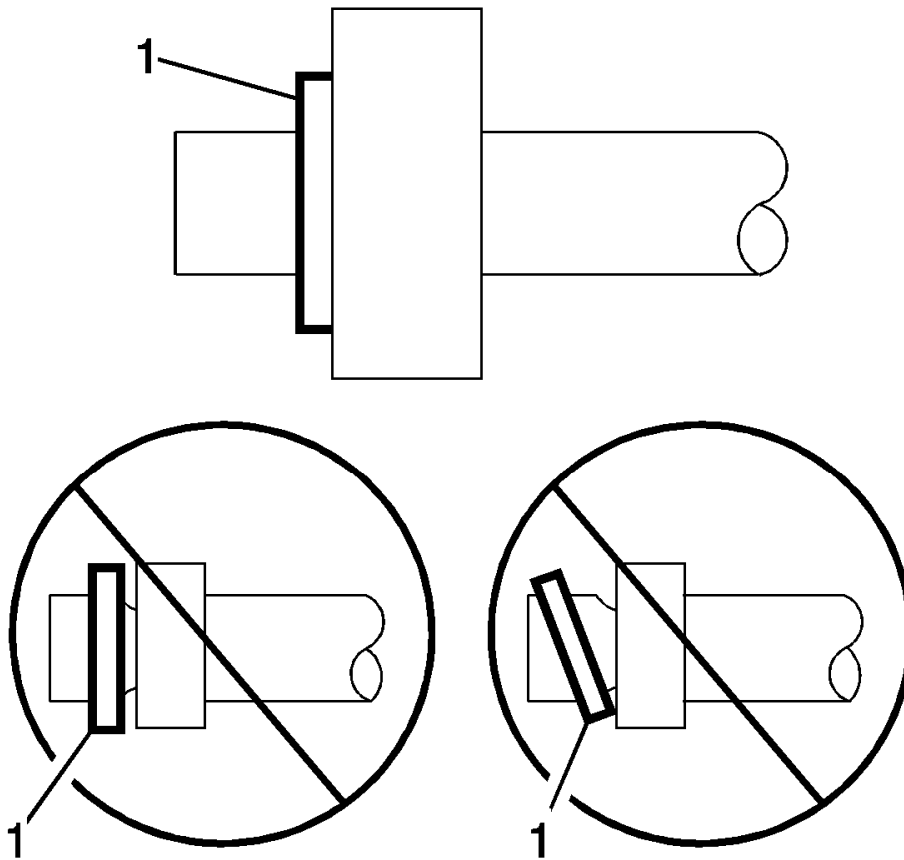


Fig. 14: Identifying Proper Seating Of A/C Refrigerant O-Ring
Courtesy of GENERAL MOTORS COMPANY

3. Using a lint-free clean, dry cloth, clean the sealing surfaces of the A/C refrigerant components.
4. Carefully install the NEW sealing washer (1) onto the A/C refrigerant component.

The sealing washer (1) must completely bottom against the surface of the fitting.

NOTE: After tightening the A/C components, there should be a slight sealing gap of approximately 1.2 mm (3/64 in) between the A/C line and the A/C component.

5. Assemble the remaining A/C refrigerant components. Refer to the appropriate repair procedure.

AIR CONDITIONING O-RING SEAL REPLACEMENT

Removal Procedure

1. Disassemble the A/C refrigerant components. Refer to the appropriate repair procedure.
2. Remove the O-ring seal from the A/C refrigerant component.
3. Inspect the O-ring seal for signs of damage to help determine the root cause of the failure.
4. Inspect the A/C components for damage or burrs. Repair if necessary.

NOTE: Cap or tape the open A/C refrigerant components immediately to prevent system contamination.

5. Cap or tape the A/C refrigerant components.
6. Discard the O-ring seal.

Installation Procedure

1. Inspect the new O-ring seal for any sign of cracks, cuts, or damage. Replace if necessary.
2. Remove the cap or tape from the A/C refrigerant components.
3. Using a lint-free clean, dry cloth, carefully clean the sealing surfaces of the A/C refrigerant components.

NOTE: DO NOT allow any of the mineral base 525 viscosity refrigerant oil on the new O-ring seal to enter the refrigerant system.

4. Lightly coat the new O-ring seal with mineral base 525 viscosity refrigerant oil.

NOTE: DO NOT reuse O-ring seals.

5. Carefully slide the new O-ring seal onto the A/C refrigerant component.

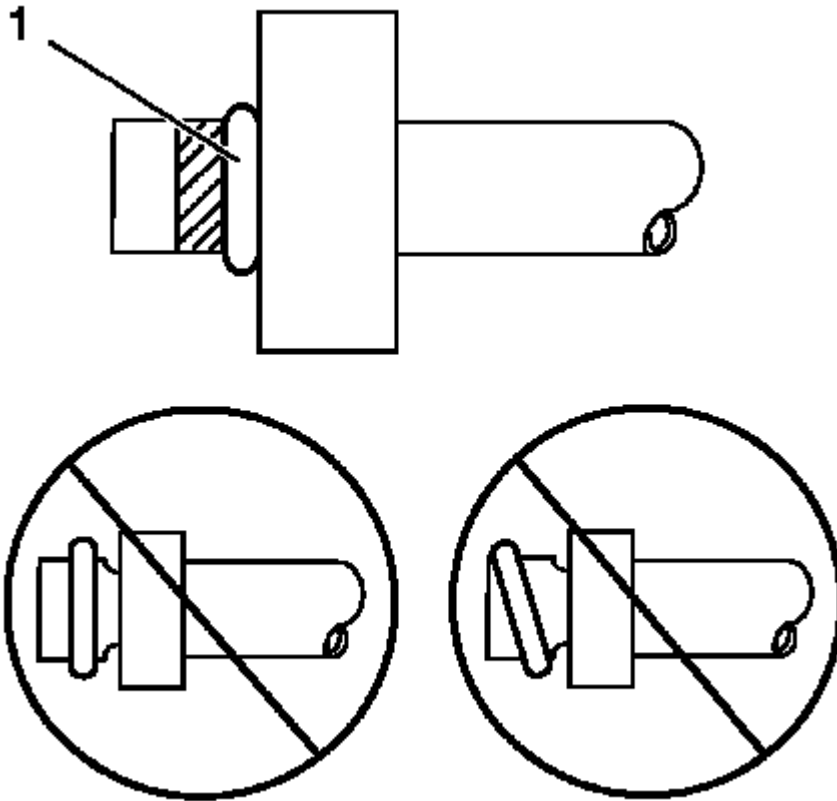


Fig. 15: O-ring

Courtesy of GENERAL MOTORS COMPANY

6. The O-ring seal (1) must be fully seated.
7. Assemble the A/C components.

AIR CONDITIONING COMPRESSOR AND CONDENSER HOSE REPLACEMENT (1.2L LL0, 1.0L LFM)

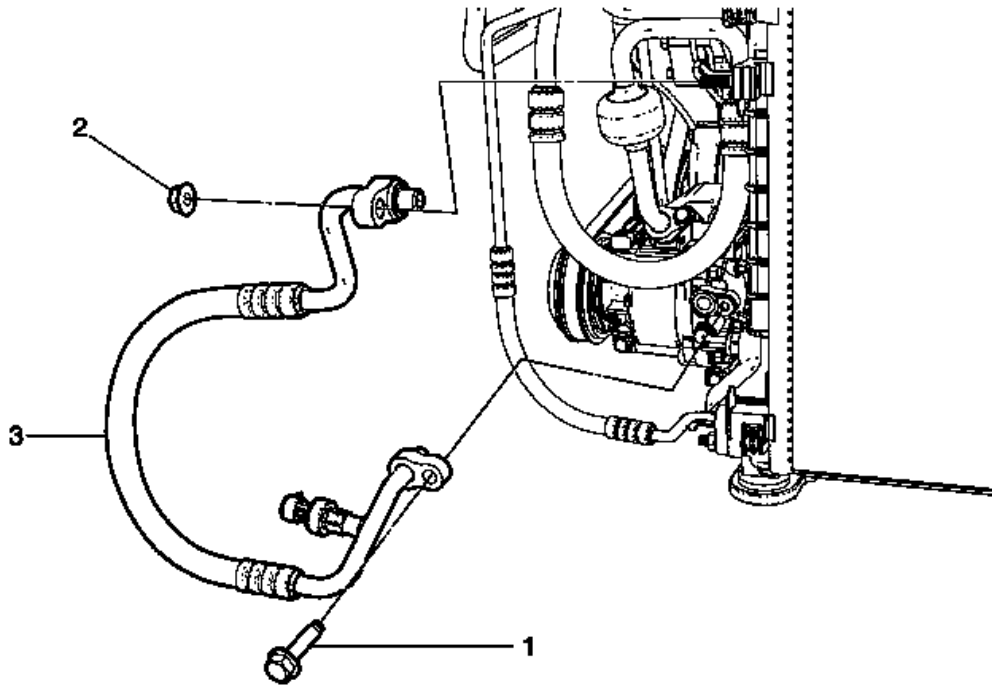


Fig. 16: Air Conditioning Compressor and Condenser Hose
 Courtesy of GENERAL MOTORS COMPANY

Air Conditioning Compressor and Condenser Hose Replacement (1.2L LL0, 1.0L LFM)

Callout	Component Name
Preliminary Procedures 1. Recover the refrigerant. Refer to <u>Refrigerant Recovery and Recharging</u>. 2. Remove the front bumper fascia opening lower cover. Refer to <u>Front Bumper Fascia Opening Lower Cover Replacement</u>. 3. Disconnect the A/C refrigerant pressure sensor electrical connector.	
1	Air Conditioning Compressor and Condenser Hose Nut to Air Conditioning Condenser CAUTION: Refer to <u>Fastener Caution</u> . Tighten 22 (16 lb ft)
2	Air Conditioning Compressor and Condenser Hose Bolt to Air Conditioning Compressor Tighten 22 (16 lb ft)
3	Air Conditioning Compressor and Condenser Hose

AIR CONDITIONING EVAPORATOR HOSE ASSEMBLY REPLACEMENT (1.2L LL0, 1.0L LFM)

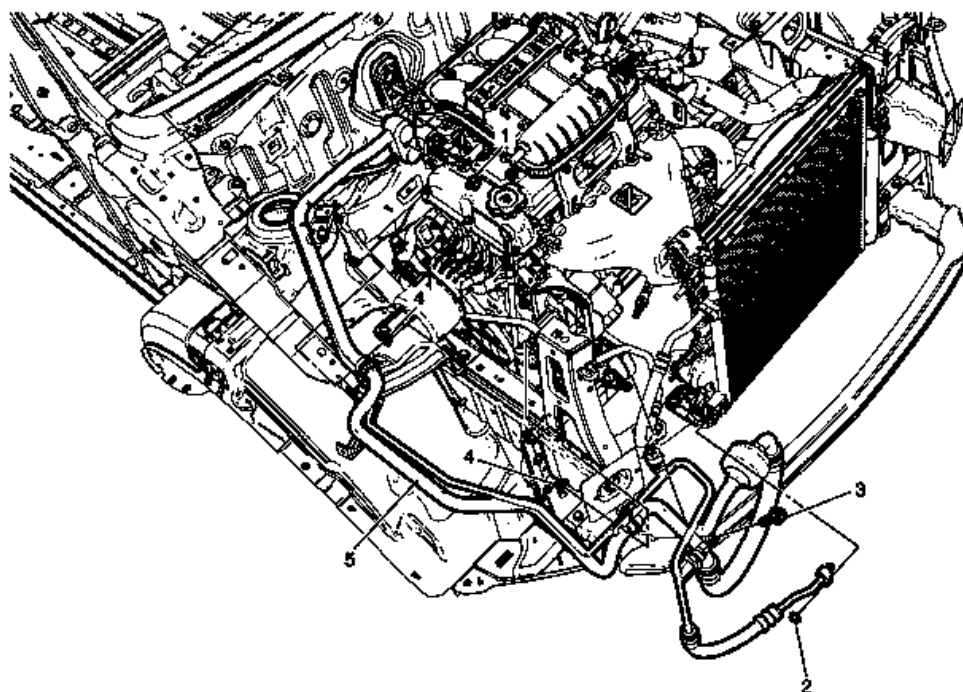


Fig. 17: Air Conditioning Evaporator Hose Assembly
 Courtesy of GENERAL MOTORS COMPANY

Air Conditioning Evaporator Hose Assembly Replacement (1.2L LL0, 1.0L LFM)

Callout	Component Name
Preliminary Procedures 1. Recover the refrigerant. Refer to <u>Refrigerant Recovery and Recharging</u>. 2. Remove the air cleaner assembly. Refer to <u>Air Cleaner Assembly Replacement</u>. 3. Remove the front bumper fascia opening lower cover. Refer to <u>Front Bumper Fascia Opening Lower Cover Replacement</u>. 4. Remove the plenum lower panel. Refer to <u>Plenum Lower Panel Replacement</u>. 5. Put aside the radiator surge tank after removing the screws. Refer to <u>Radiator Surge Tank Replacement (LL0)</u>, <u>Radiator Surge Tank Replacement (LFM)</u>. 6. Disconnect the left rear (LR) and right rear (RR) brake pipes from the brake pressure modulator valve (BPMV). Refer to <u>Brake Pressure Modulator Valve Replacement</u>. 7. Disconnect the A/C refrigerant pressure sensor electrical connector.	
1	Air Conditioning Evaporator Hose Assembly Nut to Air Conditioning Evaporator Thermal Expansion Valve (Qty: 1) CAUTION: Refer to <u>Fastener Caution</u> .

	Tighten 22 (16 lb ft)
2	Air Conditioning Evaporator Hose Assembly Nut to Air Conditioning Condenser (Qty: 1) Tighten 22 (16 lb ft)
3	Air Conditioning Evaporator Hose Assembly Bolt to Air Conditioning Compressor (Qty: 1) Tighten 22 (16 lb ft)
4	Air Conditioning Evaporator Hose Assembly Mounting Bracket Nut (Qty: 2) Tighten 10 (89 lb in)
5	Air Conditioning Evaporator Hose Assembly

AIR CONDITIONING (AC) REFRIGERANT FILTER REPLACEMENT

Special Tools

GE 39400-A Halogen Leak Detector

For equivalent regional tools, refer to **Special Tools**.

Removal Procedure

1. Recover the refrigerant. Refer to **Refrigerant Recovery and Recharging**.
2. Remove the front bumper fascia opening lower cover. Refer to **Front Bumper Fascia Opening Lower Cover Replacement**.

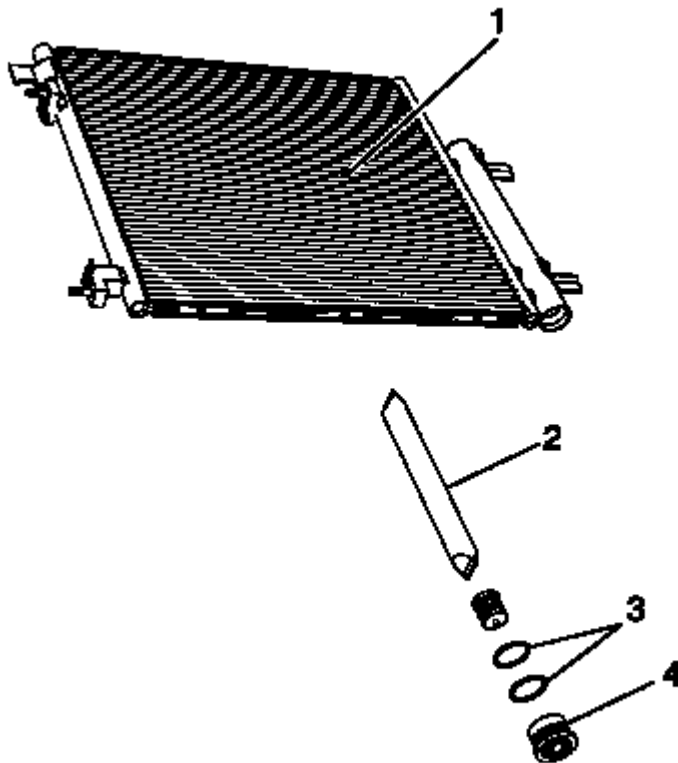


Fig. 18: AC Refrigerant Filter Components
Courtesy of GENERAL MOTORS COMPANY

NOTE: Cap all A/C components immediately to prevent system contamination.

3. Remove the air conditioning receiver and dehydrator plug (4).
4. Remove and discard the sealing washers (3).
5. Remove the refrigerant filter (2) from the condenser (1).

Installation Procedure

1. Uncap A/C components.
2. Install new sealing washers (3). Refer to **Air Conditioning O-Ring Seal Replacement.**

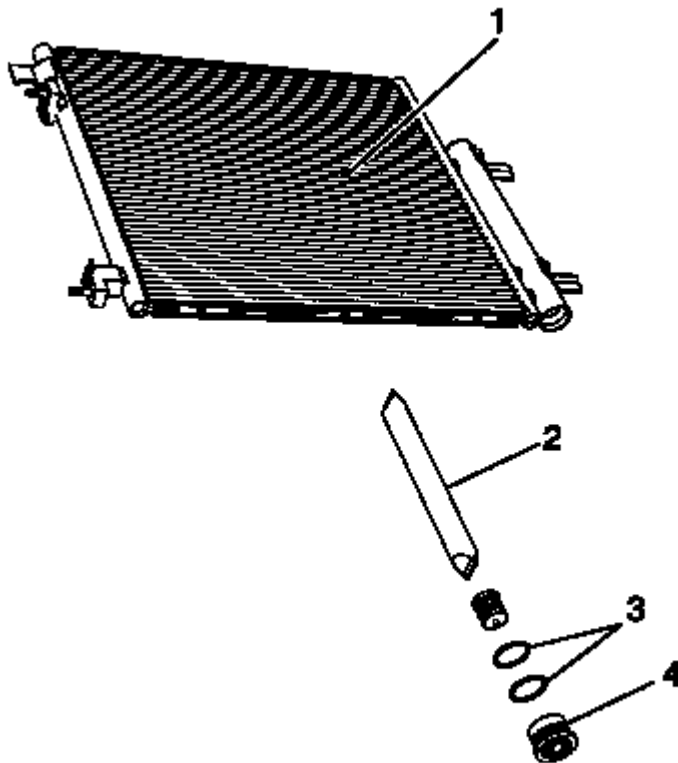


Fig. 19: AC Refrigerant Filter Components
Courtesy of GENERAL MOTORS COMPANY

3. Install the refrigerant filter (2) into the air conditioning condenser (1).
4. Install the air conditioning receiver and dehydrator plug (4).
5. Install the front bumper fascia opening lower cover. Refer to **Front Bumper Fascia Opening Lower Cover Replacement** .
6. Evacuate and charge the refrigerant system. Refer to **Refrigerant Recovery and Recharging**.
7. Leak test the fittings using the **GE 39400-A** detector.

AIR CONDITIONING REFRIGERANT SERVICE VALVE CORE REPLACEMENT

Special Tools

- **GE-39400-A** Halogen Leak Detector
- **GE-46246** Valve Core Removal Tool

For equivalent regional tools, refer to **Special Tools**.

Removal Procedure

1. Recover the refrigerant. Refer to **Refrigerant Recovery and Recharging**.

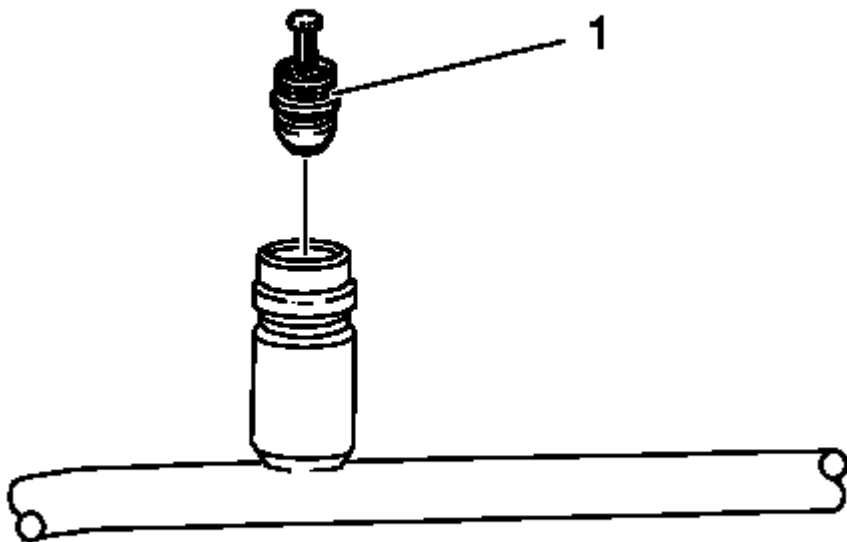


Fig. 20: Service Port Valve Core

Courtesy of GENERAL MOTORS COMPANY

2. Remove the service port valve core (1) using the **GE-46246** remover.

Installation Procedure

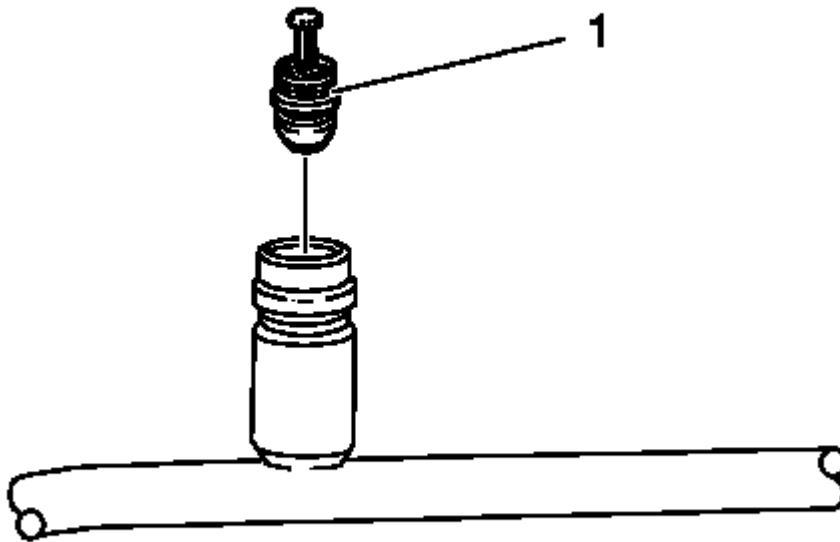


Fig. 21: Service Port Valve Core
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

1. Install the service port valve core (1) using the **GE-46246** remover and tighten to 0.4 N.m (4 lb in).
2. Evacuate and charge the refrigerant system. Refer to Refrigerant Recovery and Recharging.
3. Leak test the fittings using the **GE-39400-A** detector.

AIR CONDITIONING EVAPORATOR THERMAL EXPANSION VALVE REPLACEMENT

Special Tools

GE-39400-A Halogen Leak Detector

For equivalent regional tools, refer to Special Tools.

Removal Procedure

1. Recover the refrigerant. Refer to Refrigerant Recovery and Recharging.

2. Remove the radiator surge tank screws. Refer to **Radiator Surge Tank Replacement (LL0) , Radiator Surge Tank Replacement (LFM) .**
3. Remove the A/C evaporator hose assembly mounting bracket nut from the wheelhouse panel side. Refer to **Air Conditioning Evaporator Hose Assembly Replacement (1.2L LL0, 1.0L LFM).**

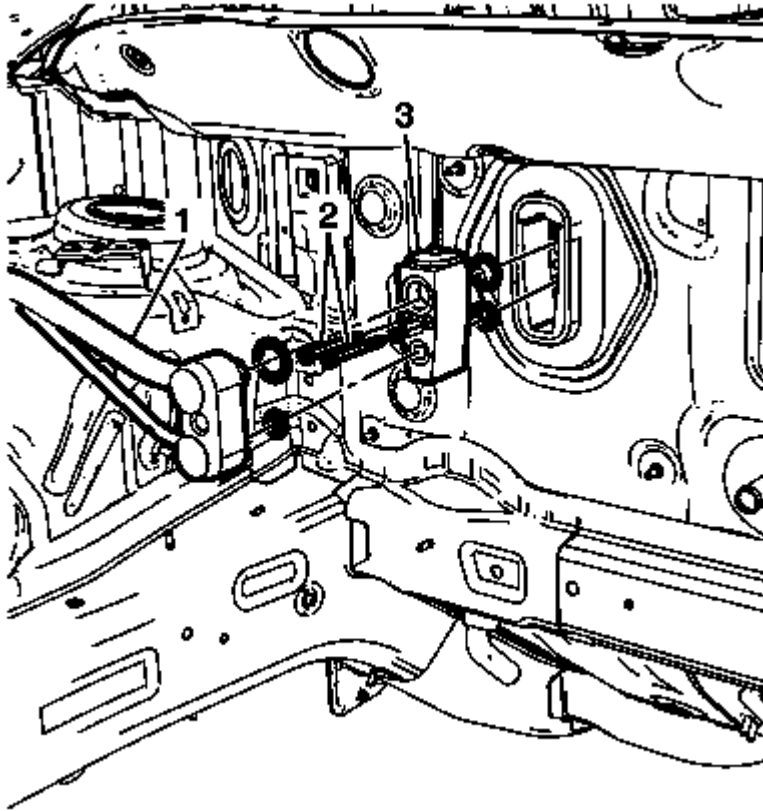


Fig. 22: A/C Evaporator Hose And A/C Evaporator TXV
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the A/C evaporator hose (1) from A/C evaporator TXV. Refer to **Air Conditioning Evaporator Hose Assembly Replacement (1.2L LL0, 1.0L LFM).**
5. Remove the 2 A/C TXV bolts (2).
6. Remove the TXV (3).

Installation Procedure

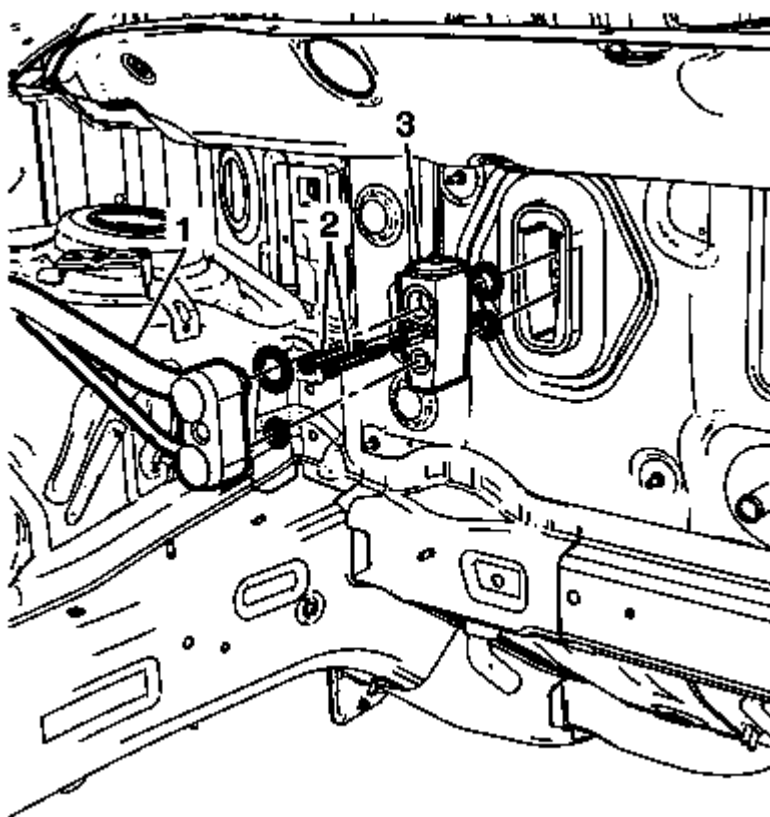


Fig. 23: A/C Evaporator Hose And A/C Evaporator TXV
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

NOTE: Use NEW O-ring seals. Refer to Air Conditioning O-Ring Seal Replacement.

1. Install A/C TXV (3) and the 2 A/C TXV bolts (2) and tighten to 3.5 N.m (31 lb in).
2. Connect the air conditioning evaporator hose (1) to A/C evaporator TXV (3). Refer to Air Conditioning Evaporator Hose Assembly Replacement (1.2L LL0, 1.0L LFM).
3. Install the A/C evaporator hose assembly mounting bracket nut from the wheelhouse panel side. Refer to Air Conditioning Evaporator Hose Assembly Replacement (1.2L LL0, 1.0L LFM).
4. Install the radiator surge tank screws. Refer to Radiator Surge Tank Replacement (LL0) , Radiator Surge Tank Replacement (LFM) .
5. Evacuate and charge the refrigerant system. Refer to Refrigerant Recovery and Recharging.
6. Leak test the fittings using the GE-39400-A detector.

AIR CONDITIONING (A/C) REFRIGERANT PRESSURE SENSOR REPLACEMENT (1.2L LL0, 1.0L LFM)

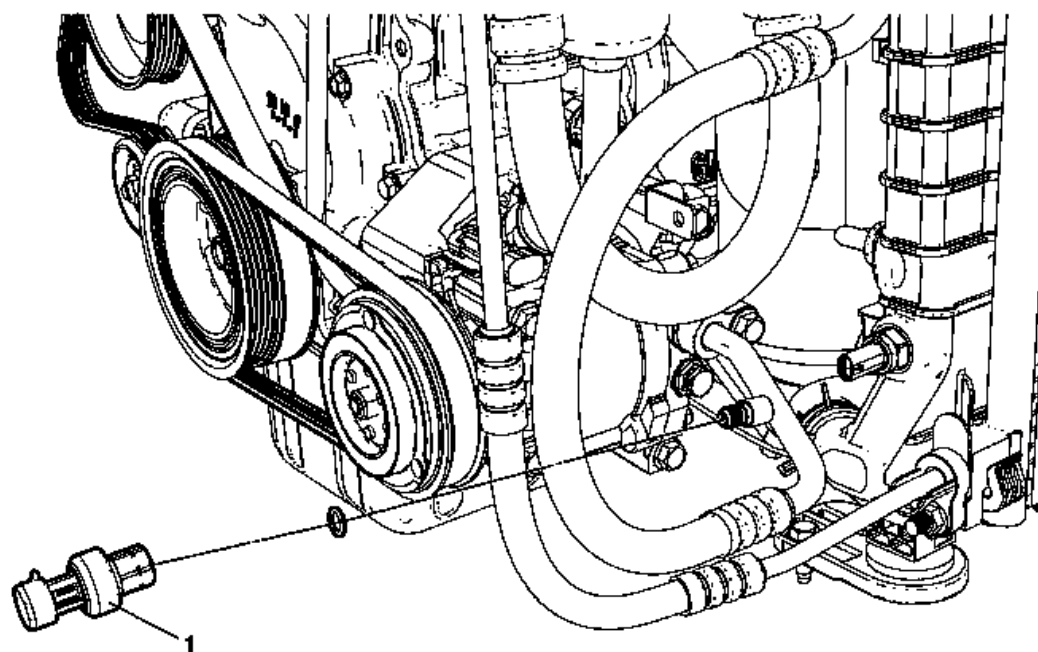


Fig. 24: Air Conditioning (A/C) Refrigerant Pressure Sensor
 Courtesy of GENERAL MOTORS COMPANY

Air Conditioning (A/C) Refrigerant Pressure Sensor Replacement (1.2L LL0, 1.0L LFM)

Callout	Component Name
Preliminary Procedure Remove the front bumper fascia opening lower cover. Refer to <u>Front Bumper Fascia Opening Lower Cover Replacement</u> .	
1	Air Conditioning Refrigerant Pressure Sensor CAUTION: Refer to <u>Fastener Caution</u> . Procedure 1. Disconnect the air conditioning refrigerant pressure sensor connector. 2. Remove and discard the O-ring and replace with NEW. Refer to <u>Air Conditioning O-Ring Seal Replacement</u> . Tighten 8 (71 lb in)

AIR CONDITIONING CONDENSER REPLACEMENT (GASOLINE ENGINE)

Removal Procedure

1. Recover the refrigerant. Refer to Refrigerant Recovery and Recharging.
2. Remove the front bumper fascia. Refer to Front Bumper Fascia Replacement.

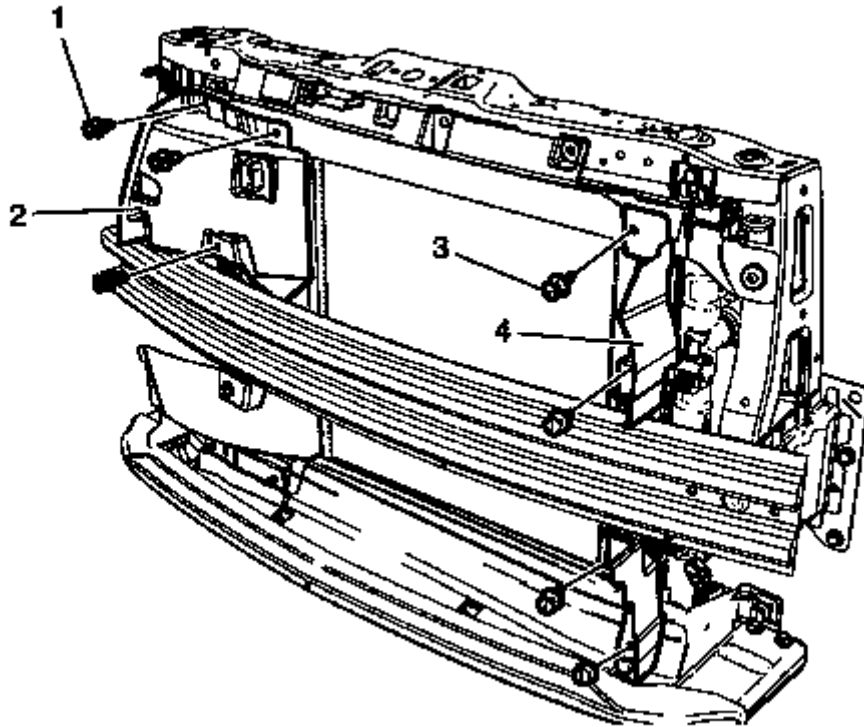


Fig. 25: Identifying Side Opening Cover Retainers
Courtesy of GENERAL MOTORS COMPANY

3. Remove the 3 right side opening cover retainer (1) and right side opening cover (2).
4. Remove the 4 left side opening cover retainer (3) and left side opening cover (4).

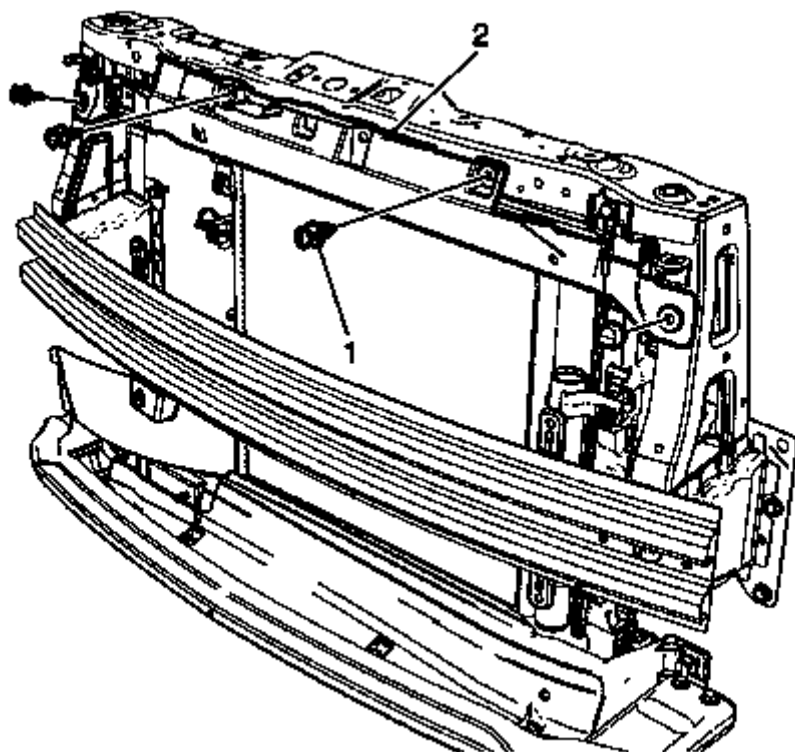


Fig. 26: Identifying Upper Opening Cover Retainers
Courtesy of GENERAL MOTORS COMPANY

5. Remove the 4 upper opening cover retainer (1) and upper opening cover (2).

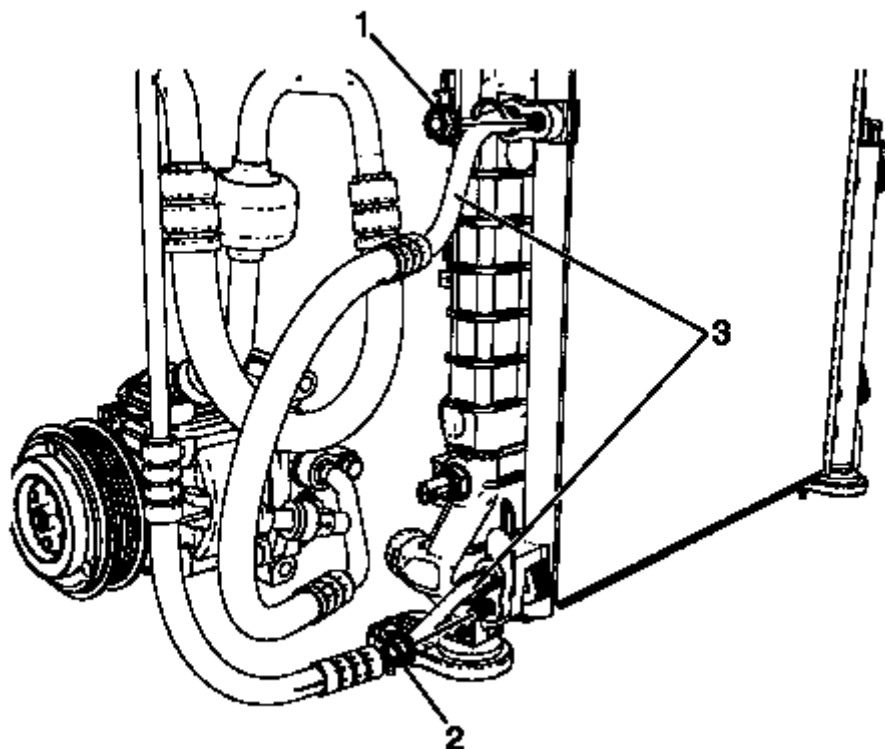


Fig. 27: Locating Air Conditioning Hose Fasteners
Courtesy of GENERAL MOTORS COMPANY

6. Remove air conditioning compressor and condenser hose nut (1).
7. Remove air conditioning evaporator hose assembly nut (2).
8. Remove air conditioning hoses (3) from the air conditioning condenser.

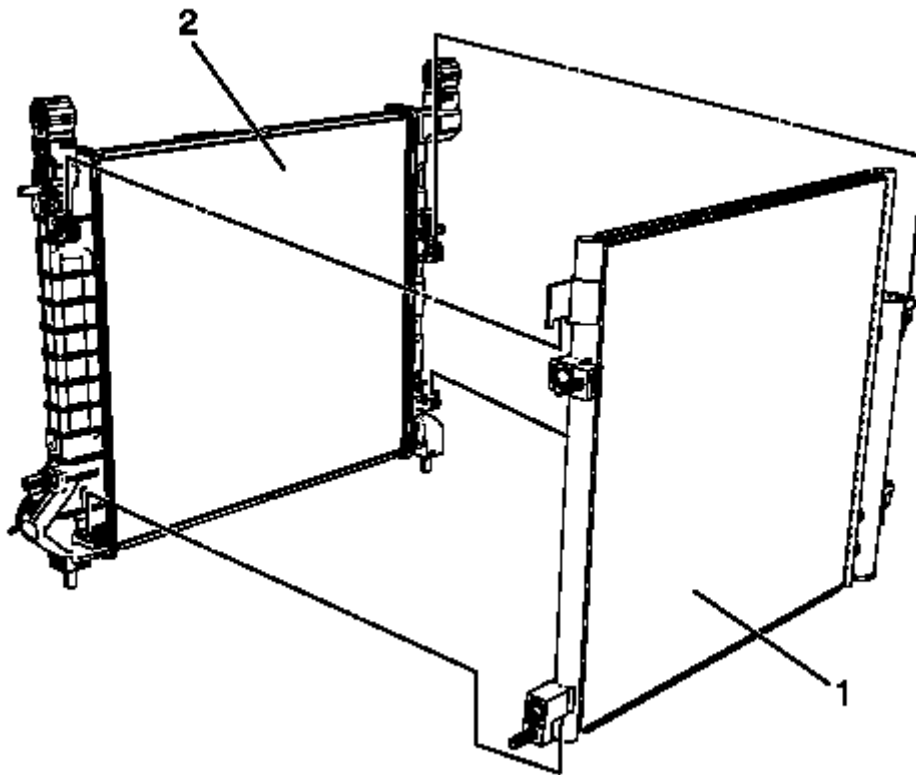


Fig. 28: Identifying Air Conditioning Condenser & Radiator
Courtesy of GENERAL MOTORS COMPANY

9. Unclip air conditioning condenser (1) from the radiator (2).

Installation Procedure

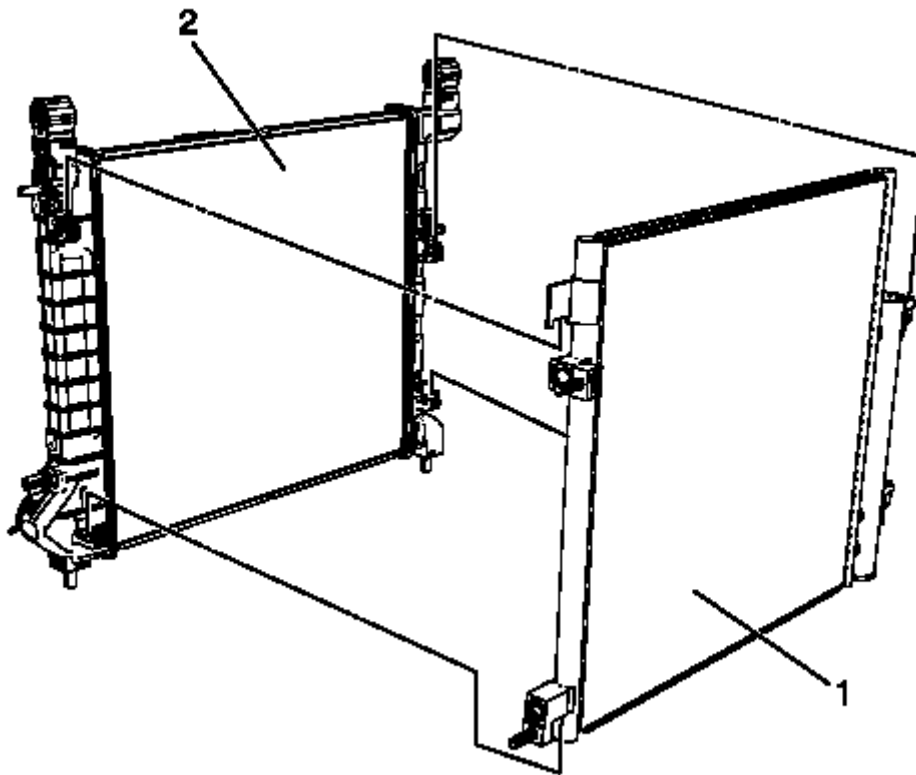


Fig. 29: Identifying Air Conditioning Condenser & Radiator
Courtesy of GENERAL MOTORS COMPANY

1. Clip the air conditioning condenser (1) to the radiator (2).

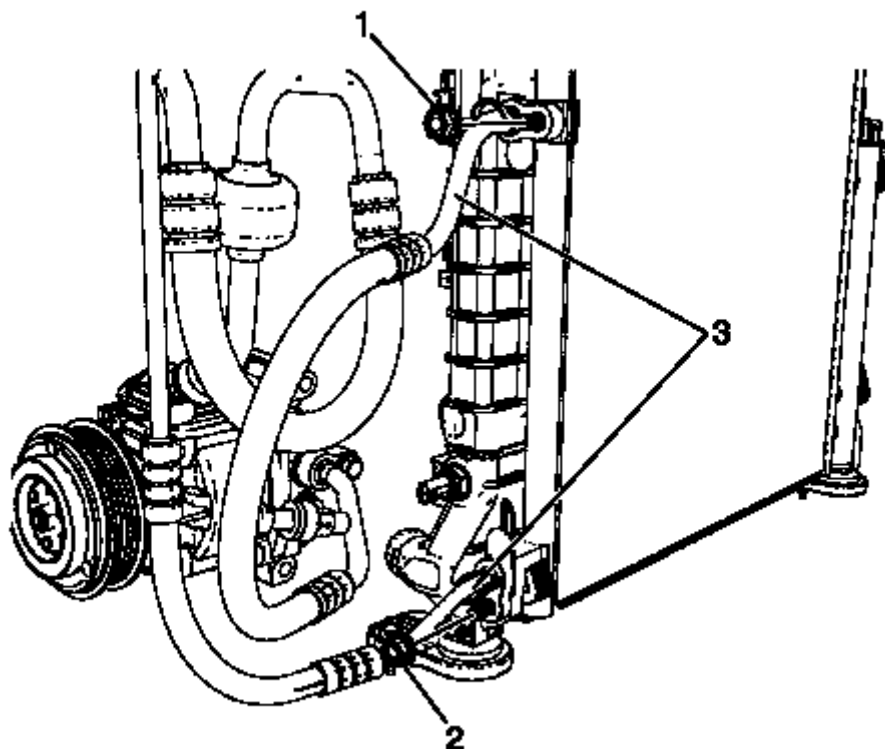


Fig. 30: Locating Air Conditioning Hose Fasteners
Courtesy of GENERAL MOTORS COMPANY

2. Install air conditioning hoses (3) to the air conditioning condenser.

CAUTION: Refer to Fastener Caution .

3. Install air conditioning evaporator hose assembly nut (2) and tighten to 22 (16 lb in).
4. Install air conditioning compressor and condenser nut (1) and tighten to 22 (16 lb in).

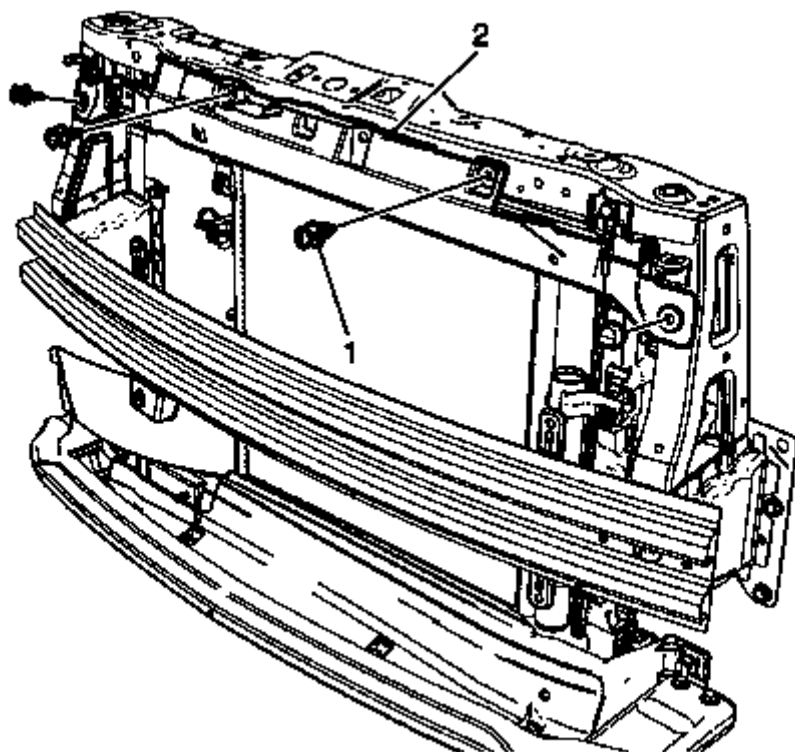


Fig. 31: Identifying Upper Opening Cover Retainers
Courtesy of GENERAL MOTORS COMPANY

5. Install the upper opening cover (2) and 4 upper opening cover retainer (1).

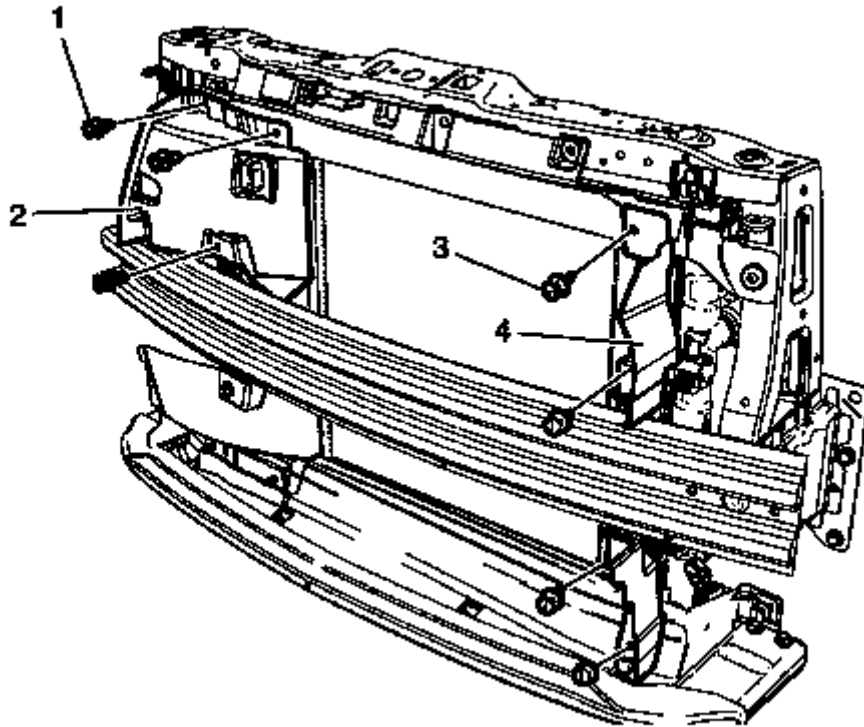


Fig. 32: Identifying Side Opening Cover Retainers
Courtesy of GENERAL MOTORS COMPANY

6. Install the left side opening cover (4) and 4 left side opening cover retainer (3).
7. Install the right side opening cover (2) and 3 right side opening cover retainer (1).
8. Install the front bumper fascia. Refer to **Front Bumper Fascia Replacement** .
9. Charge the refrigerant system. Refer to **Refrigerant Recovery and Recharging**.

CONDENSER OUTLET TUBE REPLACEMENT

Removal Procedure

1. Recover the refrigerant. Refer to **Refrigerant Recovery and Recharging**.
2. Remove the charge air cooler inlet duct. Refer to .

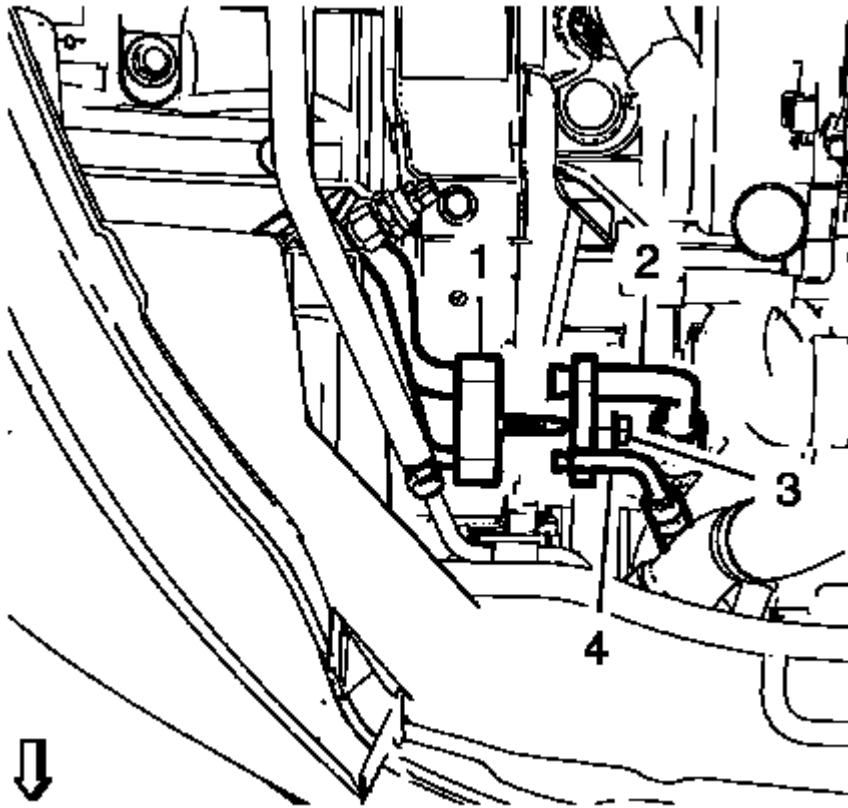


Fig. 33: Air Conditioning Condenser And Evaporator Hose Fitting Nut
Courtesy of GENERAL MOTORS COMPANY

3. Remove the air conditioning condenser and evaporator hose fitting nut (3) from the air conditioning evaporator hose (1).
4. Loosen the air conditioning compressor hose (2) and the condenser outlet tube (4).

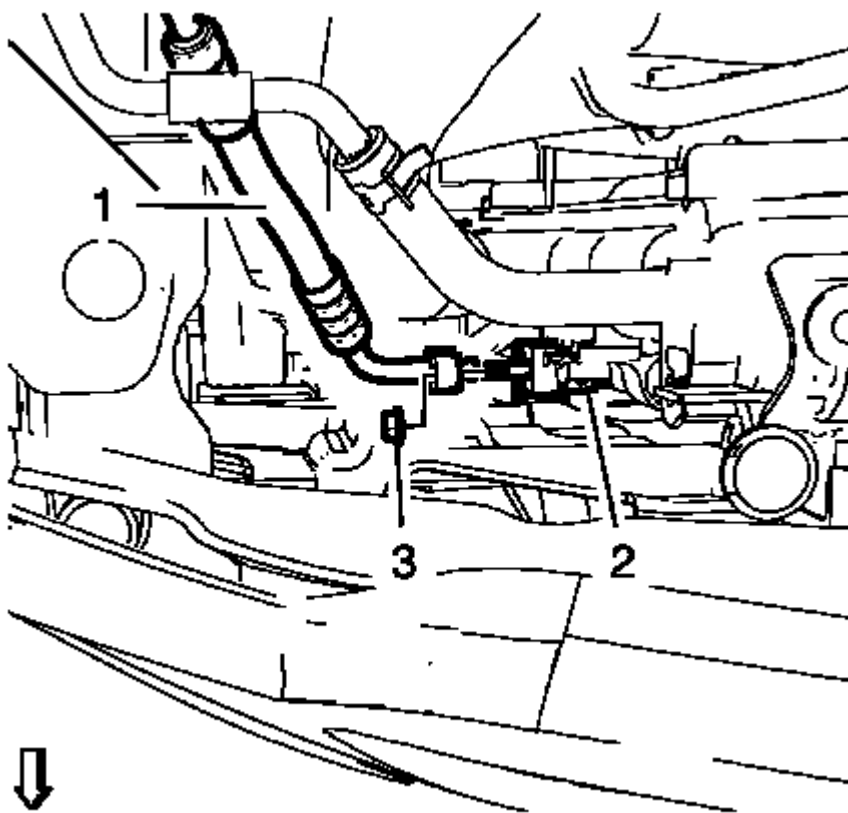


Fig. 34: Condenser Outlet Tube Nut
Courtesy of GENERAL MOTORS COMPANY

5. Remove the condenser outlet tube nut (3) from the air conditioning condenser (2).
6. Remove the condenser outlet tube (1).

Installation Procedure

1. Install NEW system seals to the air conditioning condenser outlet tube and the air conditioning condenser and the evaporator hose. Refer to **Air Conditioning System Seal Replacement**.

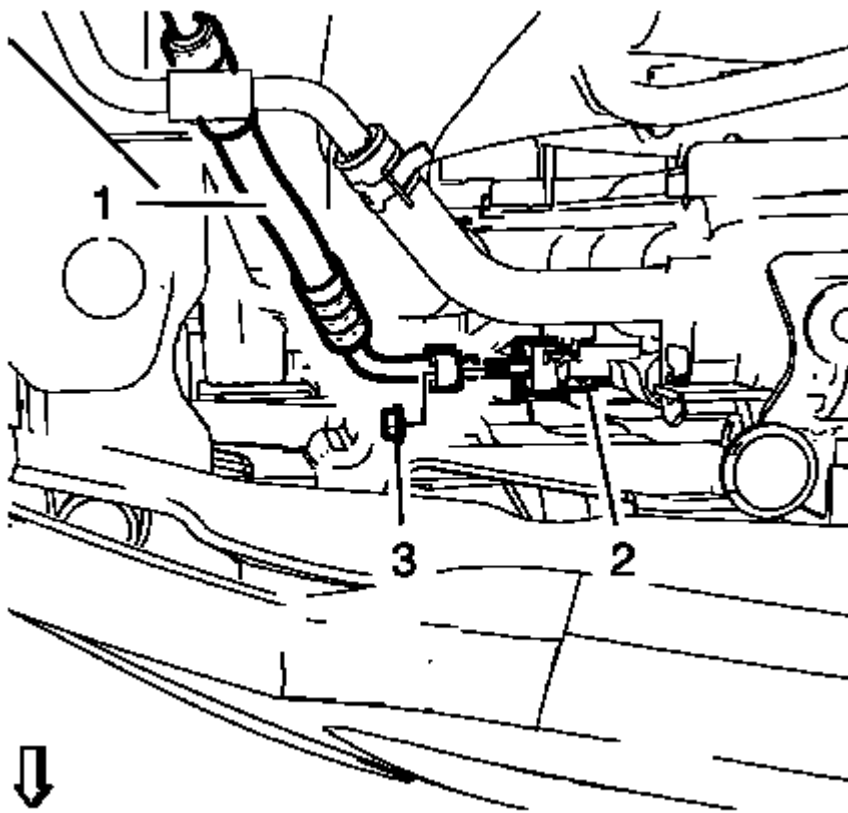


Fig. 35: Condenser Outlet Tube Nut
Courtesy of GENERAL MOTORS COMPANY

2. Install the condenser outlet tube (1).

CAUTION: Refer to Fastener Caution .

3. Install the condenser outlet tube nut (3) to the air conditioning condenser (2) and tighten to 9 N.m (80 lb in).

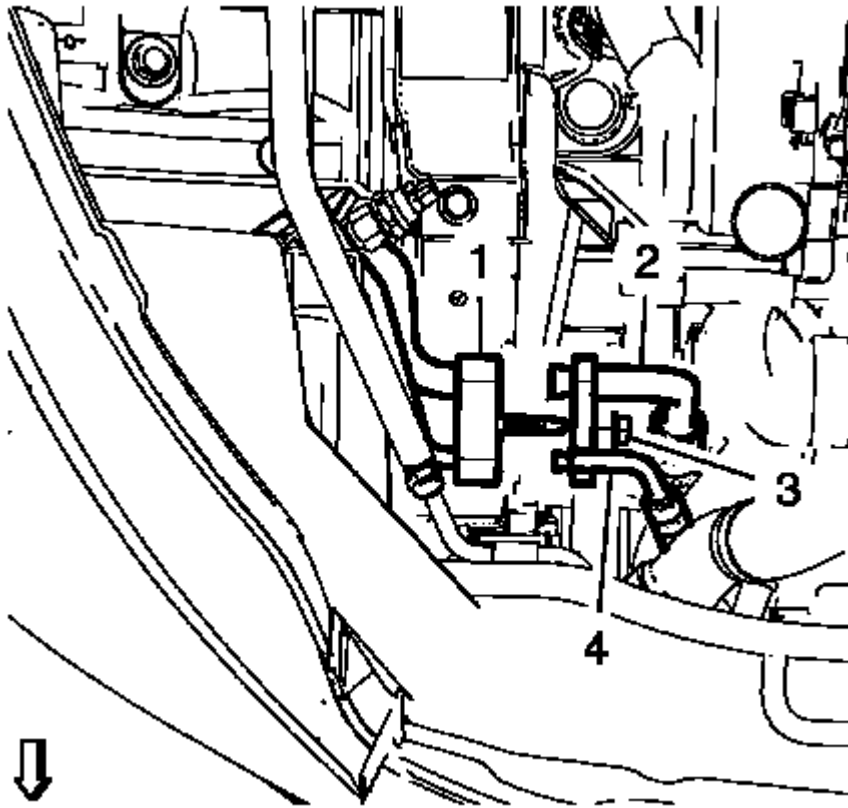


Fig. 36: Air Conditioning Condenser And Evaporator Hose Fitting Nut
Courtesy of GENERAL MOTORS COMPANY

4. Install the condenser outlet tube (4) to the air conditioning compressor hose (2).
5. Install the condenser outlet tube and the air conditioning compressor hose assembly to the air conditioning evaporator hose (1).
6. Install the air conditioning condenser and evaporator hose fitting nut (3) to the air conditioning evaporator hose (1) and tighten to 22 N.m (16 lb ft)..
7. Install the charge air cooler inlet duct. Refer to .
8. Evacuate and charge the refrigerant system. Refer to **Refrigerant Recovery and Recharging**.

AIR CONDITIONING (A/C) EVAPORATOR AND BLOWER MODULE ASSEMBLY REPLACEMENT

Removal Procedure

1. Drain the cooling system. Refer to **Cooling System Draining and Filling** .
2. Recover the refrigerant. Refer to **Refrigerant Recovery and Recharging**.
3. Disconnect the heater hoses from the heater core. Refer to **Heater Inlet Hose Replacement (1.0L LMT, 1.19L LC5, and 1.2L LMU)**, and **Heater Outlet Hose Replacement (1.0L LMT, 1.19L LC5, and 1.2L LMU)**.

4. Remove the instrument panel (I/P) tie bar. Refer to **Instrument Panel Tie Bar Replacement** .

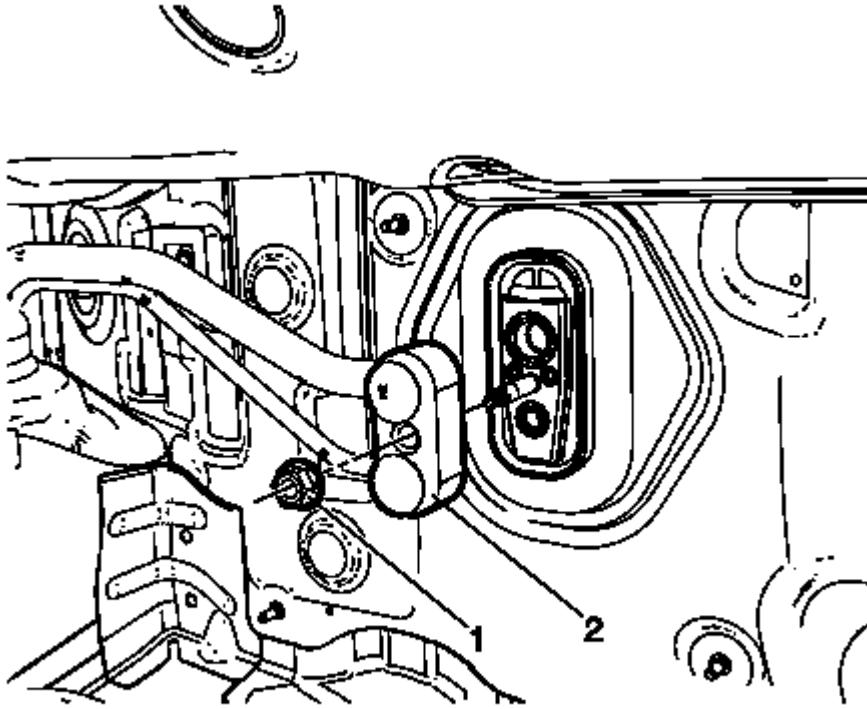


Fig. 37: A/C Evaporator Hose Assembly Nut
Courtesy of GENERAL MOTORS COMPANY

5. Remove the A/C evaporator hose assembly nut (1).
6. Disconnect the A/C evaporator hose assembly (2) from the thermal expansion valve.

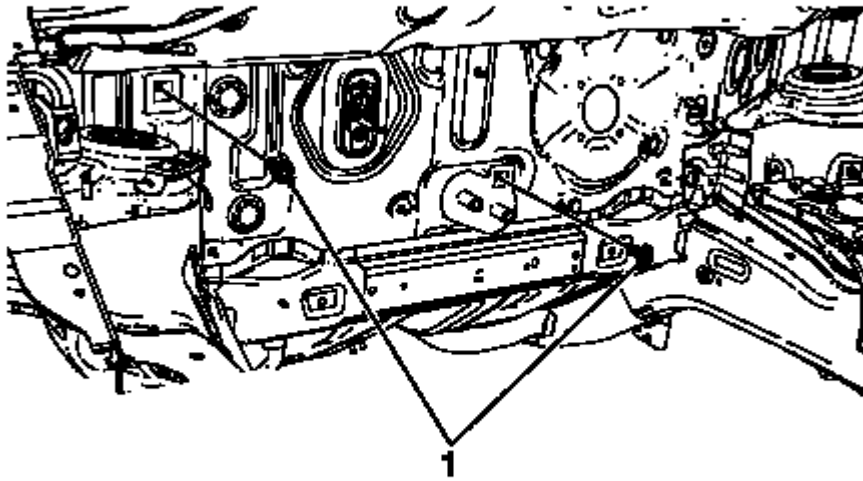


Fig. 38: HVAC Module Assembly And Dash Panel Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Remove the HVAC module assembly to dash panel bolts (1).

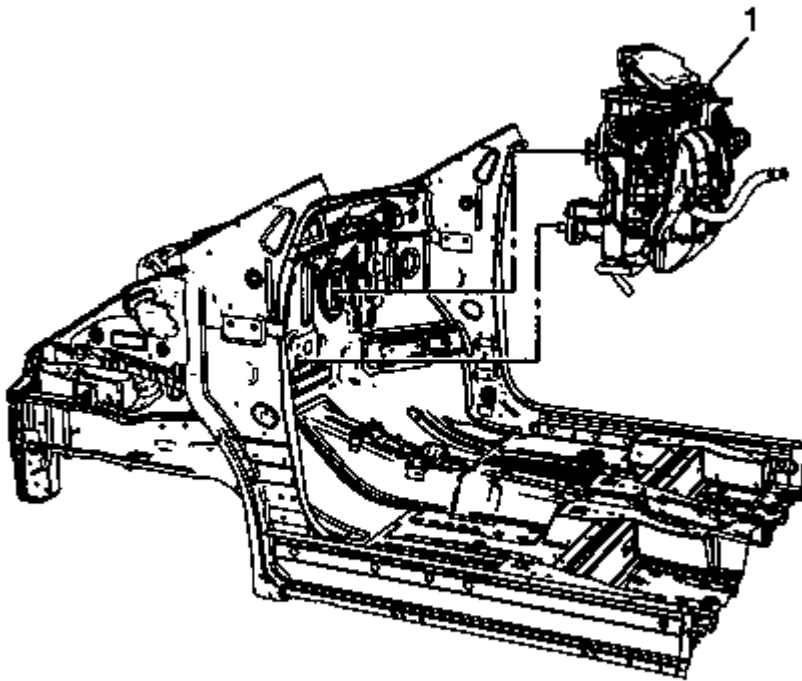


Fig. 39: HVAC Module Assembly
Courtesy of GENERAL MOTORS COMPANY

8. Remove the HVAC module assembly (1).

Installation Procedure

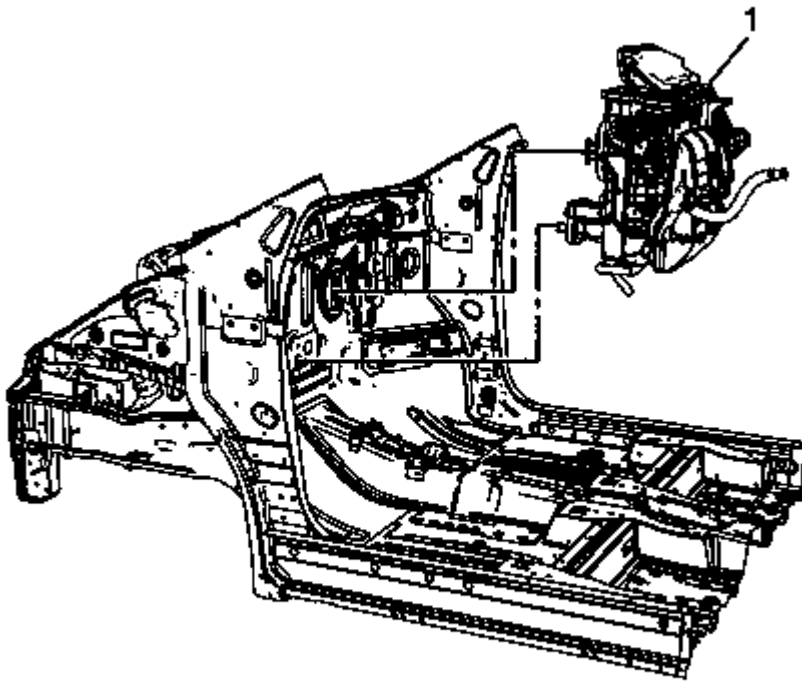


Fig. 40: HVAC Module Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Install the HVAC module assembly (1).

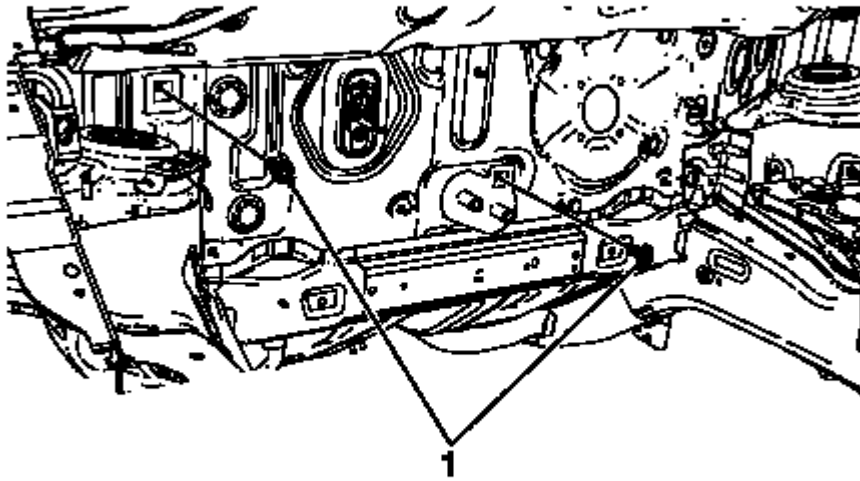


Fig. 41: HVAC Module Assembly And Dash Panel Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

2. Install the HVAC module assembly to dash panel bolts (1) and tighten to 6 N.m (53 lb in).

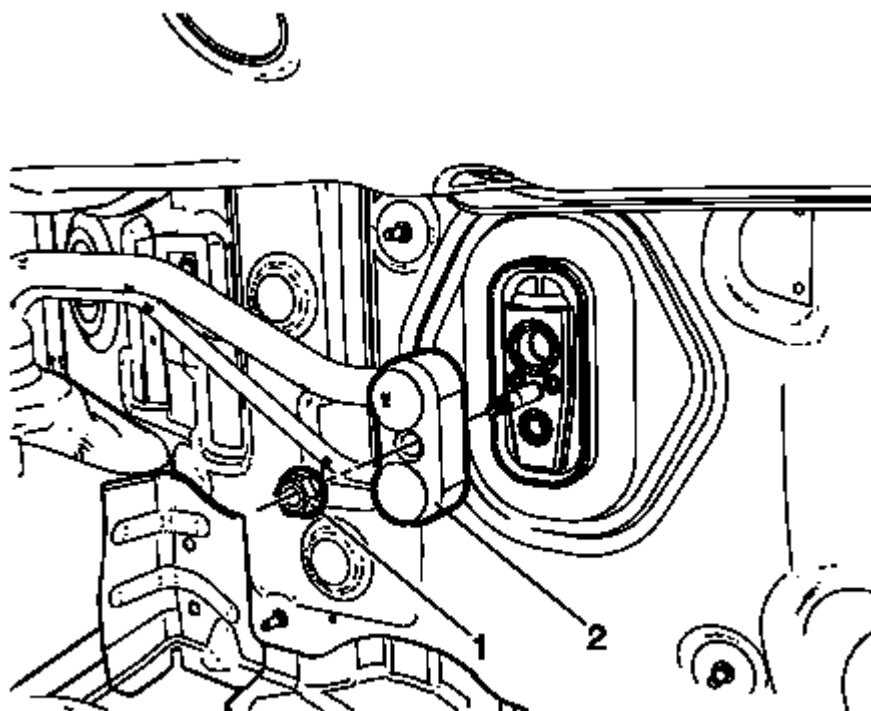


Fig. 42: A/C Evaporator Hose Assembly Nut
Courtesy of GENERAL MOTORS COMPANY

3. Connect the A/C evaporator hose assembly (2) to the thermal expansion valve.
4. Install the A/C evaporator hose assembly nut (1) and tighten to 20 N.m (15 lb ft).
5. Install the I/P tie bar. Refer to **Instrument Panel Tie Bar Replacement** .
6. Connect the heater hoses to the heater core. Refer to **Heater Inlet Hose Replacement (1.0L LMT, 1.19L LC5, and 1.2L LMU)**, and **Heater Outlet Hose Replacement (1.0L LMT, 1.19L LC5, and 1.2L LMU)**.
7. Evacuate and charge the refrigerant system. Refer to **Refrigerant Recovery and Recharging**.
8. Fill the cooling system. Refer to **Cooling System Draining and Filling** .

AIR CONDITIONING EVAPORATOR CORE REPLACEMENT

Removal Procedure

1. Recover the refrigerant. Refer to **Refrigerant Recovery and Recharging**.
2. Remove the air conditioning (A/C) evaporator and blower module assembly. Refer to **Air Conditioning (A/C) Evaporator and Blower Module Assembly Replacement**.

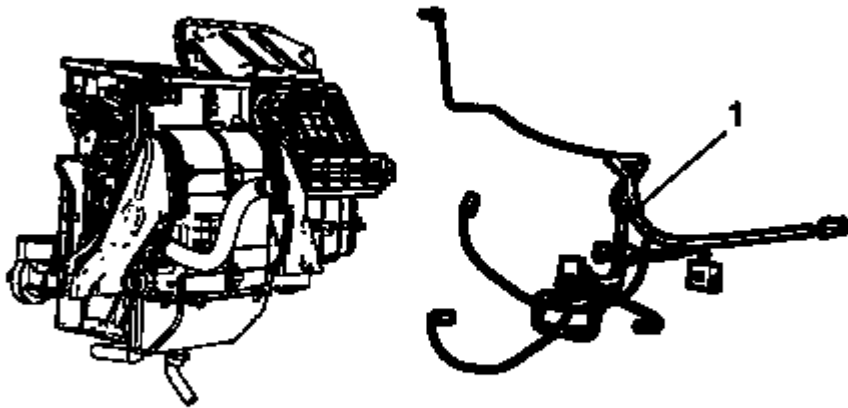


Fig. 43: A/C Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the electrical connectors.
4. Remove the A/C module wiring harness (1).
5. Remove the floor air outlet ducts. Refer to **Floor Air Outlet Duct Replacement - Left Side (Left Hand Drive)**, and **Floor Air Outlet Duct Replacement - Right Side**.
6. Remove the heater core. Refer to **Heater Core Replacement**.

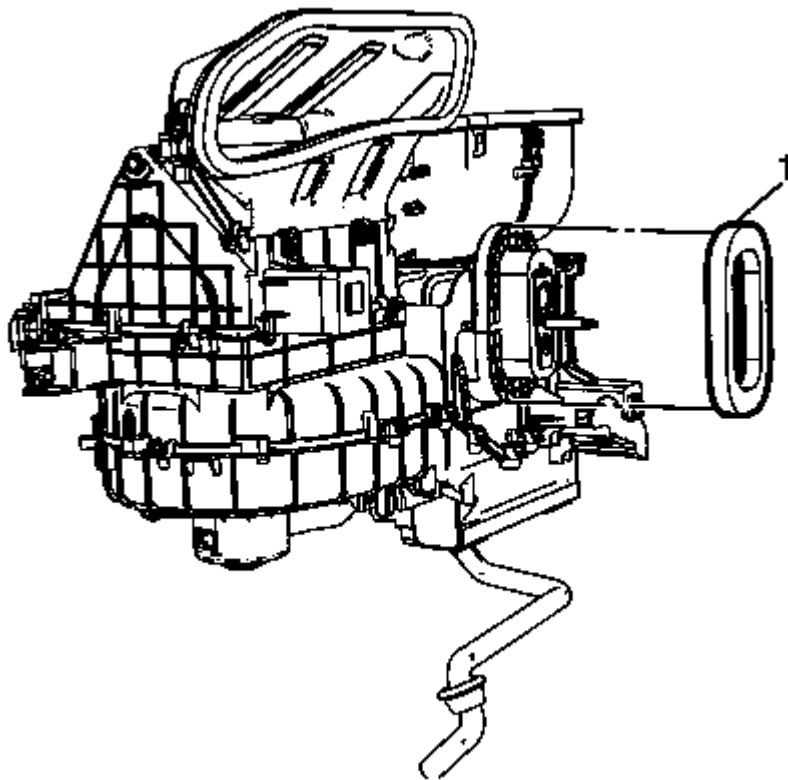


Fig. 44: A/C Evaporator Tube Seal
Courtesy of GENERAL MOTORS COMPANY

7. Remove the A/C evaporator tube seal (1).

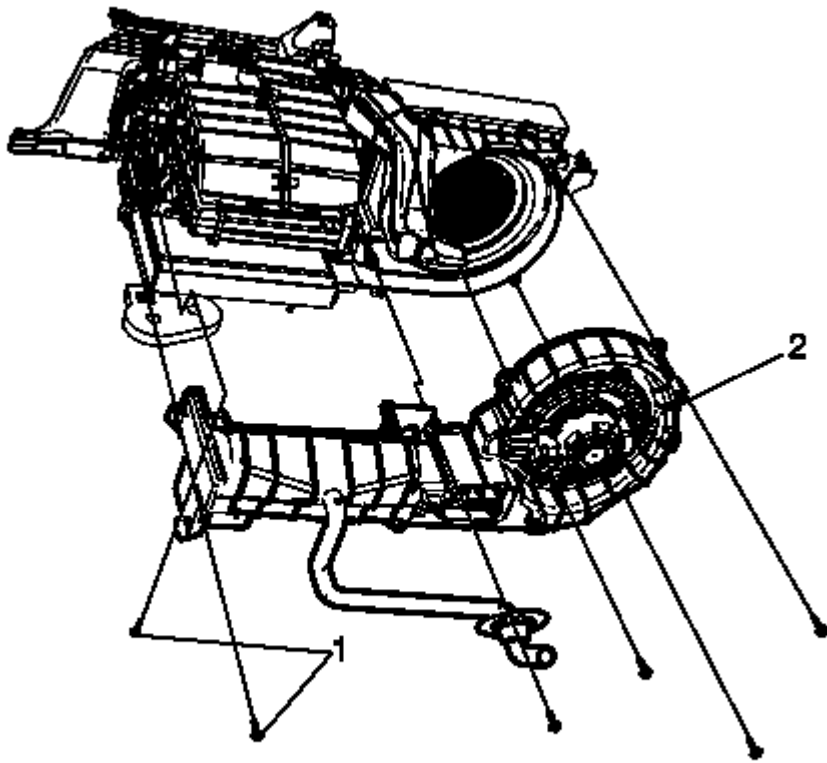


Fig. 45: Heater And A/C Evaporator Case Screws
Courtesy of GENERAL MOTORS COMPANY

8. Remove the heater and A/C evaporator case screws (1).
9. Remove the heater and A/C evaporator case (2) from A/C evaporator and blower module assembly (3).

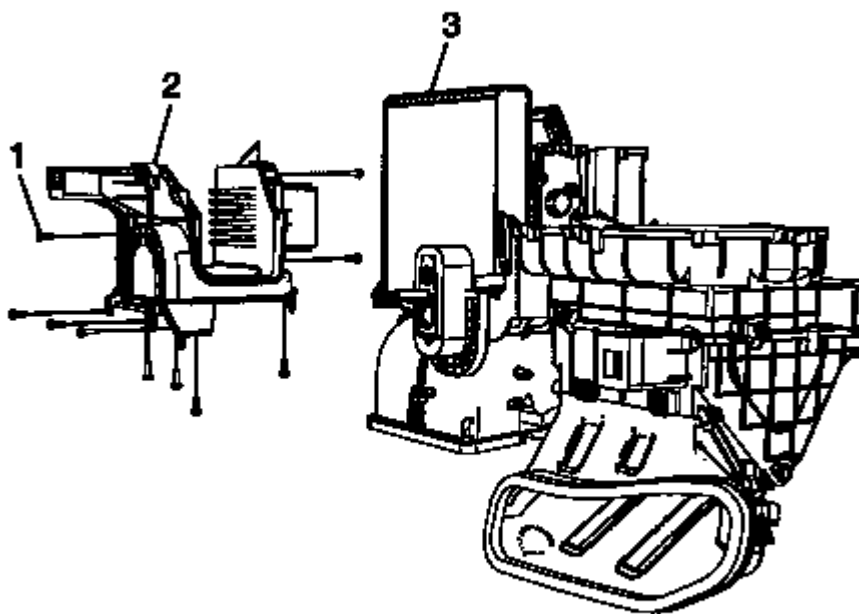


Fig. 46: Evaporator Rear Cover And Screws
Courtesy of GENERAL MOTORS COMPANY

10. Remove the evaporator rear cover screws (1).
11. Remove the evaporator rear cover (2) from A/C evaporator and blower module assembly.
12. Remove the A/C evaporator core (3).

Installation Procedure

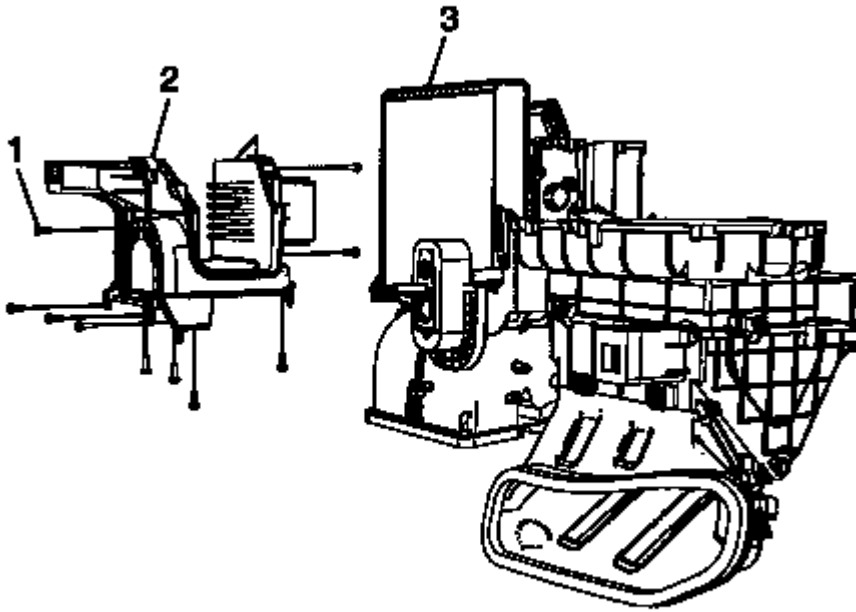


Fig. 47: Evaporator Rear Cover And Screws
Courtesy of GENERAL MOTORS COMPANY

1. Install the A/C evaporator core (3).
2. Install the evaporator rear cover (2) to A/C evaporator and blower module assembly.

CAUTION: Refer to Fastener Caution .

3. Install the evaporator rear cover screws (1) and tighten to 1.2 (11 lb in).

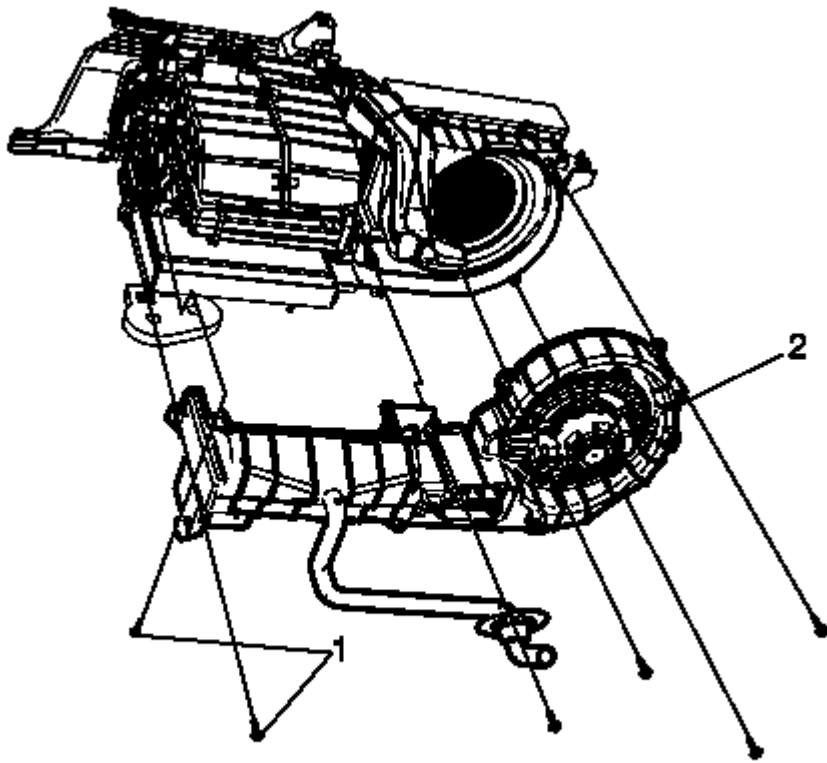


Fig. 48: Heater And A/C Evaporator Case Screws
Courtesy of GENERAL MOTORS COMPANY

4. Install the heater and A/C evaporator case (2) to A/C evaporator and blower module assembly (3).
5. Install the heater and A/C evaporator case screws (1) and tighten to 1.2 (11 lb in).

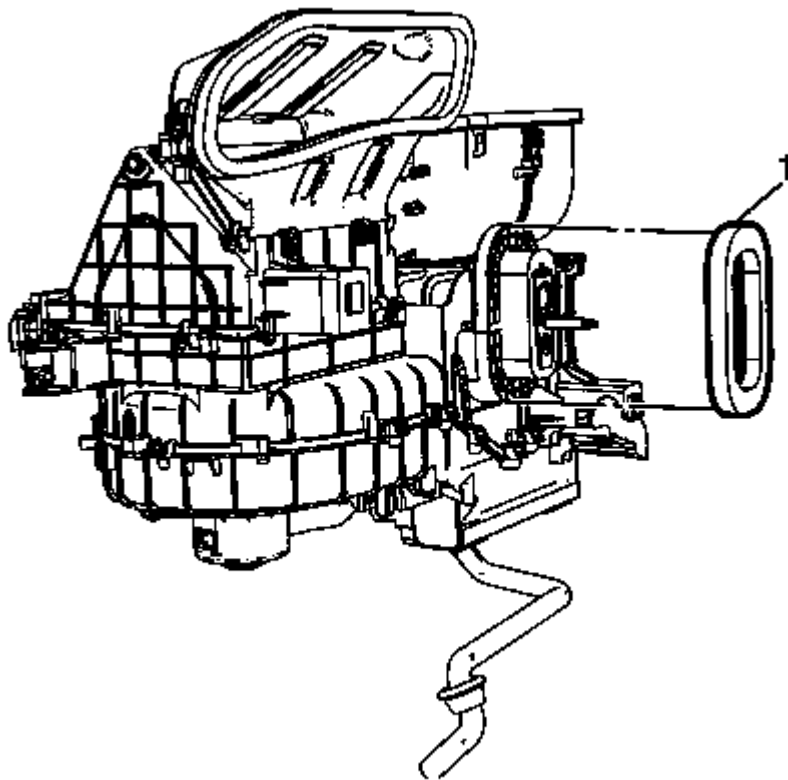


Fig. 49: A/C Evaporator Tube Seal
Courtesy of GENERAL MOTORS COMPANY

6. Install the A/C evaporator tube seal (1).
7. Install the heater core. Refer to **Heater Core Replacement**.
8. Install the floor air outlet ducts. Refer to **Floor Air Outlet Duct Replacement - Left Side (Left Hand Drive)**, and **Floor Air Outlet Duct Replacement - Right Side**.

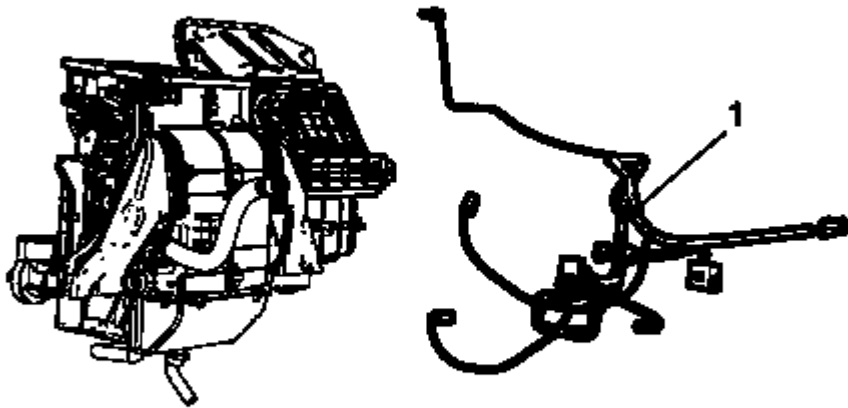


Fig. 50: A/C Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

9. Install the A/C module wiring harness (1).
10. Connect the electrical connectors.
11. Install the A/C evaporator and blower module assembly. Refer to **Air Conditioning (A/C) Evaporator and Blower Module Assembly Replacement**.
12. Evacuate and charge the refrigerant system. Refer to **Refrigerant Recovery and Recharging**.

HEATER INLET HOSE REPLACEMENT (1.0L LMT, 1.19L LC5, AND 1.2L LMU)

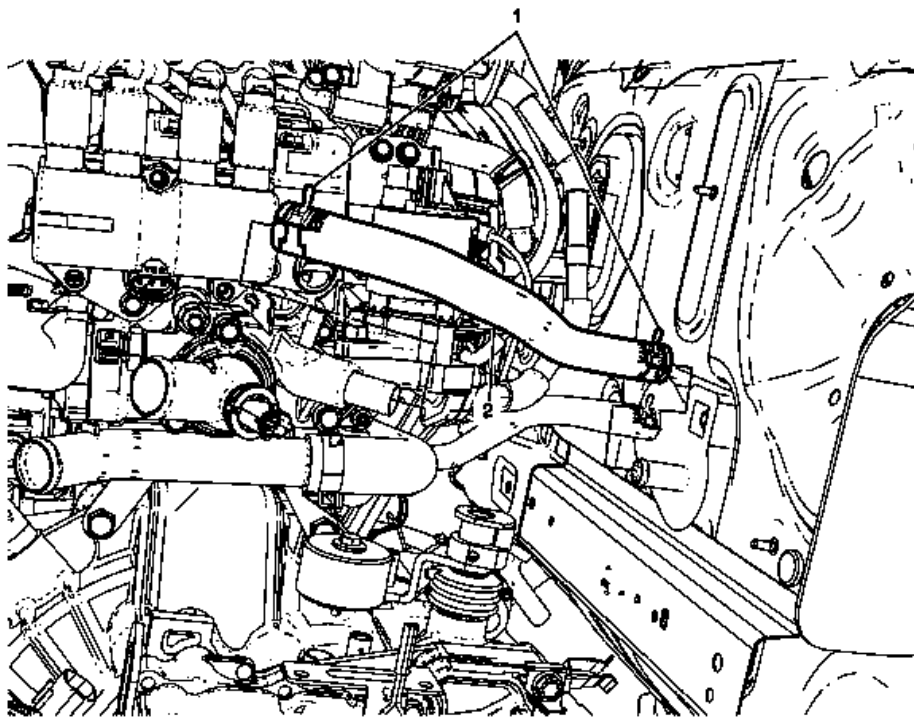


Fig. 51: Heater Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

Heater Inlet Hose Replacement (1.0L LMT, 1.19L LC5, and 1.2L LMU)

Callout	Component Name
Preliminary Procedure	
Drain the cooling system. Refer to <u>Cooling System Draining and Filling</u> .	
1	Heater Inlet Clamp (Qty: 2)
2	Heater Inlet Hose

HEATER OUTLET HOSE REPLACEMENT (1.0L LMT, 1.19L LC5, AND 1.2L LMU)

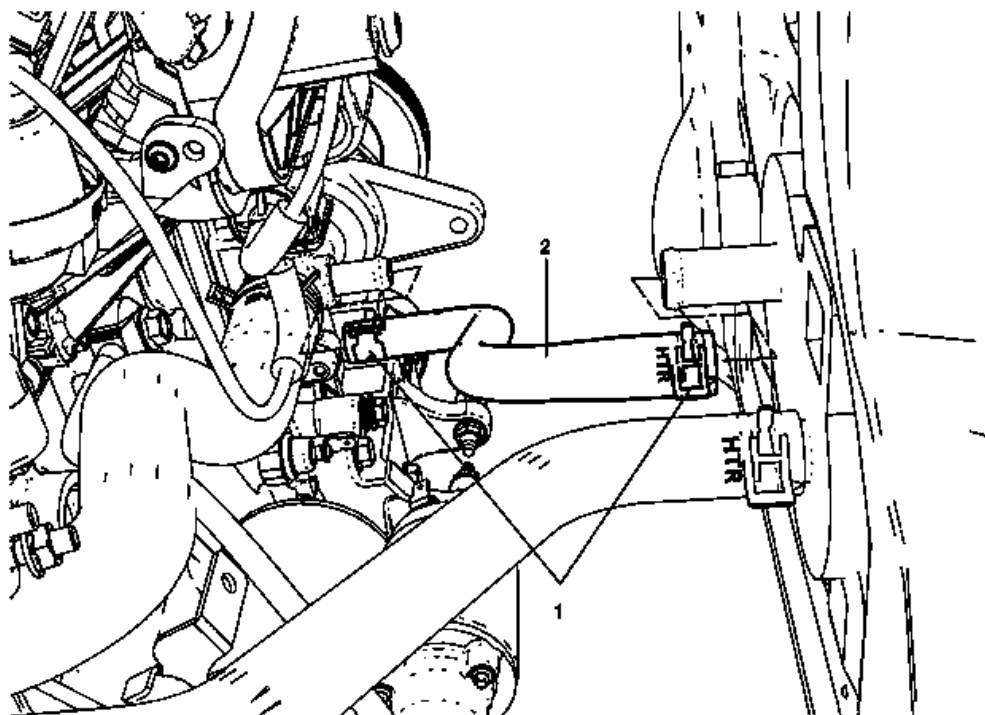


Fig. 52: Heater Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

Heater Outlet Hose Replacement (1.0L LMT, 1.19L LC5, and 1.2L LMU)

Callout	Component Name
Preliminary Procedures	
1. Drain the cooling system. Refer to <u>Cooling System Draining and Filling</u> .	
2. Remove the air cleaner assembly. Refer to <u>Air Cleaner Assembly Replacement</u> .	
1	Heater Outlet Clamp (Qty: 2)
2	Heater Outlet Hose

PASSENGER COMPARTMENT AIR FILTER REPLACEMENT (LEFT HAND DRIVE)

Removal Procedure

1. Remove the instrument panel (I/P) compartment. Refer to Instrument Panel Compartment Replacement .

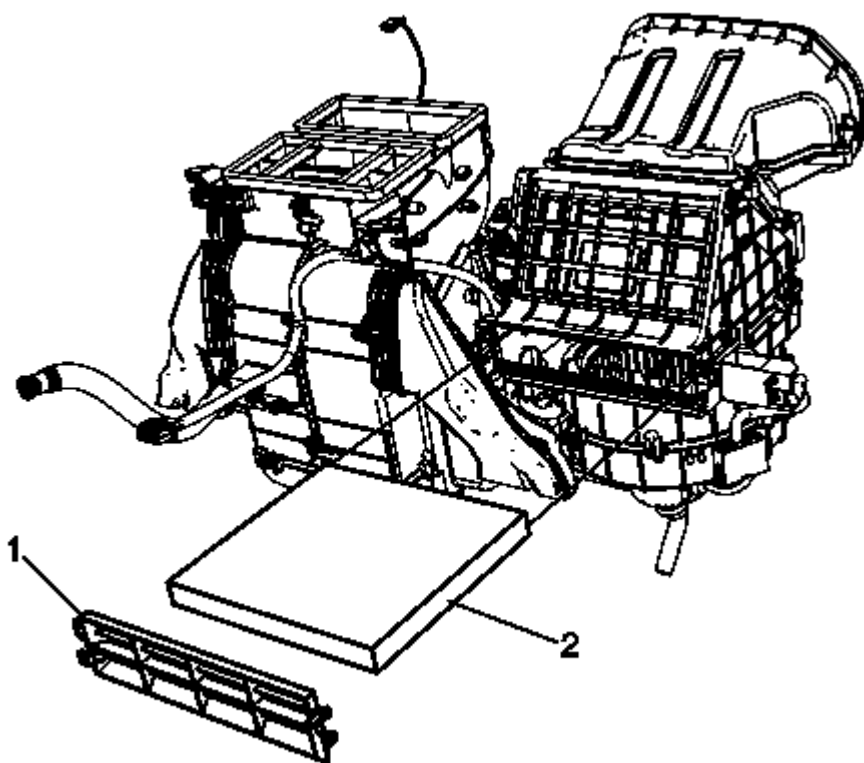


Fig. 53: Passenger Compartment Air Filter Housing Cover
Courtesy of GENERAL MOTORS COMPANY

2. Remove the passenger compartment air filter housing cover (1).
3. Remove the passenger compartment air filter (2).

Installation Procedure

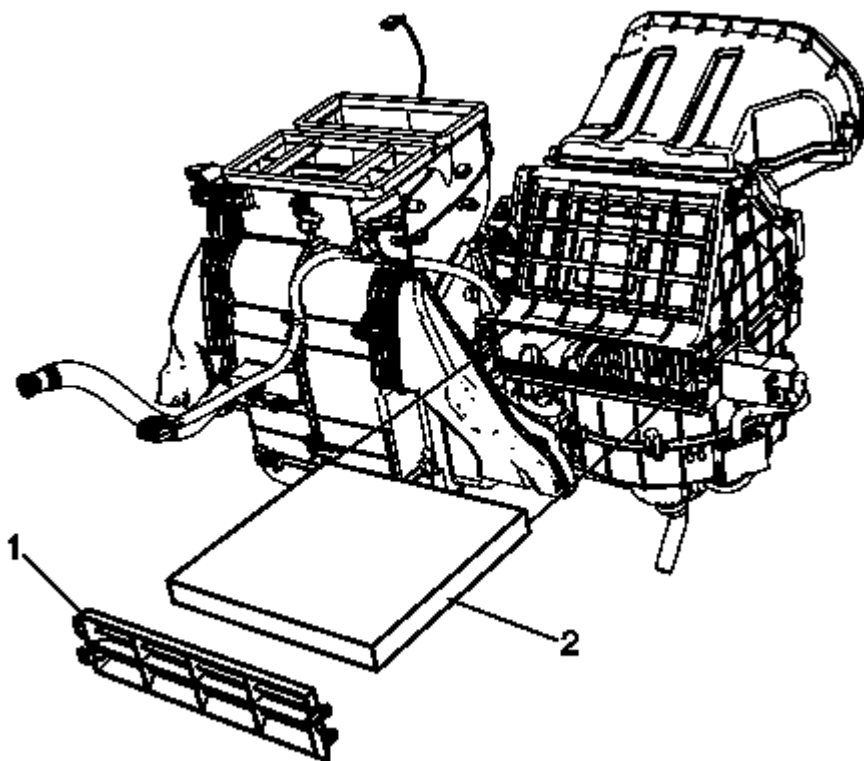


Fig. 54: Passenger Compartment Air Filter Housing Cover
Courtesy of GENERAL MOTORS COMPANY

1. Install the passenger compartment air filter (2).
2. Install the passenger compartment air filter housing cover (1).
3. Install the I/P compartment. Refer to **Instrument Panel Compartment Replacement** .

BLOWER MOTOR RESISTOR REPLACEMENT (LEFT HAND DRIVE)

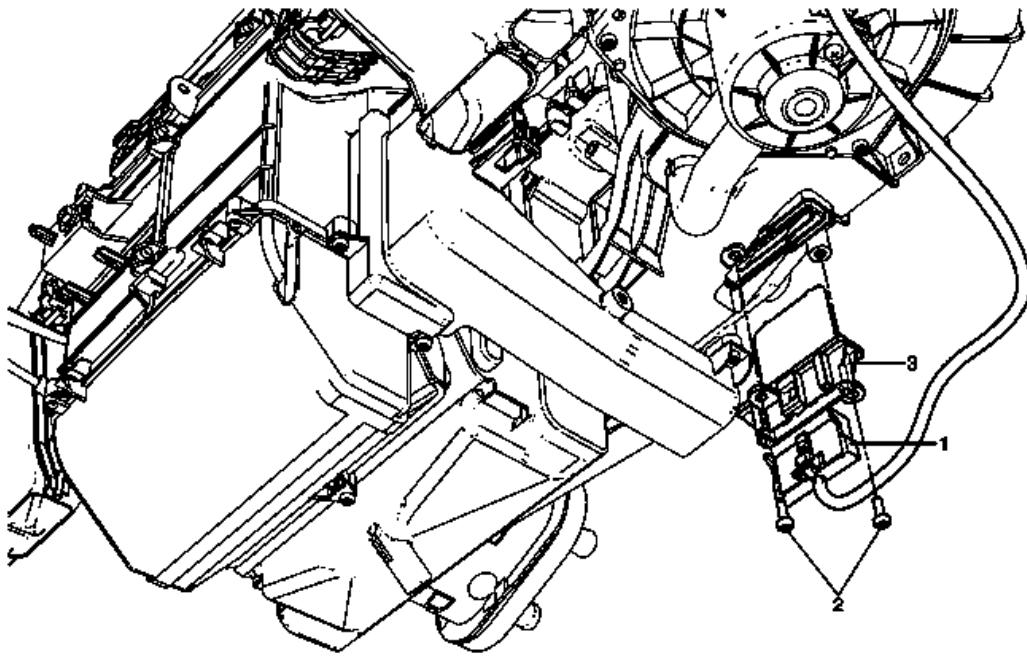


Fig. 55: Blower Motor Resistor
 Courtesy of GENERAL MOTORS COMPANY

Blower Motor Resistor Replacement (Left Hand Drive)

Callout	Component Name
Preliminary Procedure Disconnect the battery negative cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> .	
1	Blower Motor Resistor Electrical Connector
2	Blower Motor Resistor Screw (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 1.2 N.m (11 lb in)
3	Blower Motor Resistor

BLOWER MOTOR REPLACEMENT

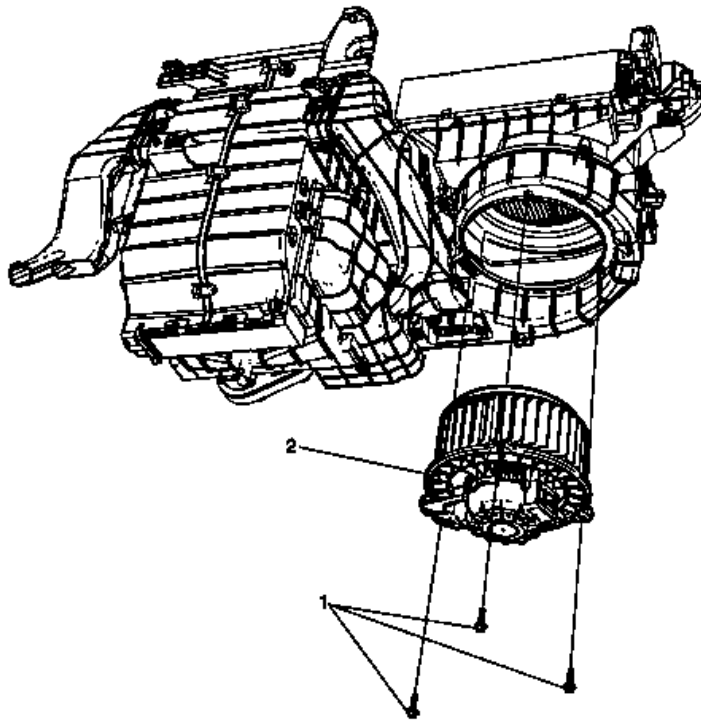


Fig. 56: Blower Motor

Courtesy of GENERAL MOTORS COMPANY

Blower Motor Replacement

Callout	Component Name
Preliminary Procedures 1. Disconnect the battery negative cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Remove the inflatable restraint instrument panel lower module. Refer to <u>Instrument Panel Lower Airbag Replacement - Passenger Side</u> . 3. Disconnect the electrical connector.	
1	Blower Motor Screw (Qty: 3) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 1.2 (11 lb in)
2	Blower Motor Procedure Disconnect the blower motor tube.

INSTRUMENT PANEL OUTER AIR OUTLET REPLACEMENT - LEFT SIDE

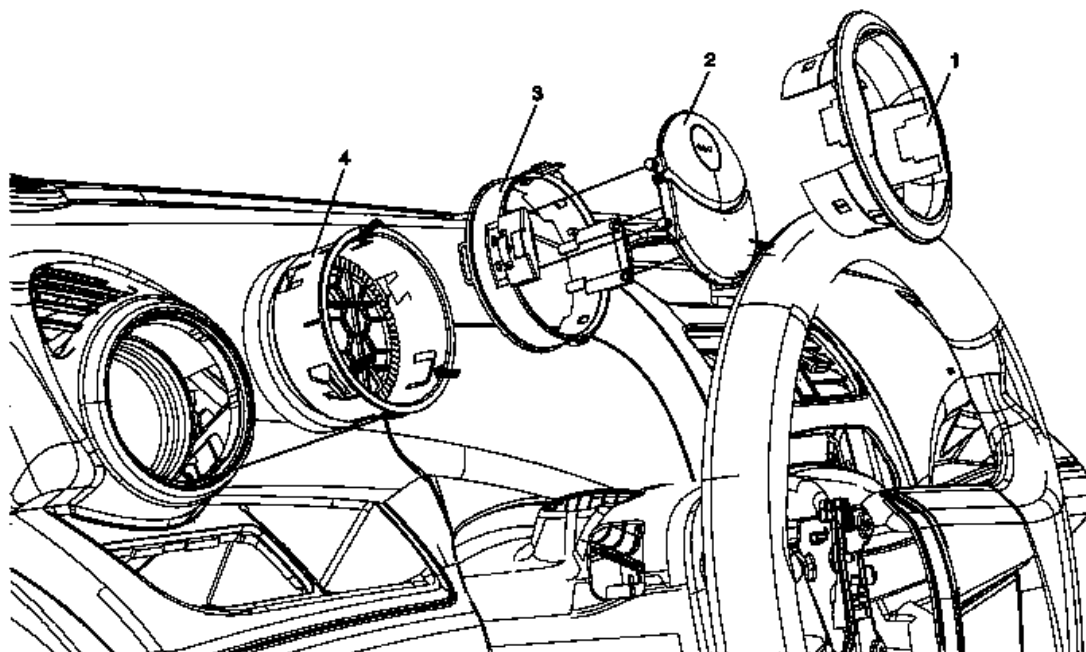


Fig. 57: Instrument Panel Outer Air Outlet
Courtesy of GENERAL MOTORS COMPANY

Instrument Panel Outer Air Outlet Replacement - Left Side

Callout	Component Name
1	Inner Air Outlet Nozzle TIP: Carefully use a flat-bladed screwdriver to remove the inner air outlet nozzle.
2	Air Outlet Cover
3	Outer Air Outlet Nozzle
4	Air Outlet Nozzle Housing TIP: Release the portion shown as the arrow with a flat-bladed screwdriver to remove the nozzle housing.

INSTRUMENT PANEL CENTER AIR OUTLET REPLACEMENT

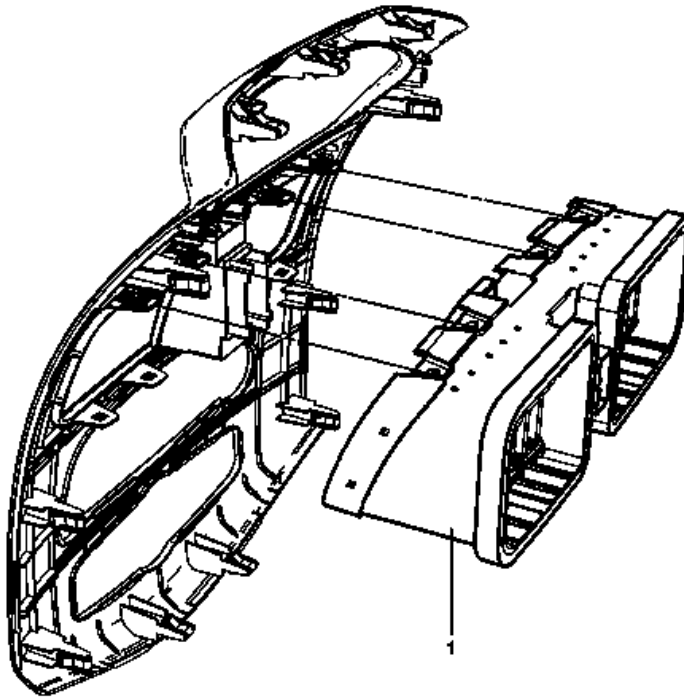


Fig. 58: Instrument Panel Center Air Outlet
 Courtesy of GENERAL MOTORS COMPANY

Instrument Panel Center Air Outlet Replacement

Callout	Component Name
Preliminary Procedure Remove the instrument panel center molding. Refer to <u>Instrument Panel Center Molding Replacement</u> .	
1	Instrument Panel Center Air Outlet

INSTRUMENT PANEL OUTER AIR OUTLET REPLACEMENT - RIGHT SIDE

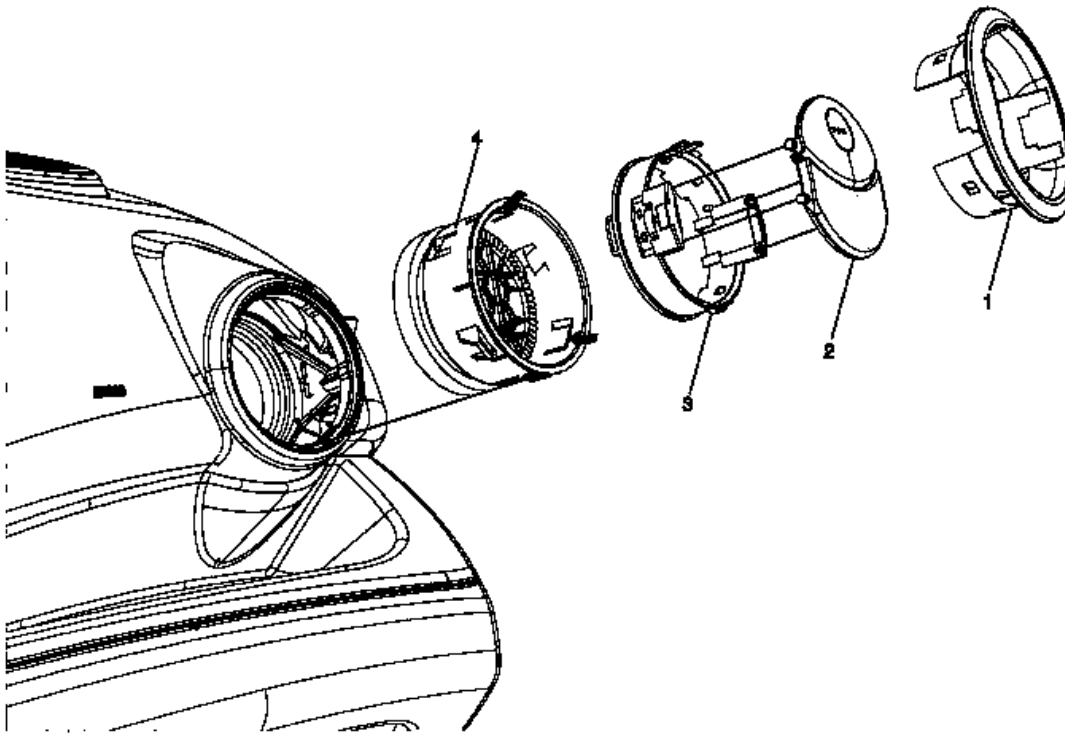


Fig. 59: Instrument Panel Outer Air Outlet
 Courtesy of GENERAL MOTORS COMPANY

Instrument Panel Outer Air Outlet Replacement - Right Side

Callout	Component Name
1	Inner Air Outlet Nozzle TIP: Carefully use a flat-bladed screwdriver to remove the inner air outlet nozzle.
2	Air Outlet Cover
3	Outer Air Outlet Nozzle
4	Air Outlet Nozzle Housing TIP: Release the portion shown as the arrow with a flat-bladed screwdriver to remove the nozzle housing.

INSTRUMENT PANEL OUTER AIR OUTLET DUCT REPLACEMENT

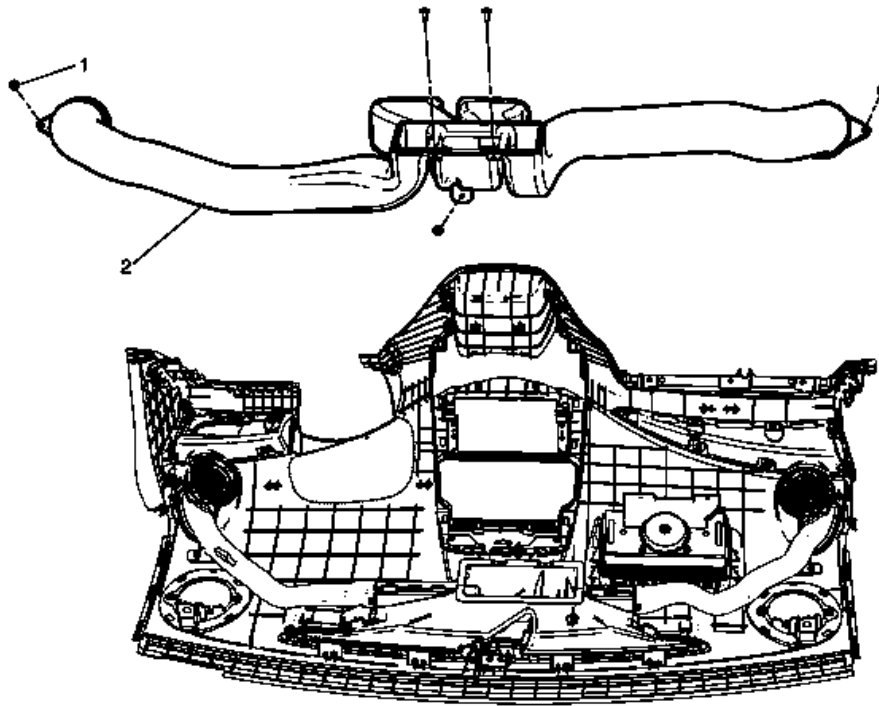


Fig. 60: Instrument Panel Outer Air Outlet Duct
 Courtesy of GENERAL MOTORS COMPANY

Instrument Panel Outer Air Outlet Duct Replacement

Callout	Component Name
Preliminary Procedure	
Remove the instrument panel (I/P) assembly. Refer to <u>Instrument Panel Assembly Replacement</u> .	
1	I/P Outer Air Outlet Duct Screw (Qty: 5) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 1.3 N.m (12 lb in)
2	I/P Outer Air Outlet Duct

WINDSHIELD DEFROSTER NOZZLE REPLACEMENT

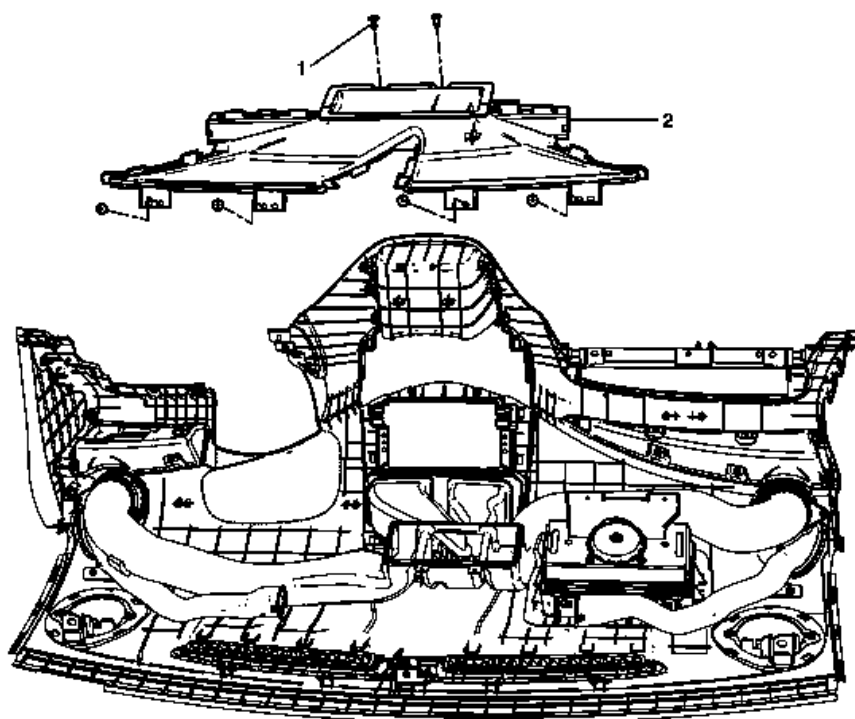


Fig. 61: Windshield Defroster Nozzle
 Courtesy of GENERAL MOTORS COMPANY

Windshield Defroster Nozzle Replacement

Callout	Component Name
Preliminary Procedure	
Remove the instrument panel (I/P) assembly. Refer to <u>Instrument Panel Assembly Replacement</u> .	
1	Windshield Defroster Nozzle Screw (Qty: 6) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 1.3 N.m (12 lb in)
2	Windshield Defroster Nozzle

FLOOR AIR OUTLET DUCT REPLACEMENT - LEFT SIDE (LEFT HAND DRIVE)

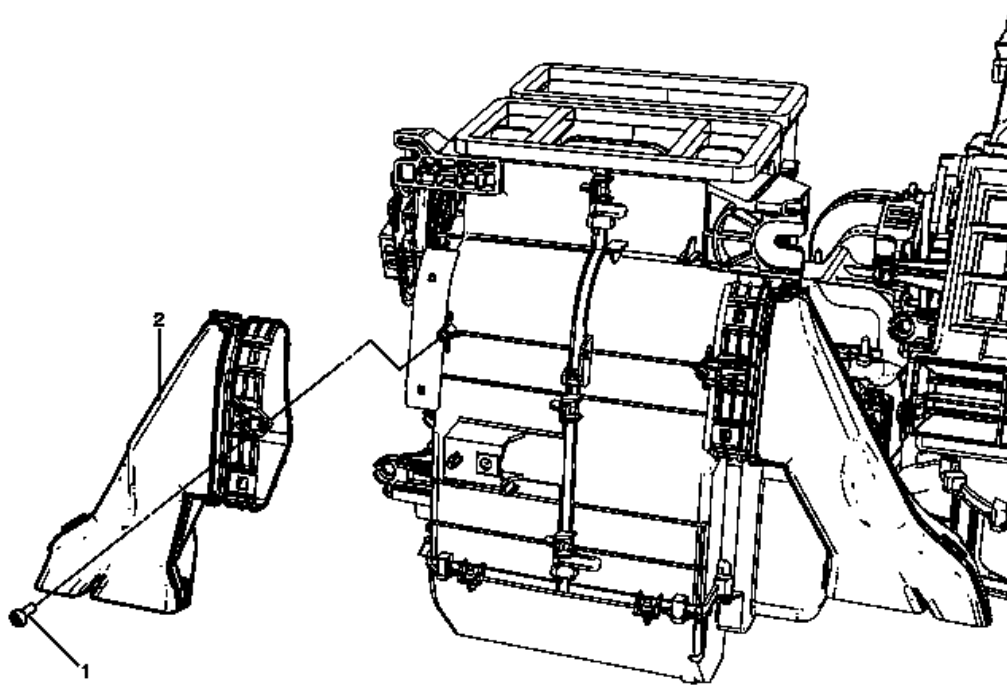


Fig. 62: Floor Air Outlet Duct - Left Side (Left Hand Drive)
 Courtesy of GENERAL MOTORS COMPANY

Floor Air Outlet Duct Replacement - Left Side (Left Hand Drive)

Callout	Component Name
Preliminary Procedure 1. Remove the steering column opening filler. Refer to <u>Steering Column Opening Filler Replacement</u> . 2. Remove the radio. Refer to <u>Radio Replacement</u> .	
1	Left Floor Air Outlet Duct Screw (Qty: 1) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 1.2 N.m (11 lb in)
2	Floor Air Outlet Duct - Left

FLOOR AIR OUTLET DUCT REPLACEMENT - RIGHT SIDE

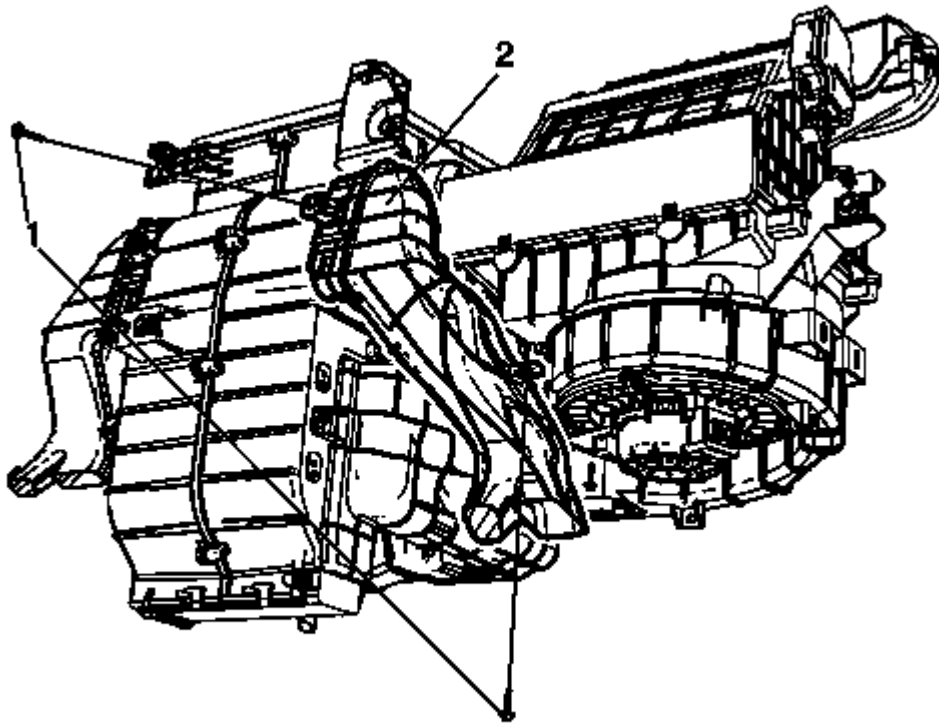


Fig. 63: Floor Air Outlet Duct - Right Side
 Courtesy of GENERAL MOTORS COMPANY

Floor Air Outlet Duct Replacement - Right Side

Callout	Component Name
Preliminary Procedure Remove the inflatable restraint instrument panel lower module. Refer to <u>Instrument Panel Lower Airbag Replacement - Passenger Side</u> .	
1	Right Floor Air Outlet Duct Bolt (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 1.2 (11 lb in)
2	Floor Air Outlet Duct - Right

HEATER CORE REPLACEMENT

Removal Procedure

1. Remove the air conditioning (A/C) evaporator and blower module assembly. Refer to **Air Conditioning (A/C) Evaporator and Blower Module Assembly Replacement**.

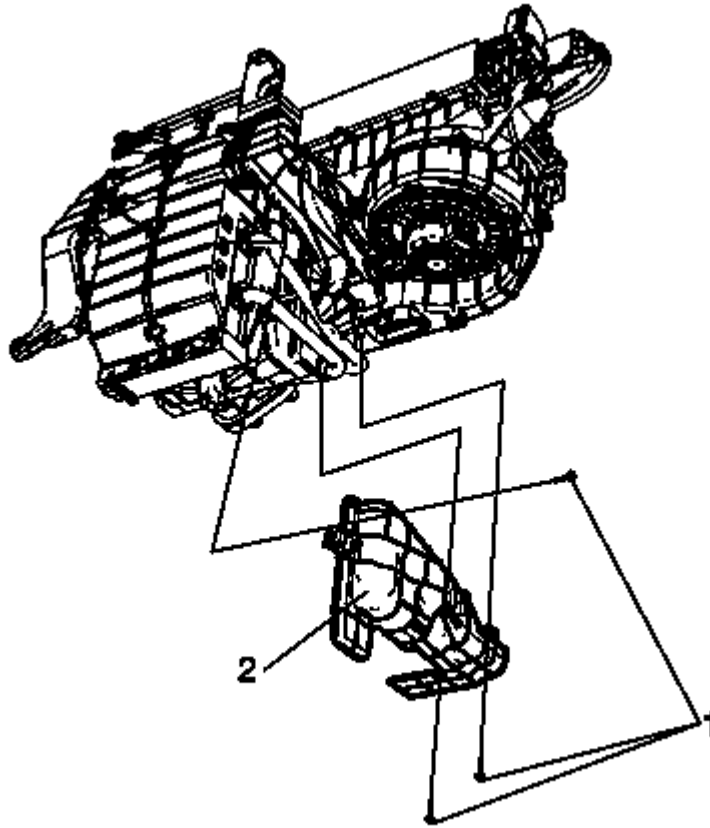


Fig. 64: Heater Core Pipe Side Cover
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the evaporator air temperature sensor connector from the heater core pipe side cover.
3. Remove the heater core pipe side cover screws (1).
4. Remove the heater core pipe side cover (2).

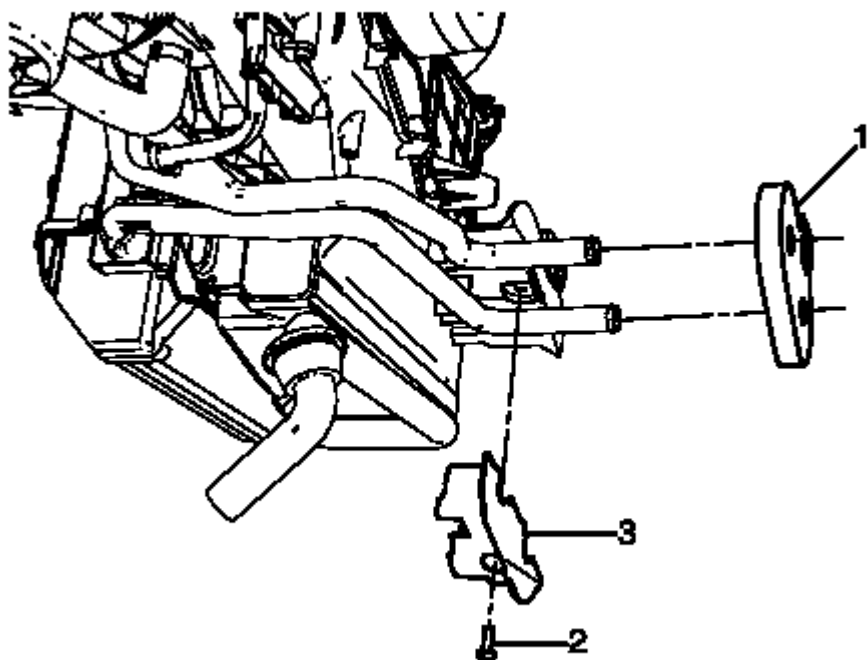


Fig. 65: Heater Core Pipe Tube Seal

Courtesy of GENERAL MOTORS COMPANY

5. Remove the heater core pipe tube seal (1).
6. Remove the heater core pipe under cover screw (2).
7. Remove the heater core pipe under cover (3).

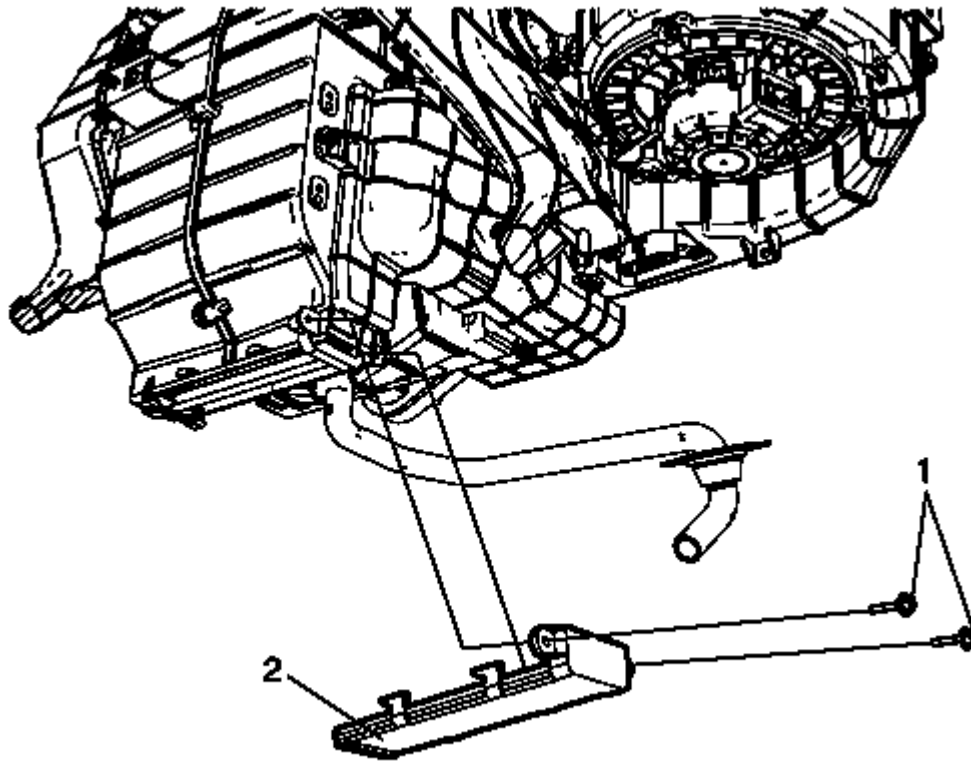


Fig. 66: Heater Core Cover Screws
Courtesy of GENERAL MOTORS COMPANY

8. Remove the heater core cover screws (1).
9. Remove the heater core cover (2).

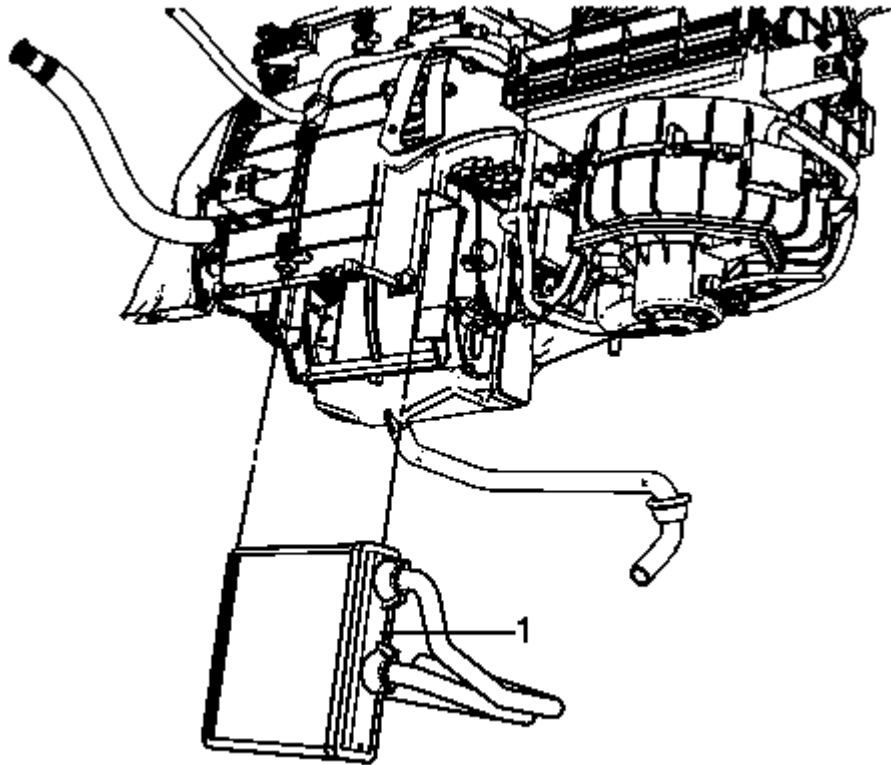


Fig. 67: Heater Core

Courtesy of GENERAL MOTORS COMPANY

10. Remove the heater core (1) from the air conditioning evaporator and blower module assembly.

Installation Procedure

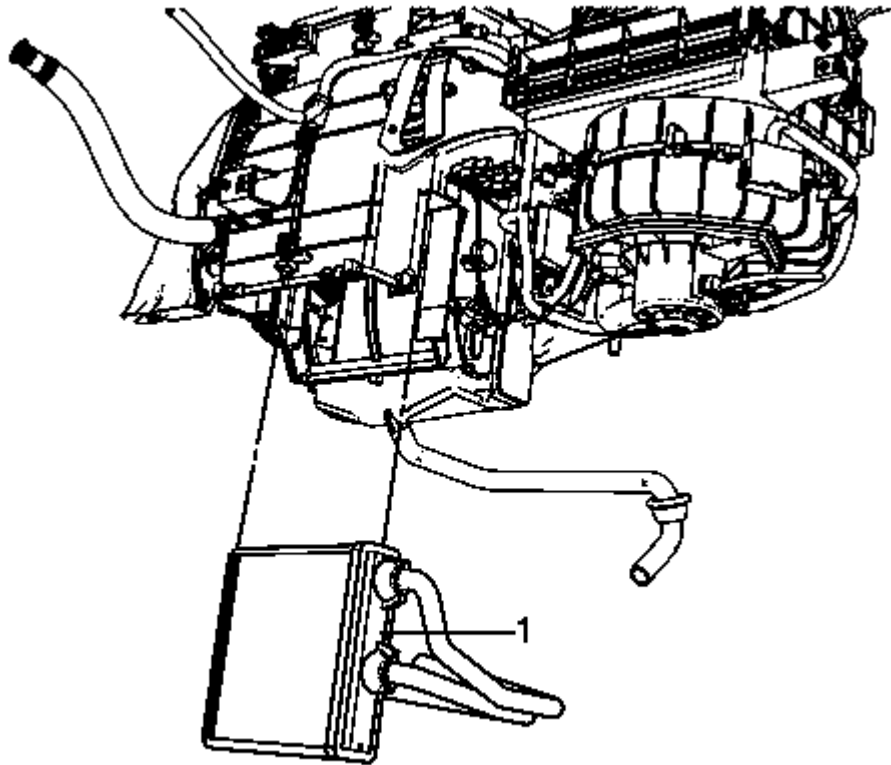


Fig. 68: Heater Core

Courtesy of GENERAL MOTORS COMPANY

1. Install the heater core (1) to the air conditioning evaporator and blower module assembly.

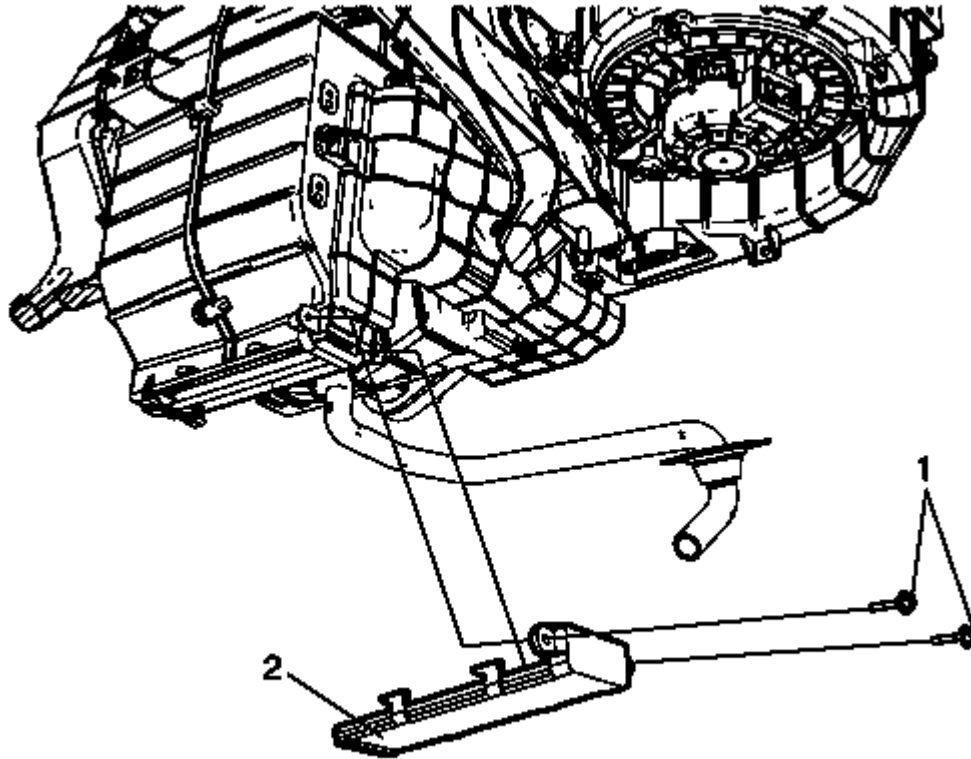


Fig. 69: Heater Core Cover Screws
Courtesy of GENERAL MOTORS COMPANY

2. Install the heater core cover (2).

CAUTION: Refer to Fastener Caution .

3. Install the heater core cover screws (1) and tighten to 1.2 (11 lb in).

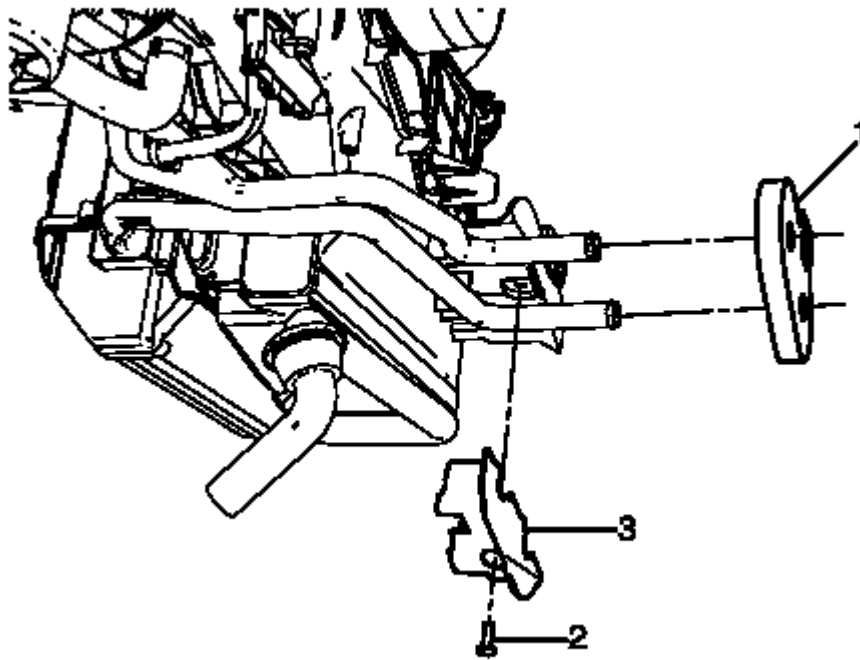


Fig. 70: Heater Core Pipe Tube Seal
Courtesy of GENERAL MOTORS COMPANY

4. Install the heater core pipe under cover (3).
5. Install the heater core pipe under cover screw (2) and tighten to 1.2 (11 lb in).
6. Install the heater core pipe tube seal (1).

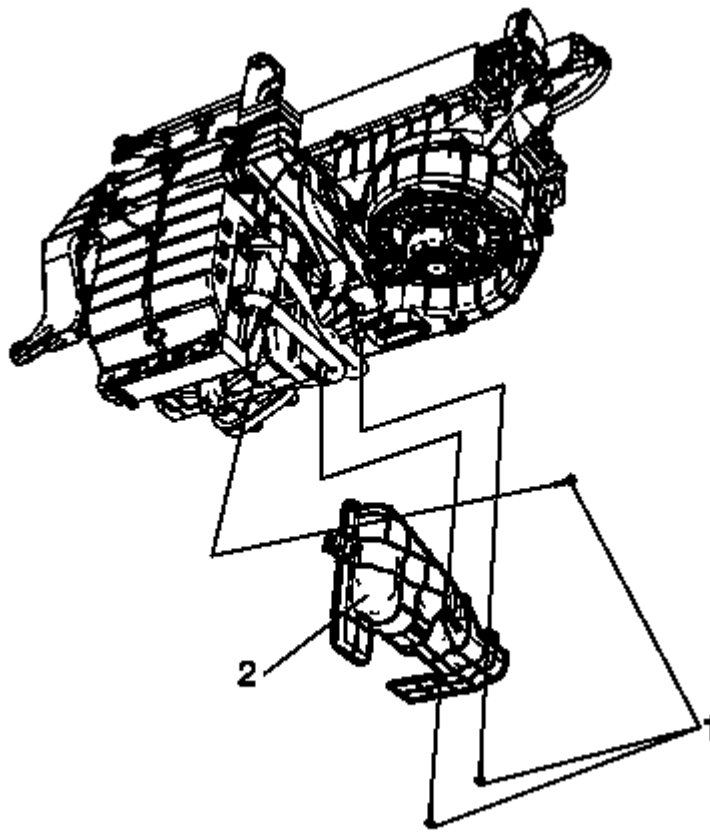


Fig. 71: Heater Core Pipe Side Cover
Courtesy of GENERAL MOTORS COMPANY

7. Install the heater core pipe side cover (2).
8. Install the heater core pipe side cover screws (1) and tighten to 1.2 (11 lb in).
9. Connect the evaporator air temperature sensor connector to the heater core pipe side cover.
10. Install the air conditioning evaporator and blower module assembly. Refer to **Air Conditioning (A/C) Evaporator and Blower Module Assembly Replacement**.

DESCRIPTION AND OPERATION

HEATING AND AIR CONDITIONING SYSTEM DESCRIPTION AND OPERATION

Engine Coolant

Engine coolant is the key element of the heating system. The thermostat controls engine operating coolant temperature. The thermostat also creates a restriction for the cooling system that promotes a positive coolant flow and helps prevent cavitation. Coolant enters the heater core through the inlet heater hose, in a pressurized state.

The heater core is located inside the HVAC module. The heat of the coolant flowing through the heater core is absorbed by the ambient air drawn through the HVAC module. Heated air is distributed to the passenger

compartment, through the HVAC module, for passenger comfort.

The amount of heat delivered to the passenger compartment is controlled by opening or closing the HVAC module air temperature door. The coolant exits the heater core through the return heater hose and recirculated back through the engine cooling system.

A/C Cycle

Refrigerant is the key element in an air conditioning system. R-134a is presently the only EPA approved refrigerant for automotive use. R-134a is an very low temperature gas that can transfer the undesirable heat and moisture from the passenger compartment to the outside air.

The A/C compressor is belt driven and operates when the magnetic clutch is engaged. The compressor builds pressure on the vapor refrigerant. Compressing the refrigerant also adds heat to the refrigerant. The refrigerant is discharged from the compressor, through the discharge hose, and forced to flow to the condenser and then through the balance of the A/C system. The A/C system is mechanically protected with the use of a high pressure relief valve. If the high pressure switch were to fail or if the refrigerant system becomes restricted and refrigerant pressure continued to rise, the high pressure relief will pop open and release refrigerant from the system.

Compressed refrigerant enters the condenser in a high temperature, high pressure vapor state. As the refrigerant flows through the condenser, the heat of the refrigerant is transferred to the ambient air passing through the condenser. Cooling the refrigerant causes the refrigerant to condense and change from a vapor to a liquid state.

The condenser is located in front of the radiator for maximum heat transfer. The condenser is made of aluminum and aluminum cooling fins, which allows rapid heat transfer for the refrigerant. The semi-cooled liquid refrigerant exits the condenser and flows through the liquid line, to the thermal expansion valve.

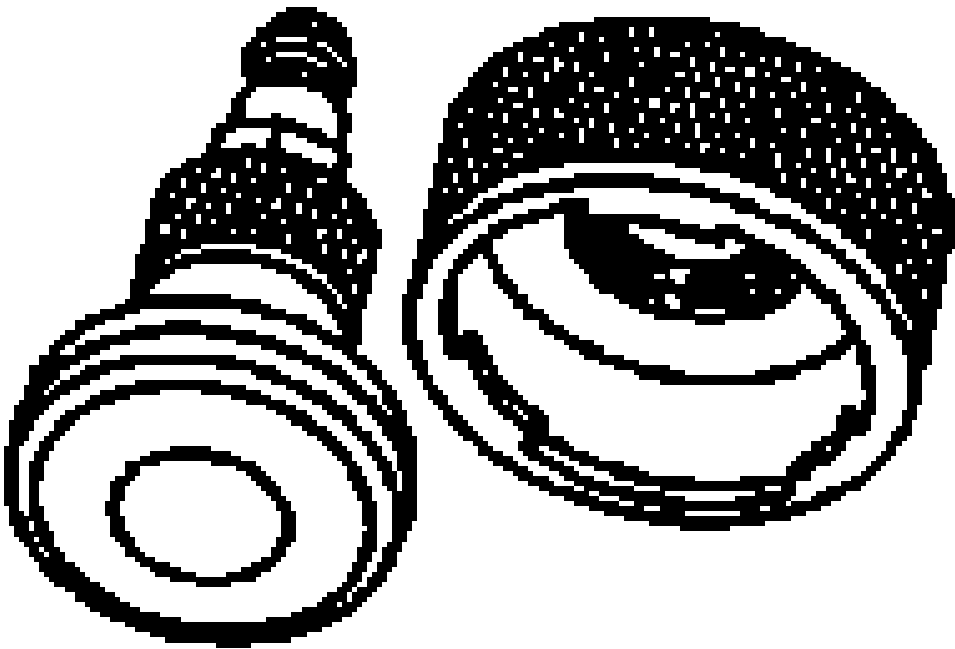
The thermal expansion valve is located in the liquid line between the condenser and the evaporator. The thermal expansion valve is the dividing point for the high and the low pressure sides of the A/C system. As the refrigerant passes through the thermal expansion valve, the pressure of the refrigerant is lowered. Due to the pressure differential of the liquid refrigerant, the refrigerant will begin to vaporize at the thermal expansion valve. The thermal expansion valve also meters the amount of liquid refrigerant that can flow into the evaporator.

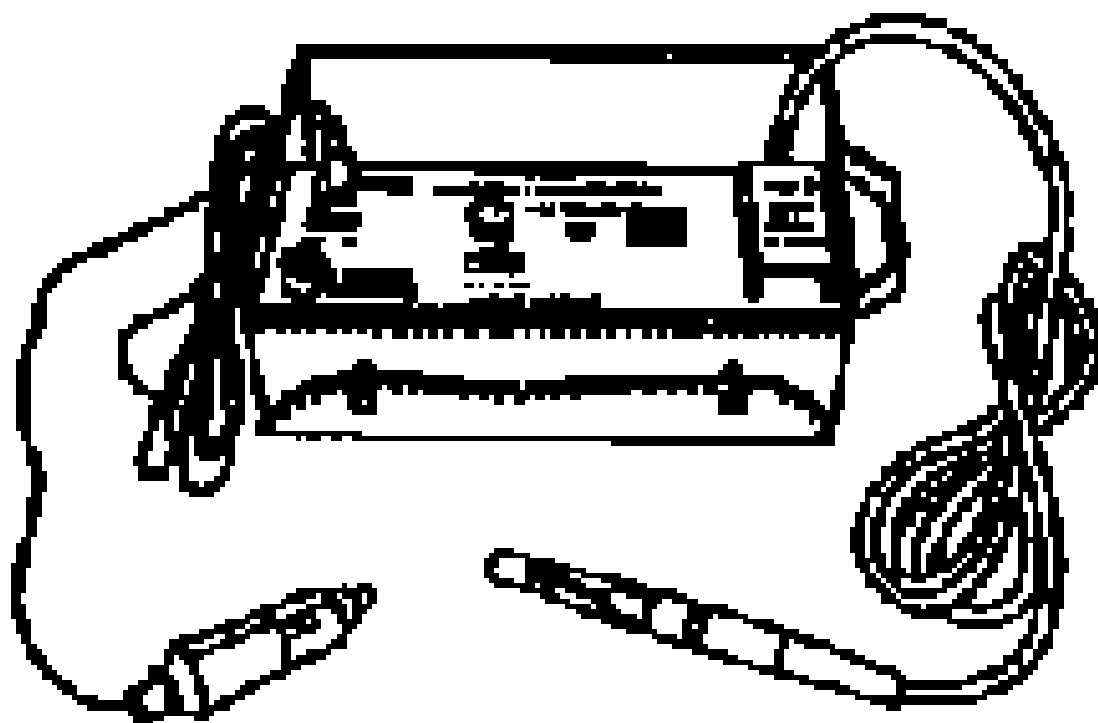
Refrigerant exiting the thermal expansion valve flows into the evaporator core in a low pressure, liquid state. Ambient air is drawn through the HVAC module and passes through the evaporator core. Warm and moist air will cause the liquid refrigerant boil inside of the evaporator core. The boiling refrigerant absorbs heat from the ambient air and draws moisture onto the evaporator. The refrigerant exits the evaporator back through the thermal expansion valve and into the suction line and back to the compressor, in a vapor state completing the A/C cycle of heat removal. At the compressor, the refrigerant is compressed again and the cycle of heat removal is repeated.

The conditioned air is distributed through the HVAC module for passenger comfort. The heat and moisture removed from the passenger compartment will also change form, or condense, and is discharged from the HVAC module as water under the vehicle.

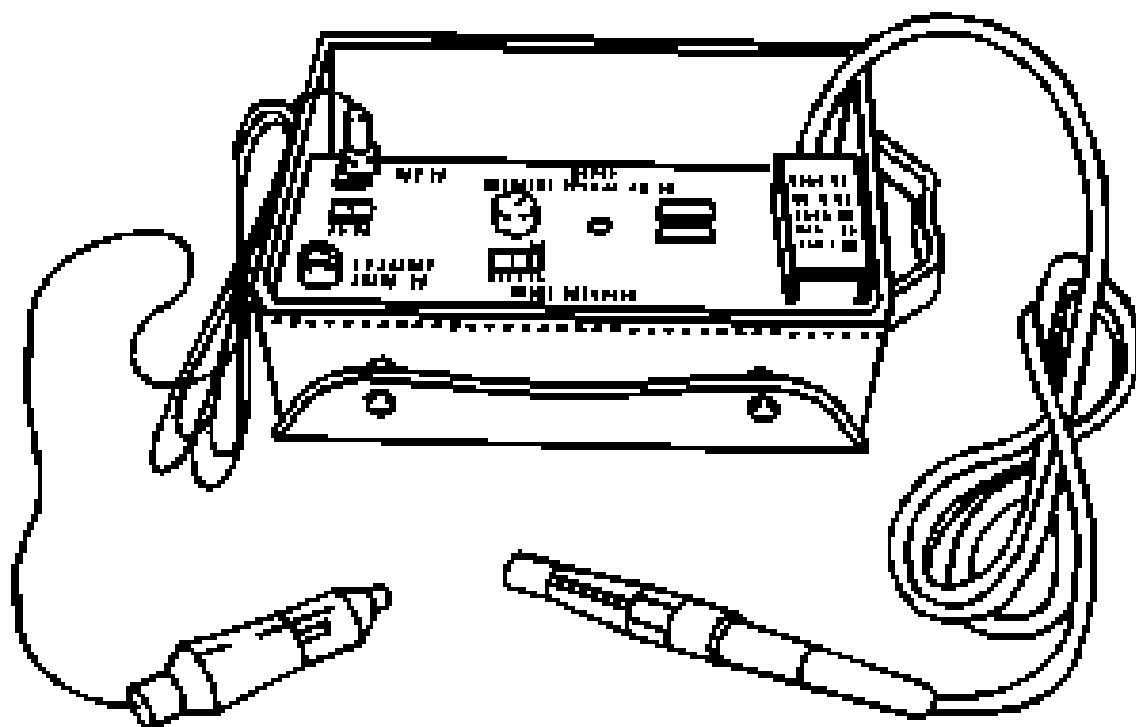
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

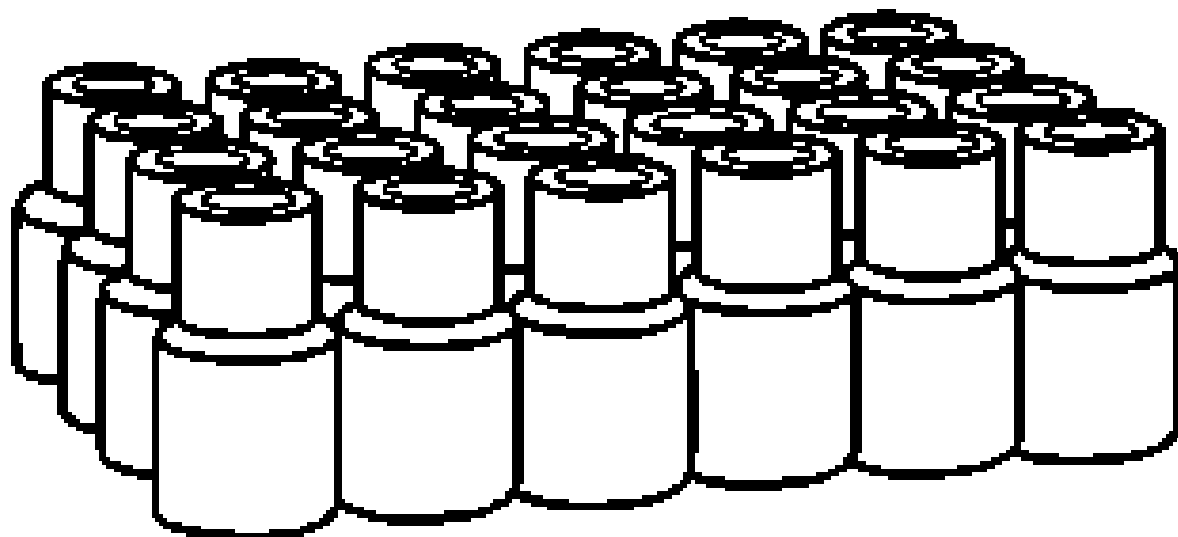
Illustration	Tool Number/ Description
	CH-50198 J-25030-A J-37872 GE-48965 Clutch Plate Holder



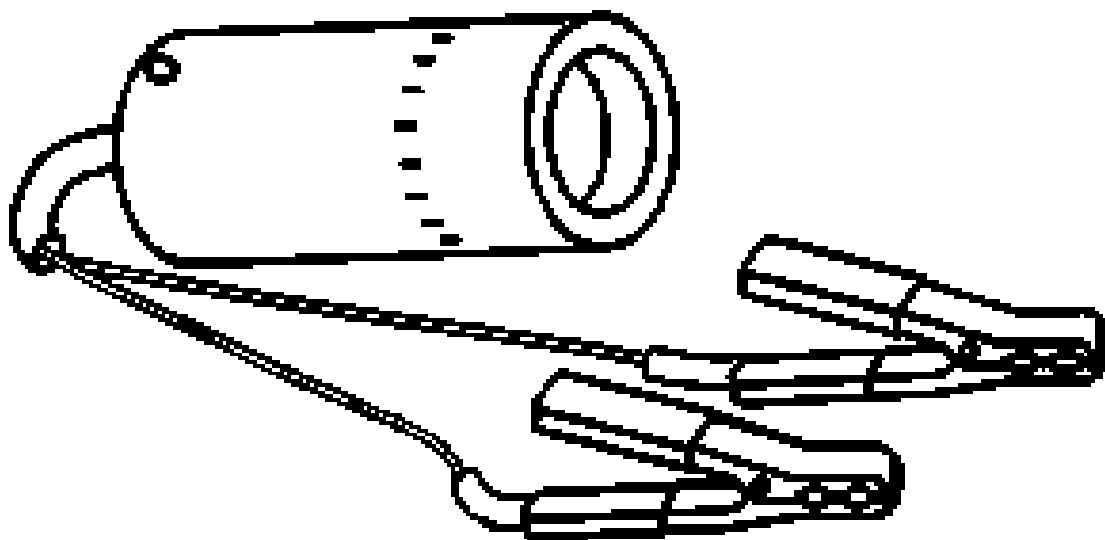
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GE-39400
Electronic
Halogen
Leak
Detector



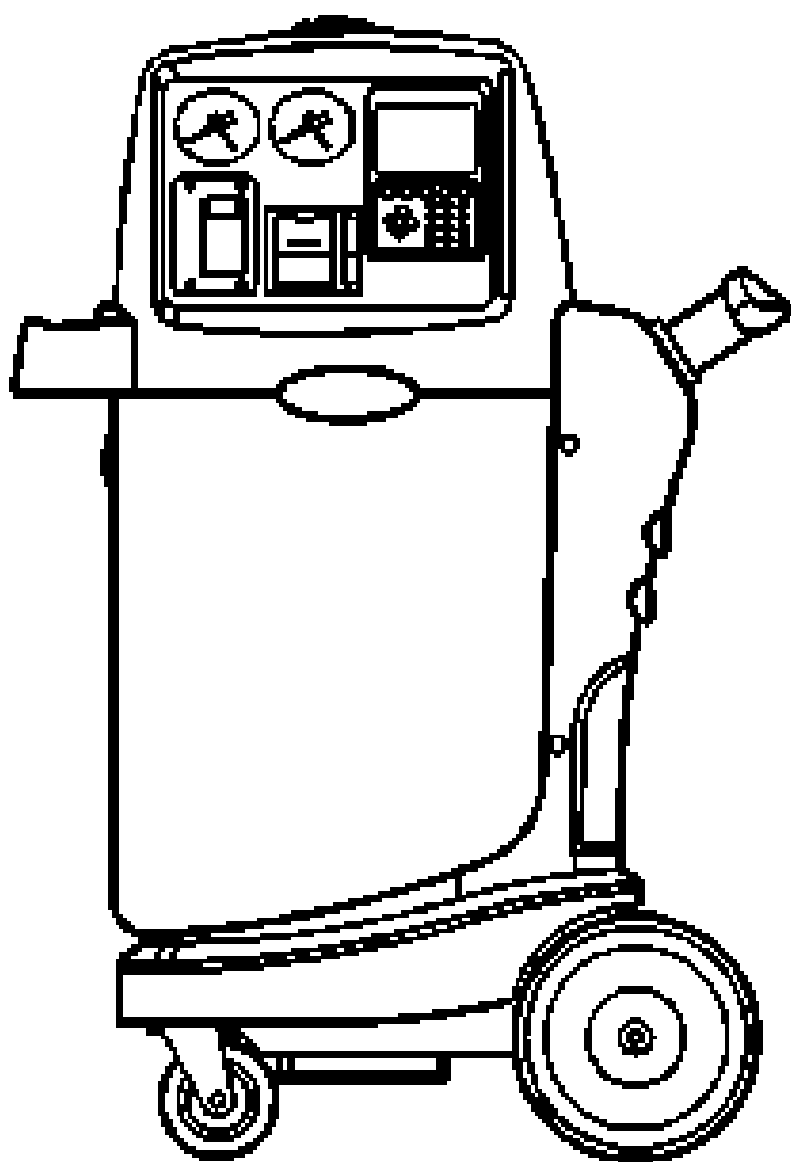
J-39400-A
GE-39400-A
Halogen
Leak
Detector



J-41447
GE-41447
R-134A A/C
Tracer Dye-
Box of 24



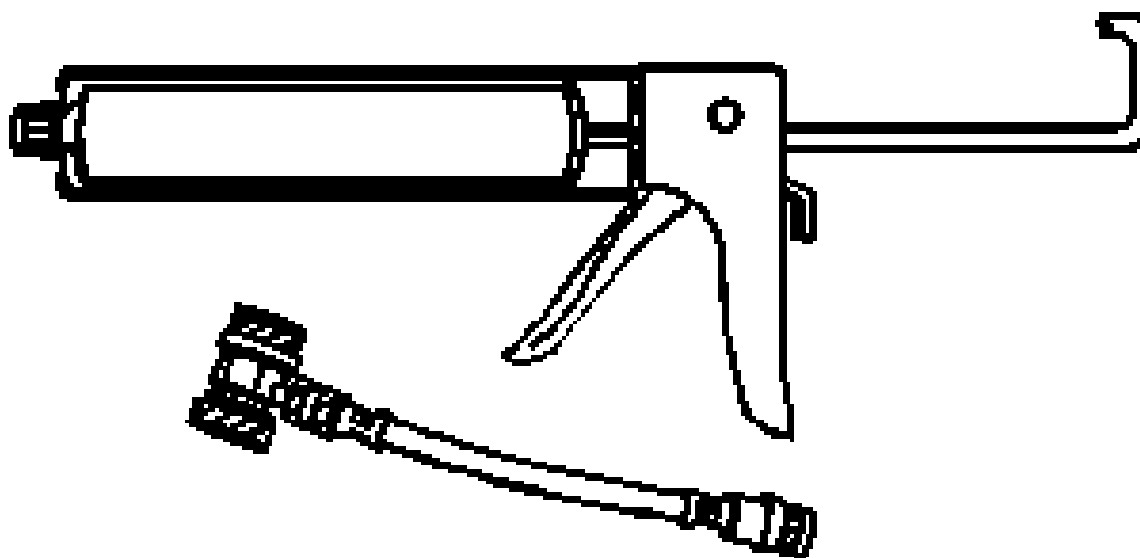
J-42220
BO-42220
Universal
12V Leak
Detection
Lamp



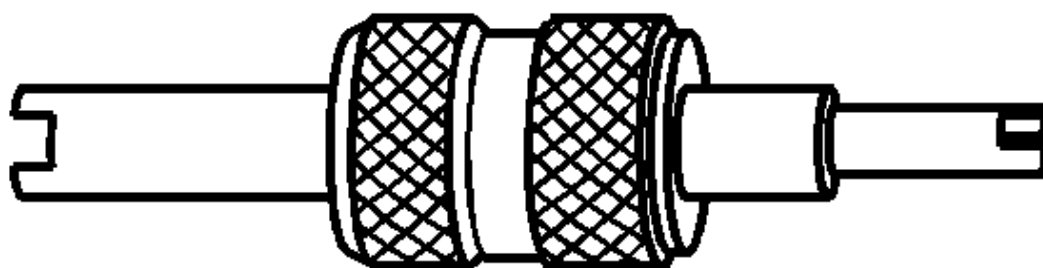
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ACR 2000
Air
Conditioning
Service
Center



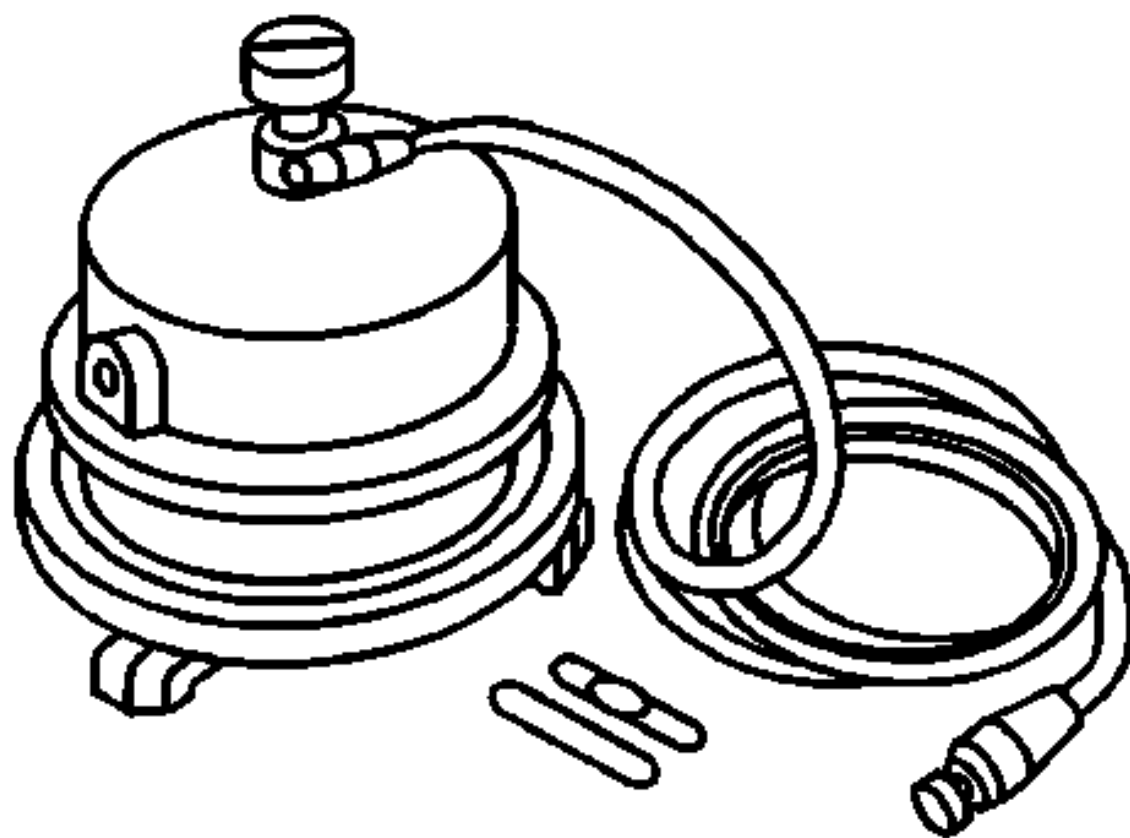
J-43872
GE-43872
Florescent
Dye Cleaner



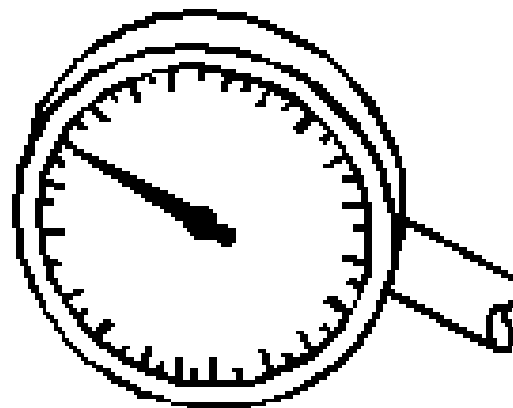
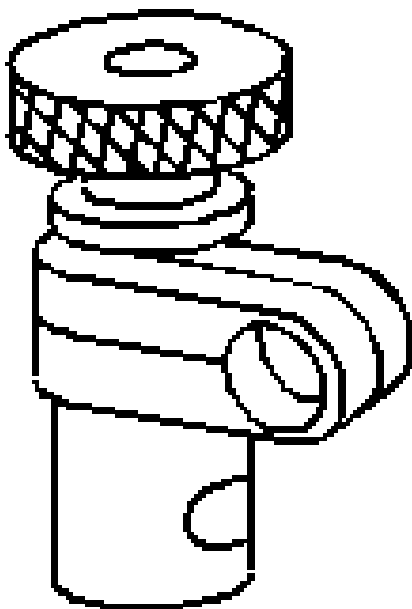
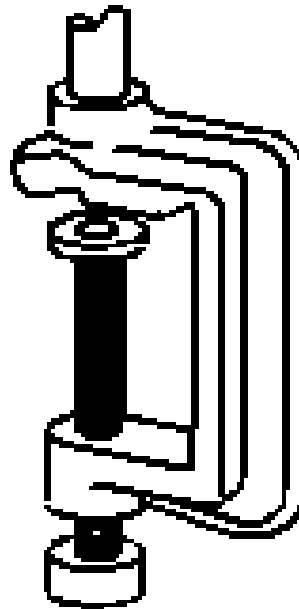
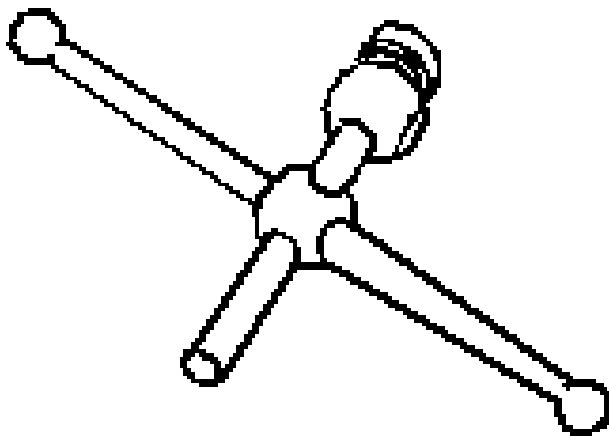
J-45037
GE-45037-A
A/C Oil
Injector



J-46246
GE-46246
Valve Core
Tool



J-46297
GE-46297
A/C Dye
Injector Kit



J-46297-12
GE-46297-
12
Replacement
Dye
Cartridges

ACCESSORIES & EQUIPMENT

Horns - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Horn Bolt	21 N.m	16 lb ft
Steering Wheel Horn Contact Bolt	5.5 N.m	49 lb in

SCHEMATIC WIRING DIAGRAMS

HORN WIRING SCHEMATICS

Horn Wiring Schematics

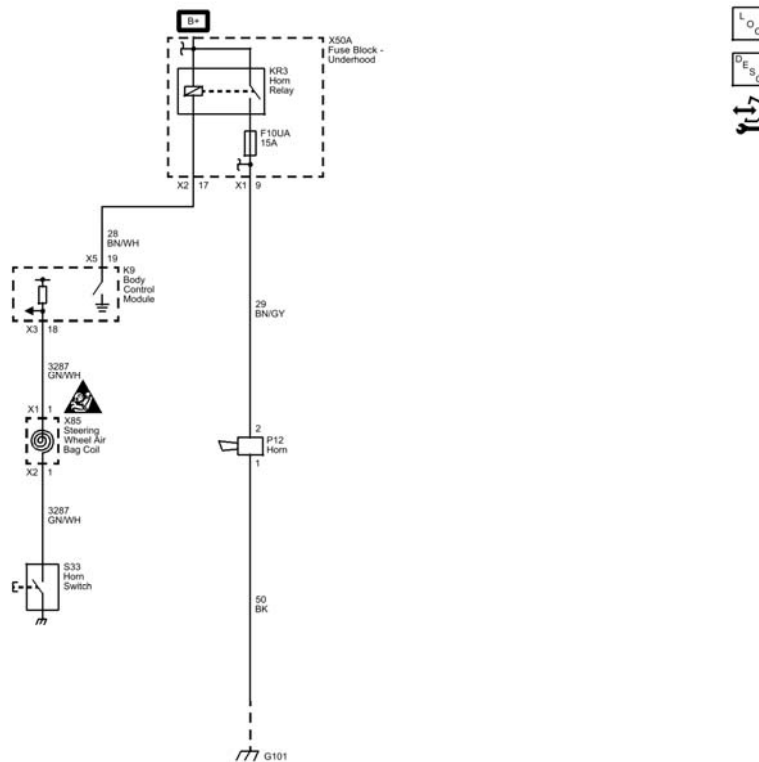


Fig. 1: Horn Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC B2750</u>	DTC B2750 Horn Relay Secondary Circuit

DTC B2750: HORN RELAY

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B2750

Horn Relay Secondary Circuit

For symptom byte information refer to: **Symptom Byte List**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	B2750 02	B2750 04	B2750 01	-

Circuit/System Description

The Body Control Module provides a ground for the Horn printed circuit board relay within the underhood fuse block. The underhood fuse block will then provide B+ voltage to the horn control circuit, sounding the horn.

Conditions for Running the DTC

When the horn output is actively being requested by the Body Control Module.

Conditions for Setting the DTC

B2750 01

The Body Control Module detects a short to voltage in the horn relay control circuit.

B2750 02

The Body Control Module detects a short to ground in the horn relay control circuit.

B2750 04

The Body Control Module detects an open/high resistance in the horn relay control circuit.

Action Taken When the DTC Sets

The Body Control Module will command the horn when requested but the horn will be inoperative.

Conditions for Clearing the DTC

- The DTC clears when the fault is no longer detected.
- The current DTC will become history when the request for the output is removed.
- The history DTC will clear after 50 consecutive fault-free ignition cycles have occurred.

Reference Information

Schematic Reference

Horn Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Horns System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the operation of the P12 Horn when commanding the Horn Relay On and Off with a scan tool.
 - **If the P12 Horn is always ON or always OFF**

Refer to Circuit/System Testing.

- **If the P12 Horn turns ON and OFF**

3. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the X1 harness connector at the X50A Fuse Block-Underhood, ignition ON.
2. Verify the P12 Horn is not activated.
 - **If the P12 Horn is activated**
 1. Ignition OFF, disconnect the harness connector at the P12 Horn, ignition ON.
 2. Test for less than 1 V between the control circuit terminal 2 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, test or replace the P12 Horn.
 - **If the P12 Horn is not activated**
3. Connect a 15A fused jumper wire between the control circuit terminal 9 and B+.
4. Verify the P12 Horn activates.
 - **If the P12 Horn does not activate**
 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the P12 Horn, ignition ON.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than Infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the P12 Horn.
 - **If the P12 Horn activates**
5. Ignition OFF, connect the X1 harness connector at the X50A Fuse Block-Underhood. Disconnect the X5 harness connector at the K9 Body Control Module, ignition ON.
6. Verify the P12 Horn is not activated.
 - **If the P12 Horn is activated**
 1. Ignition OFF, disconnect the X2 harness connector at the X50A Fuse Block-Underhood.
 2. Test for infinite resistance between the control circuit terminal 19 X5 at the K9 Body Control Module and ground.
 - If less than Infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, test or replace the X50A Fuse Block-Underhood.
 - **If the P12 Horn is not activated**
7. Connect a 3 A fused jumper wire between the control circuit terminal 19 and ground.
8. Verify the P12 Horn activates.
 - **If the P12 Horn does not activate**

1. Ignition OFF, remove the jumper wire, disconnect the X2 harness connector at the X50A Fuse Block-Underhood, ignition ON.
2. Test for less than 1 V between the control circuit terminal 19 X5 at the K9 Body Control Module and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the X50A Fuse Block-Underhood.
 - **If the P12 Horn activates**
9. Replace the K9 Body Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Fuse Block Replacement**
- **Control Module References** for Body Control Module replacement, programming and setup

SYMPTOMS - HORNS

IMPORTANT: The following steps must be completed before using the symptom tables:

1. Perform **Diagnostic System Check - Vehicle** , before using the symptom tables in order to verify that all of the following are true:
 - There are no DTCs set
 - The control modules can communicate via the serial data link
2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Horns System Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the horn system. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Perform the following if a horn buzzes or has a harsh tone.
 - Inspect for debris in the joint where the horn fastens to the vehicle.
 - Test the torque of the horn mounting hardware. The horn mounting hardware should be tightened to a torque of 10 N.m (7 lb ft).

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure **Horns Malfunction** in order to diagnose the symptom.

HORNS MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Horn Switch Signal	1	2	2	-
Horn Relay Control	B2750 02	B2750 04	B2750 01	-
Horn Control	2	2	1	-
Horn Ground	-	2	-	-
1. Horn Always On 2. Horn Inoperative				

Circuit/System Description

The body control module monitors the horn switch signal circuit, when the horn pad is pressed, the BCM detects the drop in the horn switch signal circuit and provides a ground for the horn PCB relay within the underhood fuse block. The underhood fuse block will then provide B+ voltage to the horn control circuit, sounding the horns

Diagnostic Aids

A short to ground in the horn relay control circuit or a short to voltage in the horn control circuit will cause the horns to sound continuously until the horns overheat and become inoperative.

Rotate the steering wheel while pressing the horn pad to identify intermittent and poor connections within the steering column.

If diagnosing a Horn- Poor Tone condition, inspect the following:

- Debris or water in the horn assembly
- Proper horn mounting hardware torque-Refer to **Fastener Tightening Specifications**.
- Debris in the joint where the horns attach to the vehicle

- Debris in direct contact with the horn
- Vehicle components vibrating while the horn is sounding

Reference Information

Schematic Reference

Horn Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Horns System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Horn Switch parameter changes between Active and Inactive when pressing and releasing the horn pad.
 - **If the parameter does not change**

Refer to Circuit/System Testing - Horn Switch Malfunction.
 - **If the parameter changes**
3. Verify the P12 Horn turns ON and OFF and emit a clear and even tone when commanding the Horn Relay On and Off with a scan tool.
 - **If the P12 Horn does not turn ON and OFF**

Refer to Circuit/System Testing - Horns or Horn Command Malfunction.
 - **If the sound emitted is not clear and even**

Refer to Circuit/System Testing - Horn - Poor Tone.

- If the P12 Horn turns ON and OFF and emit a even and clear tone

4. All OK.

Circuit/System Testing

Horn Switch Malfunction

NOTE: Refer to SIR Service Precautions .

1. Ignition OFF, disconnect the X1 harness connector at the X85 Steering Wheel Air Bag Coil. Ignition ON
2. Verify the scan tool Horn Switch parameter is Inactive.
 - **If not Inactive**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If Inactive**
3. Install a 3 A fused jumper wire between the signal circuit terminal 1 and ground.
4. Verify the scan tool Horn Switch parameter is Active.
 - **If not Active**
 1. Ignition OFF, remove the 3 A fused jumper wire, disconnect the harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If Active**
5. Test or replace the S33 Horn Switch.

Horns or Horn Command Malfunction

1. Ignition OFF and all vehicle systems OFF. Disconnect the harness connector at the P12 Horn. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 1 ohms between the ground circuit terminal 1 and ground.
 - **If 1 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.
- If less than 2 ohms, repair the open/high resistance in the ground connection.

- **If less than 1 ohms**

3. Connect a test lamp between the control circuit terminal 2 and ground, Ignition ON.
4. Verify the test lamp does not turn ON and OFF when commanding the Horn Relay On and Off with a scan tool.
 - **If the test lamp turns ON and OFF**

Test or replace the P12 Horn.

- **If the test lamp does not turn ON and OFF**

5. Ignition OFF, connect the harness connector at the P12 Horn. Disconnect the X1 harness connector at the X50A Fuse Block-Underhood, Ignition ON.
6. Verify the P12 Horn is not activated.

- **If the P12 Horn is activated**

1. Ignition OFF, disconnect the harness connector at the P12 Horn, Ignition ON.
2. Test for less than 1 V between the control circuit terminal 2 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, test or replace the P12 Horn.

- **If the P12 Horn is not activated**

7. Connect a 15 A fused jumper wire between the control circuit terminal 9 and B+.
8. Verify the P12 Horn activates.

- **If the P12 Horn does not activate**

1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the P12 Horn, Ignition ON.
2. Test for infinite resistance between the control circuit and ground.
 - If less than Infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the P12 Horn.

- **If the P12 Horn activates**

9. Ignition OFF, connect the X1 harness connector at the X50A Fuse Block-Underhood. Disconnect the X5 harness connector at the K9 Body Control Module, Ignition ON.
10. Verify the P12 Horn is not activated.
 - **If the P12 Horn is activated**
 1. Ignition OFF, disconnect the X2 harness connector at the X50A Fuse Block-Underhood.
 2. Test for infinite resistance between the K9 Body Control Module control circuit terminal 19 X5 and ground.

- If less than Infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the X50A Fuse Block-Underhood.
- **If the P12 Horn is not activated**
- 11. Connect a 3 A fused jumper wire between the control circuit terminal 19 and ground.
- 12. Verify the P12 Horn activates.
 - **If the P12 Horn does not activate**
 1. Ignition OFF, remove the jumper wire, disconnect the X2 harness connector at the X50A Fuse Block-Underhood, Ignition ON.
 2. Test for less than 1 V between the K9 Body Control Module control circuit terminal 19 X5 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the X50A Fuse Block-Underhood.
 - **If the P12 Horn activates**
- 13. Replace the K9 Body Control Module.

Horn - Poor Tone

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the P12 Horn. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 1 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the high resistance in the circuit.
 - If less than 2 ohms, repair high resistance in the ground connection.
 - **If less than 10 ohms**
3. Ignition OFF, disconnect the X1 harness connector at the X50A Fuse Block-Underhood.
4. Test for less than 2 ohms between the P12 Horn control circuit terminal 2 and the X50A Fuse Block-Underhood control circuit terminal 9 X1.
 - **If 2 ohms or greater**

Repair the high resistance in the control circuit.
 - **If less than 2 ohms**
5. Test or replace the P12 Horn.

Component Testing

Horn Test

1. Ignition OFF, disconnect the harness connector at the P12 Horn.
2. Install a 15 A fused jumper wire between the control terminal 2 and 12 V. Install a jumper wire between the ground terminal 1 and ground.
3. Verify the P12 Horn turns ON and OFF
 - **If the P12 Horn does not turn ON and OFF**

Replace the P12 Horn.

- **If the P12 Horn turns ON and OFF**
4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Fuse Block Replacement**
- **Horn Replacement**
- **Steering Wheel Horn Contact Replacement**
- **Control Module References** for body control module replacement, programming and setup

REPAIR INSTRUCTIONS

HORN REPLACEMENT

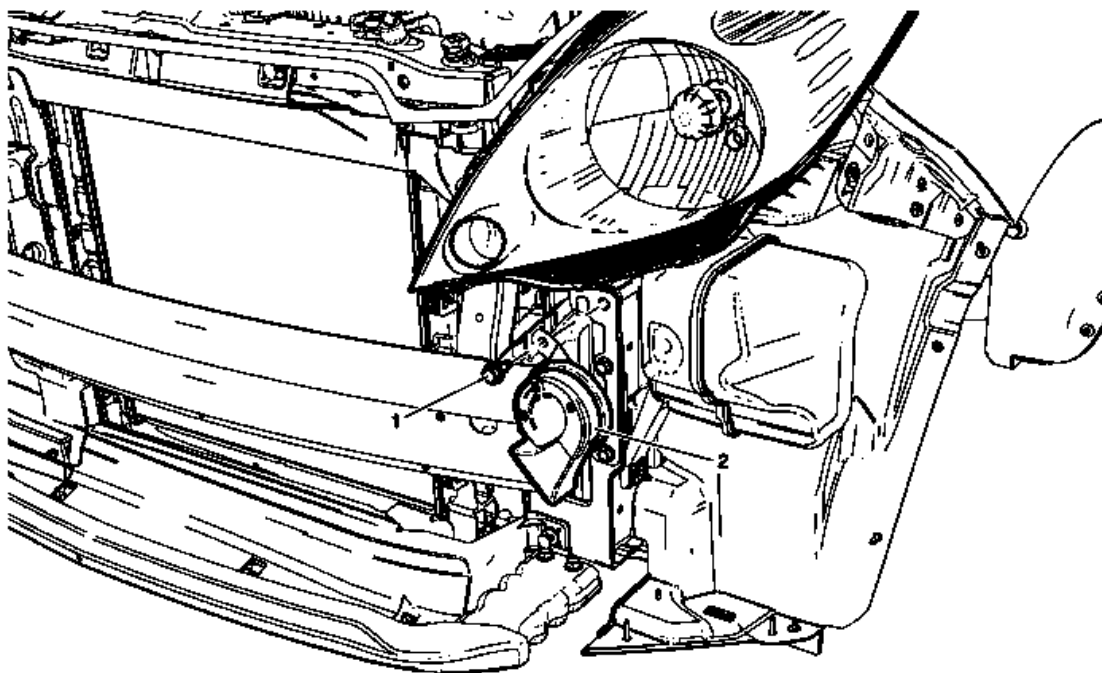


Fig. 2: Horn Bolt

Courtesy of GENERAL MOTORS COMPANY

Horn Replacement

Callout	Component Name
Preliminary Procedure 1. Remove the tire and wheel. Refer to <u>Tire and Wheel Removal and Installation</u> . 2. Remove the front wheel house liner. Refer to <u>Front Wheelhouse Liner Replacement</u> . 3. Remove the air cleaner resonator assembly. Refer to <u>Air Cleaner Resonator Replacement</u> .	
1	Horn Bolt (Qty: 1) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 21 N.m (16 lb ft)
2	Horn TIP: Disconnect electrical connectors.

STEERING WHEEL HORN CONTACT REPLACEMENT

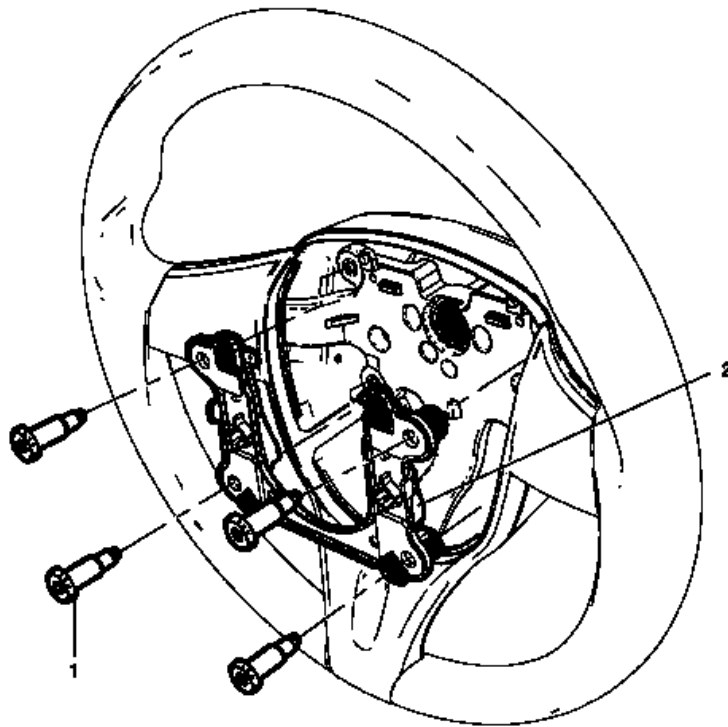


Fig. 3: Steering Wheel Horn Contact
 Courtesy of GENERAL MOTORS COMPANY

Steering Wheel Horn Contact Replacement

Callout	Component Name
Preliminary Procedure Remove inflatable restraint steering wheel module. Refer to <u>Airbag Steering Wheel Module Replacement</u> .	
1	Steering Wheel Horn Contact Bolt (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 5.5 N.m (49 lb in)
2	Steering Wheel Horn Contact TIP: Disconnect the electrical connector.

DESCRIPTION AND OPERATION

HORNS SYSTEM DESCRIPTION AND OPERATION

System Description

The horn system consists of the following components:

- HORN fuse
- Underhood fuse block (contains PCB horn relay)
- Horn switch
- Horn
- Body control module (BCM)

14 Horns Block Diagram

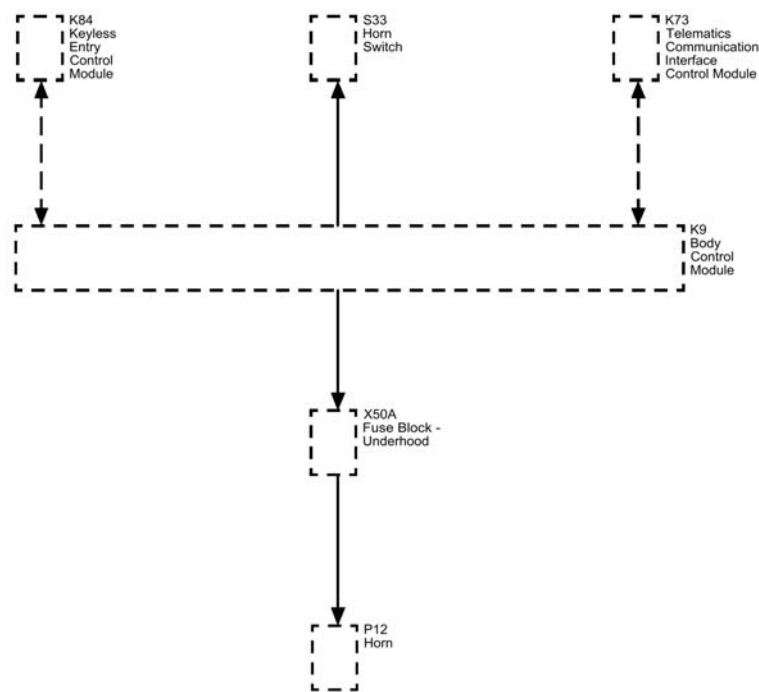


Fig. 4: Horns System Description
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
HW	Hard-Wired
DA	Serial Data
DA	Serial Data
HW	Hard-Wired
HW	Hard-Wired
K84	K84 Keyless Entry Control Module
S33	S33 Horn Switch
K73	K73 Telematics Communication Interface Control Module
K9	K9 Body Control Module

X50A	X50A Fuse Block - Underhood
P12	P12 Horn

System Operation

The vehicle horn system is activated under the following conditions:

- When the horn switch is depressed
- The BCM commands the horns ON under any of the following conditions:
 - When the content theft deterrent system detects a vehicle intrusion-For further information refer to **Theft Systems Description and Operation** .
 - When the panic button is depressed on the remote control door lock transmitter-For further information refer to **Keyless Entry System Description and Operation** .
 - When the keyless entry system is used to lock the vehicle, a horn chirp may sound to notify the driver that the vehicle has been locked. The notification feature may be enabled or disabled through personalization. For further information refer to **Keyless Entry System Description and Operation** .

When the OnStar® system is used to sound the horns if equipped-For further information, refer to **OnStar Description and Operation** .

Circuit Operation

Battery positive voltage is applied at all times to the horn relay coil and the horn relay switch. Pressing either of the horn switches applies ground to the horn relay control circuit. The BCM may also apply ground to the horn relay control circuit as described above. When the horn relay control circuit is grounded, the horn relay is energized and battery positive voltage is applied to the horns through the horn control circuit. The horns sound as long as ground is applied to the horn relay control circuit.

HVAC

HVAC - Manual - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Air Inlet Valve Link Screw	1.2 N.m	11 lb in
Heater and Air Conditioning Control Screws	2.5 N.m	23 lb in
Mode Valve Link Screw	1.2 N.m	11 lb in
Temperature Valve Link Screw	1.2 N.m	11 lb in

SCHEMATIC WIRING DIAGRAMS

HVAC WIRING SCHEMATICS

Power, Ground, and Air Inlet Actuator Wiring Schematics

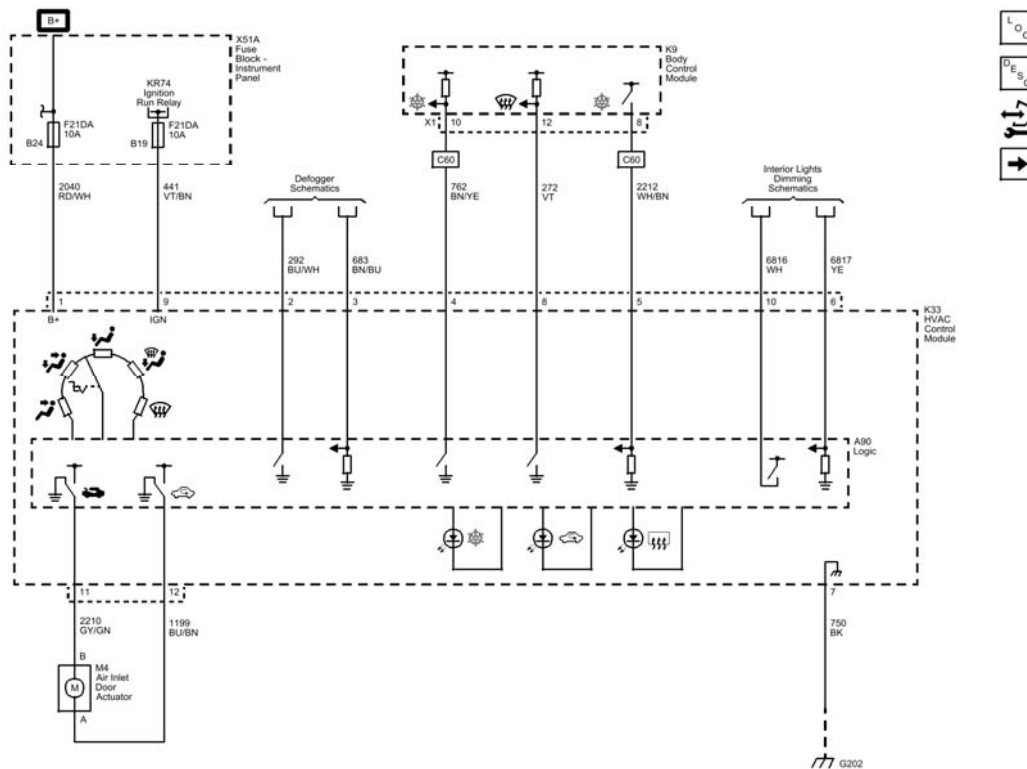


Fig. 1: Power, Ground, and Air Inlet Actuator Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

Blower Controls Wiring Schematics

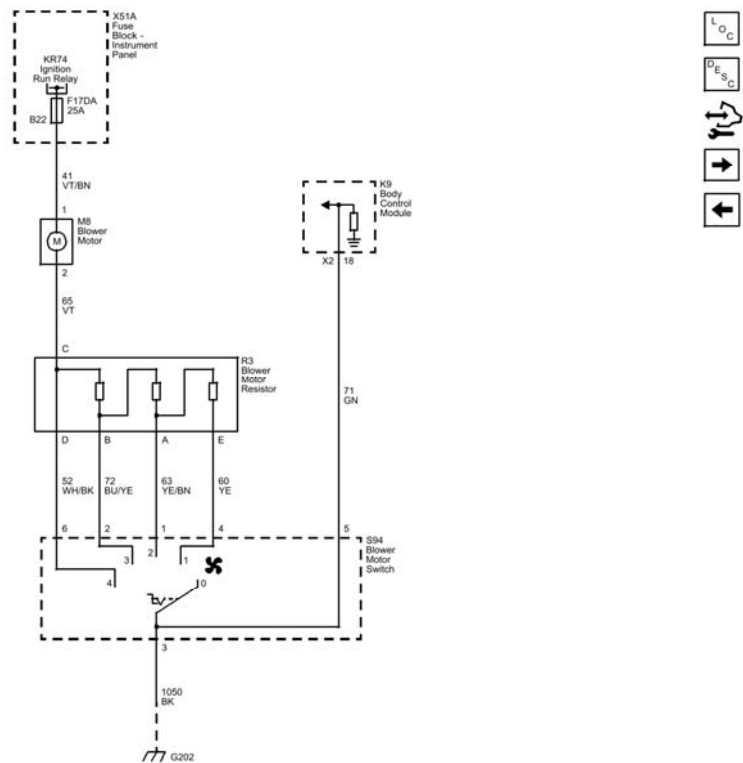


Fig. 2: Blower Controls Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

Compressor Controls (C60) Wiring Schematics

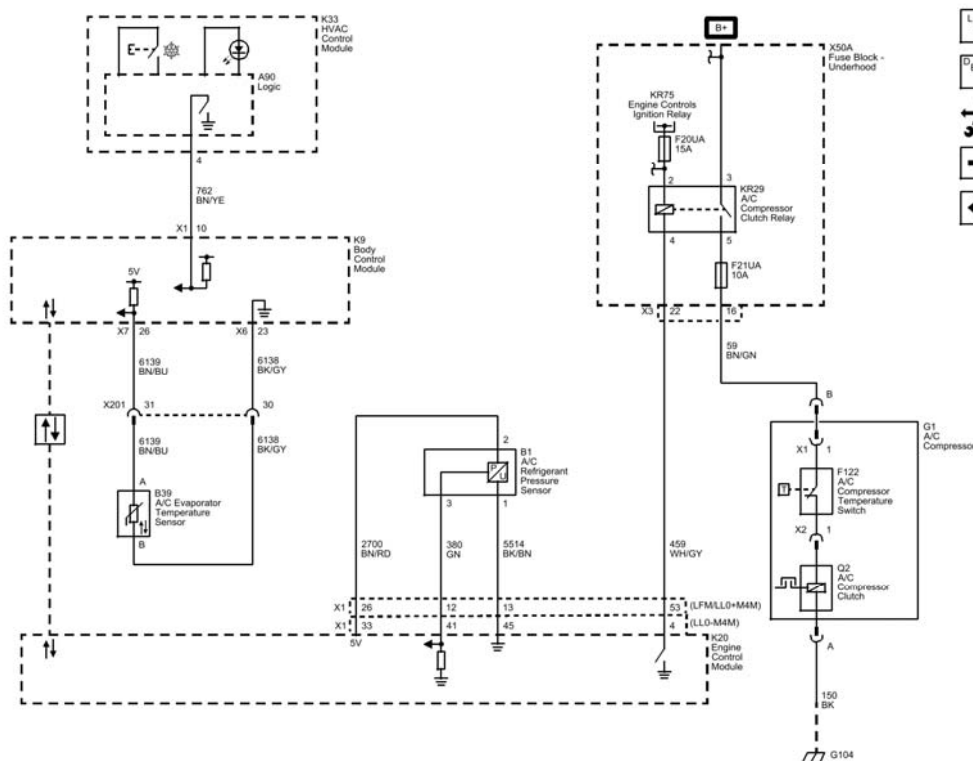


Fig. 3: Compressor Controls (C60) Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

HVAC COMPONENT REPLACEMENT REFERENCE

HVAC Component Replacement Reference

Scan Tool Name	Component Code / Schematic Name	Service Name	Repair Instruction Name
Air Inlet Door Actuator	M4 Air Inlet Door Actuator	Air Inlet Door Actuator	<u>Air Inlet Valve Actuator Replacement</u>
Evaporator Temperature	B39 A/C Evaporator Temperature Sensor	Evaporator Air Temperature Sensor	<u>Evaporator Air Temperature Sensor Replacement</u>
A/C High Side Pressure	B1 A/C Refrigerant Pressure Sensor	A/C Refrigerant Pressure Sensor	<u>Air Conditioning (A/C) Refrigerant Pressure Sensor Replacement (1.2L LL0, 1.0L LFM)</u>
Blower Motor	M8 Blower Motor	Blower Motor	<u>Blower Motor Replacement</u>
A/C Compressor Clutch	Q2 A/C Compressor	A/C Compressor Clutch	<u>Air Conditioning Clutch Replacement (1.2L LL0,</u>

	Clutch		<u>1.0L LFM)</u>
Blower Motor Switch	S94 Blower Motor Switch	Blower Motor Switch	<u>Heater and Air Conditioning Control Replacement (Left Hand Drive), Heater and Air Conditioning Control Replacement (Right Hand Drive)</u>
Blower Motor Resistor	R3 Blower Motor Resistor	Blower Motor Resistor	<u>Blower Motor Resistor Replacement (Left Hand Drive)</u>
Remote Heater and Air Conditioning Control Module	K33 HVAC Control Module	Heater and Air Conditioning Control	<u>Heater and Air Conditioning Control Replacement (Left Hand Drive), Heater and Air Conditioning Control Replacement (Right Hand Drive)</u>

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC B3933</u>	DTC B3933 02 Air Conditioning Evaporator Temperature Sensor Circuit Short to Ground DTC B3933 05 Air Conditioning Evaporator Temperature Sensor Circuit High Voltage/Open
<u>DTC B393D</u>	DTC B393D 02 Air Conditioning Indicator Circuit Short To Ground
<u>DTC P0532 or P0533</u>	DTC P0532 Air Conditioning (A/C) Refrigerant Pressure Sensor Circuit Low Voltage DTC P0533 Air Conditioning (A/C) Refrigerant Pressure Sensor Circuit High Voltage
<u>DTC P0645, P0646, or P0647</u>	DTC P0645 Air Conditioning (A/C) Compressor Clutch Relay Control Circuit DTC P0646 Air Conditioning (A/C) Compressor Clutch Relay Control Circuit Low Voltage DTC P0647 Air Conditioning (A/C) Compressor Clutch Relay Control Circuit High Voltage

DTC B3933: EVAPORATOR TEMPERATURE SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.

- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B3933 02

Air Conditioning Evaporator Temperature Sensor Circuit Short to Ground

DTC B3933 05

Air Conditioning Evaporator Temperature Sensor Circuit High Voltage/Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	B3933 02, 2	B3933 05, 1	B3933 05, 1	-
Low Reference	-	B3933 05, 1	-	-
1. The A/C compressor does not turn ON. 2. The A/C compressor is always ON, does not cycle ON and OFF.				

Circuit/System Description

The temperature sensor is a 2-wire negative temperature coefficient thermistor. The body control module provides a signal circuit and low reference circuit to the sensor. As the air temperature surrounding the sensor increases, the sensor resistance decreases. The sensor signal voltage decreases as the resistance decreases. The sensor operates within a temperature range between -40 to 85°C (-40 to 185°F).

Conditions for Running the DTC

- Ignition ON.
- The HVAC control module is ON.

Conditions for Setting the DTC

The body control module detects the sensor signal voltage is less than 0.1 V or greater than 4.9 V for more than 50 ms.

Action Taken When the DTC Sets

The A/C compressor is disabled if the last test is not passed.

Conditions for Clearing the DTC

The sensor signal is within specified range between 0.1-4.9 V.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Manual HVAC Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool A/C Evaporator Temperature Sensor parameter is within 5°C (9°F) of ambient temperature
 - **If not within 5°C (9°F) of ambient temperature**

Refer to Circuit/System Testing.
 - **If within 5°C (9°F) of ambient temperature**
3. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B39 A/C Evaporator Temperature Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 ohms between the low reference circuit terminal B and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, replace the K9 Body Control Module.
 - **If less than 10 ohms**
- 3. Ignition ON.
- 4. Verify the scan tool BCM A/C Evaporator Temperature Sensor parameter is greater than 4.9 V.
 - **If 4.9 V or less**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal A and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If greater than 4.9 V**
- 5. Install a 3 A fused jumper wire between the signal circuit terminal A and the low reference circuit terminal B.
- 6. Verify the scan tool A/C Evaporator Temperature Sensor is less than 0.1 V.
 - **If 0.1 V or greater**
 1. Ignition OFF, remove the jumper wire and disconnect the harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Ignition OFF.
 4. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If less than 0.1 V**
- 7. Test or replace the B39 A/C Evaporator Temperature Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **HVAC Component Replacement Reference**
- **Control Module References** for K9 Body Control Module replacement, programming and setup

DTC B393D: AIR CONDITIONING INDICATOR CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B393D 02

Air Conditioning Indicator Circuit Short To Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	B393D 02	1	2	-
1. A/C Indicator always OFF 2. A/C Indicator always ON				

Circuit/System Description

When the body control module receives a command to activate the air conditioning system, it applies B+ to the A/C indicator control circuit causing the indicator to illuminate.

Conditions for Running the DTC

- Ignition ON
- A/C system ON

Conditions for Setting the DTC

The body control module detects a short to ground on the A/C indicator control circuit.

Action Taken When the DTC Sets

The air conditioning ON indicator will be inoperative

Conditions for Clearing the DTC

- When the fault is no longer present, the DTC will be a history DTC.
- The history DTC will clear after 50 fault-free ignition cycles occurred.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

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Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the air conditioning indicator turns ON and OFF when commanding the BCM A/C Indicator On and Off with a scan tool.
 - **If the air conditioning indicator does not turn ON or OFF**

Refer to Circuit/System Testing

- **If the air conditioning indicator turns ON and OFF**
3. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the X1 harness connector at the K33 HVAC Control Module, ignition ON.
2. Connect a test lamp between the control circuit terminal 5 and ground.
3. Verify the test lamp turns ON and OFF when commanding the A/C Indicator On and Off with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, remove the test lamp and disconnect the X1 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Ignition OFF, remove the test lamp and disconnect the X1 harness connector at the K9 Body

Control Module, ignition ON.

2. Test for less than 1 V between the control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K9 Body Control Module.

○ **If the test lamp turns ON and OFF**

4. Replace the K33 HVAC Control Module.

5. Ignition ON.

6. Verify the air conditioning indicator turns ON and OFF when commanding the BCM A/C Indicator On and Off with a scan tool.

○ **If the air conditioning indicator does not turn ON or OFF**

Replace the K9 Body Control Module.

○ **If the air conditioning indicator turns ON and OFF**

7. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for K33 HVAC Control Module and K9 Body Control Module replacement, programming and setup

DTC P0532 OR P0533: AIR CONDITIONING (A/C) REFRIGERANT PRESSURE SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of the diagnostic category.

DTC Descriptors

DTC P0532

Air Conditioning (A/C) Refrigerant Pressure Sensor Circuit Low Voltage

DTC P0533

Air Conditioning (A/C) Refrigerant Pressure Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
---------	-----------------	----------------------	------------------	--------------------

5 V Reference	P0532, P0641	P0532	P0533	-
Signal	P0532	P0532	P0533	-
Low Reference	-	P0533	-	-

Circuit/System Description

The engine control module (ECM) monitors the high side refrigerant pressure through the A/C refrigerant pressure sensor. The ECM supplies a 5 V reference and a low reference to the sensor. Changes in the A/C refrigerant pressure cause the sensor signal to the ECM to vary. When the pressure is high, the signal voltage is high. When the pressure is low, the signal voltage is low. The ECM may use this information to turn the cooling fans on as well as to monitor clutch engagement. The HVAC module will receive the A/C refrigerant pressure information from the ECM via serial data.

Conditions for Running the DTC

- Engine is running.
- Any of the conditions for setting the DTC are met for 15 s.
- Battery voltage is between 11-18 V.

Conditions for Setting the DTC

P0532

The ECM detects that the A/C pressure is less than 1 psi (0.25 V).

P0533

The ECM detects that the A/C pressure is more than 428 psi (4.92 V).

Action Taken When the DTC Sets

- The A/C compressor is disabled.
- The ECM will illuminate the malfunction indicator lamp (MIL).

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Diagnostic Aids

A malfunction within the refrigerant system causing high pressure can cause this DTC to set.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON
2. Verify the scan tool ECM A/C High Side Pressure Sensor parameter is between 6.8 kPa (1 psi) and 2950 kPa (428 psi).
 - **If not between 6.8 kPa (1 psi) and 2950 kPa (428 psi)**

Refer to Circuit/System Testing

- **If between 6.8 kPa (1 psi) and 2950 kPa (428 psi)**
3. All OK

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B1 A/C Refrigerant Pressure Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 ohms between the low reference circuit terminal 1 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, replace the K20 Engine Control Module.
 - **If less than 10 ohms**
- 3. Ignition ON.
- 4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 2 and ground.
 - **If less than 4.8 V**
 - 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 - 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 - 3. Test for less than 2 ohms in the 5 V reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If greater than 5.2 V**
 - 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
 - 2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If between 4.8-5.2 V**
- 5. Verify the scan tool ECM A/C High Side Pressure Sensor parameter is less than .25 V.
 - **If .25 V or greater**
 - 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
 - 2. Test for less than 1 V between the signal circuit terminal 3 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If less than .25 V**
- 6. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the 5 V reference circuit terminal 2.
- 7. Verify the scan tool ECM A/C High Side Pressure Sensor parameter is greater than 4.8 V.
 - **If 4.8 V or less**
 - 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module.
 - 2. Test for infinite resistance between the signal circuit terminal 3 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 - 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If greater than 4.8 V**

8. Test or replace the B1 A/C Refrigerant Pressure Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **HVAC Component Replacement Reference**
- **Control Module References** for engine control module replacement, programming and setup

DTC P0645, P0646, OR P0647: AIR CONDITIONING (A/C) COMPRESSOR CLUTCH RELAY

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0645

Air Conditioning (A/C) Compressor Clutch Relay Control Circuit

DTC P0646

Air Conditioning (A/C) Compressor Clutch Relay Control Circuit Low Voltage

DTC P0647

Air Conditioning (A/C) Compressor Clutch Relay Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Relay Coil Ignition	P0645	P0645	-	-
Relay Switch B+	1	1	-	-
Relay Coil Control	P0646	P0645	P0647	-
Relay Switch Control	1	1	1	-
Ground	-	1	-	-
1. A/C Compressor Malfunction				

Circuit/System Description

When the ECM receives an A/C request signal from the body control module via serial data, and system conditions are such that A/C operation is allowed, the ECM will apply ground through the A/C compressor

clutch relay control circuit, energizing the A/C compressor clutch relay. With the relay energized, battery voltage is applied through the control circuit to the A/C compressor clutch assembly, engaging the A/C compressor.

Conditions for Running the DTC

- The ignition voltage is between 11-18 volts.
- The engine speed is greater than 600 RPM.
- An A/C request is made.

Conditions for Setting the DTC

P0645

The ECM detects an open on the A/C compressor clutch relay control circuit.

P0646

The ECM detects a short to ground on the A/C compressor clutch relay control circuit.

P0647

The ECM detects a short to voltage at the A/C compressor clutch relay control circuit.

Action Taken When the DTC Sets

The A/C compressor is inoperative.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

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- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the Q2 A/C Compressor Clutch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 ohms between the Q2 A/C Compressor Clutch ground circuit terminal A and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Connect a test lamp between the control circuit terminal B and ground, ignition ON.
4. Verify the test lamp does not turn ON and OFF when commanding the Q2 A/C Compressor Clutch On and Off with a scan tool.
 - **If the test lamp turns ON and OFF**

Test or replace the Q2 A/C Compressor Clutch.

- **If the test lamp does not turn ON and OFF**
5. Ignition OFF, connect the harness connector at the Q2 A/C Compressor Clutch and disconnect the X3 harness connector at the X50A Fuse Block - Underhood, ignition ON.
 6. Verify the Q2 A/C Compressor Clutch is not activated.
 - **If the Q2 A/C Compressor Clutch is activated**
 1. Ignition OFF, disconnect the harness connector at the Q2 A/C Compressor Clutch, ignition ON.
 2. Test for less than 1 V between the control circuit terminal B and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, test or replace the Q2 A/C Compressor Clutch.
 - **If the Q2 A/C Compressor Clutch is not activated**

7. Connect a 10 A fused jumper wire between the control circuit terminal 16 and B+.
8. Verify the Q2 A/C Compressor Clutch activates.
 - **If the Q2 A/C Compressor Clutch does not activate**
 1. Ignition OFF, remove the jumper wire and disconnect the harness connector at the Q2 A/C Compressor Clutch, ignition ON.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the Q2 A/C Compressor Clutch.
 - **If the Q2 A/C Compressor Clutch activates**
9. Ignition OFF, connect the X3 harness connector at the X50A Fuse Block - Underhood and disconnect the harness connector at the K20 Engine Control Module, ignition ON.
10. Verify the Q2 A/C Compressor Clutch is not activated.
 - **If the Q2 A/C Compressor Clutch is activated**
 1. Ignition OFF, disconnect the X3 harness connector at the X50A Fuse Block - Underhood.
 2. Test for infinite resistance between the X3 X50A Fuse Block - Underhood control circuit terminal 22 and ground.
 - If less than Infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, test or replace the X50A Fuse Block - Underhood.
 - **If the Q2 A/C Compressor Clutch is not activated**
11. Connect a 3 A fused jumper wire between the K20 Engine Control Module control circuit terminal for the KR29 A/C Compressor Clutch Relay and ground.
12. Verify the Q2 A/C Compressor Clutch activates.
 - **If the Q2 A/C Compressor Clutch does not activate**
 1. Ignition OFF, remove the jumper wire, disconnect the X3 harness connector at the X50A Fuse Block - Underhood, ignition ON.
 2. Test for less than 1 V between the X3 X50A Fuse Block - Underhood control circuit terminal 22 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the X50A Fuse Block - Underhood.
 - **If the Q2 A/C Compressor Clutch activates**
13. Replace the K20 Engine Control Module.

Component Testing

Compressor Clutch Test

1. Ignition OFF, disconnect the Q2 A/C Compressor Clutch.
2. Test for 3.9 - 4.3 ohms between terminal A and terminal B.

- **If not between 3.9 - 4.3 ohms**

Replace the Q2 A/C Compressor Clutch.

- **If between 3.9 - 4.3 ohms**

3. Test for infinite resistance between terminal A and ground.

- **If less than infinite resistance**

Replace the Q2 A/C Compressor Clutch.

- **If infinite resistance**

4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **HVAC Component Replacement Reference**
- **Control Module References** for engine control module replacement, programming and setup

SYMPTOMS - HVAC SYSTEMS - MANUAL

NOTE: **The following steps must be completed before using the symptom tables:**

1. Perform the **Diagnostic System Check - Vehicle** before using the HVAC System Malfunction procedure in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Manual HVAC Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which may affect the operation of the HVAC System. Refer to **Checking Aftermarket Accessories**.
- Inspect the easily accessible or visible system components for obvious damage or conditions which may cause the symptom.
- Verify the A/C compressor turns freely and is not seized.
- Verify that the customer is using the correct key to enable personalization and is not inadvertently activating auxiliary HVAC controls.

- The A/C compressor will not operate in cold outside air temperatures.
- The following conditions may cause window fogging:
 - Wet carpet or mats
 - High humidity
 - Interior water leak
 - Blocked A/C evaporator drain tube
 - Maximum passenger capacity
 - Blocked body pressure relief valves
- Inspect the air distribution system for causes of reduced air flow:
 - Obstructed or dirty passenger compartment air filter, if equipped
 - Blocked or damaged air inlet or outlet vents

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to **HVAC System Malfunction** in order to diagnose the symptom:

HVAC SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Aids

Check the following mechanical fault sources:

- Air distribution box
- Air distribution hoses/air distribution ducts
- Mode and temperature door cables

The scan tool BCM A/C Evaporator Temperature Sensor parameter displays voltage values. In order to correlate the voltage values to temperature values, use the table below:

A/C Evaporator Temperature Sensor Voltage	A/C Evaporator Temperature Sensor Temperature
5 V	73°C (-100°F) or less

4.5 V	-62°C (-80°F)
4 V	-51°C (-60°F)
3.5 V	-40°C (-40°F)
3 V	-29°C (-20°F)
2.5 V	-18°C (0°F)
2 V	-7°C (20°F)
1.5 V	4°C (40°F)
1 V	16°C (60°F)
0.5 V	27°C (80°F)
0 V	38°C (100°F) or greater

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

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- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Special Tools

J43600 ACR Air Conditioning Service Center

Circuit/System Verification

NOTE: Check for bulletins before proceeding.

1. Ignition ON.

2. Verify the A/C compressor and the recirculation door are not both inoperative.
 - **If the A/C compressor and the recirculation door are both inoperative**

Refer to System/Circuit Testing.

- **If the A/C compressor and the recirculation door are not both inoperative**
3. Verify the blower motor operates properly with the blower motor switch in each speed position.
 - **If the blower motor does not operate properly in each speed position**

Refer to **Blower Motor Malfunction**.

- **If the blower motor operates properly in each speed position**
4. Verify the air inlet door works properly when commanded.
 - **If the air inlet door does not work properly**

Refer to **Air Recirculation Malfunction**.

- **If the air inlet door does work properly**
5. Install the **J43600** ACR Air Conditioning Service Center, ignition ON.
 6. Verify the high side pressure reading on the Air Conditioning Service Center is within 10% of the scan tool BCM A/C High Side Pressure Sensor parameter.
 - **If the reading is not within 10%**

Refer to **DTC P0532 or P0533**.

- **If the reading is within 10%**
7. Verify the scan tool A/C High Side Pressure Sensor parameter is between 269-2929 kPa (39-425 PSI).
 - **If the reading is not between 269-2929 kPa (39-425 PSI)**

Refer to **Air Conditioning (A/C) System Performance Test** .

- **If the reading is between 269-2929 kPa (39-425 PSI)**
8. Verify the scan tool BCM A/C Evaporator Temperature Sensor parameter listed is within 10% of ambient temperature.
 - **If not within 10% of ambient temperature**

Refer to **DTC B3933**.

- **If within 10% of ambient temperature**
9. Engine ON, A/C system ON
 10. Verify cool air flows from the ducts with the temperature control in the coldest position.
 - **If the air is not cool**
 1. Verify the Q2 A/C Compressor Clutch is engaged.

- If the Q2 A/C Compressor Clutch is not engaged, refer to **Air Conditioning Compressor Malfunction**.
 - If the Q2 A/C Compressor Clutch is engaged, refer to **Air Conditioning (A/C) System Performance Test**.
 - **If the air is cool**
11. Verify the A/C indicator turns ON and OFF when the A/C switch is depressed.
- **If the A/C indicator does not turn ON and OFF**
- Refer to **DTC B393D**.
- **If the A/C indicator turns ON and OFF**
12. Verify warm air flows from the ducts with the temperature control in the warmest position.
- **If the air is not warm**
- Refer to **Symptoms - Engine Cooling**.
- **If the air is warm**
13. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the X1 harness connector at the K33 HVAC Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 7 and ground.
 - **If 10 ohms or greater**
 1. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF, remove the test lamp.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K33 HVAC Control Module.
 - **If the test lamp illuminates**

4. Verify a test lamp illuminates between the ignition circuit terminal 9 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF, remove the test lamp.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K33 HVAC Control Module.
 - **If the test lamp illuminates**
5. Replace the K33 HVAC Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **HVAC Component Replacement Reference**
- **Control Module References** for HVAC control module replacement, programming and setup

AIR CONDITIONING COMPRESSOR MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Air Conditioning Request Signal	2	1	-	-
Defrost Control Signal	2	3	-	-
Blower Feedback	2	1	-	-
1. A/C compressor clutch will not engage except in defrost 2. A/C compressor clutch engaged at all times 3. A/C inoperative during defrost mode only.				

Circuit/System Description

When the A/C switch is pressed or defrost mode is selected with the blower on, and system conditions are such

that A/C operation is allowed, the ECM will apply ground through the A/C compressor clutch relay control circuit, energizing the A/C compressor clutch relay. With the relay energized, battery voltage is applied through the control circuit to the A/C compressor clutch assembly, engaging the A/C compressor.

Diagnostic Aids

In order for the A/C compressor clutch to engage, several conditions are required as follows:

- Defrost mode is selected or the A/C switch is depressed.
- Battery voltage is between 9-18 V.
- Engine coolant temperature is less than 124°C (255°F).
- Engine speed is greater than 600 RPM.
- Engine speed is less than 5 500 RPM.
- A/C high side pressure is between 269-2 929 kPa (39-425 PSI).
- Throttle position is less than 100%.
- Evaporator temperature is greater than 3°C (38°F).
- ECM does not detect excessive torque load.
- ECM does not detect insufficient idle quality.
- The ambient temperature is above 1°C (34°F).
- Blower motor must be in any other position than off.
- A/C switch is depressed.

Reference Information

Schematic Reference

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Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: Refer to **HVAC System Malfunction** before performing this procedure.

1. Ignition ON.
2. Verify the scan tool ECM A/C Request Signal parameter changes from No to Yes under both of the following conditions listed below:
 - Defrost mode selected with blower ON, A/C switch OFF
 - A/C switch depressed with blower ON, temperature controls at their coolest setting, and mode controls in any position other than defrost mode
 - **If YES under only one of the conditions above**

Refer to Circuit/System Testing - A/C Request Circuit Test.

- **If YES under neither of the conditions above**

Refer to Circuit/System Testing - Blower Feedback Test.

- **If YES under both of the conditions above**

Refer to **DTC P0645, P0646, or P0647**.

Circuit/System Testing

NOTE: You must perform the Circuit/System Verification before proceeding with Circuit/System Testing.

A/C Request Circuit Test

1. Ignition OFF, disconnect the X1 harness connector at the K33 HVAC Control Module, ignition ON.
2. Verify a test lamp illuminates between ground and the signal circuit terminals listed below:
 - Terminal 4
 - Terminal 8
 - **If the test lamp does not illuminate for both terminals**
1. Ignition OFF, remove the test lamp, disconnect the X1 harness connector at the K9 Body Control Module.
2. Test for infinite resistance between ground and the K9 Body Control Module connector X1 signal circuit terminals listed below:
 - Terminal 10
 - Terminal 12
 - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance

3. Test for less than 2 ohms in the signal circuits end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.
- If less than 2 ohms, replace the K9 Body Control Module.

- **If the test lamp does illuminate for both terminals**

3. Position the blower switch to HI

4. Install a 3 A fused jumper wire between the signal circuit terminal 4 and ground.

5. Verify the scan tool ECM A/C Request Signal parameter is Yes.

- **If the parameter is not Yes**

Replace the K9 Body Control Module.

- **If the parameter is Yes**

6. Remove the jumper wire and install a 3 A fused jumper wire between the signal circuit terminal 8 and ground.

7. Verify the scan tool ECM A/C Request Signal parameter is Yes.

- **If the parameter is not Yes**

Replace the K9 Body Control Module.

- **If the parameter is Yes**

8. Replace the K33 HVAC Control Module

Blower Feedback Test

1. Ignition OFF, disconnect the harness connector at the S94 Blower Motor Switch, ignition ON.

2. Test for 11 V or greater between signal circuit terminal 5 and ground.

- **If less than 11 V**

1. Disconnect the X2 harness connector at the K9 Body Control Module.

2. Test for infinite resistance between the S94 Blower Motor Switch signal circuit terminal 5 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 ohms in the signal circuit end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.
- If less than 2 ohms, replace the K9 Body Control Module.

- **If 11 V or greater**

3. Install a 3 A fused jumper wire between the signal circuit terminal 5 and ground.

4. Depress the A/C switch.

5. Verify the scan tool ECM A/C Request Signal parameter is Yes.

- **If the parameter is not Yes**

Replace the K9 Body Control Module.

- **If the parameter is Yes**

6. Replace the K33 HVAC Control Module

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **HVAC Component Replacement Reference**
- **Control Module References** for K33 HVAC Control Module and K9 Body Control Module replacement, programming and setup

BLOWER MOTOR MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Blower Motor Ignition Voltage	2	2	-	-
Blower Motor Control	1	2	-	-
Speed 4 Control	1	3	-	-
Speed 3 Control	1	3	-	-
Speed 2 Control	1	3	-	-
Speed 1 Control	1	3	-	-
Switch Ground	-	2	-	-
1. Unwanted Blower Operation 2. Blower Inoperative 3. Blower Speed Inoperative				

Circuit/System Description

The blower motor switch applies ground to the blower motor control circuit that corresponds to the selected blower speed. The resistors and the blower motor are in a series circuit. The following list represents the number of resistors in series with the blower motor per particular speed request:

- Low speed, 3 resistors

- Medium 1 speed, 2 resistors
- Medium 2 speed, 1 resistors

When blower switch is in the Hi speed position, ground is applied directly to the blower motor through the blower switch.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the blower motor operates in all speed positions.
 - **If the blower motor does not operate in any speed position**
 Refer to Circuit/System Testing - Blower Motor Circuit Test.
 - **If the blower motor operates in one or more, but not all speed positions**
 Refer to Circuit/System Testing - Blower Motor Switch Circuit Test.
 - **If the blower motor is always ON**
 Refer to Circuit/System Testing - Blower Motor Always ON Circuit Test.

- **If the blower motor operates correctly in all speed positions**
- 3. All OK.

Circuit/System Testing

Blower Motor Circuit Test

1. Ignition OFF, disconnect the harness connector at the R3 Blower Motor Resistor.
2. Place the blower motor switch in the high speed position.
3. Test for less than 10 ohms between the control circuit terminal D and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the X2 harness connector at the K33 HVAC Control Module.
 2. Test for less than 2 ohms between the ground circuit terminal 3 and ground.
 - If less than 2 ohms, replace the K33 HVAC Control Module.
 - If greater than 2 ohms
 3. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
4. Ignition OFF, connect the harness connector at the R3 Blower Motor Resistor and disconnect the harness connector at the M8 Blower Motor.
5. Test for less than 10 ohms between the control circuit terminal 2 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the R3 Blower Motor Resistor.
 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the R3 Blower Motor Resistor.
 - **If less than 10 ohms**
6. Ignition ON.
7. Verify a test lamp illuminates between the ignition circuit terminal 1 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Remove the test lamp, ignition OFF.
 2. Test for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Remove the test lamp, ignition OFF.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance, test or replace the M8 Blower Motor.
 - **If the test lamp illuminates**
8. Test or replace the M8 Blower Motor.

Blower Motor Switch Circuit Test

1. Ignition OFF, disconnect the harness connector at the R3 Blower Motor Resistor.
2. Test for less than 10 ohms between each control circuit terminal listed below and ground with the blower switch in the appropriate position.
 - Blower speed 1 terminal E
 - Blower speed 2 terminal A
 - Blower speed 3 terminal B
 - Blower speed 4 terminal D
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the X2 harness connector at the K33 HVAC Control Module.
 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K33 HVAC Control Module.
 - **If less than 10 ohms**
3. Test or replace the R3 Blower Motor Resistor.

Blower Motor Always ON Circuit Test

1. Ignition OFF, disconnect the harness connector at the R3 Blower Motor Resistor.
2. Place the blower motor switch in the OFF position.
3. Test for infinite resistance between each control circuit terminal listed below and ground:
 - Blower speed 1 terminal E
 - Blower speed 2 terminal A
 - Blower speed 3 terminal B
 - Blower speed 4 terminal D
 - **If less than infinite resistance**
 1. Disconnect the X2 harness connector at the K33 HVAC Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K33 HVAC Control Module.
 - **If infinite resistance**
4. Ignition OFF, disconnect the harness connector at the M8 blower motor.
5. Test for infinite resistance between the control circuit terminal 2 and ground.
 - **If less than infinite resistance**

Repair the short to ground on the circuit

- **If infinite resistance**

6. All OK

Component Testing

Blower Switch

1. Ignition OFF, disconnect the X2 harness connector at the K33 HVAC Control Module.
2. Test for infinite resistance between the ground terminal 3 and each control terminal with the blower switch in the OFF position.

- **If less than infinite resistance**

Replace the K33 HVAC Control Module.

- **If infinite resistance**

3. Test for less than 2 ohms between the ground terminal 3 and each control terminal with the switch in the appropriate position.

- **If 2 ohms or greater**

Replace the K33 HVAC Control Module.

- **If less than 2 ohms**

4. All OK.

Blower Motor Resistor

1. Ignition OFF, disconnect the harness connector at the R3 Blower Motor Resistor.
2. Test for 2.7-3.3 ohms between terminal C and terminal E.

- **If not between 2.7-3.3 ohms**

Replace the R3 Blower Motor Resistor.

- **If between 2.7-3.3 ohms**

3. Test for 1.62-1.98 ohms between terminal C and terminal A.

- **If not between 1.62-1.98 ohms**

Replace the R3 Blower Motor Resistor.

- **If between 1.62-1.98 ohms**

4. Test for 0.72-0.88 ohms between terminal C and terminal B.

- **If not between 0.72-0.88 ohms**

Replace the R3 Blower Motor Resistor.

- **If between 0.72-0.88 ohms**

5. Test for 0.36-0.44 ohms between terminal C and terminal D.

- **If not between 0.36-0.44 ohms**

Replace the R3 Blower Motor Resistor.

- **If between 0.36-0.44 ohms**

6. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **HVAC Component Replacement Reference**
- **Control Module References** for HVAC control module replacement, programming and setup

AIR RECIRCULATION MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control - Terminal A	1	1	1	-
Control - Terminal B	1	1	1	-
1. Air inlet door is inoperative.				

Circuit/System Description

The air inlet actuator is a 2-wire bi-directional electric motor. There are two control circuits that enable the actuator to operate. The control circuits use either a 0 or 12-volt value to coordinate the actuator movement. When the actuator is at rest, both control circuits have a value of approximately 12 V. In order to move the actuator, the HVAC control module grounds one of the control circuits while providing the other with 12 V. The HVAC control module reverses the polarity of the control circuits to move the actuator in the opposite direction.

Reference Information

Schematic Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the M4 Air Inlet Door Actuator moves between the RECIRCULATE and FRESH AIR position within 20 s when pressing the recirculation switch.
 - **If the M4 Air Inlet Door Actuator does not move between the RECIRCULATE and FRESH AIR position**

Refer to Circuit/System Testing.
 - **If the M4 Air Inlet Door Actuator moves between the RECIRCULATE and FRESH AIR position**
3. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the X1 harness connector at the K33 HVAC Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 7 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
- 3. Ignition ON.
- 4. Verify a test lamp illuminates between the ignition circuit terminal 9 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF, remove the test lamp..
 2. Test for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF, remove the test lamp.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K33 HVAC Control Module.
 - **If the test lamp illuminates**
- 5. Ignition OFF, connect the harness connector at the K33 HVAC Control Module and disconnect the harness connector at the M4 Air Inlet Door Actuator.
- 6. Connect a test lamp between control circuit terminal A and control circuit terminal B, ignition ON.
- 7. Verify the test lamp illuminates for approximately 20 s when commanding the RECIRCULATE and FRESH AIR positions using the recirculate switch.
 - **If the test lamp does not illuminate during either of the commands**
 1. Ignition OFF, remove the test lamp and disconnect the X1 harness connector at the K33 HVAC Control Module, ignition ON.
 2. Test for less than 2 ohms in each control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms
 3. Test for infinite resistance between each control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K33 HVAC Control Module.
 - **If the test lamp illuminates during each of the commands**
- 8. Test or replace the M4 Air Inlet Door Actuator.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **HVAC Component Replacement Reference**
- **Control Module References** for K33 HVAC Control Module replacement, programming and setup

REPAIR INSTRUCTIONS

HEATER AND AIR CONDITIONING CONTROL REPLACEMENT (LEFT HAND DRIVE)

Removal Procedure

WARNING: Refer to Battery Disconnect Warning .

1. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection .
2. Remove the instrument panel (I/P) compartment. Refer to Instrument Panel Compartment Replacement .
3. Remove the radio. Radio Replacement .

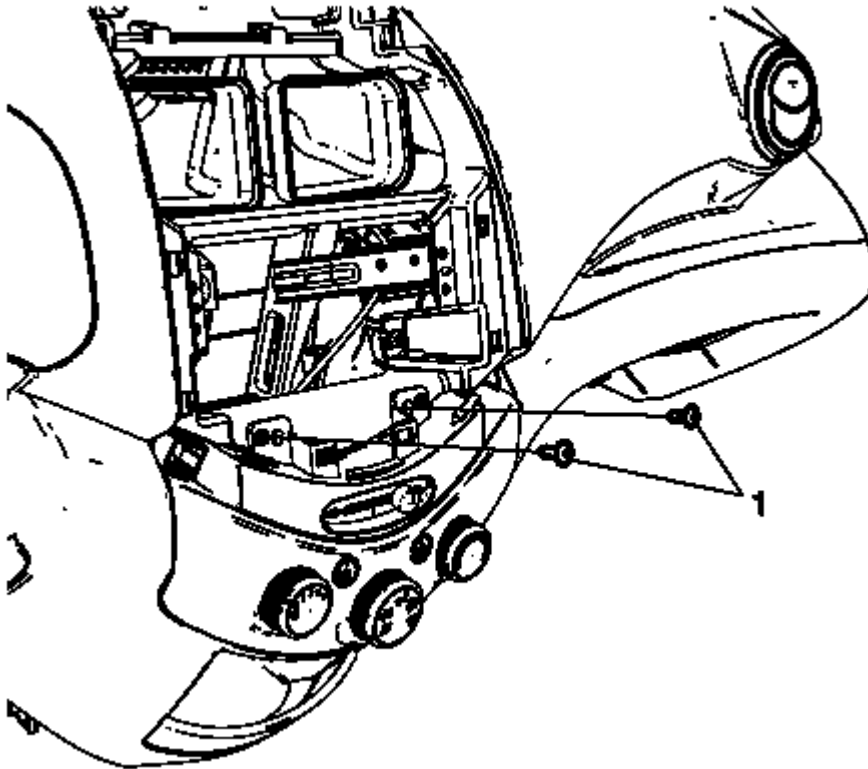


Fig. 4: Heater And Air Conditioning (A/C) Control Screws
Courtesy of GENERAL MOTORS COMPANY

4. Remove the heater and air conditioning (A/C) control screws (1).

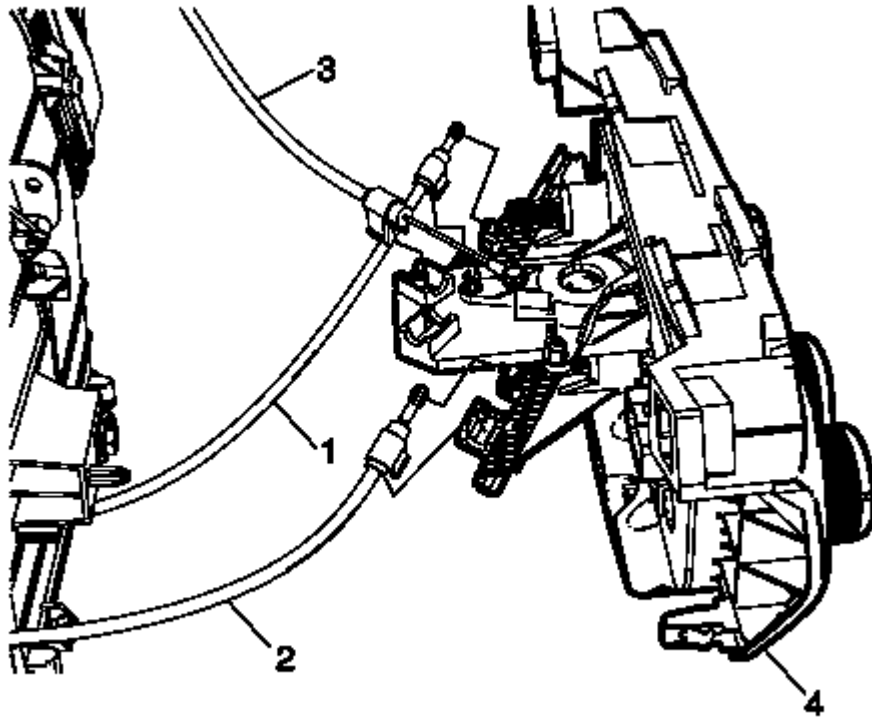


Fig. 5: Heater And A/C Control

Courtesy of GENERAL MOTORS COMPANY

5. Remove the heater and A/C control (4) by pulling it out to provide clearance for the removal of the cables.

NOTE: **Note the location of the cables to facilitate their reinstallation.**

6. Disconnect the temperature control cable (1), mode control cable (2) and air inlet control cable (3).
7. Disconnect the electrical connectors.

Installation Procedure

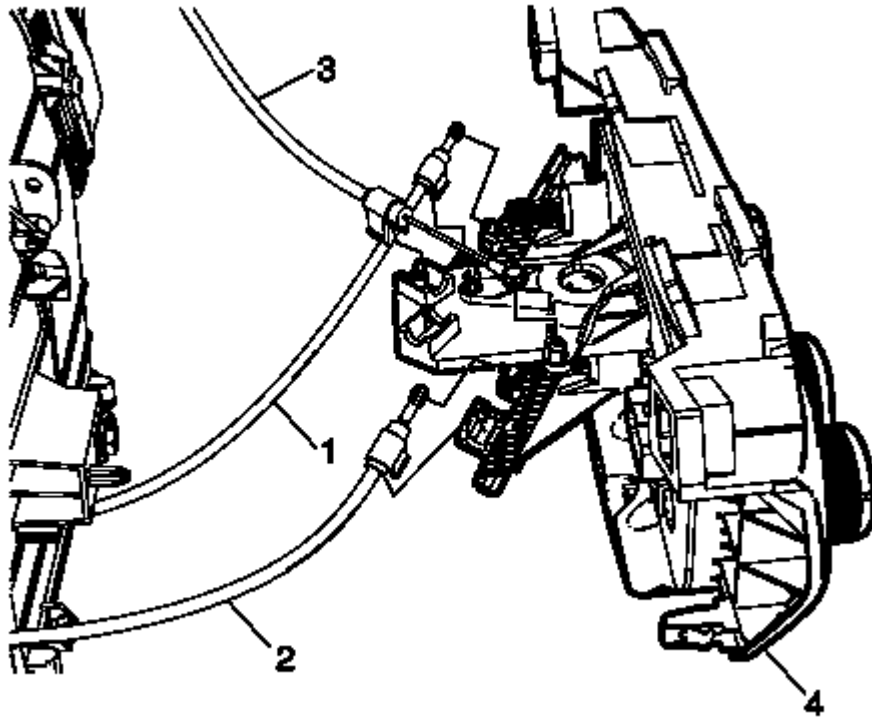


Fig. 6: Heater And A/C Control

Courtesy of GENERAL MOTORS COMPANY

1. Connect the electrical connectors.
2. Connect the temperature control cable (1), mode control cable (2) and air inlet control cable (3).
3. Install the heater and A/C control (4) by gently inserting the heater and A/C control into the proper position on the I/P.

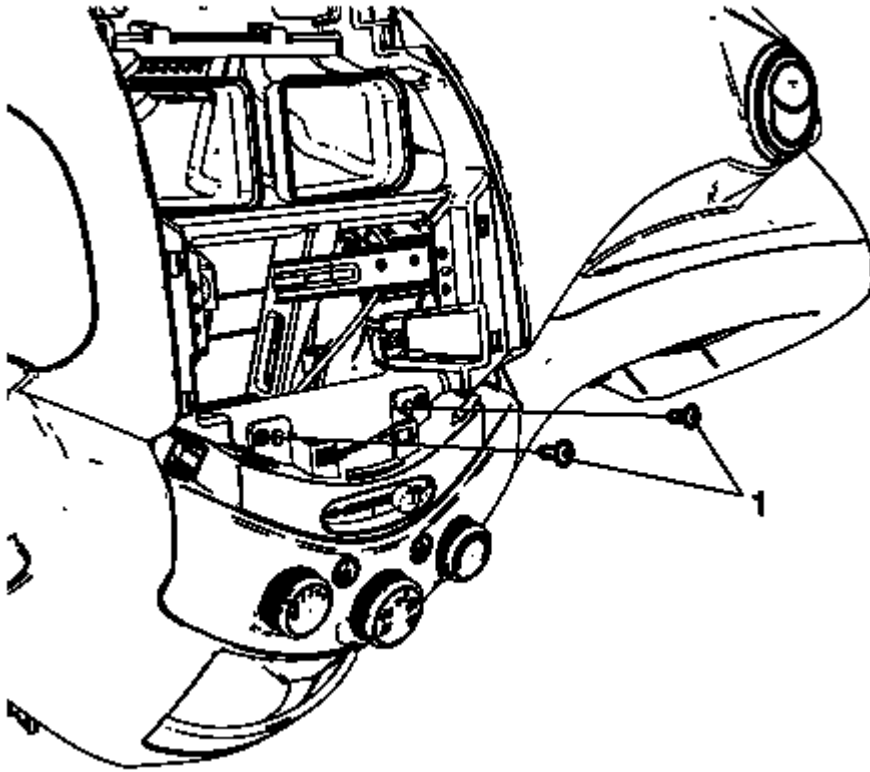


Fig. 7: Heater And Air Conditioning (A/C) Control Screws
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

4. Install the heater and A/C control screws (1) and tighten to 2.5 N.m (23 lb in).
5. Install the radio. Refer to Radio Replacement .
6. Install the I/P compartment. Refer to Instrument Panel Compartment Replacement .
7. Connect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection .

HEATER AND AIR CONDITIONING CONTROL REPLACEMENT (RIGHT HAND DRIVE)

Removal Procedure

WARNING: Refer to Battery Disconnect Warning .

1. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection .

2. Remove the instrument panel (I/P) compartment. Refer to **Instrument Panel Compartment Replacement** .
3. Remove the radio. **Radio Replacement** .

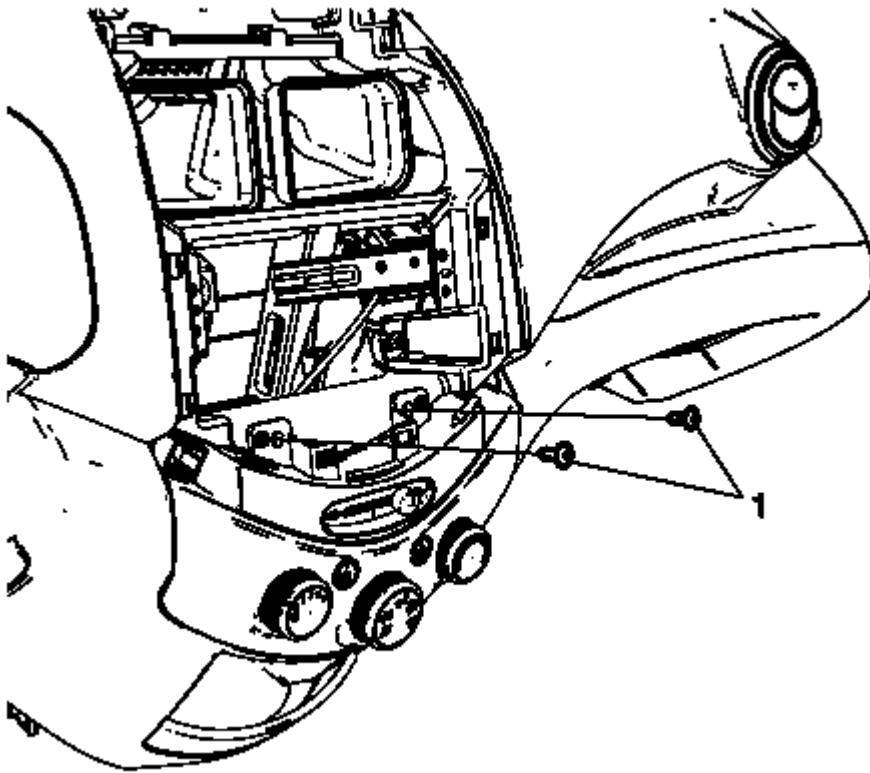


Fig. 8: Heater And Air Conditioning (A/C) Control Screws
Courtesy of GENERAL MOTORS COMPANY

4. Remove the heater and air conditioning (A/C) control screws (1).

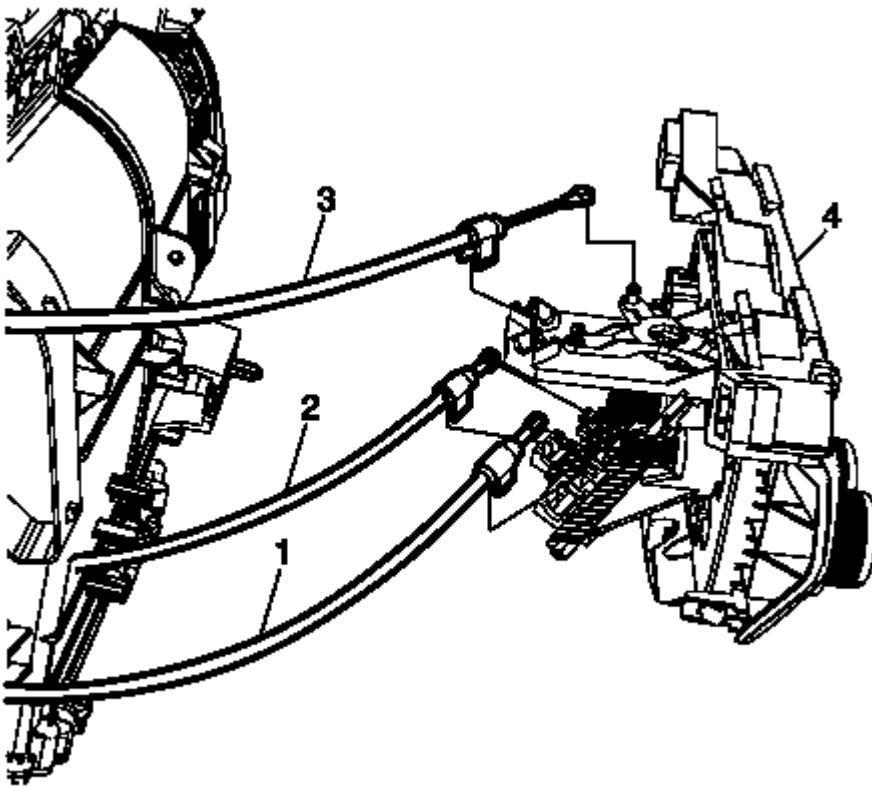


Fig. 9: Heater And A/C Control

Courtesy of GENERAL MOTORS COMPANY

5. Remove the heater and A/C control (4) by pulling it out to provide clearance for the removal of the cables.

NOTE: **Note the location of the cables to facilitate their reinstallation.**

6. Disconnect the temperature control cable (1), mode control cable (2) and air inlet control cable (3).
7. Disconnect the electrical connectors.

Installation Procedure

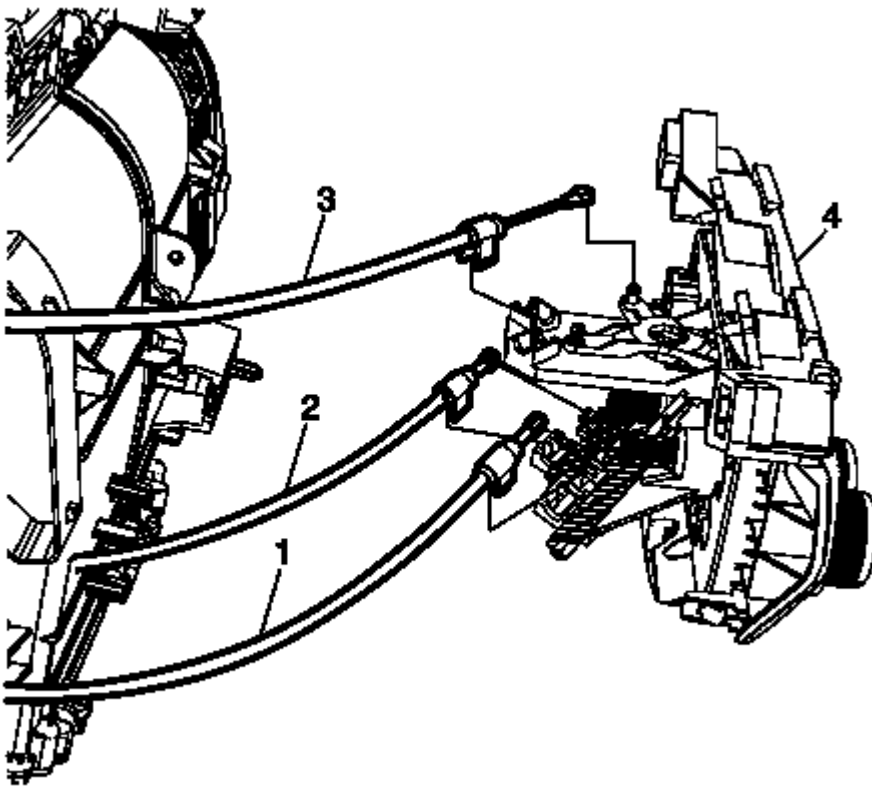


Fig. 10: Heater And A/C Control

Courtesy of GENERAL MOTORS COMPANY

1. Connect the electrical connectors.
2. Connect the temperature control cable (1), mode control cable (2) and air inlet control cable (3) to the heater and A/C control (4).
3. Install the heater and air conditioning control (4) by gently inserting the heater and air conditioning control into the proper position on the instrument panel.

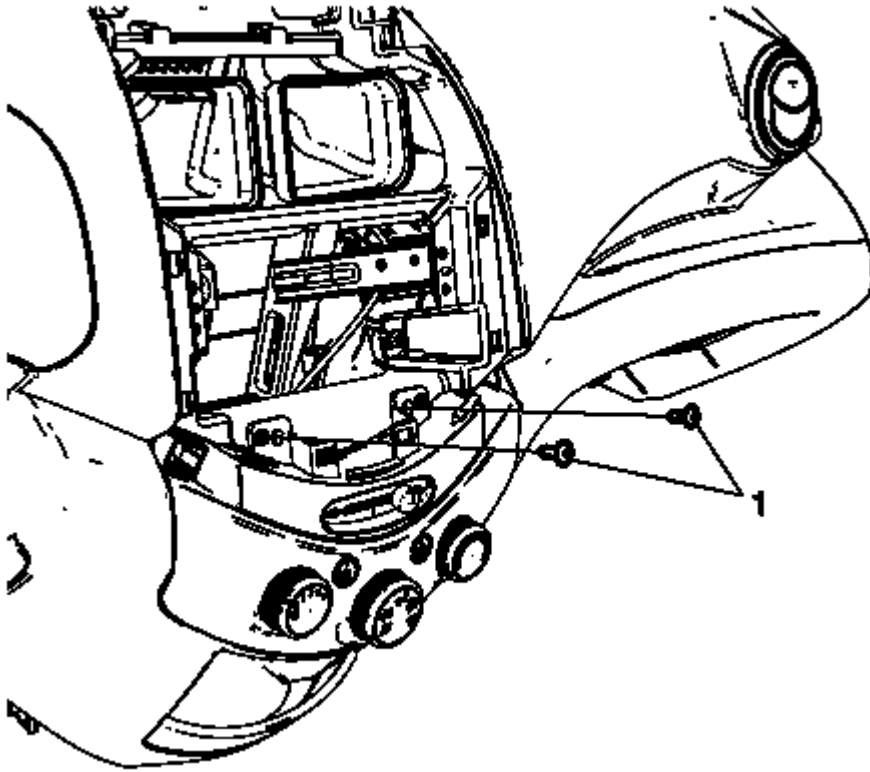


Fig. 11: Heater And Air Conditioning (A/C) Control Screws
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

4. Install the heater and A/C control screws (1) and tighten to 2.5 N.m (23 lb in).
5. Install the radio. Refer to Radio Replacement .
6. Install the I/P compartment. Refer to Instrument Panel Compartment Replacement .
7. Connect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection .

MODE VALVE LINK REPLACEMENT

Removal Procedure

1. Remove the left side floor air outlet duct. Refer to Floor Air Outlet Duct Replacement - Left Side (Left Hand Drive) .
2. Disconnect the stop lamp switch connector.

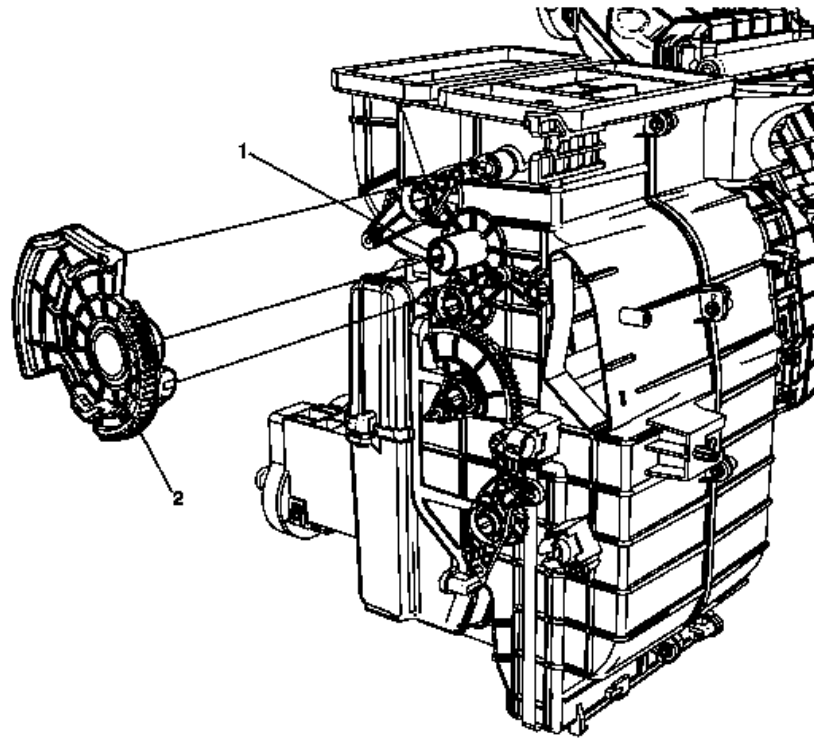


Fig. 12: Mode Valve Link And Locking Tap
Courtesy of GENERAL MOTORS COMPANY

3. Remove the mode valve link (2) pressing the locking tap (1) of module.

Installation Procedure

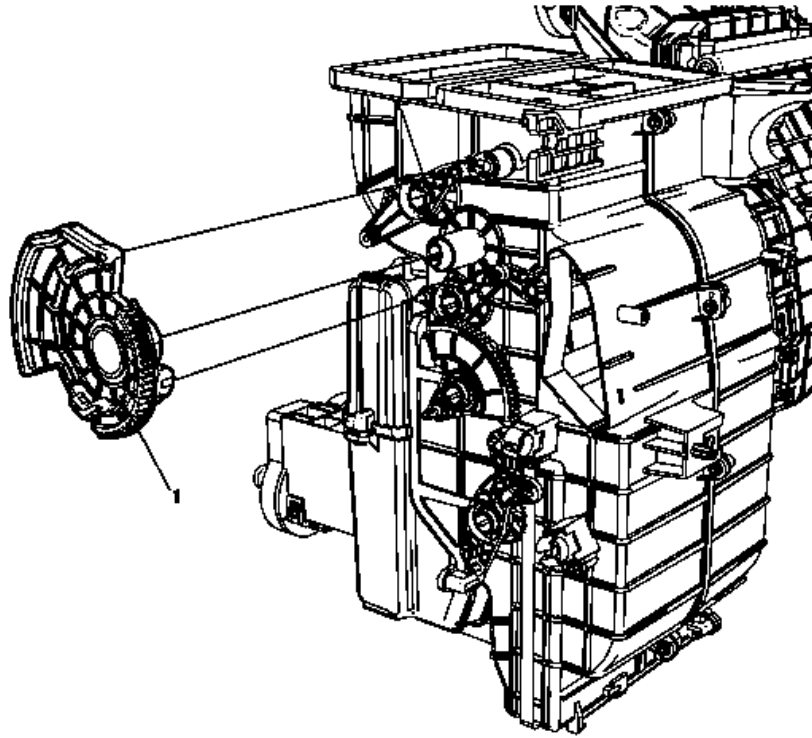


Fig. 13: Mode Valve Link

Courtesy of GENERAL MOTORS COMPANY

1. Install the mode valve link (1).
2. Connect the stop lamp switch connector.
3. Install the left side floor air outlet duct. Refer to **Floor Air Outlet Duct Replacement - Left Side (Left Hand Drive)** .

TEMPERATURE VALVE LINK REPLACEMENT

Removal Procedure

1. Remove the left floor air outlet duct. Refer to **Floor Air Outlet Duct Replacement - Left Side (Left Hand Drive)** .

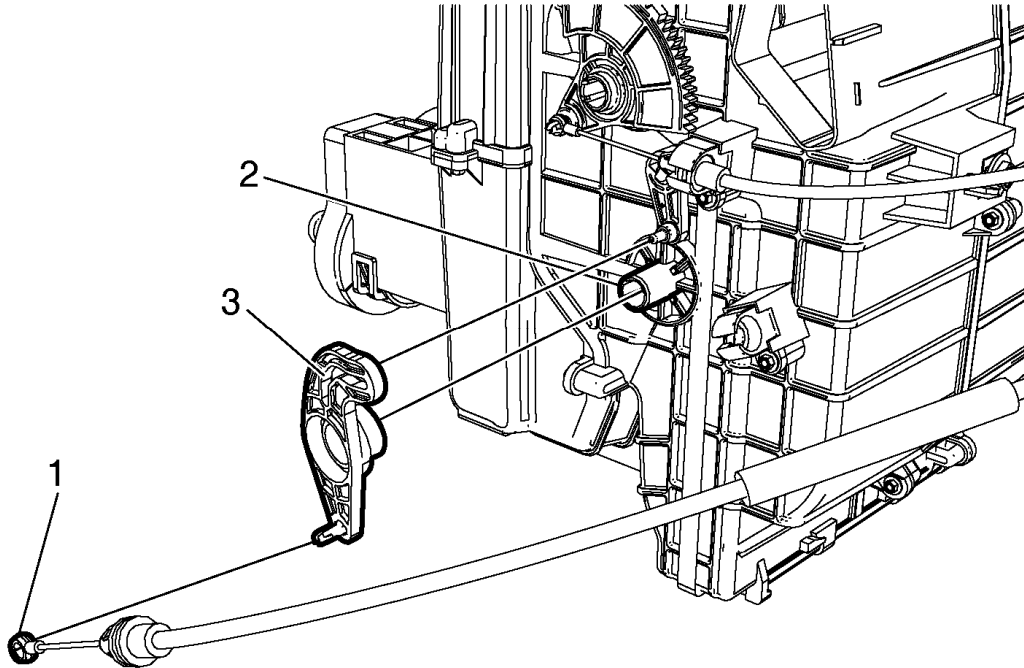


Fig. 14: Temperature Control Cable
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the temperature control cable (1) from the air conditioning (A/C) evaporator and blower module assembly.
3. Remove the temperature cable link (3) releasing the locking tap (2) of module.

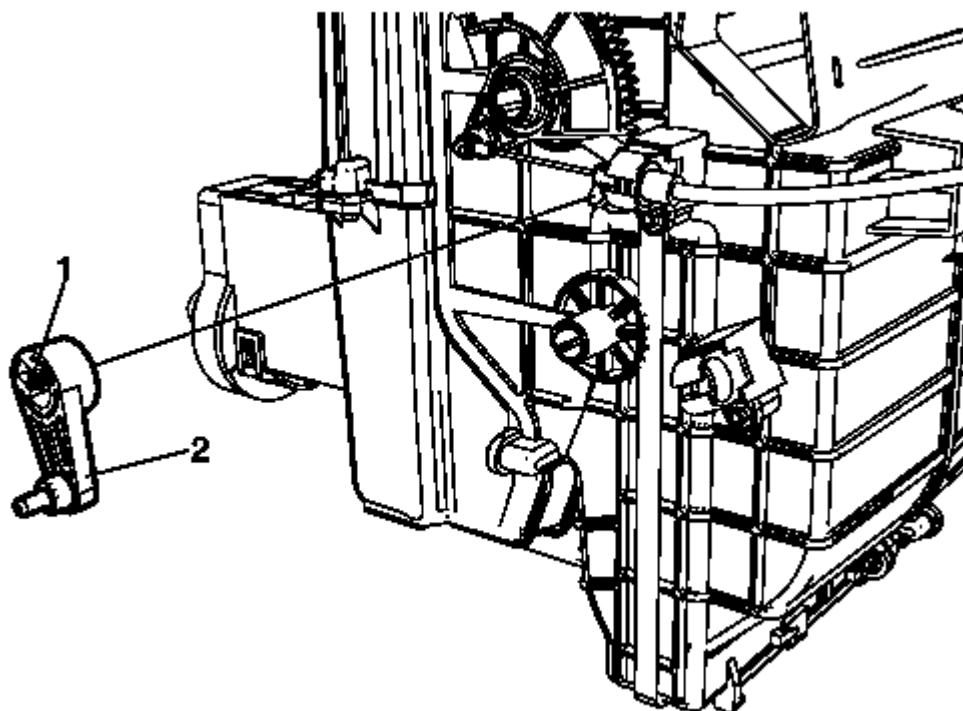


Fig. 15: Temperature Valve Link
Courtesy of GENERAL MOTORS COMPANY

4. Remove the temperature valve link (2) releasing the locking tap (1) of valve link.

Installation Procedure

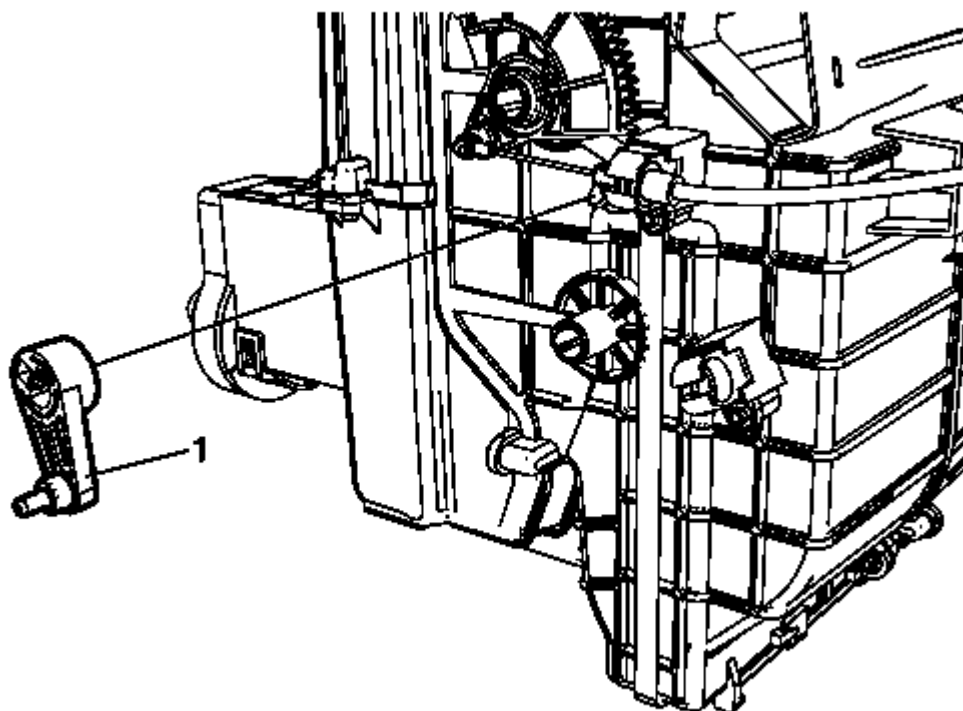


Fig. 16: Temperature Valve Link
Courtesy of GENERAL MOTORS COMPANY

1. Install the temperature valve link.

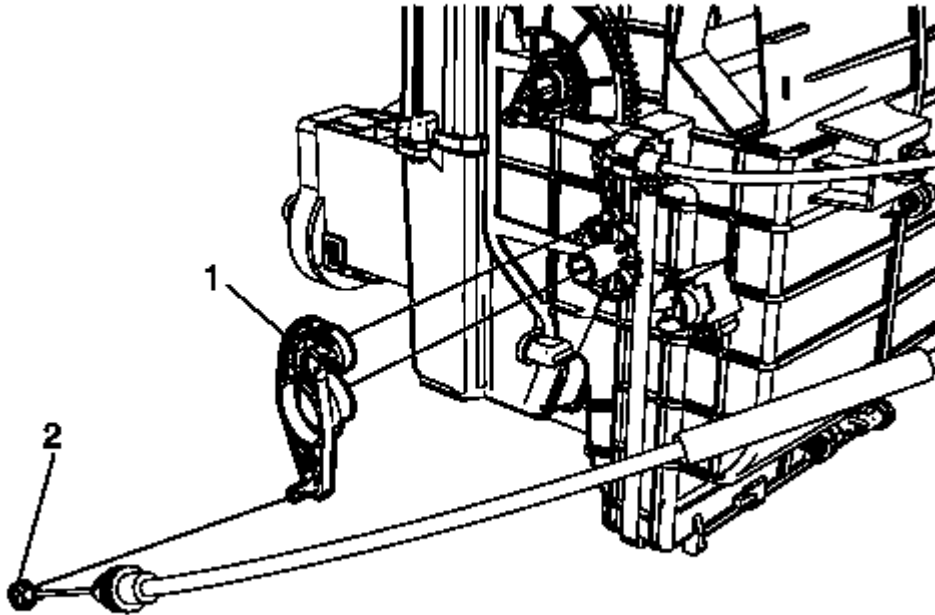


Fig. 17: Temperature Cable Link
Courtesy of GENERAL MOTORS COMPANY

2. Install the temperature cable link (1).
3. Connect the temperature control cable (2) to the A/C evaporator and blower module assembly.
4. Install the left floor air outlet duct. Refer to **Floor Air Outlet Duct Replacement - Left Side (Left Hand Drive)** .

AIR INLET VALVE LINK REPLACEMENT (LEFT HAND DRIVE)

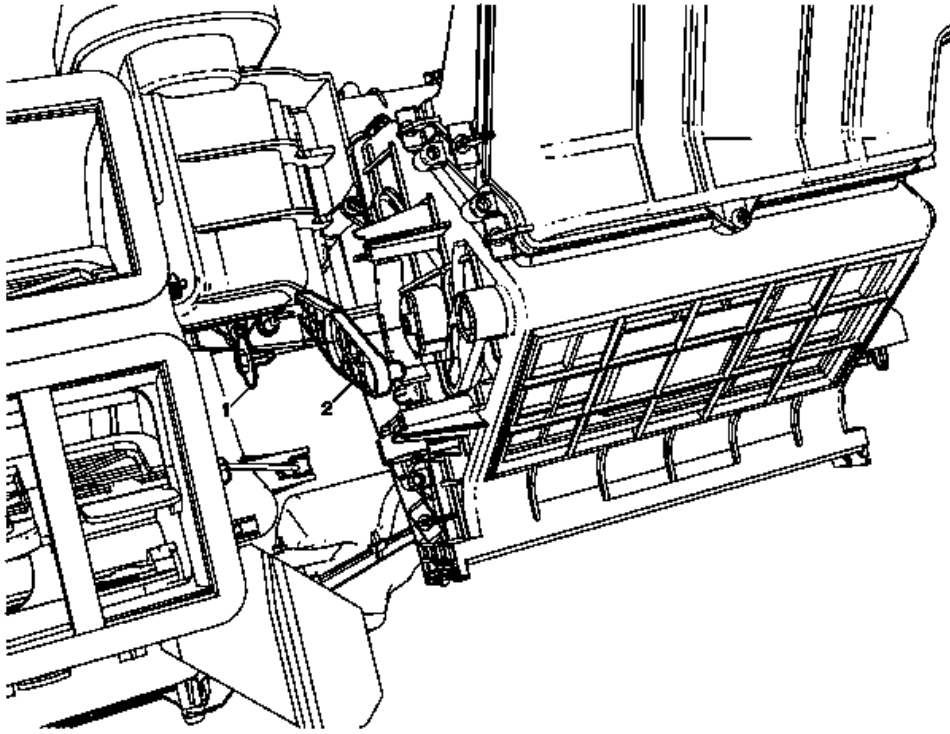


Fig. 18: Air Inlet Valve Link (Left Hand Drive)

Courtesy of GENERAL MOTORS COMPANY

Air Inlet Valve Link Replacement (Left Hand Drive)

Callout	Component Name
Preliminary Procedure 1. Remove the right side floor air outlet duct. Refer to <u>Floor Air Outlet Duct Replacement - Right Side</u> . 2. Disconnect the air inlet control cable from the air conditioning (A/C) evaporator and blower module assembly. Refer to <u>Air Conditioning Evaporator Hose Assembly Replacement (1.2L LL0, 1.0L LFM)</u> .	
1	Air Inlet Valve Link Screw (Qty: 1) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 1.2 N.m (11 lb in)
2	Air Inlet Valve Link

AIR INLET VALVE LINK REPLACEMENT (RIGHT HAND DRIVE)

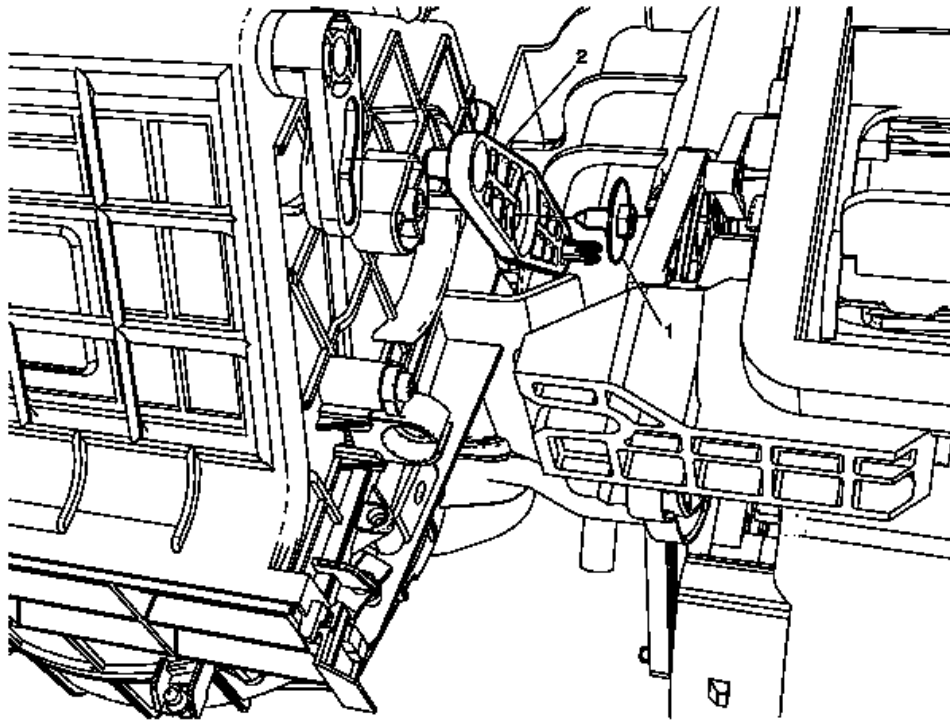


Fig. 19: Air Inlet Valve Link (Right Hand Drive)
 Courtesy of GENERAL MOTORS COMPANY

Air Inlet Valve Link Replacement (Right Hand Drive)

Callout	Component Name
Preliminary Procedure 1. Remove the left side floor air outlet duct. Refer to <u>Floor Air Outlet Duct Replacement - Left Side (Left Hand Drive)</u> . 2. Disconnect the air inlet control cable from the air conditioning (A/C) evaporator and blower module assembly. Refer to <u>Air Conditioning Evaporator Hose Assembly Replacement (1.2L LL0, 1.0L LFM)</u> .	
1	Air Inlet Valve Link Screw (Qty: 1) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 1.2 N.m (11 lb in)
2	Air Inlet Valve Link

TEMPERATURE CONTROL CABLE REPLACEMENT

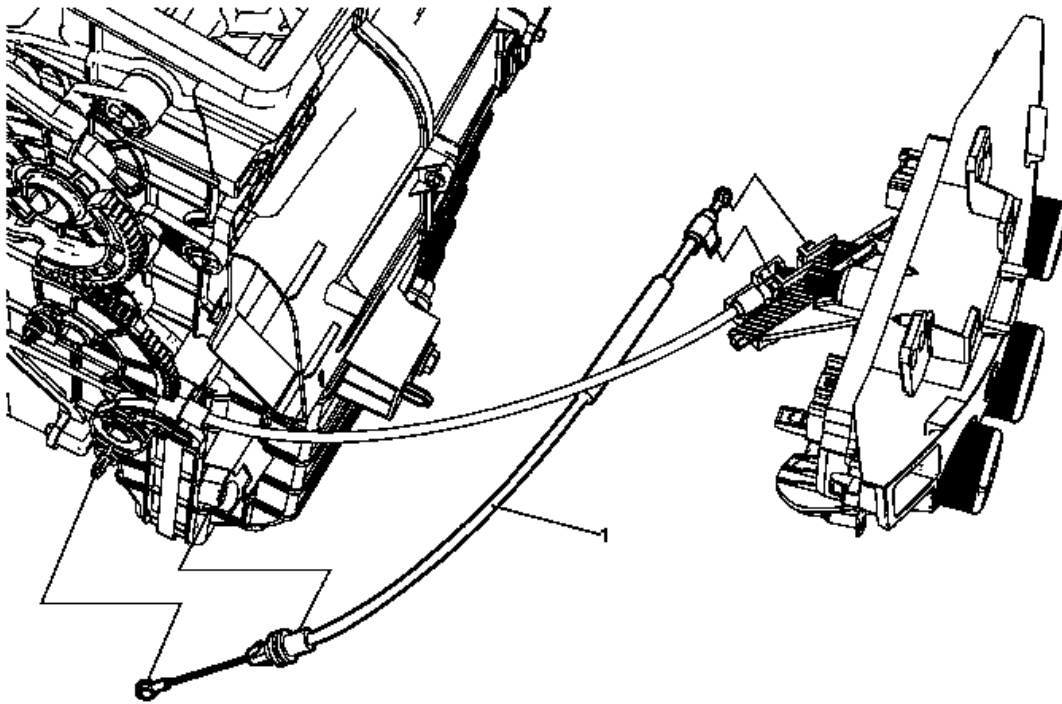


Fig. 20: Temperature Control Cable
 Courtesy of GENERAL MOTORS COMPANY

Temperature Control Cable Replacement

Callout	Component Name
Preliminary Procedure Disconnect the temperature control cable from the heater and air conditioning (A/C) control. Refer to <u>Heater and Air Conditioning Control Replacement (Left Hand Drive)</u> , <u>Heater and Air Conditioning Control Replacement (Right Hand Drive)</u> .	
1	Temperature Control Cable Procedure 1. Disconnect the cable eyelet from the temperature valve link. 2. Disconnect the temperature control cable from the temperature control cable retainer.

MODE CONTROL CABLE REPLACEMENT

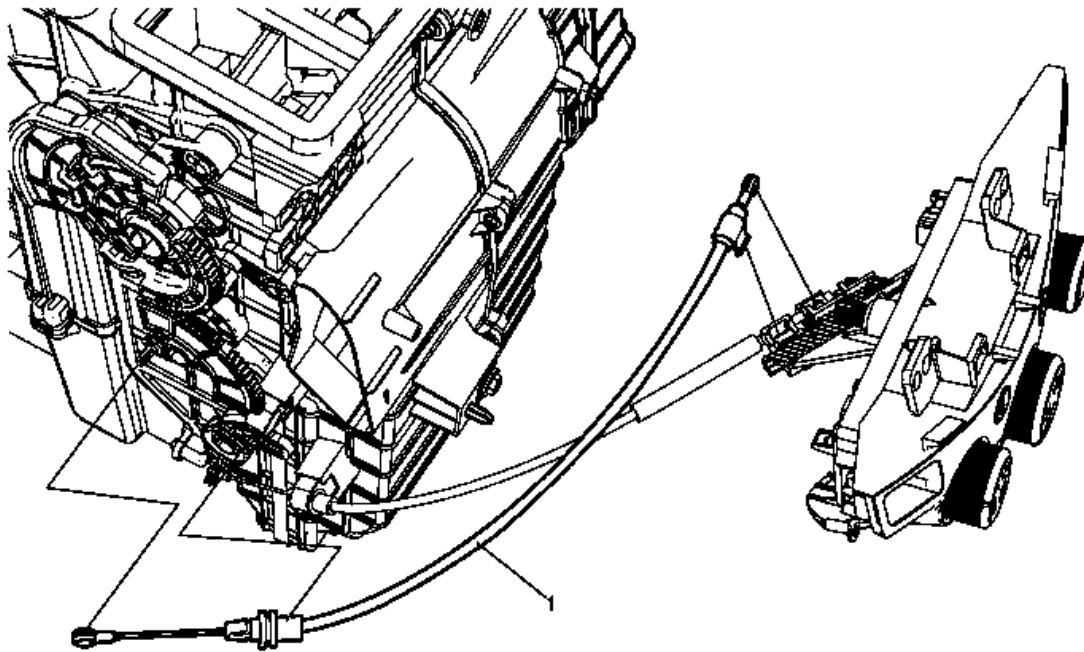


Fig. 21: Mode Control Cable
 Courtesy of GENERAL MOTORS COMPANY

Mode Control Cable Replacement

Callout	Component Name
Preliminary Procedure Disconnect the mode control cable from the heater and air conditioning (A/C) control. Refer to Heater and Air Conditioning Control Replacement (Left Hand Drive) , Heater and Air Conditioning Control Replacement (Right Hand Drive) .	
1	Mode Control Cable Procedure 1. Disconnect the cable eyelet from the mode valve link. 2. Disconnect the mode control cable from the mode control cable retainer.

INSIDE AIR RECIRCULATING CONTROL CABLE REPLACEMENT (LEFT HAND DRIVE)

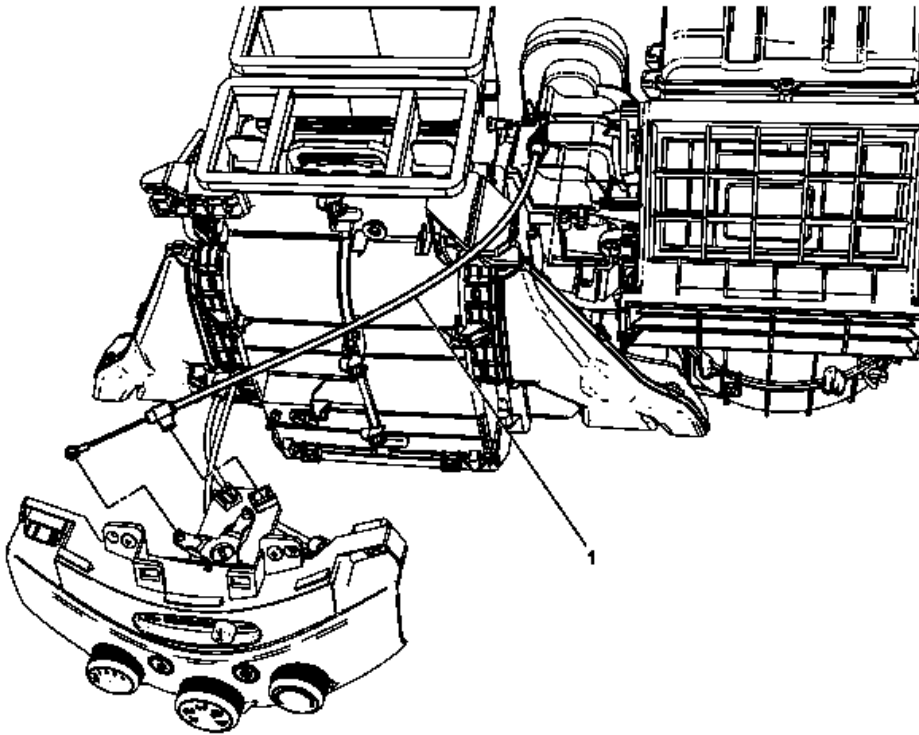


Fig. 22: Inside Air Recirculating Control Cable (Left Hand Drive)
 Courtesy of GENERAL MOTORS COMPANY

Inside Air Recirculating Control Cable Replacement (Left Hand Drive)

Callout	Component Name
Preliminary Procedure 1. Remove the right side floor air outlet duct. Refer to <u>Floor Air Outlet Duct Replacement - Right Side</u> . 2. Disconnect the air inlet control cable from the heater and air conditioning (A/C) control. Refer to <u>Mode Control Cable Replacement</u>.	
1	Air Inlet Control Cable Procedure 1. Disconnect the cable eyelet from the air inlet valve link. 2. Disconnect the air inlet control cable from the air inlet control cable retainer.

INSIDE AIR RECIRCULATING CONTROL CABLE REPLACEMENT (RIGHT HAND DRIVE)

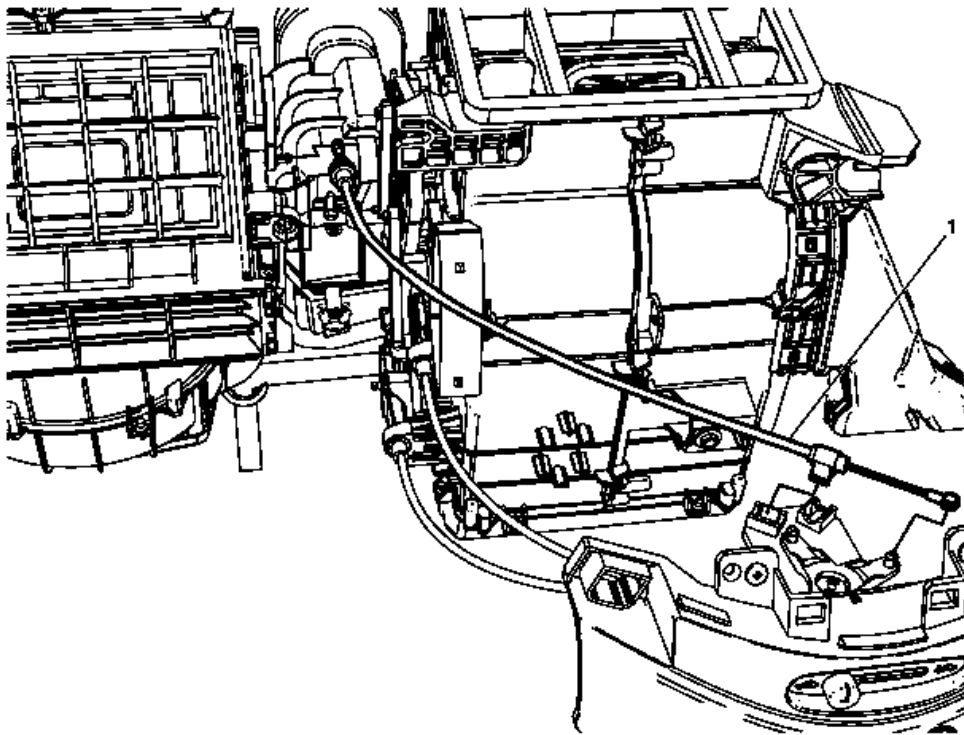


Fig. 23: Inside Air Recirculating Control Cable (Right Hand Drive)
 Courtesy of GENERAL MOTORS COMPANY

Inside Air Recirculating Control Cable Replacement (Right Hand Drive)

Callout	Component Name
Preliminary Procedures	
1. Remove the left side floor air outlet duct. Refer to <u>Floor Air Outlet Duct Replacement - Left Side (Left Hand Drive)</u> . 2. Disconnect the air inlet control cable from the heater and air conditioning (A/C) control. Refer to <u>Heater and Air Conditioning Control Replacement (Left Hand Drive)</u>, <u>Heater and Air Conditioning Control Replacement (Right Hand Drive)</u>.	
1	Air Inlet Control Cable Procedure 1. Disconnect the cable eyelet from the air inlet valve link. 2. Disconnect the air inlet control cable from the air inlet control cable retainer.

AIR INLET VALVE ACTUATOR REPLACEMENT

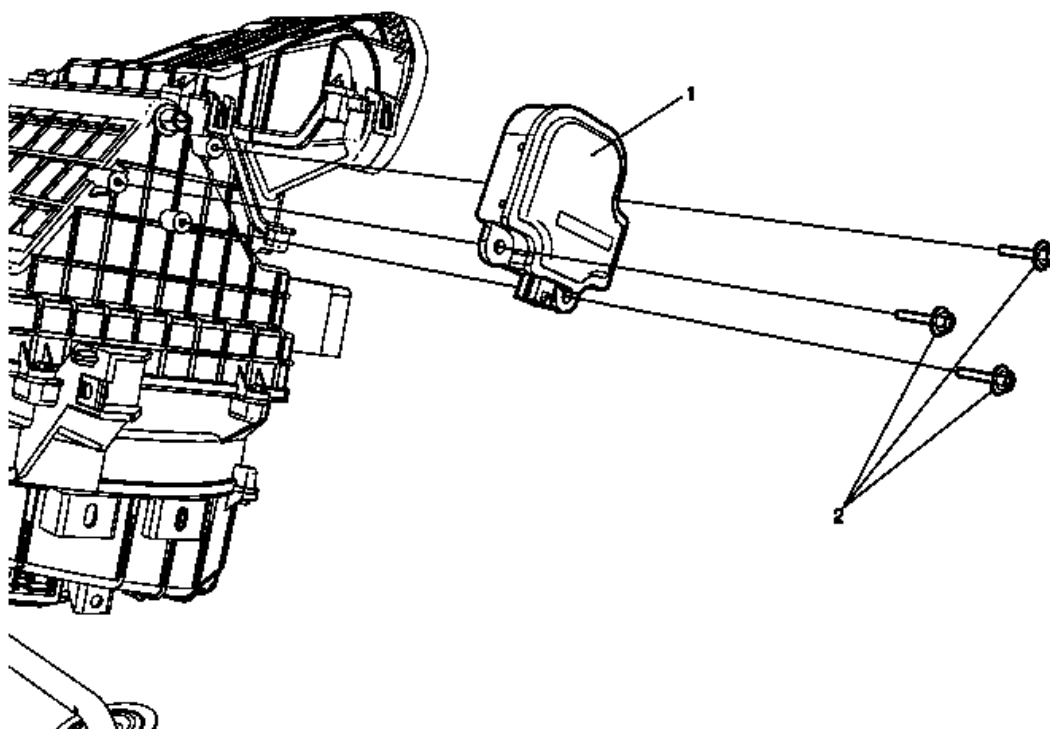


Fig. 24: Air Inlet Valve Actuator
 Courtesy of GENERAL MOTORS COMPANY

Air Inlet Valve Actuator Replacement

Callout	Component Name
Preliminary Procedures	
1. Disconnect the battery negative cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Remove the instrument panel assembly. Refer to <u>Instrument Panel Assembly Replacement</u> .	
1	Air Inlet Valve Actuator Bolt (Qty: 3) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 1.2 (11 lb in)
2	Air Inlet Valve Actuator Procedure Disconnect the electrical connector.

EVAPORATOR AIR TEMPERATURE SENSOR REPLACEMENT

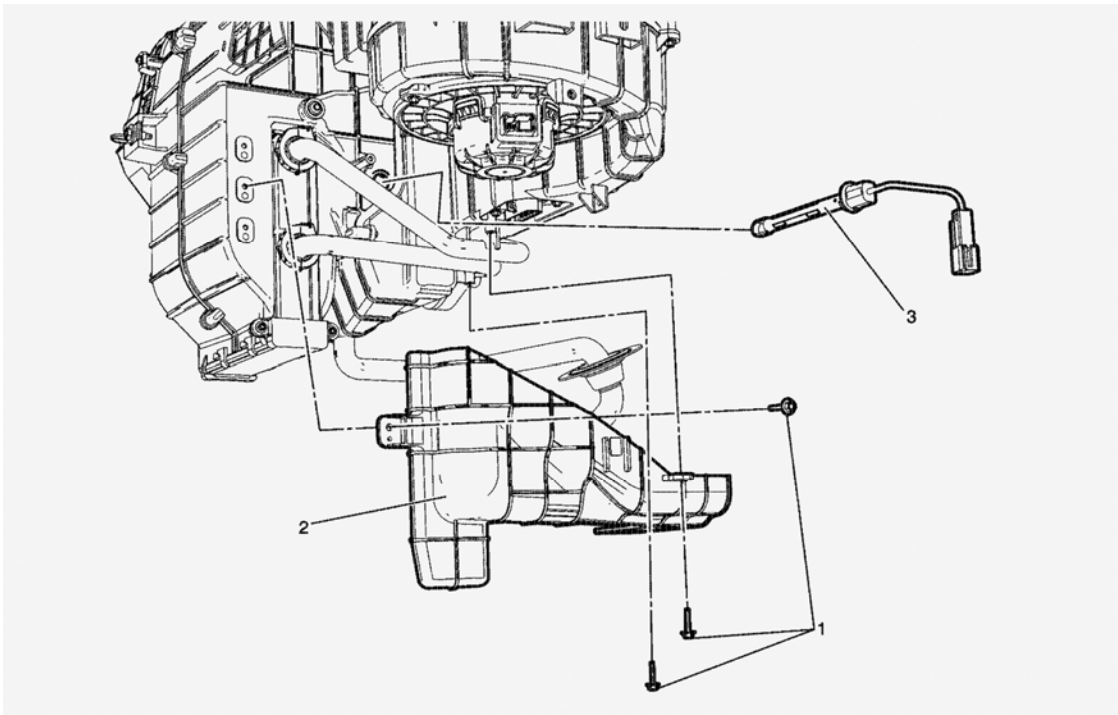


Fig. 25: Evaporator Air Temperature Sensor
 Courtesy of GENERAL MOTORS COMPANY

Evaporator Air Temperature Sensor Replacement

Callout	Component Name
1	Heater Core Pipe Side Cover Screw (Qty: 3) CAUTION: Refer to <u>Fastener Caution</u> .
2	Heater Core Pipe Side Cover
3	Evaporator Air Temperature Sensor Procedure 1. Disconnect the electrical connector. 2. Rotate the inside air temperature sensor to remove.

DESCRIPTION AND OPERATION

MANUAL HVAC DESCRIPTION AND OPERATION

The air temperature and the air delivery description and operation are divided into five areas:

- HVAC Control Components
- Air Speed

- Air Delivery
- Heating and A/C Operation
- Recirculation Operation

HVAC Control Components

HVAC Control Assembly

The HVAC control assembly interfaces between the operator and the HVAC system to maintain air temperature and distribution settings. The air temperature and mode doors are controlled by cables. The recirculation actuator is electrically controlled.

There are two different HVAC control assemblies. The first type uses serial data to communicate system messages and requests to other module. The other uses discrete hard-wired signals to communicate commands. The hard-wired HVAC control assembly cannot communicate via serial data.

HVAC control module programming can not be performed on the hard-wired HVAC control assembly.

The HVAC control module supports the following features:

Feature	Availability
Afterblow	NO
Purge	NO
Personalization	NO
Actuator Calibration	NO

Evaporator Temperature Sensor

The evaporator temperature sensor is a two-wire negative temperature co-efficient thermistor. The sensor operates within a temperature range of -40 to +85°C (-40 to +185°F). The sensor is installed at the evaporator and measures its temperature. If the temperature drops under 1°C (34°F), the compressor will be switched off in order to prevent a frozen evaporator.

A/C Refrigerant Pressure Sensor

The engine control module (ECM) monitors the high side refrigerant pressure through the A/C refrigerant pressure sensor. The ECM supplies a 5V reference and a low reference to the sensor. Changes in the A/C refrigerant pressure cause the sensor signal to the ECM to vary. When the pressure is high, the signal voltage is high. When the pressure is low, the signal voltage is low. When pressure is high, the ECM commands the cooling fans on. When pressure is too high or too low, the ECM will inhibit activation of the A/C compressor.

A/C Compressor

The A/C compressor is belt driven and operates when the magnetic clutch is engaged. When the A/C switch is pressed, an A/C request message to the ECM. If the ECM determines that conditions are acceptable for A/C operation, it will ground the A/C compressor clutch relay control circuit, which activate the A/C compressor

clutch relay. With the relay contacts closed, battery voltage is supplied to the A/C compressor clutch. The A/C compressor clutch will engage and the compressor will operate.

Air Speed

The HVAC control assembly applies a ground to the blower motor control circuit that corresponds to the selected blower speed. The resistors and the blower motor are in a series circuit. The following list represents the number of resistors in series with the blower motor per particular speed request:

- Low speed, 3 resistors
- Medium 1 speed, 2 resistors
- Medium 2 speed, 1 resistors

When blower switch is in the Hi speed position, ground is applied directly to the blower motor through the blower switch.

Air Delivery

The HVAC control assembly controls the distribution of air by the use of recirculation actuator and the mechanically controlled mode door. The modes that may be selected are:

- Defrost - Air flow is directed at the windshield
- Defog - Air flow is split between the windshield and floor
- Vent - Air flow is directed to the vents located in the instrument panel
- Bi-Level - Air flow is split between the instrument panel vents and the floor vents
- Floor - Air flow is directed to the floor

The desired air distribution mode can be selected with the air distribution knob at the HVAC control assembly. Depending on the position of the flap, air is distributed through various ducts leading to the outlets in the instrument panel. When the defrost position is selected, the HVAC control assembly will command the recirculation actuator to outside air, reducing window fogging.

Heating and A/C Operation

The purpose of the heating and A/C system is to provide heated and cooled air to the interior of the vehicle. The A/C system will also remove humidity from the interior and reduce windshield fogging. Regardless of the temperature setting, the following can affect the rate that the HVAC system can achieve the desired temperature:

- Recirculation actuator setting
- Difference between inside and desired temperature
- Blower motor speed setting
- Mode setting

When the A/C switch is pressed, an A/C request message to the ECM. If the ECM determines that conditions

are acceptable for A/C operation, it will ground the A/C compressor clutch relay control circuit, which activate the A/C compressor clutch relay. With the relay contacts closed, battery voltage is supplied to the A/C compressor clutch. The A/C compressor clutch will engage and the compressor will operate.

The following conditions must be met in order to activate the A/C compressor:

- Battery voltage is between 9-18 V
- Engine coolant temperature is less than 120°C (248 °F)
- Engine speed is greater than 600 RPM
- Engine speed is less than 6200 RPM
- A/C high side pressure is between 220-3100 kPa (32-450 PSI)
- Throttle position is less than 95%
- Evaporator temperature is greater than 3°C (38°F)
- ECM does not detect an excessive torque load
- ECM does not detect insufficient idle quality
- Outside air temperature is greater than 3°C (38°F)
- Blower motor ON

The temperature door controls the temperature of the air entering the passenger compartment. Air entering the passenger compartment passes through the heater core and/or the evaporator core. The position of the temperature door determines how much air passes through the heater or evaporator core. As the temperature control is moved to a hotter setting, the temperature door will direct more air through the heater core. As the temperature control is moved to a cooler setting, more air will be passed through the evaporator core.

Recirculation Operation

Recirculation Actuator

The recirculation actuator is a two-wire bi-directional electric motor. There are two control circuits that allow actuator operation. The control circuits use either a 0 or 12-volt value to coordinate the actuator movement. When the actuator is at rest, both control circuits have a value of 0 volts. To move the actuator, the HVAC control module grounds one of the control circuits while providing the other with 12 volts. The HVAC control module reverses the polarity of the control circuits to move the actuator in the opposite direction.

BRAKES

Hydraulic Brakes - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
ABC Pedal Module to Dash Panel Retaining Nuts	22	16 lb ft
Brake Master Cylinder Brake Pipe Fittings	18	13 lb ft
Brake Master Cylinder Nuts	13	115 lb in
Front Brake Hose to Brake Caliper Banjo Retaining Bolt	40	30 lb ft
Front Brake Hose to Front Brake Pipe Fitting	18	13 lb ft
Power Brake Booster Pump to Bracket Bolts/Nuts	7	62 lb in
Power Brake Booster Pump Bracket to Transmission Bracket Bolts	22	16 lb ft
Power Brake Booster Pump Bracket to Transmission Case Bolt	22	16 lb ft
Rear Brake Hose to Rear Brake Pipe Fitting	18	13 lb in
Rear Brake Hose to Wheel Cylinder Pipe Fitting	18	13 lb ft
Vacuum Brake Booster to ABC Pedal Module Retaining Nuts	22	16 lb ft

BRAKE COMPONENT SPECIFICATIONS

Brake Component Specifications

Application	Specification	
	Metric	English
Brake Caliper Bleeder Valve- Front	8.5 N.m	75 lb in
Drum Brake Wheel Cylinder Bleeder Valve- Rear	8.5 N.m	75 lb in

BRAKE SYSTEM SPECIFICATIONS

Brake System Specifications

Component	Application	Specification
Brake Fluid	Type Capacity	DOT 4 + 0.5 L (0.528 qts)
Brake Booster	Make Type Size	KDAC Single Vacuum Suspended 231.00 mm (9.094 in)
	Maximum Specification with 445	

Brake Pedal Travel	N.m (100 lbs) of force applied to the pedal with the ignition OFF and the booster power reserve depleted.	XXX mm (XXX in)
Master Cylinder	Type Bore Size Nominal Stroke	Fore/Aft Split 22.22 mm (0.875 in) 32.00 mm (1.260 in)

SCHEMATIC WIRING DIAGRAMS

HYDRAULIC BRAKE WIRING SCHEMATICS

Hydraulic Brakes Wiring Schematics

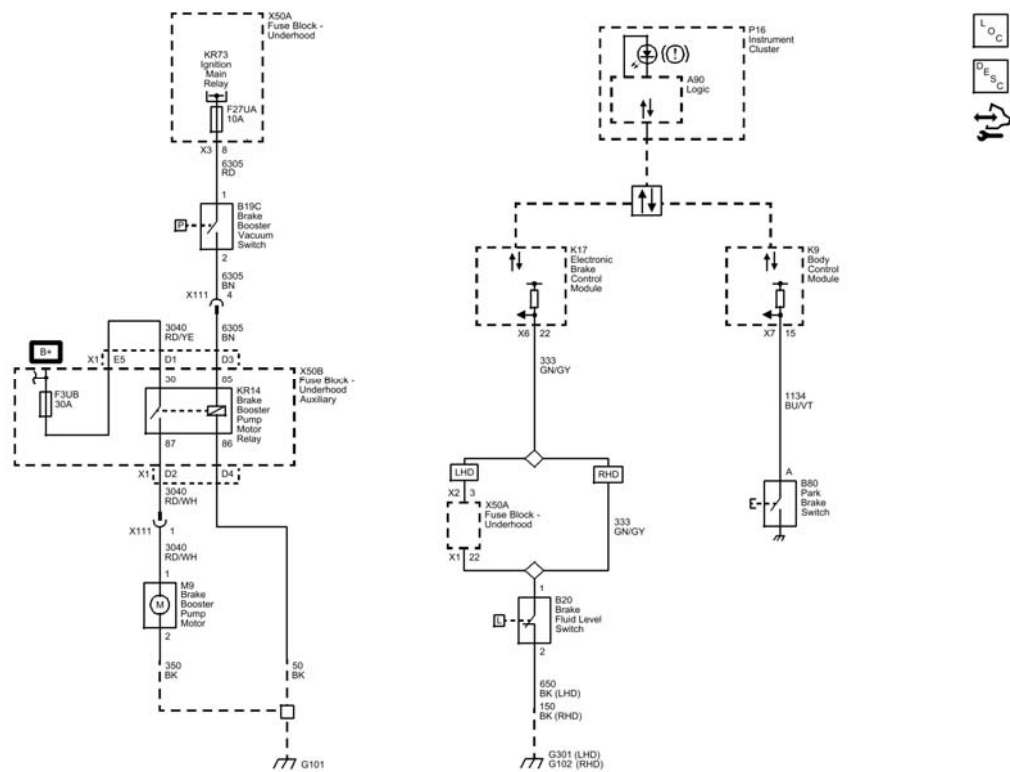


Fig. 1: Hydraulic Brakes Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
-----	-------------

DTC C0267

DTC C0267 Low Brake Fluid Indicated

DTC C0267: LOW BRAKE FLUID**Diagnostic Instructions**

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor**DTC C0267**

Low Brake Fluid Indicated

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	C0267 00	C0267 00	-	-
Ground	-	C0267 00	-	-

Circuit/System Description

The brake fluid level switch monitors the level of the brake fluid in the brake fluid reservoir. When the electronic brake control module sees the brake fluid level switch input open, the DTC is set.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

Low brake fluid level is detected for 5 s.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Brake Warning System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that the brake fluid has the proper level. The fluid level should be above minimum level.
 - **If low**

Refer to **Brake Fluid Loss**.

- **If above minimum level**
2. Ignition ON.
3. Verify the scan tool Brake Fluid Level Sensor parameter. The reading should be Ok.
 - **If the parameter is Low**

Refer to Circuit/System Testing.

- **If the parameter is Ok**
4. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the B20 Brake Fluid Level Switch.
2. Test for less than 10 ohms between the ground circuit terminal 2 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**

3. Ignition ON.
4. Verify the scan tool Brake Fluid Level Sensor parameter is Low.
 - **If the parameter is not Low**
 1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K17 Electronic Brake Control Module.
 - **If the parameter is Low**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and ground.
6. Verify the scan tool Brake Fluid Level Sensor parameter is Ok.
 - **If the parameter is not Ok**
 1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V.
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K17 Electronic Brake Control Module.
 - **If the parameter is Ok**
7. Test or replace the B20 Brake Fluid Level Switch.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Brake Fluid Level Indicator Switch Replacement**
- **Control Module References** for Electronic Brake Control Module replacement, programming and setup.

SYMPTOMS - HYDRAULIC BRAKES

NOTE: The following steps must be completed before using the symptom tables.

1. Perform the **Brake System Vehicle Road Test** before using the hydraulic brake symptom tables in order to duplicate the customers concern.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to the following:
 - **Brake Warning System Description and Operation**
 - **Hydraulic Brake System Description and Operation**
 - **Brake Booster Vacuum Assist Description and Operation**

- **ABS Description and Operation (With FX3)** , **ABS Description and Operation (Without FX3)**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the hydraulic brake system. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components, for obvious damage or conditions, which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Brake Booster Pump Motor Malfunction**
- **Brake Warning Indicator Malfunction**

BRAKE BOOSTER PUMP MOTOR MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Brake Booster Pump Relay B+	1	1	-
Brake Booster Pump Motor B+	1	1	2
Brake Booster Vacuum Switch Ignition	1	1	-
Brake Booster Pump Relay Coil Control	1	1	2
Brake Booster Pump Motor Ground	-	1	-
Brake Booster Pump Relay Ground	-	1	-
1. Brake Booster Pump Always Off 2. Brake Booster Pump Always On			

Circuit/System Description

The brake booster vacuum switch monitors the amount of vacuum available to the power brake booster. When

the vacuum within the system drops, the switch within the brake booster vacuum sensor closes allowing voltage to be supplied to the brake booster pump relay.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Brake Booster Vacuum Assist Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Circuit/System Testing

Brake Booster Pump Motor Inoperative

1. Ignition OFF and all vehicle systems OFF, disconnect the KR14 Brake Booster Pump Motor Relay. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 86 and ground.
 - **If 10 ohms or greater**
 1. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Ignition ON.
4. Verify that a test lamp illuminates between the B+ circuit terminal 30 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**
- 1. Ignition OFF.
- 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, disconnect the M9 brake booster pump motor.
- 1. Test for infinite resistance between the Brake Booster Pump Motor control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the brake booster pump motor.
- **If the test lamp illuminates**
- 5. Connect a 40 A fused jumper wire between the B+ circuit terminal 30 and the control circuit terminal 87.
- 6. Verify the M9 Brake Booster Pump Motor is activated.
 - **If the M9 Brake Booster Pump Motor does not activate**
 - 1. Ignition OFF, disconnect the harness connector at the M9 Brake Booster Pump Motor.
 - 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms.
 - 3. Test for less than 10 ohms between the ground circuit terminal 2 and ground.
 - If 10 ohms or greater, repair the open/high resistance in the ground circuit.
 - If less than 10 ohms, replace the M9 Brake Booster Pump Motor.
 - **If the M9 Brake Booster Pump Motor activates**
- 7. Ignition OFF, disconnect the B19C Brake Booster Vacuum Switch, ignition ON.
- 8. Verify that a test lamp illuminates between the ignition circuit terminal 1 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 - 1. Ignition OFF.
 - 2. Test for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 - 1. Ignition OFF.
 - 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, repair the short to ground on the relay control circuit.
 - **If the test lamp illuminates**
- 9. Verify that a test lamp does not illuminate between the control circuit terminal 2 and ground.
 - **If the test lamp illuminates**

Repair the short to voltage on the circuit.

- **If the test lamp does not illuminate**
- 10. Reconnect the KR14 Brake Booster Pump Motor Relay, connect a 10 A fused jumper wire between the ignition circuit terminal 1 and the control circuit terminal 2 at the harness connector of the B19C Brake Booster Vacuum Switch.
- 11. Verify the M9 Brake Booster Pump Motor is activated.
 - **If the M9 Brake Booster Pump Motor does not activate**
 1. Ignition OFF, disconnect the KR14 Brake Booster Pump Motor Relay.
 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the KR14 Brake Booster Pump Motor Relay.
 - **If the M9 Brake Booster Pump Motor activates**
- 12. Test or replace the B19C Brake Booster Vacuum Switch.

Brake Booster Pump Motor Always On

1. Ignition OFF and all vehicle systems OFF, disconnect the M9 Brake Booster Pump Motor. It may take up to 2 minutes for all vehicle systems to power down.
2. Verify that a test lamp does not illuminate between the Brake Booster Pump Motor control circuit terminal 1 and ground.
 - **If the test lamp illuminates**

Repair the short to voltage on the circuit.
 - **If the test lamp does not illuminate**
3. Disconnect the B19C Brake Booster Vacuum Switch.
4. Verify that a test lamp does not illuminate between the relay control circuit terminal 2 and ground.
 - If the test lamp illuminates, repair the short to voltage on the circuit.
 - If the test lamp does not illuminates, replace the relay.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Power Brake Booster Vacuum Sensor Replacement**
- **Power Brake Booster Pump Replacement (Automatic Transmission), Power Brake Booster Pump Replacement (Manual Transmission), Power Brake Booster Pump Replacement (CVT)**

BRAKE WARNING INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.

- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	C0267 00	1	1	-
Ground	-	1	-	-
1. Brake Warning Indicator Malfunction				

Circuit/System Description

The instrument cluster turns ON the brake warning indicator for 5 s after ignition ON. The body control module monitors the parking brake switch and will request the instrument cluster via serial data to turn the brake warning indicator ON when the parking brake is applied. The electronic brake control module monitors the brake fluid level in the brake fluid reservoir. When the fluid within the brake fluid reservoir is below the minimum level, contacts within the brake fluid level switch closes causing the voltage within the signal circuit to drop. The electronic brake control module will detect the voltage drop and will send a serial data message to the instrument cluster commanding the brake warning indicator to illuminate.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Brake Warning System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that the brake fluid has the proper level. The fluid level should be above minimum level.
 - **If low**

Refer to **Brake Fluid Loss**.

- **If above minimum level**
2. Ignition ON.
 3. Verify the scan tool Brake Fluid Level Sensor parameter. The reading should be Ok.
 - **If the parameter is Low**

Refer to Brake Fluid Level Switch Malfunction.

- **If the parameter is Ok**
4. Verify the brake warning indicator turns ON and OFF, when commanding the instrument cluster All Indicators ON and OFF with a scan tool.
 - **If the brake warning indicator does not turn ON and OFF**

Replace the P16 Instrument Cluster.

- **If the brake warning indicator turns ON and OFF**
5. Verify the scan tool Park Brake Switch parameter changes between Applied and Released while applying and releasing the parking brake.
 - **If the parameter does not change between Applied and inactive**

Refer to Park Brake Switch Malfunction.

- **If the parameter changes between Applied and Released**
6. Apply the parking brake.
 7. Verify the brake warning indicator turns ON.
 - **If the brake warning indicator does not turn ON**

Replace the K9 Body Control Module.

- **If the brake warning indicator turns ON**
8. Release the parking brake.
 9. Verify the brake warning indicator turns OFF.
 - **If the brake warning indicator does not turn OFF**

Refer to Brake Fluid Level Switch Malfunction.

- **If the brake warning indicator turns OFF**
10. All OK.

Circuit/System Testing

NOTE: **Circuit/System Verification must be performed before Circuit/System Testing.**

Park Brake Switch Malfunction

1. Ignition OFF, disconnect the harness connector at the B80 Park Brake Switch.
2. Inspect the B80 Park Brake Switch for physical damage and correct installation.
 - **If physical damage or incorrect installation is found**

Replace the B80 Park Brake Switch.
 - **If physical damage or incorrect installation is not found**
3. Ignition ON.
4. Verify the scan tool Park Brake Switch parameter is Released.
 - **If the parameter is not Released**
 1. Ignition OFF, disconnect the harness connector X7 at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If the parameter Released**
5. Install a 3 A fused jumper wire between the signal circuit terminal A and ground.
6. Verify the scan tool Park Brake Switch parameter is Applied.
 - **If the parameter is not Applied**
 1. Ignition OFF, disconnect the harness connector X7 at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V.
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If the parameter is Applied**
7. Test or replace the B80 Park Brake Switch.

Brake Fluid Level Switch Malfunction

1. Ignition OFF, disconnect the harness connector at the B20 Brake Fluid Level Switch.
2. Test for less than 10 ohms between the ground circuit terminal 2 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.

2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Ignition ON.
4. Verify the scan tool Brake Fluid Level Sensor parameter is Low.
 - **If the parameter is not Low**
 1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K17 Electronic Brake Control Module.
 - **If the parameter is Low**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and ground.
6. Verify the scan tool Brake Fluid Level Sensor parameter is Ok.
 - **If the parameter is not Ok**
 1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V.
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K17 Electronic Brake Control Module.
 - **If the parameter is Ok**
7. Test or replace the B20 Brake Fluid Level Switch.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Brake Fluid Level Indicator Switch Replacement**
- **Parking Brake Indicator Switch Replacement**
- **Control Module References** for control module replacement, programming and setup.

BRAKE PULSATION

Brake Pulsation

Step	Action	Yes	No
DEFINITION: Fluctuation or pulsation is felt through the brake pedal, steering wheel, seat, floor, and/or in the vehicle ONLY when braking.			

1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to <u>Symptoms - Hydraulic Brakes</u>
2	1. Inspect the disc brake system for the following conditions: • Excessive thickness variation of rotor friction surfaces • Excessive assembled lateral runout (LRO) of rotor friction surfaces • Hard spots, heat checks, blueing discoloration of rotor friction surfaces; possibly due to brake drag • Excessive corrosion of rotor friction surfaces; including red, gray or black oxidation • Loose, damaged or missing caliper or lining hardware • Bent of damaged caliper or mounting component • Excessive LRO of wheel hub/axle flange; due to damage and/or loose or excessively worn bearings 2. Adjust, repair or replace components as necessary. Refer to <u>Disc Brake System Diagnosis</u>.		
	Did you find and correct a condition?	Go to Step 4	Go to Step 3
3	1. Inspect the drum brake system for the following conditions: • Out of round or damaged drum • Excessive radial runout of drum friction surface • Hard spots, heat checks, blueing discoloration of drum friction surface; possibly due to brake drag • Bent of damaged drum • Excessive radial runout of wheel hub/axle flange; due to damage and/or loose or excessively worn bearings 2. Adjust, repair or replace components as necessary. Refer to <u>Drum Brake System Diagnosis</u>.		
	Did you find and correct a condition?	Go to Step 4	Go to <u>Symptoms - Hydraulic Brakes</u>

4	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to <u>Brake System Vehicle Road Test</u>.		
	Is the condition still present?	Go to Step 2	System OK

BRAKE SYSTEM NOISE

Brake System Noise

Step	Action	Yes	No
DEFINITION: Vehicle exhibits abnormal noise when braking; vehicle may exhibit abnormal noise during motion just after brake pedal release.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to <u>Symptoms - Hydraulic Brakes</u>
2	1. Inspect the disc brake system for the following conditions: • Lining wear indicator contact with rotor • Debris trapped between rotor and splash shield or backing plate; and/or debris trapped between rotor and linings • Contaminated linings • Aftermarket linings • Glazed linings • Distorted, cracked or damaged linings • Excessively worn linings • Damaged or excessively worn caliper hardware and/or lining hardware • Incorrectly installed, loose or missing caliper hardware and/or lining hardware • Lack of lubrication or excessive corrosion on metal to metal contact surfaces • Bent or damaged splash shield or backing plate • Hard spots, heat checks, blueing discoloration of rotor friction surfaces • Glazed rotor friction surfaces • Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. Refer to <u>Disc Brake System Diagnosis</u>.		

	Did you find and correct a condition?	Go to Step 10	Go to Step 3
3	1. Inspect the drum brake system for the following conditions: • Glazed linings • Contaminated linings • Aftermarket linings • Distorted, damaged or excessively worn linings • Improper adjustment • Weak or damaged return spring or springs • Weak or damaged hold down spring or springs • Cracked, scored, excessively worn or damaged drum • Out of round or damaged drum • Hard spots, heat checks, blueing discoloration of drum friction surface • Threaded or spiral grooves in drum friction surface • Distorted or damaged backing plate • Lack of lubrication on backing plate • Excessive dust or foreign matter in drum 2. Adjust, repair or replace components as necessary. Refer to <u>Drum Brake System Diagnosis</u>.		
	Did you find and correct a condition?	Go to Step 10	Go to Step 4
4	1. Inspect the brake assist system for the following conditions: • Lack of lubrication or excessively worn pushrod or pedal pivots or pivot bushings • Bent or damaged pedal pushrod, pedal and pedal bracket • Damaged or improperly operating vacuum booster and/or check valve, if equipped • Low power steering fluid level, if equipped with hydraulic boost • Improperly tensioned, excessively worn or damaged power steering belt, if equipped with hydraulic boost • Restricted return hose from hydraulic booster, if equipped • Improperly operating hydraulic booster, if equipped		

	• Improperly functioning power steering system, if equipped with a hydraulic booster assembly • Contaminated power steering fluid, if equipped with hydraulic boost 2. Adjust, repair or replace components as necessary. Refer to <u>Brake Assist System Diagnosis</u>.		
	Did you find and correct a condition?	Go to Step 10	Go to Step 5
5	1. Inspect the hydraulic brake system for the following conditions. • Improper operation of wheel cylinder pistons, if equipped • Improper operation of caliper pistons • Contaminated brake fluid 2. Adjust, repair or replace components as necessary. Refer to <u>Hydraulic Brake System Diagnosis</u>.		
	Did you find and correct a condition?	Go to Step 10	Go to Step 6
6	Is the vehicle equipped with a drum-in-rotor type of park brake system?	Go to Step 7	Go to Step 9
7	Ensure the park brake shoes are not adjusted too tightly, possibly causing a noise under certain conditions. Are the park brake shoes adjusted too tightly?	Go to Step 8	Go to Step 9
8	1. Clean and inspect the park brake shoes for excessive wear and/or damage. 2. Inspect the drum portion of the rotors for excessive wear, blueing discoloration, heat spots and excessive radial runout. 3. If any of these conditions are present, replace the affected components. 4. Adjust the park brake system.		
	Did you find and correct a condition?	Go to Step 10	Go to Step 9
9	Inspect the park brake system for proper operation. Refer to <u>Park Brake System Diagnosis</u>. Did you find and correct a condition?	Go to Step 10	Go to <u>Symptoms - Hydraulic Brakes</u>
10	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to <u>Brake System Vehicle Road Test</u>.		
	Is the condition still present?	Go to Step 2	System OK

BRAKING ACTION UNEVEN - PULLS TO ONE SIDE

Test Description

The number below refer to the step number on the diagnostic table:

5

Suspension components that are not operating properly may cause a disturbance to the vehicle during application of the brake system.

6

Steering components that are not operating correctly may cause a disturbance to the vehicle during application of the brake system.

Braking Action Uneven - Pulls to One Side

Step	Action	Yes	No
DEFINITION: Vehicle pulls to one side only when braking.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to <u>Symptoms - Hydraulic Brakes</u>
2	- Inspect the hydraulic brake system for the following conditions: - Kinked, pinched or damaged brake pipe or flexible brake hose - Sticking or improperly operating caliper piston - Sticking or improperly operating wheel cylinder pistons - Brake fluid leak - Adjust, repair or replace components as necessary. Refer to <u>Hydraulic Brake System Diagnosis</u>. Did you find and correct a condition?	Go to Step 7	Go to Step 3
	- Inspect the disc brake system for the following conditions: - Contaminated linings - Glazed linings - Distorted, cracked or damaged linings on one side - Loose, damaged or missing caliper hardware and/or lining hardware - Incorrect linings on one side		

3	• Hard spots, heat checks, blueing discoloration of rotor friction surfaces; possibly due to brake drag • Glazed rotor friction surfaces • Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. Refer to <u>Disc Brake System Diagnosis</u>. Did you find and correct a condition?	Go to Step 7	Go to Step 4
4	1. Inspect the drum brake system for the following conditions: • Improper adjustment or improper adjuster operation • Weak or damaged return spring or springs • Glazed linings • Contaminated linings • Distorted or damaged linings • Incorrect linings on one side • Excessively worn or damaged drum on one side 2. Adjust, repair or replace components as necessary. Refer to <u>Drum Brake System Diagnosis</u>. Did you find and correct a condition?	Go to Step 7	Go to Step 5
5	1. Inspect the suspension system for the following conditions: • Incorrect tire pressure • Loose suspension component connections • Excessively worn or damaged suspension components 2. Adjust, repair or replace components as necessary. Refer to <u>Symptoms - Suspension General Diagnosis</u>. Did you find and correct a condition?	Go to Step 7	Go to Step 6
	1. Inspect the steering system for the following conditions:		

6	- Loose steering component connections - Excessively worn or damaged steering components 2. Adjust, repair or replace components as necessary. Refer to <u>Symptoms - Power Steering System (Electric Power Steering)</u> .		
	Did you find and correct a condition?	Go to Step 7	Go to <u>Symptoms - Hydraulic Brakes</u>
7	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to <u>Brake System Vehicle Road Test</u>.		
	Is the condition still present?	Go to Step 2	System OK

BRAKING ACTION UNEVEN - FRONT TO REAR

Test Description

The number below refers to the step number on the diagnostic table:

5

Suspension components that are not operating properly may cause a disturbance to the vehicle during application of the brake system.

Braking Action Uneven - Front to Rear

Step	Action	Yes	No
DEFINITION: Braking action or stopping force sensitive or grabbing and/or more pronounced at the front or at the rear axle. Sensitive or grabbing brakes: Excessive brake jump-in force relative to brake pedal input.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to <u>Symptoms - Hydraulic Brakes</u>
2	1. Inspect the hydraulic brake system for the following conditions: - Improper operation of wheel cylinder pistons, if equipped - Improper operation of caliper pistons - Kinked, pinched or damaged brake pipe or flexible brake hose - Brake fluid leak - Improperly functioning proportioning valve, if equipped		

	• Improper operation of dynamic rear proportioning (DRP) system, if equipped 2. Adjust, repair or replace components as necessary. Refer to <u>Hydraulic Brake System Diagnosis</u>.		
	Did you find and correct a condition?	Go to Step 7	Go to Step 3
3	1. Inspect the disc brake system for the following conditions: • Contaminated linings • Glazed linings • Distorted, cracked or damaged linings • Excessively worn linings • Aftermarket linings • Damaged or excessively worn caliper hardware and/or lining hardware • Hard spots, heat checks, blueing discoloration of rotor friction surfaces • Glazed rotor friction surfaces 2. Adjust, repair or replace components as necessary. Refer to <u>Disc Brake System Diagnosis</u>.		
	Did you find and correct a condition?	Go to Step 7	Go to Step 4
4	1. Inspect the drum brake system for the following conditions. • Contaminated linings • Improper adjustment • Excessively worn or damaged linings • Weak or damaged return spring or springs • Excessively worn or damaged drums • Hard spots, heat checks, blueing discoloration of drum friction surface • Distorted or damaged backing plate 2. Adjust, repair or replace components as necessary. Refer to <u>Drum Brake System Diagnosis</u>.		
	Did you find and correct a condition?	Go to Step 7	Go to Step 5
	1. Inspect the suspension system for the following conditions:		

5	- Loose suspension component connections - Excessively worn or damaged suspension components 2. Adjust, repair or replace components as necessary. Refer to <u>Symptoms - Suspension General Diagnosis</u>.		
	Did you find and correct a condition?	Go to Step 7	Go to Step 6
6	1. Inspect the brake assist system for the following conditions: - Binding, bent or damaged pedal pushrod, pedal and pedal bracket - Damaged or improperly operating vacuum booster, if equipped - Damaged or improperly operating hydraulic booster, if equipped 2. Adjust, repair or replace components as necessary. Refer to <u>Brake Assist System Diagnosis</u>.		
	Did you find and correct a condition?	Go to Step 7	Go to <u>Symptoms - Hydraulic Brakes</u>
7	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to <u>Brake System Vehicle Road Test</u>.		
	Is the condition still present?	Go to Step 2	System OK

BRAKE PEDAL EXCESSIVE TRAVEL

Brake Pedal Excessive Travel

Step	Action	Yes	No
DEFINITION: Brake pedal travels further than expected to obtain firm pedal and/or firm pedal cannot be obtained, pedal fades away and pedal is spongy.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to <u>Symptoms - Hydraulic Brakes</u>
	Inspect the travel and feel of brake pedal applies. Perform the following: 1. Apply the brake pedal several times to fully deplete the power reserve.		

2	2. With power reserve depleted, apply the brake pedal with light, steady pressure and hold for 15 seconds. Observe pedal travel and feel. 3. Apply the brake pedal with light, steady pressure, then without pumping the pedal, reduce pressure and reapply pressure several times. Observe pedal travel and feel for each apply. 4. Apply the brake pedal slowly, then release and apply the pedal quickly. Observe pedal travel and feel for each apply. Did you complete the brake pedal travel and feel inspections?	Go to Step 3	-
3	1. Inspect the hydraulic brake system for the conditions listed, based on the following symptoms observed during the pedal travel and feel inspections. • Pedal feel was spongy. ○ Air in hydraulic system ○ External brake fluid leaks ○ Soft, weak or damaged hydraulic hoses; expanding under pressure • Pedal fell away and/or traveled to or almost to floor. ○ External brake fluid leaks ○ Poor brake fluid quality; low boiling point ○ Internal brake fluid leaks; improperly functioning master cylinder • Pedal was somewhat firm then dropped slightly and pedal rose with successive applies and pedal travel was different between slow and quick applies. ○ Internal brake fluid leaks; improperly functioning master cylinder ○ Poor brake fluid quality; low boiling point ○ Binding wheel cylinder pistons, if equipped • Pedal returned to rest slowly after any of the applies. ○ Internally damaged flexible brake hoses; hindering fluid return		

	○ Binding caliper pistons ○ Binding wheel cylinder pistons, if equipped ○ Internal brake fluid leaks; improperly functioning master cylinder 2. Repair or replace components as necessary. Refer to <u>Hydraulic Brake System Diagnosis</u>. 3. Re-inspect brake pedal apply travel and feel.		
	Did you find and correct a condition?	Go to Step 9	Go to Step 4
4	1. Inspect the drum brake system, if equipped, for the following conditions: ● Improper adjustment or improper adjuster operation ● Glazed or excessively worn linings ● Cracked, distorted or damaged linings ● Cracked, excessively worn, distorted or damaged drums ● Bell-mouth or barrel-shaped drum friction surface ● Hard spots, heat checks, blueing discoloration of drum friction surface 2. Adjust, repair or replace components as necessary. Refer to <u>Drum Brake System Diagnosis</u>. 3. Re-inspect brake pedal apply travel and feel.		
	Did you find and correct a condition?	Go to Step 9	Go to Step 5
5	1. Inspect the disc brake system for the following conditions: ● Cracked, excessively worn or damaged linings ● Cracked, excessively worn or damaged rotors ● Improperly operating, binding or damaged caliper hardware and/or lining hardware ● Loose or missing caliper hardware and/or lining hardware ● Excessive assembled lateral runout (LRO) of rotor friction surfaces ● Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. Refer to <u>Disc Brake System Diagnosis</u>.		

	3. Re-inspect brake pedal apply travel and feel. Did you find and correct a condition?	Go to Step 9	Go to Step 6
6	Inspect for proper brake pedal travel. Refer to <u>Brake Pedal Travel Measurement and Inspection.</u> Is the brake pedal travel distance within the acceptable limits?	Go to Step 8	Go to Step 7
7	1. Inspect for worn, missing, misaligned, bent or damaged brake pedal system components. - For the brake pedal pushrod component inspection, refer to <u>Brake Pedal Pushrod Inspection.</u> - Inspect the brake pedal bushings for binding, excessive wear and/or damage and inspect the brake pedal for a misaligned, bent, and/or damaged condition. 2. Replace the brake pedal system components that are worn, missing, misaligned, bent or damaged. Did you find and replace any worn, missing, misaligned, bent or damaged brake pedal system components?	Go to Step 9	Go to Step 8
8	1. Inspect the brake assist system for the following conditions: - Vacuum leaks and/or improperly operating check valve, if equipped with vacuum assist - Power steering fluid leaks, if equipped with hydraulic power assist - Damaged or improperly operating brake booster assembly 2. Adjust, repair or replace components as necessary. Refer to <u>Brake Assist System Diagnosis.</u> Did you find and correct a condition?	Go to Step 9	Go to <u>Symptoms - Hydraulic Brakes</u>
9	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to <u>Brake System Vehicle Road Test.</u> Is the condition still present?	Go to Step 2	System OK

BRAKE PEDAL EXCESSIVE EFFORT

Brake Pedal Excessive Effort

Step	Action	Yes	No
DEFINITION: Brake pedal requires an increased amount of input from the driver to obtain good braking action and/or stopping distance is increased.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to <u>Symptoms - Hydraulic Brakes</u>
2	- Inspect the brake assist system for the following conditions: - Vacuum leaks, if equipped with vacuum power assist - Power steering fluid leaks, if equipped with hydraulic power assist - Lack of lubrication, binding or excessively worn pushrod or pedal pivots or pivot bushings - Bent or damaged pedal pushrod, pedal and pedal bracket - Damaged or improperly operating brake booster assembly - Adjust, repair or replace components as necessary. Refer to <u>Brake Assist System Diagnosis</u>.		
	Did you find and correct a condition?	Go to Step 6	Go to Step 3
3	- Inspect the hydraulic brake system for the following conditions: - Binding caliper pistons - Binding wheel cylinder pistons, if equipped - Internally damaged flexible brake hoses; hindering fluid flow - External brake fluid leaks - Kinked or damaged flexible brake hoses and/or pipes - Internal brake fluid leaks; improperly operating master cylinder - Poor brake fluid quality; low boiling point - Adjust, repair or replace components as necessary. Refer to <u>Hydraulic Brake System Diagnosis</u>.		
	Did you find and correct a condition?	Go to Step 6	Go to Step 4
	Inspect the disc brake system for the following conditions:		

4	• Excessively worn linings • Glazed linings • Cracked, distorted or damaged linings • Contaminated linings • Binding, damaged or excessively worn caliper hardware and/or lining hardware • Lack of lubrication or excessive corrosion on metal to metal contact surfaces • Excessively worn or corroded rotor friction surfaces • Glazed rotor friction surfaces • Hard spots, heat checks, blueing discoloration of rotor friction surfaces 2. Adjust, repair or replace components as necessary. Refer to <u>Disc Brake System Diagnosis</u>.		
	Did you find and correct a condition?	Go to Step 6	Go to Step 5
5	1. Inspect the drum brake system, if equipped, for the following conditions: • Excessively worn linings • Improper adjustment or improper adjuster operation • Glazed linings • Cracked, distorted or damaged linings • Contaminated linings • Out of round or damaged drum • Bell-mouth or barrel-shaped drum friction surface • Hard spots, heat checks, blueing discoloration of drum friction surface • Lack of lubrication on backing plate • Excessive dust or foreign matter in drum 2. Adjust, repair or replace components as necessary. Refer to <u>Drum Brake System Diagnosis</u>.		
	Did you find and correct a condition?	Go to Step 6	Go to <u>Symptoms - Hydraulic Brakes</u>
	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper		

6	operation. Refer to <u>Brake System Vehicle Road Test.</u>		
	Is the condition still present?	Go to Step 2	System OK

BRAKES DRAG

Brakes Drag

Step	Action	Yes	No
DEFINITION: Brake system does not fully release or has delayed release; vehicle motion may be hindered by brake system without applying brakes.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to <u>Symptoms - Hydraulic Brakes</u>
2	Is the vehicle equipped with an adjustable stop lamp switch and/or an adjustable cruise control release switch?	Go to Step 3	Go to Step 4
3	1. Inspect the stop lamp switch for proper adjustment to ensure that the brake pedal is fully releasing. 2. Inspect the cruise control release switch, if equipped, for proper adjustment to ensure that the brake pedal is fully releasing.		
	Did you find and correct a condition?	Go to Step 15	Go to Step 4
4	Is the vehicle equipped with a drum-in-rotor type of park brake system?	Go to Step 5	Go to Step 7
5	Ensure the park brake shoes are not adjusted too tightly, possibly causing drag under certain conditions. Are the park brake shoes adjusted too tightly?	Go to Step 6	Go to Step 8
6	1. Clean and inspect the park brake shoes for excessive wear and/or damage. 2. Inspect the drum portion of the rotors for excessive wear, blueing discoloration and heat spots. 3. If any of these conditions are present, replace the affected components. 4. Adjust the park brake system.		
	Did you find and correct a condition?	Go to Step 15	Go to Step 8
	1. Inspect the drum brake system, if equipped, for the following conditions: • Improper adjustment • Weak or damaged return spring or springs • Distorted or damaged linings • Out of round or damaged drum • Weak or damaged hold down spring or		

7	springs • Lack of lubrication on backing plate • Distorted or damaged backing plate 2. Adjust, repair or replace components as necessary. Refer to <u>Drum Brake System Diagnosis</u>.		
	Did you find and correct a condition?	Go to Step 15	Go to Step 8
8	Inspect the park brake system for proper operation. Refer to <u>Park Brake System Diagnosis</u> . Did you find and correct a condition?	Go to Step 15	Go to Step 9
9	1. Inspect the disc brake system for the following conditions: • Binding, incorrectly installed or missing caliper hardware and/or lining hardware- Ensure free movement of linings and of caliper, if equipped with sliding type caliper. • Lack of lubrication or excessive corrosion on metal to metal contact surfaces • Distorted or damaged linings • Damaged or excessively worn caliper hardware and/or lining hardware • Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. Refer to <u>Disc Brake System Diagnosis</u>.		
	Did you find and correct a condition?	Go to Step 15	Go to Step 10
10	1. Separate the brake booster pushrod from the brake pedal. 2. Inspect the brake corners to determine if the brake drag condition is still present.		
	Do the brake corners still exhibit the brake drag condition?	Go to Step 12	Go to Step 11
11	1. Inspect the pushrod for improper position and/or damage. Correctly position or replace the pushrod if necessary. 2. Inspect the brake pedal assembly for damage and replace if necessary.		-
	Did you complete the repair or replacement?	Go to Step 15	
	1. For vacuum boost systems, disconnect the vacuum check valve from the booster to relieve vacuum reserve.		

12	2. Separate the master cylinder from the brake booster. Do not disconnect any brake pipes. 3. Inspect the brake corners to determine if the brake drag condition is still present.		
	Do the brake corners still exhibit the brake drag condition?	Go to Step 14	Go to Step 13
13	Replace the brake booster assembly. Did you complete the replacement?	Go to Step 15	-
14	1. Inspect the hydraulic brake system for the following conditions: • Improper operation of wheel cylinder pistons, if equipped • Improper operation of caliper pistons • Contaminated brake fluid • Internally damaged flexible brake hoses; hindering brake release • Damaged or improperly operating master cylinder 2. Adjust, repair or replace components as necessary. Refer to <u>Hydraulic Brake System Diagnosis</u>.		
	Did you find and correct a condition?	Go to Step 15	Go to <u>Symptoms - Hydraulic Brakes</u>
15	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to <u>Brake System Vehicle Road Test</u>.		
	Is the condition still present?	Go to Step 2	System OK

BRAKE SYSTEM SLOW RELEASE

Brake System Slow Release

Step	Action	Yes	No
DEFINITION: Brake system releases and returns to rest slowly; vehicle motion is hindered by brake system briefly after release of brake pedal.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to <u>Symptoms - Hydraulic Brakes</u>
	1. Inspect the hydraulic brake system for the following conditions: • Improper operation of wheel cylinder pistons, if equipped		

2	• Improper operation of caliper pistons • Internally damaged flexible brake hoses; hindering brake release • Contaminated brake fluid • Damaged or improperly operating master cylinder 2. Adjust, repair or replace components as necessary. Refer to <u>Hydraulic Brake System Diagnosis</u>.		
	Did you find and correct a condition?	Go to Step 6	Go to Step 3
3	1. Inspect the brake assist system for the following conditions: • Binding, bent or damaged pedal pushrod, pedal and pedal bracket • Damaged or improperly operating vacuum booster, if equipped • Restricted return hose from hydraulic booster, if equipped • Damaged or improperly operating hydraulic booster, if equipped 2. Adjust, repair or replace components as necessary. Refer to <u>Brake Assist System Diagnosis</u>.		
	Did you find and correct a condition?	Go to Step 6	Go to Step 4
4	1. Inspect the drum brake system, if equipped, for the following conditions: • Weak or damaged return spring or springs • Distorted or damaged linings • Out of round or damaged drum • Lack of lubrication on backing plate • Distorted or damaged backing plate 2. Adjust, repair or replace components as necessary. Refer to <u>Drum Brake System Diagnosis</u>.		
	Did you find and correct a condition?	Go to Step 6	Go to Step 5
	1. Inspect the disc brake system for the following conditions: • Damaged or excessively worn caliper hardware and/or lining hardware • Distorted or damaged linings • Lack of lubrication or excessive corrosion on		

5	metal to metal contact surfaces • Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. Refer to <u>Disc Brake System Diagnosis</u>.		
	Did you find and correct a condition?	Go to Step 6	Go to <u>Symptoms - Hydraulic Brakes</u>
6	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to <u>Brake System Vehicle Road Test</u>.		
	Is the condition still present?	Go to Step 2	System OK

BRAKE FLUID LOSS

Brake Fluid Loss

Step	Action	Yes	No
DEFINITION: Brake fluid level is low not related to lining wear.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to <u>Symptoms - Hydraulic Brakes</u>
2	1. Inspect the following hydraulic brake system components for brake fluid leaks: • Flexible brake hose connections; threaded and bolted • Flexible brake hose crimping joints • Brake pipe fittings • Caliper piston seals • Wheel cylinder piston seals, if equipped • Master cylinder reservoir • Master cylinder reservoir low pressure hose, if equipped • Brake pressure modulator valve (BPMV) assembly, if equipped 2. Repair or replace components as necessary. Refer to <u>Hydraulic Brake System Diagnosis</u>.		
	Did you find and correct a condition?	Go to Step 5	Go to Step 3
	1. Disconnect the vacuum check valve from the booster to relieve vacuum reserve. 2. Separate the master cylinder from the vacuum brake		

3	booster. Do not disconnect any brake pipes. 3. Inspect the rear of the master cylinder for a brake fluid leak. 4. Inspect for brake fluid in the vacuum brake booster. Did you find the brake fluid leak?	Go to Step 4	Go to <u>Symptoms - Hydraulic Brakes</u>
4	Replace the brake master cylinder and the vacuum brake booster. Did you complete the replacement?	Go to Step 5	-
5	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle to confirm proper operation. Refer to <u>Brake System Vehicle Road Test.</u> Is the condition still present?	Go to Step 2	System OK

DISC BRAKE SYSTEM DIAGNOSIS

Test Description

The numbers below refer to the step numbers on the diagnostic table:

9

Lubricant leaks from non-brake system components may come in contact with and contaminate brake system components.

10

Lubricant leaks from non-brake system components may come in contact with and contaminate brake system components.

12

Disc brake rotor shields/backing plates that come in contact with disc brake rotors may cause brake system noise.

15

Disc brake rotor thickness variation that exceeds the maximum acceptable level can cause brake pulsation.

19

Disc brake rotor thickness variation that exceeds the maximum acceptable level can cause brake pulsation.

Disc brake rotor assembled lateral runout (LRO) that exceeds the maximum acceptable level can lead to thickness variation.

Disc Brake System Diagnosis

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the DISC brake system in order to determine if the DISC brake system is operating correctly. You will be directed by the appropriate Symptom table to go to other brake system diagnostic tables as appropriate.			
1	Were you sent here from a Brake Symptom table?	Go to Step 2	Go to <u>Symptoms - Hydraulic Brakes</u>
2	Visually inspect the disc brake pads for the following conditions: Refer to <u>Brake Pad Inspection</u> . • Lining thickness below specifications • Uneven and/or abnormal wear - edge-to-edge and/or side-to-side • Looseness or damage - including brake pad hardware • Evidence of contamination from an external substance Did you find any conditions to indicate a concern with any of the front and/or rear disc brake pads?	Go to Step 3	Go to Step 12
3	Are any of the front disc brake pads contaminated?	Go to Step 8	Go to Step 4
4	Are any of the front disc brake pads worn unevenly?	Go to Step 7	Go to Step 5
5	Are any of the front disc brake pads and/or brake pad hardware loose or damaged?	Go to Step 7	Go to Step 6
6	1. Remove and inspect the worn disc brake pads for glazing, looseness, heat spots or damage. 2. Replace the worn disc brake pads as a complete axle set. Refer to <u>Front Disc Brake Pads Replacement</u> . Did you complete the inspection and replacement?	Go to Step 12	-
	CAUTION: Support the brake caliper with heavy mechanic wire and equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper,		

7	which may cause damage to the brake hose and in turn may cause a brake fluid leak. NOTE: Do NOT disconnect the hydraulic brake flex hoses from the calipers. 1. Remove the front brake caliper, as appropriate, from the mounting bracket and support the brake caliper. Refer to <u>Front Brake Caliper Replacement</u> . 2. Inspect the disc brake caliper mounting bracket and the mounting/sliding hardware for the following conditions: • Binding or seized hardware • Worn, damaged or missing hardware components • Loose, bent, cracked and damaged brake caliper mounting bracket 3. Replace components as required. Refer to <u>Front Brake Caliper Bracket Replacement</u> 4. Replace the unevenly-worn, loose or damaged disc brake pads as a complete axle set. Refer to <u>Front Disc Brake Pads Replacement</u> . Did you complete the inspection and replacement?	Go to Step 12	-
8	1. Inspect the disc brake calipers, brake hoses and brake pipes for evidence of an external brake fluid leak. 2. Replace any components found to be leaking brake fluid. Refer to the following procedures as required: • <u>Front Brake Caliper Overhaul</u> • <u>Front Brake Caliper Replacement</u> • <u>Front Brake Hose Replacement</u> • <u>Brake Pipe Replacement</u> Did you find and correct the source of the leak causing contamination of the brake pads?	Go to Step 11	Go to Step 9
	1. Inspect the wheel drive shaft outer seals for damage and evidence of a grease leak. 2. Replace any wheel drive shaft seal that is found to be leaking grease which may be the source of the		

9	contamination to the brake pads. Refer to <u>Front Wheel Drive Shaft Outer Joint Replacement</u> . Did you find and correct the source of the leak causing contamination of the brake pads?	Go to Step 11	Go to Step 10
10	1. Inspect the automatic transmission cooling system lines, if equipped, for damage and evidence of an external fluid leak which may be the source of the contamination to the pads. 2. Replace any components found to be leaking which may be the source of the contamination to the pads. Did you find and correct the source of the leak causing contamination of the pads?	Go to Step 11	-
11	1. Clean the remaining disc brake system components to remove any traces of the contaminant. CAUTION: Support the brake caliper with heavy mechanic wire and equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak. NOTE: Do NOT disconnect the hydraulic brake flex hoses from the calipers. 2. Remove the front disc brake caliper from the brake caliper mounting bracket and support the brake caliper. Refer to <u>Front Brake Caliper Replacement</u> . 3. Inspect the disc brake caliper mounting/sliding hardware for the following conditions: Refer to <u>Front Disc Brake Mounting and Hardware Inspection</u> . • Binding or seized hardware • Distorted, worn, damaged or missing hardware components		-

	4. Replace the brake mounting/sliding hardware components as required. Refer to <u>Front Disc Brake Mounting and Hardware Inspection</u> . 5. Replace the contaminated brake pads as a complete axle set. Refer to <u>Front Disc Brake Pads Replacement</u> . Did you complete the cleaning, inspection and replacement?	Go to Step 12	
12	1. Check the thickness of each of the disc brake rotors. NOTE: Make the following determination and answer the question individually for EACH rotor. 2. Make a determination for each brake rotor if the brake rotor can be REFINISHED and REMAIN ABOVE the minimum requirements. Refer to <u>Brake Rotor Thickness Measurement</u> .Does the brake rotor meet the minimum requirements for REFINISHING?	Go to Step 13	Go to Step 16
13	NOTE: Make the following determination and answer the question individually for EACH rotor. Inspect each of the brake rotors for thickness variation that exceeds the maximum acceptable level. Refer to <u>Brake Rotor Thickness Variation Measurement</u> .Does the brake rotor exhibit thickness variation that exceeds the maximum acceptable level?	Go to Step 15	Go to Step 14
14	1. Inspect each of the brake rotors for the following surface and wear conditions: Refer to <u>Brake Rotor Surface and Wear Inspection</u> . • Heavy rust and/or pitting • Cracks and/or heat spots • Excessive blueing discoloration • Deep or excessive scoring beyond maximum acceptable level		

	NOTE: Make the following determination and answer the question individually for EACH rotor. 2. Make a determination for each brake rotor if the brake rotor requires refinishing based upon the results of the inspection. 3. If the brake rotor exhibits any of the conditions listed previously, it requires refinishing. Does the brake rotor require REFINISHING?	Go to Step 15	Go to Step 20
15	1. Refinish the brake rotor. Refer to <u>Brake Rotor Refinishing</u> . 2. Inspect the brake rotor thickness. Refer to <u>Brake Rotor Thickness Measurement</u> . Were you able to REFINISH the brake rotor within the minimum requirements?	Go to Step 20	Go to Step 19
16	Is the brake disc at or below the DISCARD requirements?	Go to Step 19	Go to Step 17
17	NOTE: Make the following determination and answer the question individually for EACH rotor. Inspect each of the brake rotors for thickness variation that exceeds the maximum acceptable level. Refer to <u>Brake Rotor Thickness Variation Measurement</u> .Does the brake rotor exhibit thickness variation that exceeds the maximum acceptable level?	Go to Step 19	Go to Step 18
18	1. Inspect each of the brake rotors for the following surface and wear conditions: Refer to <u>Brake Rotor Surface and Wear Inspection</u> . • Heavy rust and/or pitting • Cracks and/or heat spots • Excessive blueing discoloration • Deep or excessive scoring beyond maximum acceptable level NOTE: Make the following determination and answer the question individually for EACH rotor.		

	2. Make a determination for each brake rotor if the rotor requires replacement based upon the results of the inspection. If the brake rotor exhibits any of the conditions listed previously, it requires replacement. Does the brake rotor require REPLACEMENT?	Go to Step 19	Go to Step 20
19	NOTE: Whenever a brake rotor is replaced, the assembled lateral runout (LRO) of the brake rotor must be measured to ensure optimum performance of the disc brakes. Replace the brake rotor. Refer to <u>Front Brake Rotor Replacement</u> .Did you complete the replacement?	Go to Step 22	-
20	NOTE: Make the following determination and answer the question individually for EACH rotor. Inspect each of the brake rotors for assembled lateral runout (LRO) that exceeds the maximum acceptable level. Refer to <u>Brake Rotor Assembled Lateral Runout Measurement</u> .Does the brake rotor exhibit assembled LRO that exceeds the maximum acceptable level?	Go to Step 21	Go to Step 22
21	Correct the LRO for each brake rotor that was determined to have LRO exceeding the maximum acceptable level. Refer to <u>Brake Rotor Assembled Lateral Runout Correction</u> . Did you complete the operation?	Go to Step 22	-
22	Install or connect components that were removed or disconnected during diagnosis. Did you complete the operation?	Disc Brake System OK Return to Symptom Table	-

DRUM BRAKE SYSTEM DIAGNOSIS

Test Description

The number below refers to the step number on the diagnostic table:

18

Drum brake backing plates that come in contact with brake drums may cause brake system noise.

Drum Brake System Diagnosis

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the DRUM brake system in order to determine if the DRUM brake system is operating properly. You will be directed by the appropriate Symptom table to go to other brake system diagnostic tables as appropriate.			
1	Were you sent here from a Brake Symptom table?	Go to Step 2	Go to <u>Symptoms - Hydraulic Brakes</u>
2	1. Remove the brake drums. Refer to <u>Brake Drum Replacement</u> . 2. Inspect the drum brake shoes for the following conditions: • Lining thickness below specifications • Uneven and/or abnormal wear - edge-to-edge and/or side-to-side • Looseness, damage, glazing and incorrect lining material Did you find any conditions to indicate a concern with any of the drum brake shoes?	Go to Step 3	Go to Step 7
3	Are any of the brake shoes contaminated?	Go to Step 4	Go to Step 5
4	1. Inspect the wheel cylinders for evidence of an external brake fluid leak. 2. Replace any wheel cylinder that is found to be leaking brake fluid. Refer to <u>Rear Brake Cylinder Replacement</u> . Did you complete the inspection and replacement?	Go to Step 6	-
5	1. Inspect the drum brake hardware for any components which are worn, damaged, discolored due to stress, broken or missing. Refer to <u>Drum Brake Hardware Inspection</u> . 2. Replace components as required. Refer to <u>Drum Brake Hardware Replacement</u> . 3. Replace the drum brake shoes. Refer to <u>Brake Shoe Replacement</u> . Did you complete the inspection and replacement?	Go to Step 8	-
	1. Clean the remaining drum brake system components to remove any traces of the contaminants. 2. Inspect the drum brake hardware for any components which are worn, damaged, discolored due to stress, broken or missing. Refer to <u>Drum</u>		

6	<u>Brake Hardware Inspection</u> . - Replace the drum brake hardware components as required. Refer to <u>Drum Brake Hardware Replacement</u> . - Replace the contaminated brake shoes. Refer to <u>Brake Shoe Replacement</u> . Did you complete the cleaning, inspection and replacement?	Go to Step 8	-
7	- Inspect the drum brake hardware for any components which are worn, damaged, discolored due to stress, broken or missing. Refer to <u>Drum Brake Hardware Inspection</u> . - Replace components as required. Refer to <u>Drum Brake Hardware Replacement</u> . Did you complete the inspection and, if necessary, the replacement?	Go to Step 8	-
8	- Check the diameter of each of the brake drums. NOTE: Make the following determination and answer the question individually for EACH rotor. - Make a determination for each brake drum if the drum can be REFINISHED and REMAIN ABOVE the minimum requirements. Refer to <u>Brake Drum Diameter Measurement</u> .Does the brake drum meet the minimum requirements for REFINISHING?	Go to Step 9	Go to Step 11
	- Inspect each of the brake drums for the following surface and wear conditions: Refer to <u>Brake Drum Surface and Wear Inspection</u> . - Braking surface conditions - Heavy rust and/or pitting - Cracks and/or heat spots - Excessive blueing discoloration - Missing balance weights - Braking surface wear conditions		

9	○ Deep or excessive scoring beyond maximum acceptable level ○ Radial runout beyond maximum acceptable level NOTE: Make the following determination and answer the question individually for EACH rotor. 2. Make a determination for each brake drum if the drum requires refinishing based upon the results of the inspection. If the brake drum exhibits any of the following conditions, it requires refinishing: ● Drum exhibits one or more of the braking surface conditions listed previously. ● Drum is beyond the acceptable level in one or more of the braking surface wear conditions listed previously Does the brake drum require REFINISHING?	Go to Step 10	Go to Step 14
10	1. Refinish the brake drum. Refer to <u>Brake Drum Refinishing</u> . 2. Inspect the brake drum diameter. Refer to <u>Brake Drum Diameter Measurement</u> . Were you able to REFINISH the brake drum within the minimum requirements?	Go to Step 14	Go to Step 13
11	Is the brake drum at or below the DISCARD requirements?	Go to Step 13	Go to Step 12
	1. Inspect each of the brake drums for the following surface and wear conditions: Refer to <u>Brake Drum Surface and Wear Inspection</u> . ● Braking surface conditions ○ Heavy rust and/or pitting ○ Cracks and/or heat spots ○ Excessive blueing discoloration ○ Missing balance weights ● Braking surface wear conditions		

	○ Missing balance weights ○ Radial runout beyond maximum acceptable level NOTE: Make the following determination and answer the question individually for EACH rotor. 2. Make a determination for each brake drum if the drum requires replacement based upon the results of the inspection. If a brake drum exhibits any of the following conditions, it requires replacement: • Drum exhibits one or more of the braking surface conditions listed previously • Drum is beyond the acceptable level in one or more of the braking surface wear conditions listed previously		
12	Does the brake drum require REPLACEMENT?	Go to Step 13	Go to Step 14
13	Replace the brake drum. Refer to <u>Brake Drum Replacement</u> . Did you complete the replacement?	Go to Step 14	-
14	Inspect the brake shoes for proper adjustment. Refer to <u>Drum Brake Adjustment</u> . Are the brake shoes adjusted properly?	Go to Step 18	Go to Step 15
15	Inspect the components of the brake drum adjustment hardware system for free movement and correct operation. Refer to <u>Drum Brake Adjusting Hardware Inspection</u> . Do the drum brake adjusting hardware components operate freely and correctly?	Go to Step 17	Go to Step 16
16	Replace the drum brake adjusting hardware components as necessary. Refer to <u>Drum Brake Adjusting Hardware Replacement</u> . Is the replacement complete?	Go to Step 17	-
17	Adjust the drum brake shoes. Refer to <u>Drum Brake Adjustment</u> . Were you able to complete the adjustment?	Go to Step 20	Return to Symptom Table
18	Inspect the drum brake backing plate for the following: • Excessive wear or rust • Damage and/or evidence of contact with the brake drum		

	Does the drum brake backing plate exhibit any of these conditions?	Go to Step 19	Go to Step 20
19	Repair or replace the drum brake backing plate as necessary. Refer to <u>Rear Brake Backing Plate Replacement</u> . Did you complete the repair or replacement?	Go to Step 20	-
20	Install or connect components that were removed or disconnected during diagnosis. Did you complete the operation?	Drum Brake System OK Return to Symptom Table	-

HYDRAULIC BRAKE SYSTEM DIAGNOSIS

Hydraulic Brake System Diagnosis

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the HYDRAULIC brake system in order to determine if the HYDRAULIC brake system is operating properly. You will be directed by the appropriate Symptom table to go to other brake system diagnostic tables as appropriate.			
1	Were you sent here from a Brake Symptom table?	Go to Step 2	Go to <u>Symptoms - Hydraulic Brakes</u>
2	Inspect and adjust the brake fluid level in the brake master cylinder. Refer to <u>Master Cylinder Reservoir Filling</u> . Was the brake fluid level low?	Go to Step 3	Go to Step 4
3	- Inspect the brake fluid for the following conditions, indicating brake fluid contamination: - Fluid separation, indicating two types of fluid are present - Swirled appearance - oil-based substance - Layered appearance - silicone-based substance - Fluid discoloration - Cloudy appearance - moisture - Dark appearance/suspended particles in fluid - dirt, rust, corrosion, brake dust - Inspect the master cylinder reservoir cap diaphragm and the reservoir-to-master cylinder grommets for swelling, indicating fluid contamination. Do any of the above conditions exist?	Go to Step 5	Go to Step 6
	Inspect the brake fluid for the following conditions, indicating brake fluid contamination:		

4	• Fluid separation, indicating two types of fluid are present ○ Swirled appearance - oil-based substance ○ Layered appearance - silicone-based substance • Fluid discoloration ○ Cloudy appearance - moisture ○ Dark appearance/suspended particles in fluid - dirt, rust, corrosion, brake dust 2. Inspect the master cylinder reservoir cap diaphragm and the reservoir-to-master cylinder grommets for swelling, indicating fluid contamination. Do any of the above conditions exist?		
5	1. Flush the hydraulic brake system. Refer to <u>Hydraulic Brake System Flushing</u>. 2. If the brake fluid WAS contaminated with an oil-based or a silicone-based fluid, indicated by fluid separation and/or a swollen master cylinder reservoir cap diaphragm and/or swollen reservoir-to-master cylinder grommets, perform the following steps. Refer to the procedures indicated. 1. Remove ALL of the following components listed. Each component contains internal rubber seals/linings which have been contaminated. 2. Clean out the hydraulic brake pipes using denatured alcohol and equivalent. 3. Dry the brake pipes using non-lubricated, filtered air. 4. Repair or replace ALL of the following components listed. Each component contains internal rubber seals/linings which have been contaminated. • Replace the brake master cylinder reservoir cap diaphragm. • <u>Master Cylinder Replacement (Right Hand Drive), Master Cylinder Replacement (Left Hand Drive)</u> • Brake master cylinder reservoir: Clean the brake master cylinder reservoir using denatured alcohol and equivalent, then dry the reservoir using non-lubricated, filtered air and if necessary, replace the		-

	brake master cylinder reservoir. • <u>Front Brake Hose Replacement</u> • <u>Rear Brake Hose Replacement</u> • <u>Front Brake Caliper Overhaul</u> • <u>Front Brake Caliper Replacement</u> • <u>Rear Brake Cylinder Replacement</u> • <u>Brake Proportion Valve Replacement (Left Hand Drive), Brake Proportion Valve Replacement (Right Hand Drive)</u>, if equipped • <u>Brake Pressure Modulator Valve Replacement</u> , if equipped 3. If the brake fluid was NOT contaminated with an oil-based fluid, but WAS contaminated with water or dirt, rust, corrosion, and/or brake dust, replace the brake master cylinder reservoir cap diaphragm which may have allowed moisture or dirt to enter the system. 4. Refill and bleed the hydraulic brake system. Refer to <u>Hydraulic Brake System Bleeding (Manual)</u>, <u>Hydraulic Brake System Bleeding (Pressure)</u>. Did you complete the operation and any required repairs and/or replacements?		
6	1. Inspect the following hydraulic brake system components for external fluid leaks. Repair or replace any of the components found to be leaking brake fluid. Refer to the appropriate procedures: • Brake master cylinder reservoir cap diaphragm • <u>Master Cylinder Replacement (Right Hand Drive), Master Cylinder Replacement (Left Hand Drive)</u> • <u>Front Brake Hose Replacement</u> • <u>Rear Brake Hose Replacement</u> • <u>Brake Pipe Replacement</u> • <u>Front Brake Caliper Overhaul</u> • <u>Front Brake Caliper Replacement</u> • <u>Brake Proportion Valve Replacement (Left Hand Drive), Brake Proportion Valve Replacement (Right Hand Drive)</u>, if equipped • <u>Brake Pressure Modulator Valve Replacement</u> , if equipped 2. If you repaired or replaced any of the brake system		

	components listed, bleed the hydraulic brake system. Refer to <u>Hydraulic Brake System Bleeding (Manual)</u>, <u>Hydraulic Brake System Bleeding (Pressure)</u>. While bleeding the hydraulic brake system, observe for the following conditions: • The presence of air in the system at a bleeder valve location other than at the repair location, except if the brake master cylinder, and/or the proportioning valve assembly, was replaced • An unrestricted and even flow of brake fluid per axle during the bleeding procedure		
	Did you find and correct a condition?	Go to Step 7	Go to Step 12
7	Was there air in the system at a bleeder valve location other than at the repair location, except if the brake master cylinder, and/or the proportioning valve assembly, was replaced?	Go to Step 19	Go to Step 8
8	Was the flow of brake fluid unrestricted and even per axle during the bleeding procedure?	Go to Step 9	Go to Step 10
9	Inspect the hydraulic function of the brake calipers and/or wheel cylinders, if equipped for proper operation. Refer to <u>Hydraulic Brake Component Operation Visual Inspection</u>. Was the hydraulic function of the brake calipers/wheel cylinders operating properly?	Go to Step 21	Go to Step 14
10	Was the flow of brake fluid restricted or uneven through front axle hydraulic components during the bleeding procedure?	Go to Step 13	Go to Step 11
11	Was the flow of brake fluid restricted or uneven through rear axle hydraulic components during the bleeding procedure?	Go to Step 17	-
12	Inspect the hydraulic function of the brake calipers/wheel cylinders for proper operation. Refer to <u>Hydraulic Brake Component Operation Visual Inspection</u>. Was the hydraulic function of the brake calipers/wheel cylinders operating properly?	Go to Step 15	Go to Step 13
13	Determine if the brake caliper is restricting the flow of brake fluid and/or not operating properly: 1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Remove the tire and wheel assemblies. Refer to <u>Tire and Wheel Removal and Installation</u> . 3. Open the suspected brake caliper bleeder valve. 4. Using a large C-clamp, compress the brake caliper piston and observe for an unrestricted flow of brake		

	fluid and for free movement of the brake caliper piston. 5. Close the caliper bleeder valve. Was the flow of brake fluid unrestricted and did the caliper piston move freely?	Go to Step 17	Go to Step 14
14	Repair or replace any brake caliper/wheel cylinder that was not operating properly. Refer to the appropriate procedure. • <u>Front Brake Caliper Overhaul</u> • <u>Front Brake Caliper Replacement</u> • <u>Rear Brake Cylinder Replacement</u> Did you complete the repair and/or replacement?	Go to Step 21	-
15	Bleed the hydraulic brake system to observe for the presence of air in the system and to observe for an unrestricted and even flow of brake fluid per axle during the bleeding procedure. Refer to <u>Hydraulic Brake System Bleeding (Manual)</u>, <u>Hydraulic Brake System Bleeding (Pressure)</u>. Was there air in the system?	Go to Step 19	Go to Step 16
16	Was the flow of brake fluid unrestricted and even per axle during the bleeding procedure?	Go to Step 21	Go to Step 17
17	1. Inspect the hydraulic brake pipes and flexible brake hoses for signs of a fluid restriction; such as being bent, kinked, pinched or damaged. Refer to <u>Brake Pipe and Hose Inspection</u>. 2. Replace any of the hydraulic brake pipes and/or flexible brake hoses found to be bent, kinked, pinched and damaged. Refer to the following procedures as necessary: • <u>Front Brake Hose Replacement</u> • <u>Rear Brake Hose Replacement</u> 3. If none of the hydraulic brake pipes or flexible brake hoses were visibly bent, kinked, pinched and damaged, replace the hydraulic brake flex hose at the restricted location. Did you find and correct a condition?	Go to Step 21	Go to Step 18
	1. If equipped with non-ABS, replace the proportioning valve assembly. Refer to <u>Brake Proportion Valve Replacement (Left Hand Drive)</u>, <u>Brake Proportion Valve Replacement (Right Hand Drive)</u>.		

18	2. If equipped with ABS, replace the brake modulator assembly, in order to correct the hydraulic brake dynamic rear proportioning mechanical operation. Refer to <u>Brake Pressure Modulator Valve Replacement</u> . Did you complete the replacement?	Go to Step 21	-
19	1. Inspect the hydraulic brake system components for brake fluid seepage at a seal and/or fitting location, which may have drawn air into the system. 2. Inspect the hydraulic brake system components for evidence of a recent repair, which may have introduced air into the system. 3. Repair or replace any of the components found to be installed incorrectly or seeping brake fluid. Did you find and correct a condition?	Go to Step 21	Go to Step 20
20	1. Inspect the brake master cylinder for internal fluid leaks. Refer to <u>Brake System Internal Leak Test</u>. 2. Repair or replace the brake master cylinder if it is found to be leaking brake fluid internally. Refer to <u>Master Cylinder Replacement (Right Hand Drive)</u>, <u>Master Cylinder Replacement (Left Hand Drive)</u>. Did you find and correct a condition?	Go to Step 21	Return to Symptom Table
21	Install or connect components that were removed or disconnected during diagnosis. Did you complete the operation?	Hydraulic Brake System OK Return to Symptom Table	-

BRAKE ASSIST SYSTEM DIAGNOSIS

Brake Assist System Diagnosis

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the brake ASSIST system in order to determine if the brake ASSIST system is operating properly. You will be directed by the appropriate Symptom table to go to other brake system diagnostic tables as appropriate.			
1	Were you sent here from a Brake Symptom table?	Go to Step 3	Go to Step 2
2	Were you sent here directly from an electrical diagnostic to investigate vacuum as a possible concern?	Go to Step 5	<u>Symptoms - Hydraulic Brakes</u>
3	Inspect for proper brake pedal travel. Refer to <u>Brake Pedal Travel Measurement and Inspection</u>. Is the brake pedal travel distance within the acceptable limits?	Go to Step 5	Go to Step 4

4	- Inspect for worn, missing, misaligned, bent or damaged brake pedal system components. - For the brake pedal pushrod component inspection, refer to <u>Brake Pedal Pushrod Inspection</u>. - Inspect the brake pedal bushings for excessive wear and/or damage and inspect the brake pedal for a misaligned, bent and/or damaged condition. - Replace the brake pedal system components that are worn, missing, misaligned, bent or damaged. Did you find and replace any worn, missing, misaligned, bent or damaged brake pedal system components?	Go to Step 5	Go to <u>Hydraulic Brake System Diagnosis</u>
5	Check the engine vacuum source that supplies vacuum to the vacuum brake booster. Refer to <u>Brake System Vacuum Source Test</u>. Is the vacuum reading within the acceptable limits?	Go to Step 6	Go to Engine Controls Diagnostics Information
6	Does the condition occur during cold start-up conditions?	Go to Step 7	Go to Step 8
7	Check engine vacuum and vacuum pump operation, if equipped, under the same cold start-up conditions. Refer to Engine Controls Diagnostics. Did you find and correct a condition?	Go to Step 22	Go to Step 9
8	During the vacuum source test, did the vacuum booster check valve operate properly?	Go to Step 10	Go to Step 9
9	Replace the vacuum booster check valve. Refer to <u>Power Brake Booster Vacuum Check Valve and Hose Replacement (Left Hand Drive), Power Brake Booster Vacuum Check Valve and Hose Replacement (Right Hand Drive)</u>. Did you complete the replacement?	Go to Step 10	-
10	If equipped with a booster mounted separate vacuum sensor, inspect the vacuum sensor grommet for cracks, cuts, dry-rot and damage. Does the vacuum sensor grommet exhibit any of the conditions listed?	Go to Step 11	Go to Step 12
11	Replace the vacuum sensor grommet. Did you complete the replacement?	Go to Step 12	-
12	- If the vehicle is equipped with a vacuum sensor, install a scan tool. - Using the Data Display function, determine if brake booster vacuum sensor data is available within either the chassis brake controls area or the powertrain engine controls area.		

	Is vacuum sensor data available through the scan tool?	Go to Step 13	Go to Step 12
13	Perform the vacuum booster leak-down test using a scan tool: 1. Release the brake pedal. 2. Accelerate the engine to approximately 3000 RPM, then release the throttle. Wait 2-3 seconds and repeat once. 3. Turn the ignition OFF. 4. Turn the ignition ON. Do not start the engine. 5. Observe and record the vacuum sensor reading on the scan tool over a period of 60 seconds. NOTE: Vacuum readings will decrease by approximately 2.7 kPa (0.8 in Hg) for every 305 m (1000 ft) of elevation above seal level. 6. Determine the rate of vacuum leak. Specification Maximum allowable vacuum leak rate: 10 kPa (3 in Hg) in 60 seconds Was the rate of vacuum leak within the specified allowable range?		
14	1. Deplete the vacuum reserve by pressing the brake pedal several times and by removing the vacuum booster check valve. 2. Separate the master cylinder from the vacuum brake booster. Do not disconnect any brake pipes. Refer to <u>Master Cylinder Replacement (Right Hand Drive), Master Cylinder Replacement (Left Hand Drive)</u>. 3. If equipped with a vacuum seal on the rear of the master cylinder, inspect the seal for damage and correct positioning on the master cylinder. Replace the vacuum seal as necessary. 4. Carefully reinstall the master cylinder to the brake booster. Refer to <u>Master Cylinder Replacement (Right Hand Drive), Master Cylinder Replacement (Left Hand Drive)</u>.		-

	Did you complete the operation?	Go to Step 15	
15	Perform the vacuum booster leak-down test using a scan tool: 1. Release the brake pedal. 2. Accelerate the engine to approximately 3000 RPM, then release the throttle. Wait 2-3 seconds and repeat once. 3. Turn the ignition OFF. 4. Turn the ignition ON. Do not start the engine. 5. Observe and record the vacuum sensor reading on the scan tool over a period of 60 seconds. NOTE: Vacuum readings will decrease by approximately 2.7 kPa (0.8 in Hg) for every 305 m (1000 ft) of elevation above seal level. 6. Determine the rate of vacuum leak. Specification Maximum allowable vacuum leak rate: 10 kPa (3 in Hg) in 60 seconds Was the rate of vacuum leak within the specified allowable range?	Go to Step 22	Go to Step 21
16	1. Separate the master cylinder from the vacuum brake booster. Do not disconnect any brake pipes. Before removing the master cylinder, first deplete the vacuum by removing the check valve or applying the brake pedal several times. Refer to <u>Master Cylinder Replacement (Right Hand Drive), Master Cylinder Replacement (Left Hand Drive)</u>. 2. If equipped with a vacuum seal on the rear of the master cylinder, inspect the seal for damage and correct positioning on the master cylinder. 3. If equipped with a vacuum seal that is part of the booster, inspect the seal for damage. Does the vacuum seal exhibit any of the conditions listed?	Go to Step 17	Go to Step 18
	1. If equipped with a vacuum seal on the rear of the		

17	master cylinder, replace the vacuum seal as necessary. Ensure the seal is positioned correctly during installation. - If equipped with a vacuum seal that requires replacement and which is part of the booster, the booster assembly must be replaced. - Carefully install the master cylinder to the brake booster. Refer to <u>Master Cylinder Replacement (Right Hand Drive), Master Cylinder Replacement (Left Hand Drive)</u>. Did you complete the replacement?	Go to Step 18	-
18	Perform the vacuum booster functional test: - If still separated, reinstall the master cylinder to the booster. Refer to <u>Master Cylinder Replacement (Right Hand Drive), Master Cylinder Replacement (Left Hand Drive)</u>. - If the engine was started after reinstalling the master cylinder to the booster, perform the following: - With the engine OFF, depress the brake pedal several times to deplete the vacuum reserve. - Depress and maintain moderate foot pressure on the brake pedal - Start the engine and observe pedal operation. - Observe for audible vacuum leaks. The brake pedal should fall slightly, then hold. Is there an audible vacuum leak coming from the brake pedal area?	Go to Step 21	Go to Step 19
19	Did the brake pedal fall slightly after the engine was started, then hold?	Go to Step 20	Go to Step 21
	Perform the vacuum booster leak-down test: - Release the brake pedal. - Accelerate the engine to approximately 3000 RPM, then release the throttle. Wait 2-3 seconds and repeat once. - Turn the ignition OFF.		

20	4. Wait 60 seconds. 5. Depress the brake pedal 2 times to check for vacuum booster available vacuum reserve. Observe pedal effort. - Both pedal applies should be assisted. - The amount of assist could diminish slightly with the second apply.		
	Were both pedal applies power assisted?	Go to Step 22	Go to Step 21
21	Replace the vacuum brake booster. Refer to <u>Power Vacuum Brake Booster Replacement (Left Hand Drive), Power Vacuum Brake Booster Replacement (Right Hand Drive)</u> . Did you complete the replacement?	Go to Step 22	-
22	Install or connect the components that were removed or disconnected during diagnosis. Did you complete the operation?	Brake Assist System OK Return to Symptom Table	-

BRAKE SYSTEM VEHICLE ROAD TEST

Preliminary Inspections

1. Visually inspect easily accessible brake system components for obvious damage and/or leaks which may indicate that the vehicle should not be driven until further inspections have been completed.
2. Inspect the brake master cylinder reservoir fluid level and adjust only if necessary for brake system road testing. Refer to **Master Cylinder Reservoir Filling**.
3. Inspect the tire inflation pressures and adjust as necessary.
4. Inspect the tire tread patterns to ensure that they are the same or very similar, especially per axle.
5. Ensure that the vehicle is not loaded unevenly prior to brake system road testing.

Road Testing Procedure

WARNING: Road test a vehicle under safe conditions and while obeying all traffic laws. Do not attempt any maneuvers that could jeopardize vehicle control. Failure to adhere to these precautions could lead to serious personal injury and vehicle damage.

1. Start the engine and allow it to idle.
2. Visually inspect if the brake warning indicator lamp remains illuminated.
3. If the brake system warning lamp remains illuminated, DO NOT proceed to test drive the vehicle until it is diagnosed and repaired. Refer to **Symptoms - Hydraulic Brakes**.
4. Select a smooth, dry, clean and level road or large lot that is as free of traffic and obstacles as possible for

brake system low speed road testing.

5. With the transmission in PARK or Neutral, lightly apply the brake pedal. Observe both the pedal feel and the pedal travel.
 - If the brake pedal apply felt spongy and the pedal travel was excessive, DO NOT drive the vehicle until it is repaired.
 - If the brake pedal apply did not feel spongy and the pedal travel was excessive, proceed to step 6.
6. Release and apply the brakes.
7. While continuing to apply the brakes, shift the transmission into DRIVE or 1st, release the brakes and allow the engine to idle the vehicle away from the stopped position. Observe for a slow release of the brake system.
8. With the aid of an assistant to observe the vehicle's performance from outside of the vehicle, drive the vehicle at a low speed and lightly apply the brakes while driving past the assistant. Have the assistant observe for brake system noise from the side of the vehicle closest to them, while you observe both the pedal effort and the pedal travel.
 - If the brake pedal apply effort was excessive and the pedal travel was excessive, DO NOT continue to test drive the vehicle until it is repaired.
 - If the brake pedal apply effort was not excessive and the pedal travel was not excessive, proceed to step 9.
9. Drive the vehicle in the opposite direction, at the same low speed and lightly apply the brakes while driving past the assistant. Have the assistant observe for brake system noise from the side of the vehicle closest to the assistant.
10. Drive the vehicle at a low speed and shift the transmission into NEUTRAL without applying the brakes. Observe for a rapid deceleration in vehicle speed, indicating possible brake drag.
11. Select a smooth, dry, clean and level road that is as free of heavy traffic as possible for brake system moderate speed road testing.
12. Drive the vehicle at a moderate speed. Observe for a pull and/or incorrect tracking of the vehicle without the brakes applied.
13. While continuing to drive the vehicle at a moderate speed, perform several light applies of the brakes. Observe the pedal effort and the pedal travel, observe for brake system noise, pulsation and/or brake drag.
 - If the brake pedal apply effort was excessive and the pedal travel was excessive, DO NOT continue to test drive the vehicle until it is repaired.
 - If the brake pedal apply effort was not excessive and the pedal travel was not excessive, proceed to step 14.
14. While continuing to drive the vehicle at a moderate speed, perform several moderate applies of the brakes. Observe the pedal effort and the pedal travel, observe for brake system pulsation and/or uneven braking action - either side to side and front to rear.

A small amount of vehicle front end dip is expected during a moderate apply of the brakes.

15. If the brake pedal apply effort was excessive and the pedal travel was excessive, DO NOT continue to test drive the vehicle until it is repaired.

BRAKE PEDAL TRAVEL MEASUREMENT AND INSPECTION

Special Tools

CH-28662 Brake Pedal Effort Gauge

For equivalent regional tools, refer to **Special Tools**.

1. With the ignition OFF and the brakes cool, apply the brakes 3-5 times and until the brake pedal becomes firm, in order to deplete the brake booster power reserve.

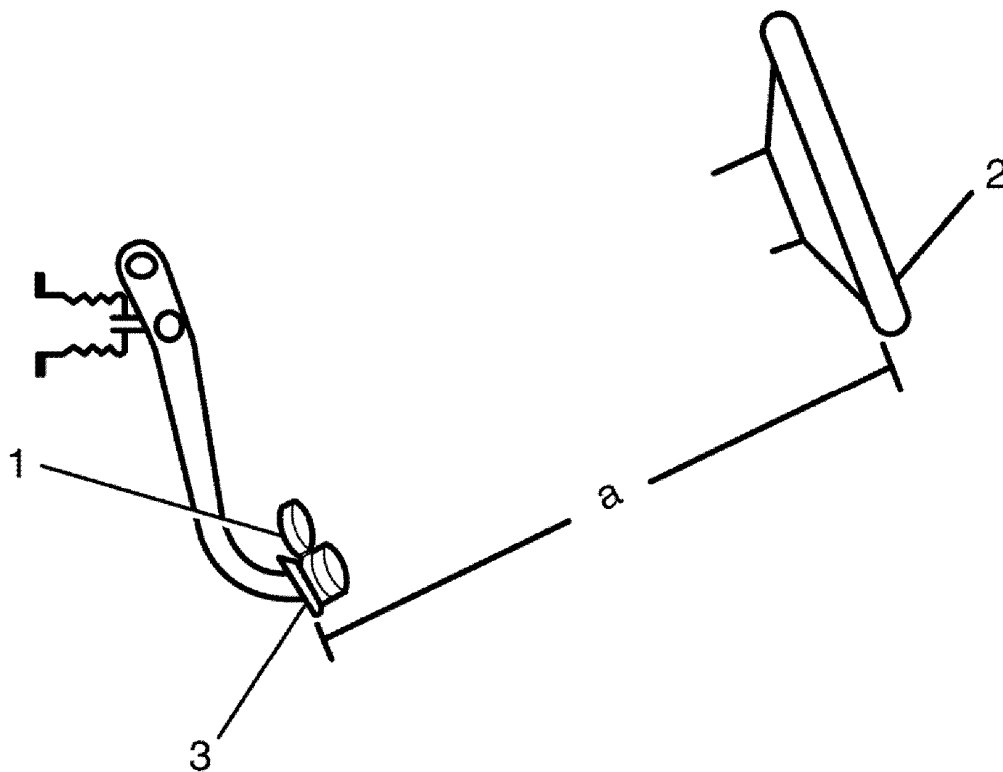


Fig. 2: Steering Wheel, Brake Pedal And Gauge
Courtesy of GENERAL MOTORS COMPANY

2. Install the **CH-28662** gauge (1) and equivalent, to the brake pedal (3).
3. Measure and record the distance (a) from the brake pedal (3) to the rim of the steering wheel (2). Note the points of measurement.

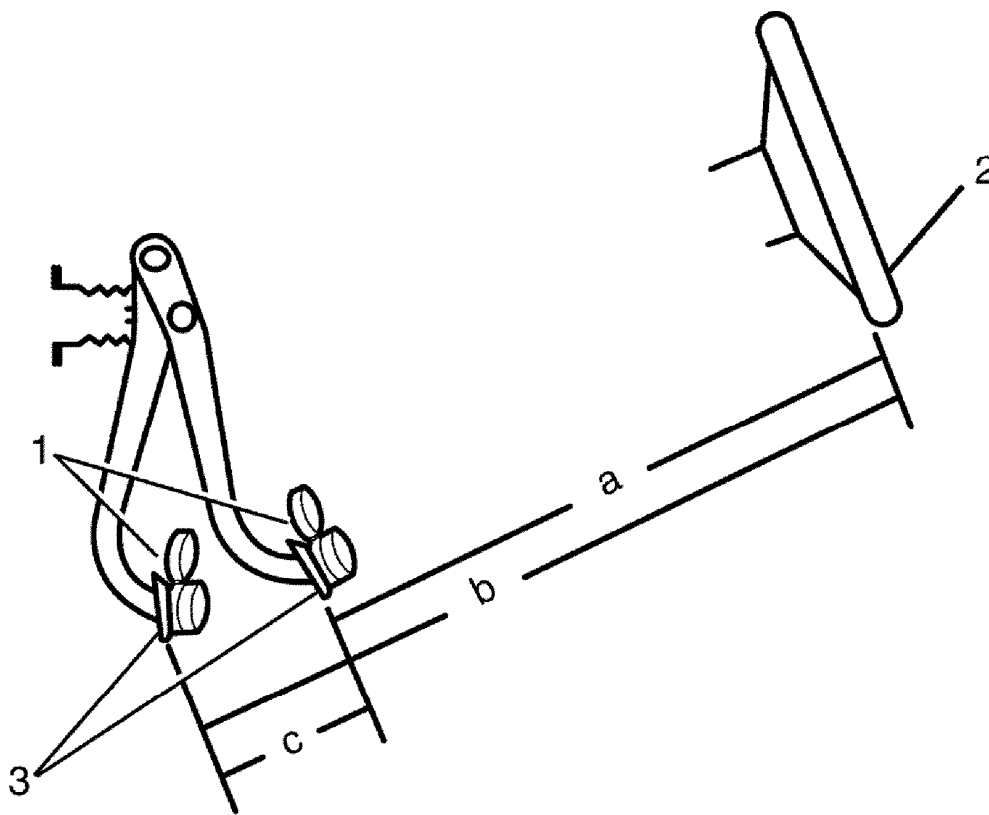


Fig. 3: Brake Pedal Components And Travel Measurement
Courtesy of GENERAL MOTORS COMPANY

4. Apply and maintain a force of 445 N (100 lb) to the brake pedal, as indicated on the **CH-28662** gauge (1) and equivalent.
5. While maintaining 445 N (100 lb) of force to the brake pedal (3), measure and record the distance (b) from the same point on the brake pedal (3) to the same point on the rim of the steering wheel (2).
6. Release the brake pedal (3) and repeat steps 4 and 5 to obtain a second measurement. After obtaining a second measurement, proceed to step 7.
7. Average the first and second measurements recorded for the 2 applies of the brakes.
8. Subtract the initial unapplied distance (a), from the average applied distance (b) to obtain the brake pedal travel measurement (c).

Specification

Maximum brake pedal travel - measured with the ignition OFF, brake booster power assist depleted and

the brakes cool.

BRAKE SYSTEM VACUUM SOURCE TEST

NOTE:

- **Engine temperature, accessory load and elevation level will affect engine vacuum.**
- **Vacuum readings will decrease by approximately 2.7 kPa (0.8 in Hg) for every 305 m (1000 ft) of elevation above sea level.**

1. Disconnect the engine vacuum hose from the vacuum brake booster check valve.
2. Install a vacuum gauge to the engine vacuum hose.
3. Start the engine and allow the engine to idle until normal operating temperatures are reached.

NOTE:

To obtain the gauge pressure from the manifold absolute pressure (MAP) sensor, subtract the absolute pressure of the MAP sensor from atmospheric pressure.

4. With the vehicle in PARK or NEUTRAL with the park brake on, the engine idling and the air conditioning (A/C) system OFF, check to see if the engine vacuum reading is the gauge pressure calculated from the pressure of the MAP sensor indicated on the scan tool.
5. Turn the ignition OFF.
6. If the engine vacuum reading is within the specified normal range, proceed to step 10.
7. If the engine vacuum reading is NOT within the specified normal range, inspect the engine vacuum hose for the following conditions.
 - Loose connection to the engine
 - Collapse, deformation or contamination
 - Cracks, cuts and brittleness
8. If any of these conditions were found with the engine vacuum hose, replace the hose, then repeat steps 2-4.
9. If none of these conditions were found with the engine vacuum hose, then there is an engine vacuum source problem, check the engine vacuum system.
10. Remove the vacuum brake booster check valve from the booster.
11. Install the check valve to the engine vacuum hose.
12. Install the vacuum gauge to the check valve.
13. Start the engine and allow the engine to idle in park or neutral with the park brake on and with the A/C system OFF, until normal operating temperatures are reached.
14. Turn the ignition OFF.

NOTE:

To obtain the gauge pressure from the manifold absolute pressure (MAP) sensor, subtract the absolute pressure of the MAP sensor from atmospheric pressure.

15. Visually inspect the engine vacuum reading is maintained at the same gauge pressure as the pressure obtained from the MAP sensor as indicated on the scan tool.
16. If the engine vacuum reading is maintained within the specified normal range, proceed to step 18.
17. If the engine vacuum reading is NOT maintained within the specified normal range, replace the vacuum brake booster check valve, then repeat steps 11-15.
18. Inspect the vacuum brake booster check valve grommet for the following conditions:
 - Loose connection to the vacuum brake booster
 - Deformation or contamination
 - Cracks, cuts or brittleness
19. If any of these conditions were found with the check valve grommet, replace the grommet.

BRAKE SYSTEM EXTERNAL LEAK INSPECTION

WARNING: Refer to Brake Fluid Irritant Warning .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

1. In order to inspect for external brake fluid leaks, first inspect the fluid level in the master cylinder.

While a slight brake fluid level drop can be considered a normal condition due to brake lining wear, a very low level may indicate a brake fluid leak in the hydraulic system.

2. If the fluid level is abnormally low, adjust the brake fluid level. Refer to **Master Cylinder Reservoir Filling**.
3. Start the engine and allow it to idle.
4. Apply constant, moderate foot pressure to the brake pedal.

If the brake pedal gradually falls away while under foot pressure, there may be a brake fluid leak.

5. Turn the ignition OFF.
6. Visually inspect the following brake system components for brake fluid leaks, excessive corrosion and damage. Give particular attention to all brake pipe and flexible hose connections to ensure that there are not any slight brake fluid leaks - even though the brake pedal may feel firm and hold steady:
 - Master cylinder brake pipe fittings
 - All brake pipe connections
 - Brake pipes
 - Brake hoses and connections
 - Brake calipers and/or wheel cylinders
7. While slight dampness around the master cylinder reservoir can be considered acceptable, brake fluid leaking from any of the brake system components requires immediate attention. If any of these

components exhibit signs of brake fluid leakage, repair or replace those components. After the repair or replacement, reinspect the hydraulic brake system to assure proper function.

BRAKE SYSTEM INTERNAL LEAK TEST

WARNING: Refer to Brake Fluid Irritant Warning .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

1. Start the engine and allow it to idle.
2. Apply light, steady pressure to the brake pedal. Observe both the brake pedal feel and travel.
3. Release the brakes and turn the ignition OFF.
4. If the brake pedal apply felt spongy, but the brake pedal travel was not excessive, perform the following steps:
 1. Inspect the brake system for external leaks. Refer to Brake System External Leak Inspection.
 2. Pressure bleed the brake system in order to purge any air that may be trapped in the system. Refer to Hydraulic Brake System Bleeding (Manual), Hydraulic Brake System Bleeding (Pressure).

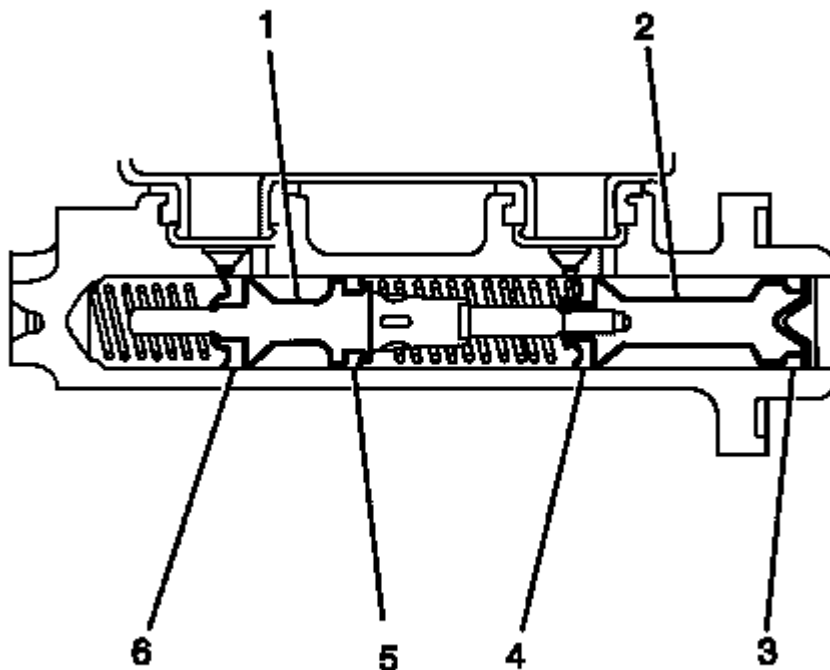


Fig. 4: Master Cylinder Inspection Points
Courtesy of GENERAL MOTORS COMPANY

5. If the brake pedal apply did not feel spongy, but the brake pedal travel was excessive, perform the following steps:
 1. Loosen the master cylinder-to-vacuum brake booster retaining nuts.
 2. Carefully pull the master cylinder away from the vacuum brake booster just enough to inspect the mounting surface of the master cylinder.
 3. Inspect the master cylinder mounting surface at the primary piston (2) for brake fluid leaks.
6. If the master cylinder exhibits any leakage around the primary piston (2), then the primary piston primary seal (4) and/or secondary seal (3) is leaking and the master cylinder requires overhaul or replacement.
7. If the master cylinder primary piston (2) does not exhibit any leakage, pressure bleed the brake system. Refer to **Hydraulic Brake System Bleeding (Manual)**, **Hydraulic Brake System Bleeding (Pressure)**.
8. If the brake pedal apply did not feel spongy and the brake pedal travel was initially steady and not excessive, but then gradually fell, then the master cylinder requires overhaul or replacement due to an internal leak past the secondary piston (1) from the secondary piston primary seal (6) or secondary seal (5).
9. If the brake pedal apply did not feel spongy and the brake pedal travel was initially steady and not excessive, then fell slightly, then became steady again, then the brake pressure modulator valve (BPMV) may be leaking internally and may require replacement.

HYDRAULIC BRAKE COMPONENT OPERATION VISUAL INSPECTION

Disc Brake

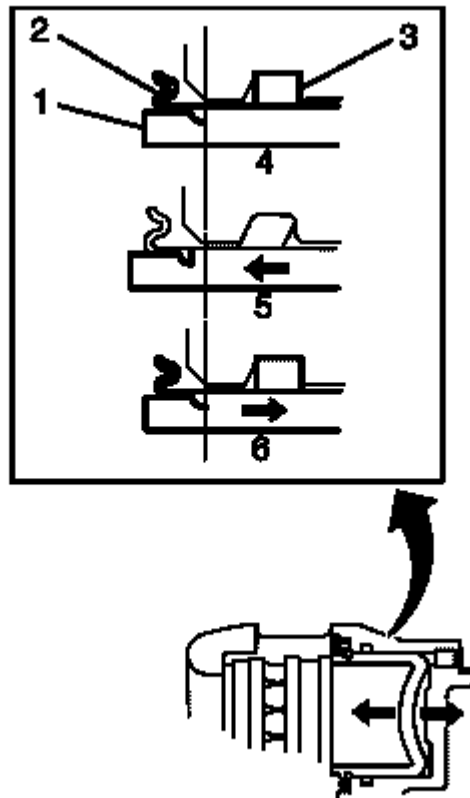


Fig. 5: Hydraulic Brake Component Operation
Courtesy of GENERAL MOTORS COMPANY

1. With the tire and wheel assemblies removed and the brake rotors retained by wheel lug nuts, visually inspect the brake caliper piston dust boot (2) sealing area to ensure that there are no brake fluid leaks.
2. If any evidence of a brake fluid leak is present, the brake caliper requires overhaul or replacement.
3. While the brake system is at rest (4), observe the position of the brake caliper piston (1) in relation to the brake caliper housing.
4. Have an assistant apply and release the brake pedal several times while you observe the operation of the hydraulic brake caliper.
 1. Observe the brake caliper piston (1) for unrestricted and even movement during each apply of the brake system (5).
 2. Observe the brake caliper piston (1) for an unrestricted and even return motion during each release of the brake system (6).
5. If the brake caliper piston (1) did not exhibit unrestricted and even movement during brake system apply and/or release, the piston square seal (3) may be worn or damaged and the brake caliper may require overhaul or replacement.

Drum Brakes

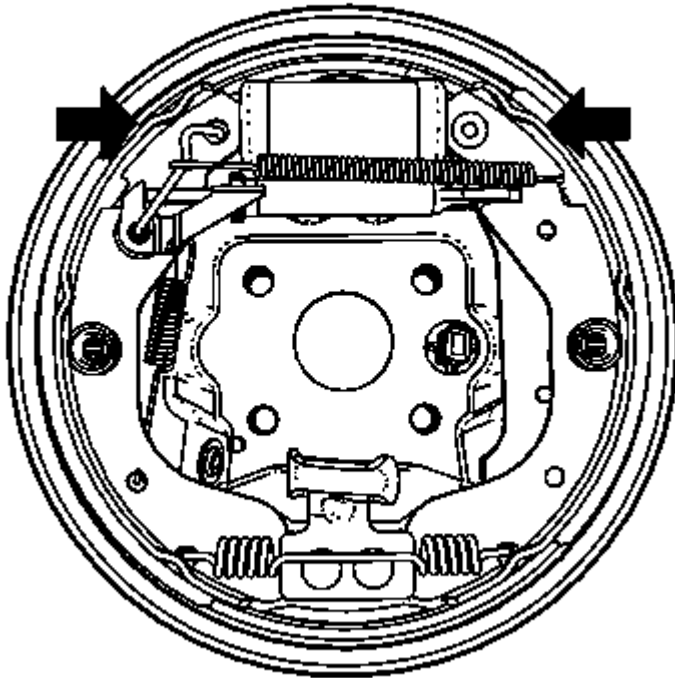


Fig. 6: Wheel Cylinder Piston Boot sealing Areas
Courtesy of GENERAL MOTORS COMPANY

1. With the rear tire and wheel assemblies and the brake drums removed, visually inspect the wheel cylinder pistons boot sealing areas to ensure that there are no brake fluid leaks.
2. If any evidence of a brake fluid leak is present, the brake wheel cylinder requires replacement.
3. Using firm hand pressure, simultaneously and evenly apply force on both brake shoes in order to compress the wheel cylinder pistons into their bore.
4. Evenly release the force from both brake shoes to allow the wheel cylinder pistons to return.
5. If one or both of the wheel cylinder pistons did not exhibit unrestricted and even movement during apply and/or release of force, the wheel cylinder may require replacement.

BRAKE PIPE AND HOSE INSPECTION

WARNING: Refer to Brake Fluid Irritant Warning .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

1. Visually inspect all of the brake pipes for the following conditions:
 - Kinks, incorrect routing, missing or damaged retainers
 - Leaking fittings, excessive corrosion
2. If any of the brake pipes exhibited any of the conditions listed, then the identified pipe and pipes, require replacement.
3. Ensure that the vehicle axles are correctly supported at ride height in order to maintain the proper relationship of the flexible brake hoses to the chassis.

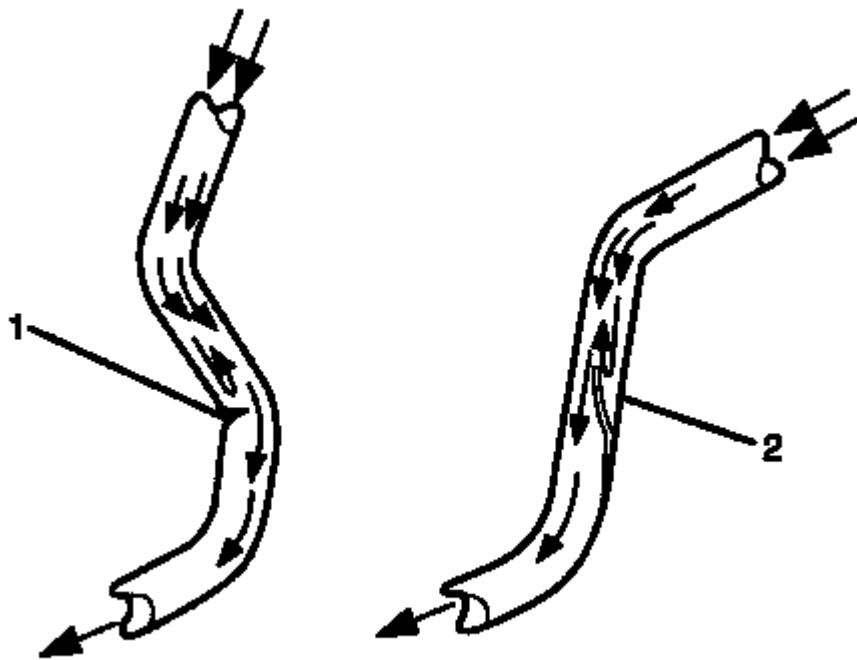


Fig. 7: Flexible Brake Hose Inspection Points
Courtesy of GENERAL MOTORS COMPANY

4. Visually inspect all of the flexible brake hoses for the following conditions:
 - Kinks (1), improper routing, twists, chafing, missing or damaged retainers
 - Leaking connections, perished, cracked, blistered, brittle or bulging hoses
5. If any of the flexible brake hoses exhibited any of the conditions listed, then the identified flexible brake hose and hoses require replacement.
6. Squeeze the flexible brake hoses with firm finger pressure to inspect for soft spots (2), indicating an internal restriction. Inspect the entire length of each flexible brake hose.
7. If any of the flexible brake hoses were found to have soft spots (2), then the identified flexible brake hose and hoses require replacement.

BRAKE PEDAL PUSHROD INSPECTION

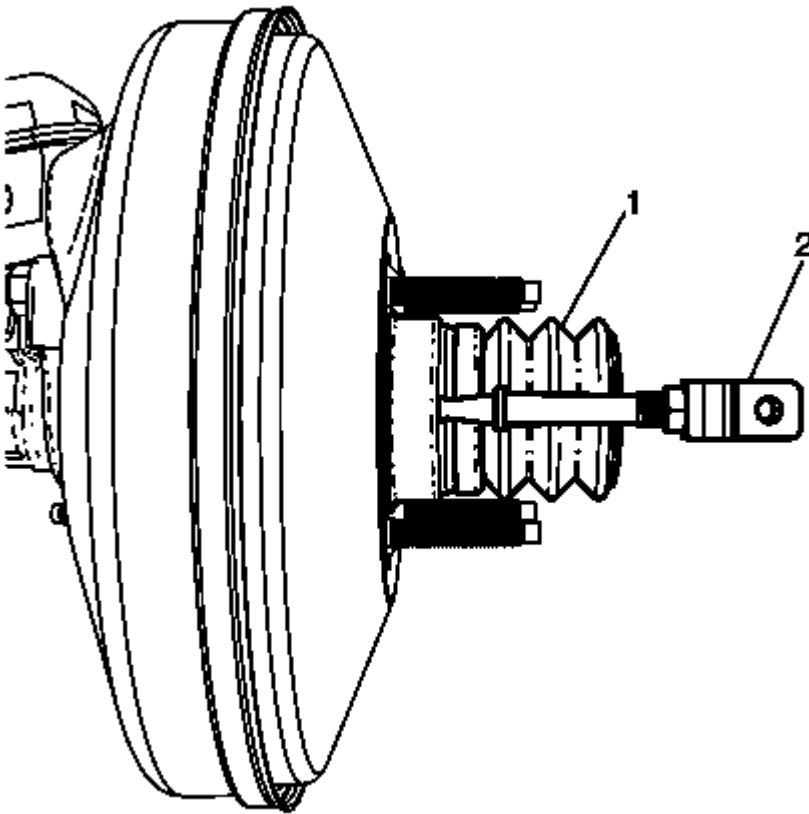


Fig. 8: Brake Pedal Pushrod

Courtesy of GENERAL MOTORS COMPANY

1. Disconnect the brake pedal pushrod (2) from the brake pedal.
2. Reposition the pedal pushrod boot (1) toward the front of the vehicle to expose as much of the pedal pushrod (2) as possible.
3. Inspect the brake pedal pushrod (2) for straightness.
4. If the brake pedal pushrod (2) is not straight, then the pushrod requires replacement.
5. Return the pedal pushrod boot (1) to its original position on the pedal pushrod (2).
6. Connect the brake pedal pushrod (2) to the brake pedal.

REPAIR INSTRUCTIONS

MASTER CYLINDER RESERVOIR FILLING

WARNING: Refer to Brake Fluid Irritant Warning .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

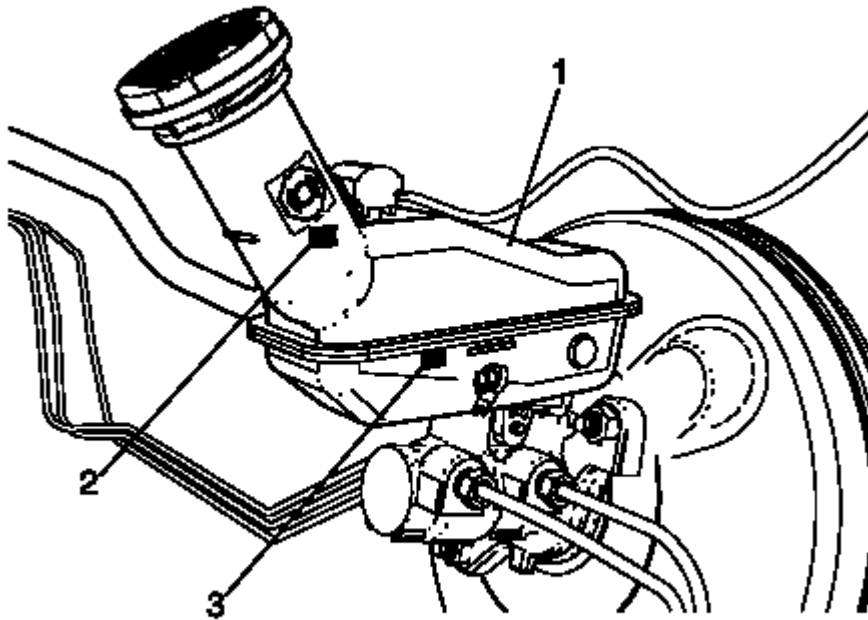


Fig. 9: Brake Master Cylinder Reservoir
Courtesy of GENERAL MOTORS COMPANY

1. Visually inspect the brake fluid level through the brake master cylinder reservoir (1).
2. If the brake fluid level is at or below the minimum allowable level (3) during routine fluid checks, the brake system should be inspected for wear and possible brake fluid leaks.

NOTE: If brake fluid is to be added to the brake master cylinder reservoir (1), clean the outside of the reservoir and around the reservoir cap prior to removing the cap.

3. If the brake fluid level is at or below the minimum allowable level (3) and an inspection of the brake system did not reveal wear or brake fluid leaks, the brake fluid may be topped up to the maximum fill level (2).
4. If a brake system service was just completed, the brake fluid may be topped up to the maximum fill level (2).
5. If the brake fluid level is above the minimum allowable level (3), adding brake fluid is not recommended under normal conditions.

MASTER CYLINDER RESERVOIR REPLACEMENT

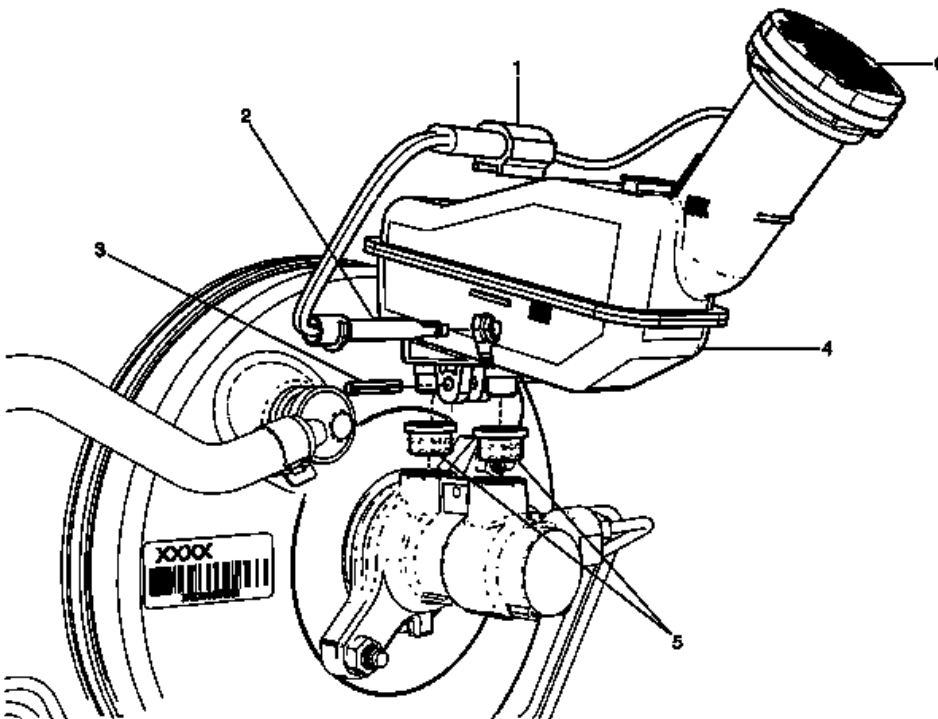


Fig. 10: Master Cylinder Reservoir
Courtesy of GENERAL MOTORS COMPANY

Master Cylinder Reservoir Replacement

Callout	Component Name
WARNING: Refer to <u>Brake Fluid Irritant Warning</u>	
CAUTION: Refer to <u>Brake Fluid Effects on Paint and Electrical Components Caution</u>	
Preliminary Procedure Remove the brake master cylinder. Refer to <u>Master Cylinder Replacement (Right Hand Drive)</u> , <u>Master Cylinder Replacement (Left Hand Drive)</u> .	
1	Brake Fluid Indicator Switch Connector
2	Brake Fluid Level Indicator Switch
3	Brake Master Cylinder Reservoir Pin
4	Brake Master Cylinder Reservoir Procedure Drain the brake fluid from the reservoir.
5	Brake Master Cylinder Reservoir Seal Procedure Apply a small amount of the clean recommended brake fluid to the seals.

MASTER CYLINDER REPLACEMENT (RIGHT HAND DRIVE)**Removal Procedure**

WARNING: Refer to Brake Fluid Irritant Warning .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

1. Place the ignition switch in the OFF position.
2. Remove the radiator surge tank to gain easy tool access. Refer to Radiator Surge Tank Replacement (LL0) , Radiator Surge Tank Replacement (LFM) .
3. Apply and release the brake pedal several times until the pedal becomes firm to deplete the power vacuum brake booster vacuum reserve.
4. Thoroughly clean the master cylinder reservoir and the master cylinder body to remove any dirt and debris.
5. Disconnect the brake fluid level indicator switch electrical connector.

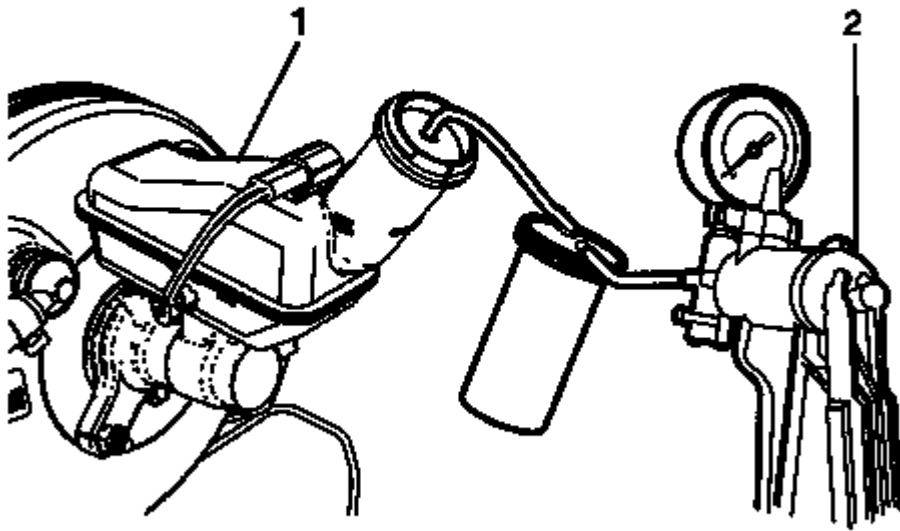


Fig. 11: Master Cylinder Reservoir
Courtesy of GENERAL MOTORS COMPANY

6. Siphon the brake fluid out of the master cylinder reservoir (1) using an air vacuum pump or a hand vacuum pump (2).

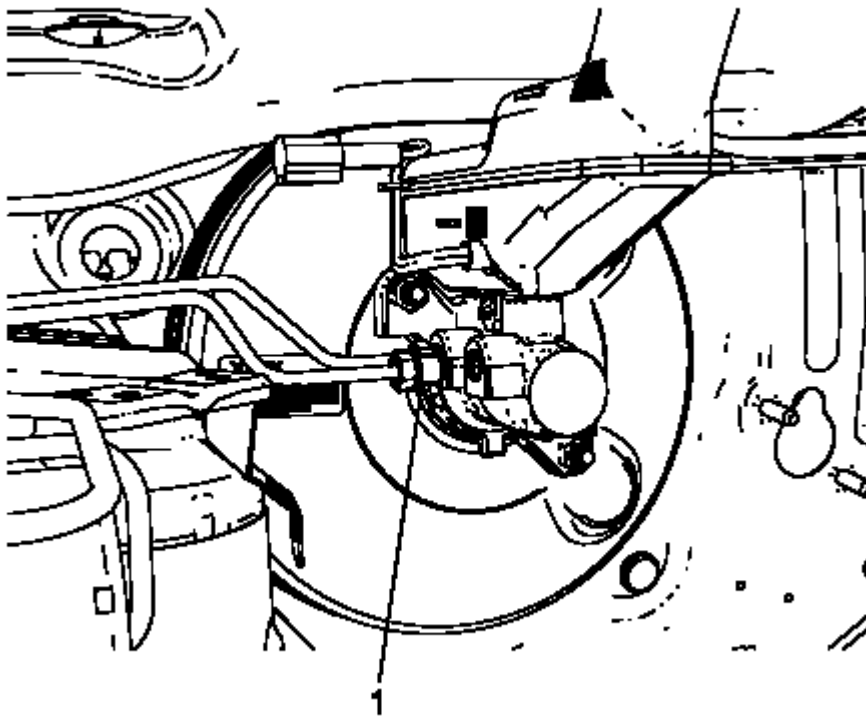


Fig. 12: Master Cylinder Secondary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

7. Disconnect the master cylinder secondary brake pipe fitting (1).

Cap the brake pipe fitting and plug the master cylinder outlet port to prevent brake fluid loss and contamination.

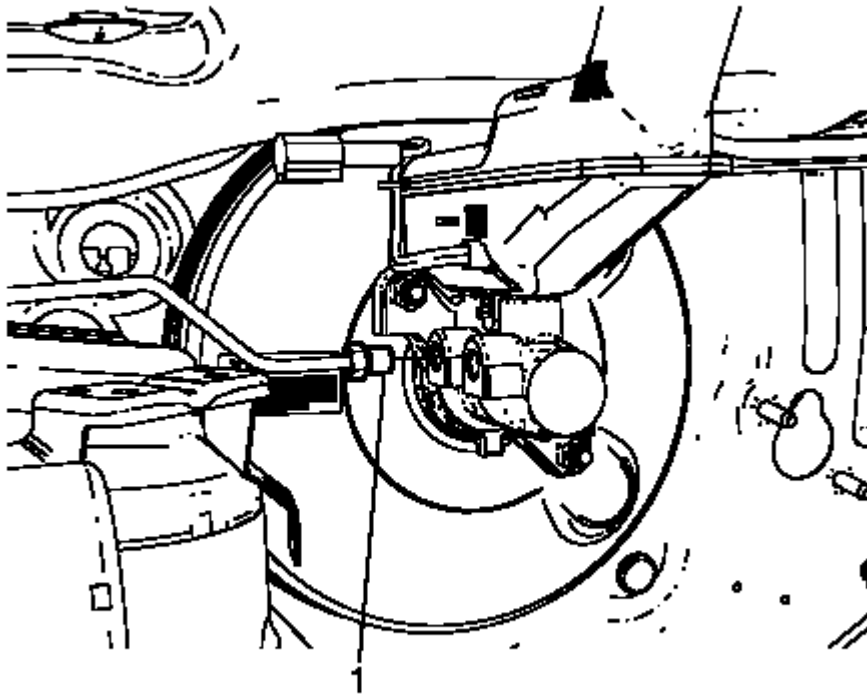


Fig. 13: Master Cylinder Primary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

8. Disconnect the master cylinder primary brake pipe fitting (1).

Cap the brake pipe fitting and plug the master cylinder outlet port to prevent brake fluid loss and contamination.

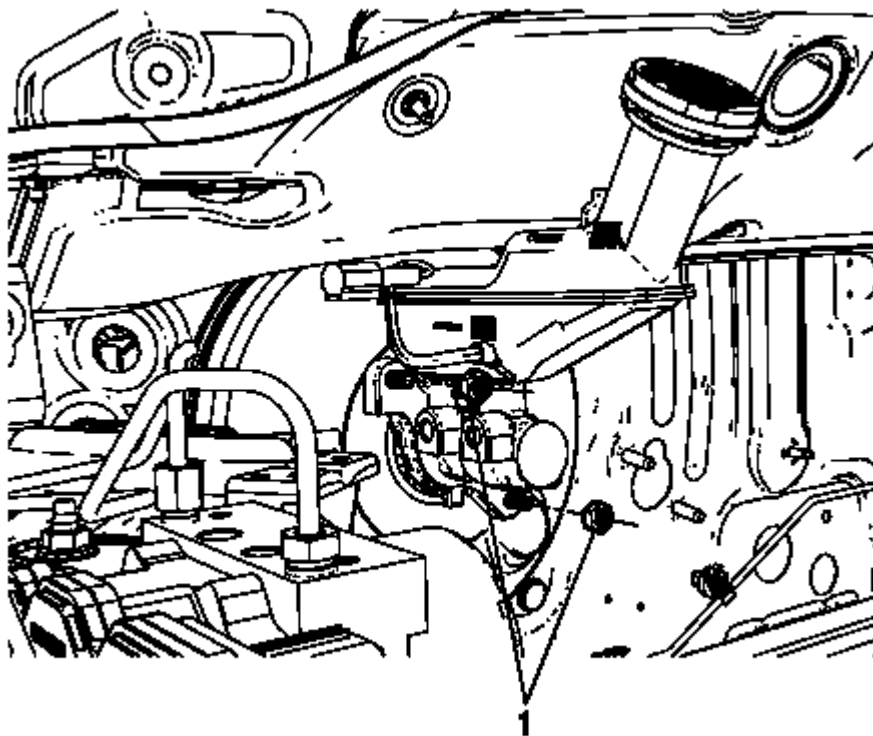


Fig. 14: Master Cylinder Nuts

Courtesy of GENERAL MOTORS COMPANY

9. Remove the master cylinder nuts (1).

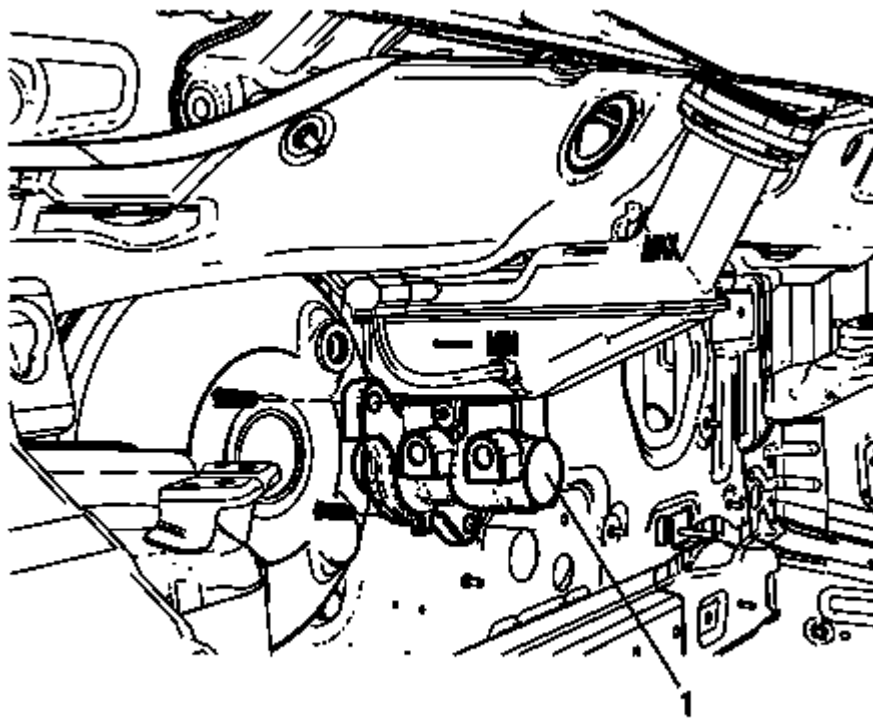


Fig. 15: Master Cylinder

Courtesy of GENERAL MOTORS COMPANY

10. Remove the master cylinder (1) from the power vacuum brake booster.
11. Remove the brake fluid level indicator switch, if necessary. Refer to **Brake Fluid Level Indicator Switch Replacement**.
12. Remove the master cylinder reservoir, if necessary. Refer to **Master Cylinder Reservoir Replacement**.

Installation Procedure

1. Install the master cylinder reservoir, if removed. Refer to **Master Cylinder Reservoir Replacement**.
2. Bench bleed the master cylinder. Refer to **Master Cylinder Bench Bleeding**.
3. Install the brake fluid level indicator switch, if removed. Refer to **Brake Fluid Level Indicator Switch Replacement**.

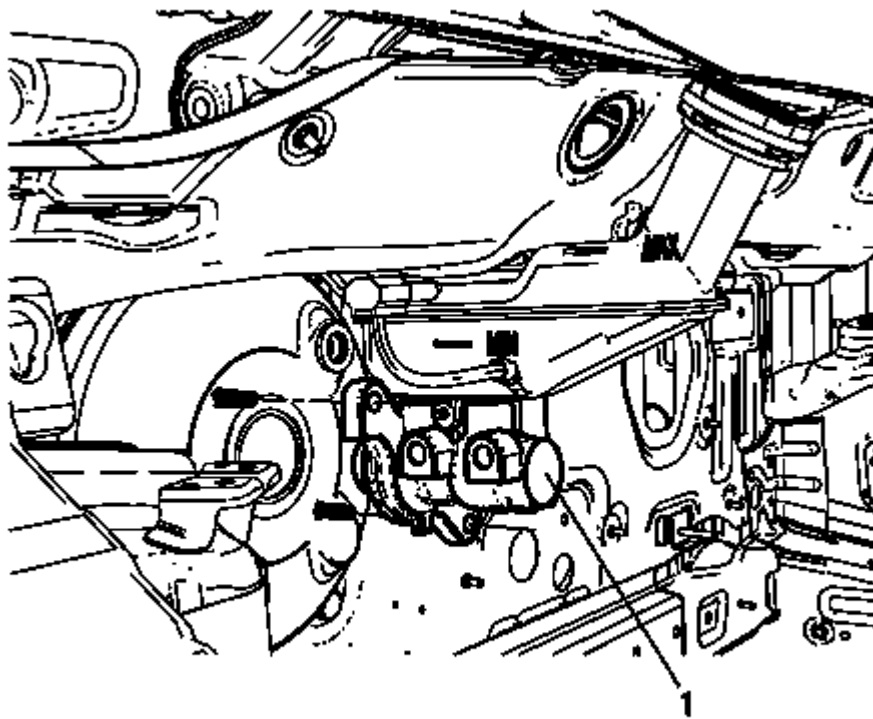


Fig. 16: Master Cylinder

Courtesy of GENERAL MOTORS COMPANY

4. Install the master cylinder (1) to the power vacuum brake booster.

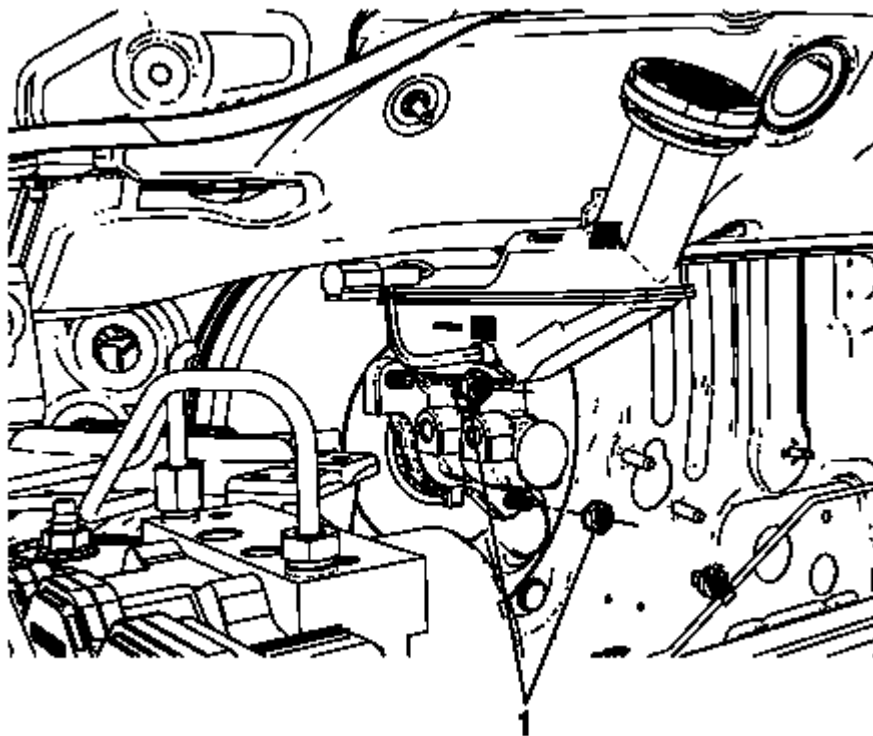


Fig. 17: Master Cylinder Nuts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

5. Install the master cylinder nuts (1) and tighten the nuts to 13 N.m (115 lb in).

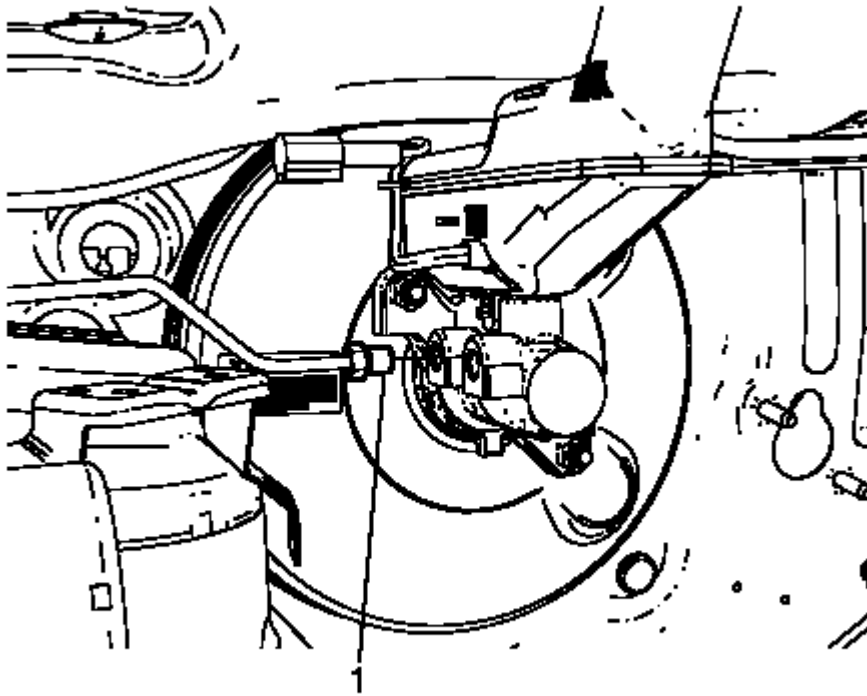


Fig. 18: Master Cylinder Primary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

6. Connect the master cylinder primary brake pipe fitting (1) and tighten to 18 N.m (13 lb in).

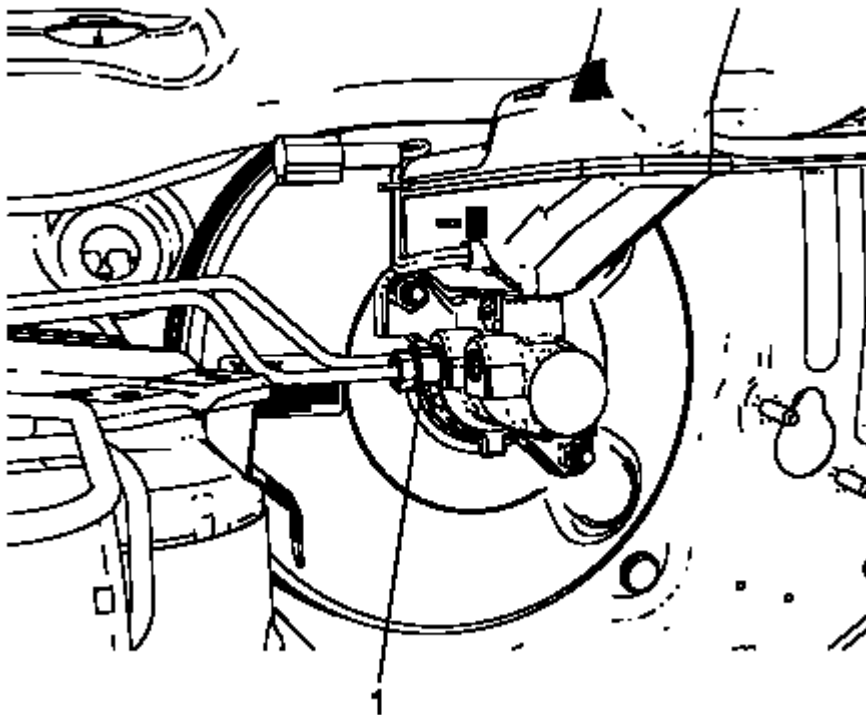


Fig. 19: Master Cylinder Secondary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

7. Connect the master cylinder secondary brake pipe fitting (1) and tighten to 18 N.m (13 lb in).
8. Connect the brake fluid level indicator switch electrical connector.
9. Install the radiator surge tank. Refer to **Radiator Surge Tank Replacement (LL0)** , **Radiator Surge Tank Replacement (LFM)** .
10. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)**, **Hydraulic Brake System Bleeding (Pressure)**.

MASTER CYLINDER REPLACEMENT (LEFT HAND DRIVE)

Removal Procedure

WARNING: Refer to **Brake Fluid Irritant Warning** .

CAUTION: Refer to **Brake Fluid Effects on Paint and Electrical Components Caution** .

1. Place the ignition switch in the OFF position.

2. Remove the battery. Refer to **Battery Replacement** .
3. Remove the air cleaner and air inlet hose as an assembly. Refer to **Air Cleaner Assembly Replacement** .

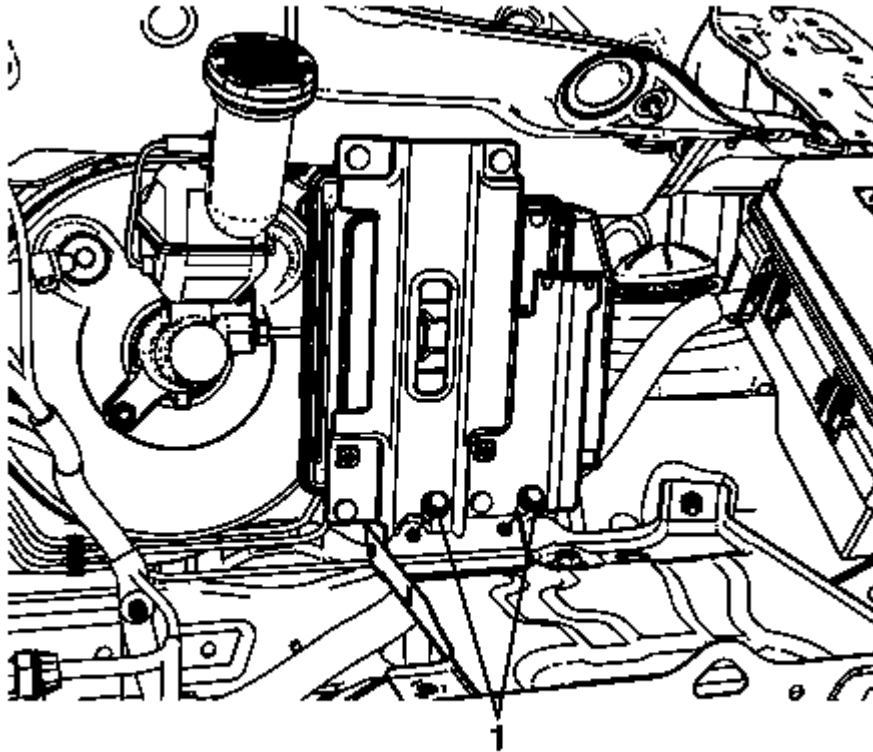


Fig. 20: Engine Control Module (ECM) Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove the engine control module (ECM) bracket bolts (1) and position the ECM and ECM bracket aside. Refer to **Engine Control Module Replacement** .
5. Apply and release the brake pedal several times until the pedal becomes firm to deplete the power vacuum brake booster vacuum reserve.
6. Thoroughly clean the master cylinder reservoir and the master cylinder body to remove any dirt and debris.
7. Disconnect the brake fluid level indicator switch electrical connector.

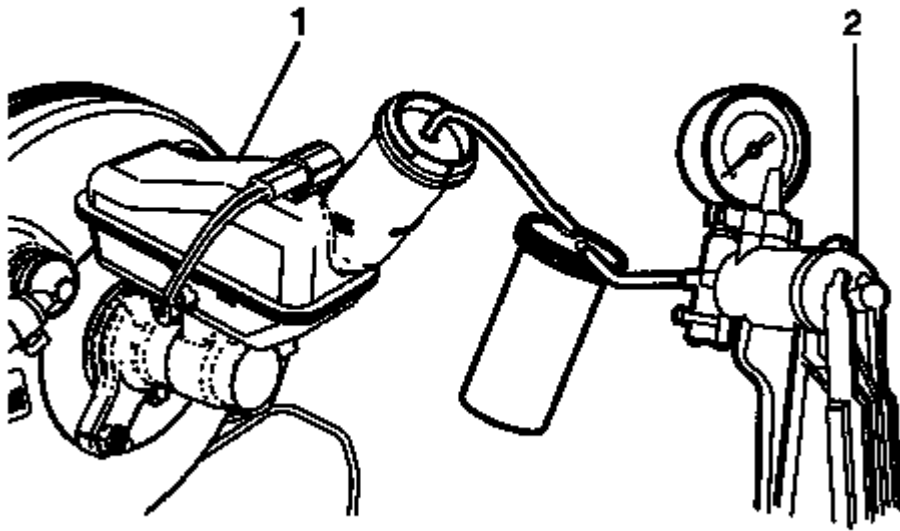


Fig. 21: Master Cylinder Reservoir

Courtesy of GENERAL MOTORS COMPANY

8. Siphon the brake fluid out of the master cylinder reservoir (1) using an air vacuum pump or a hand vacuum pump (2).

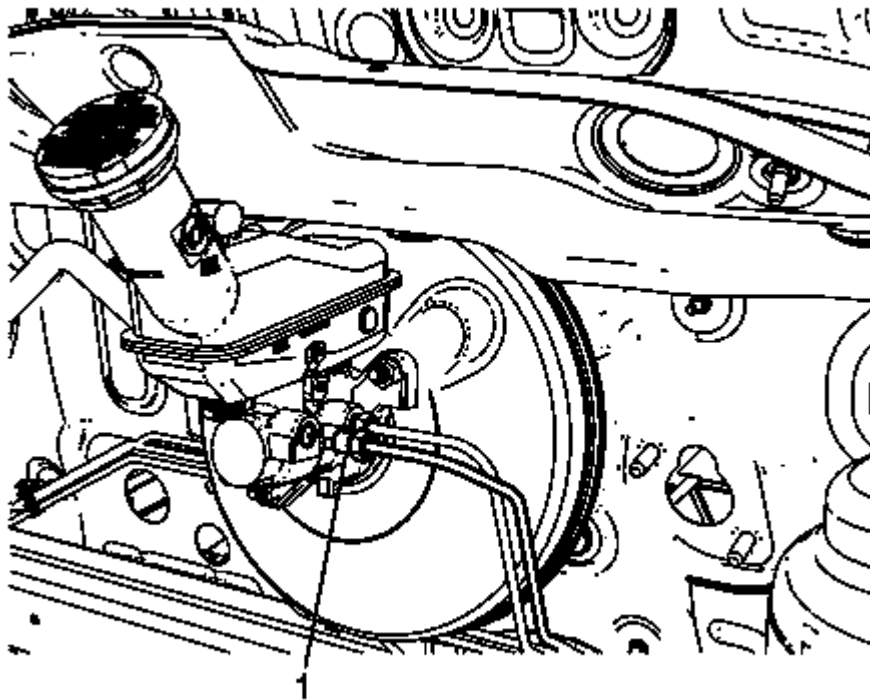


Fig. 22: Master Cylinder Secondary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

9. Disconnect the master cylinder secondary brake pipe fitting (1).

Cap the brake pipe fitting and plug the master cylinder outlet port to prevent brake fluid loss and contamination.

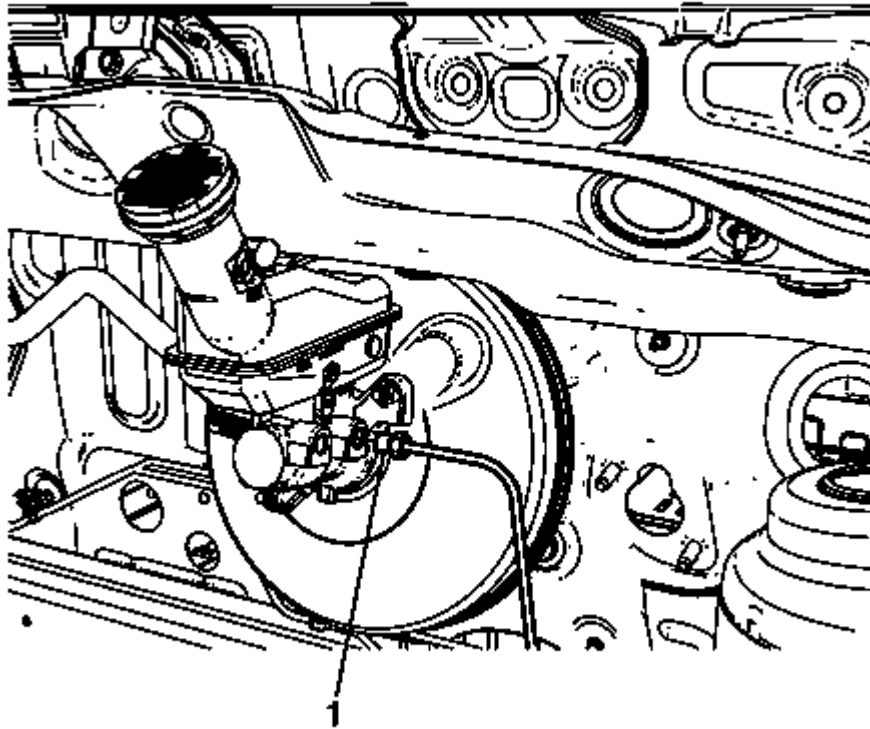


Fig. 23: Master Cylinder Primary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

10. Disconnect the master cylinder primary brake pipe fitting (1).

Cap the brake pipe fitting and plug the master cylinder outlet port to prevent brake fluid loss and contamination.

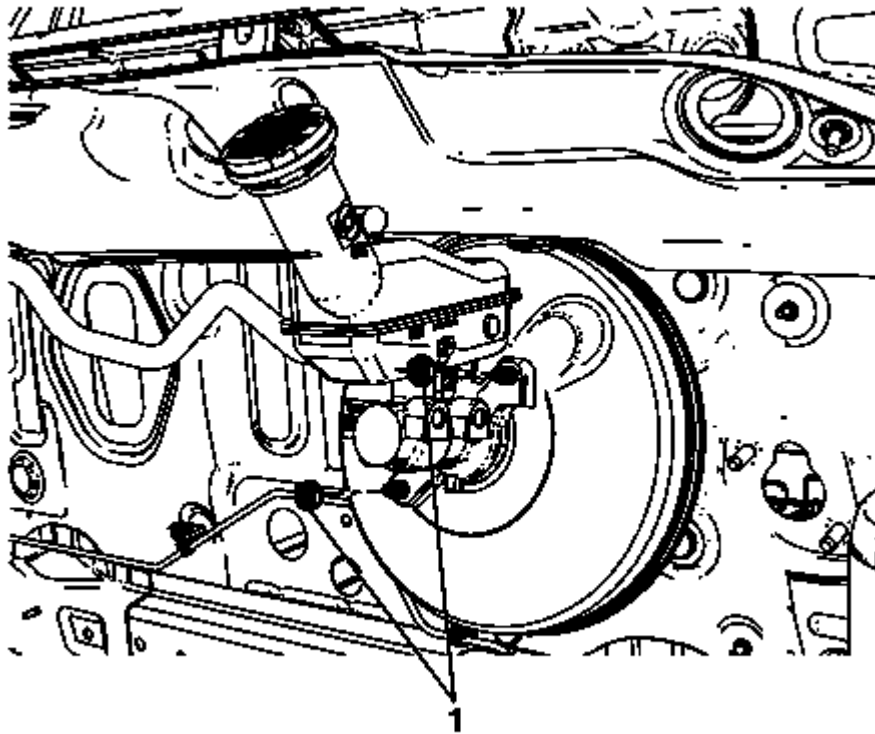


Fig. 24: Master Cylinder Nuts
Courtesy of GENERAL MOTORS COMPANY

11. Remove the master cylinder nuts (1).

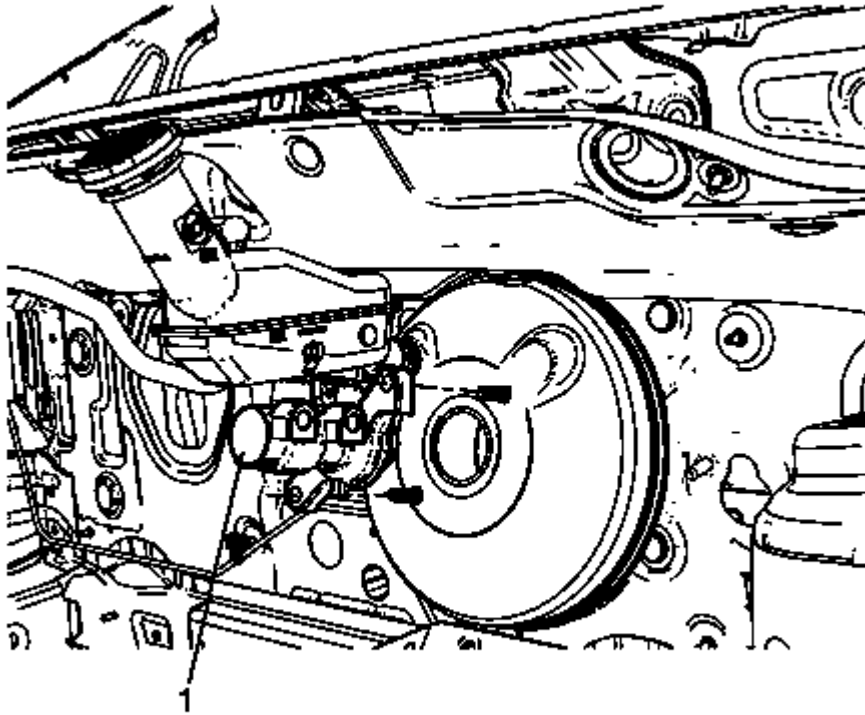


Fig. 25: Master Cylinder

Courtesy of GENERAL MOTORS COMPANY

12. Remove the master cylinder (1) from the power vacuum brake booster.
13. Remove the brake fluid level indicator switch, if necessary. Refer to **Brake Fluid Level Indicator Switch Replacement**.
14. Remove the master cylinder reservoir, if necessary. Refer to **Master Cylinder Reservoir Replacement**.

Installation Procedure

1. Install the master cylinder reservoir, if removed. Refer to **Master Cylinder Reservoir Replacement**.
2. Bench bleed the master cylinder. Refer to **Master Cylinder Bench Bleeding**.
3. Install the brake fluid level indicator switch, if removed. Refer to **Brake Fluid Level Indicator Switch Replacement**.

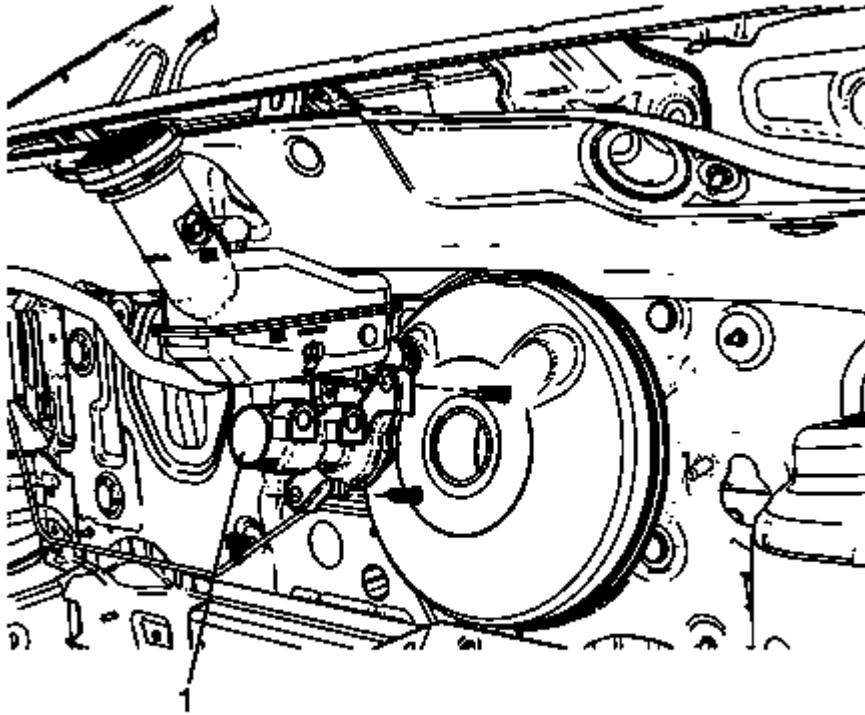


Fig. 26: Master Cylinder

Courtesy of GENERAL MOTORS COMPANY

4. Install the master cylinder (1) to the power vacuum brake booster.

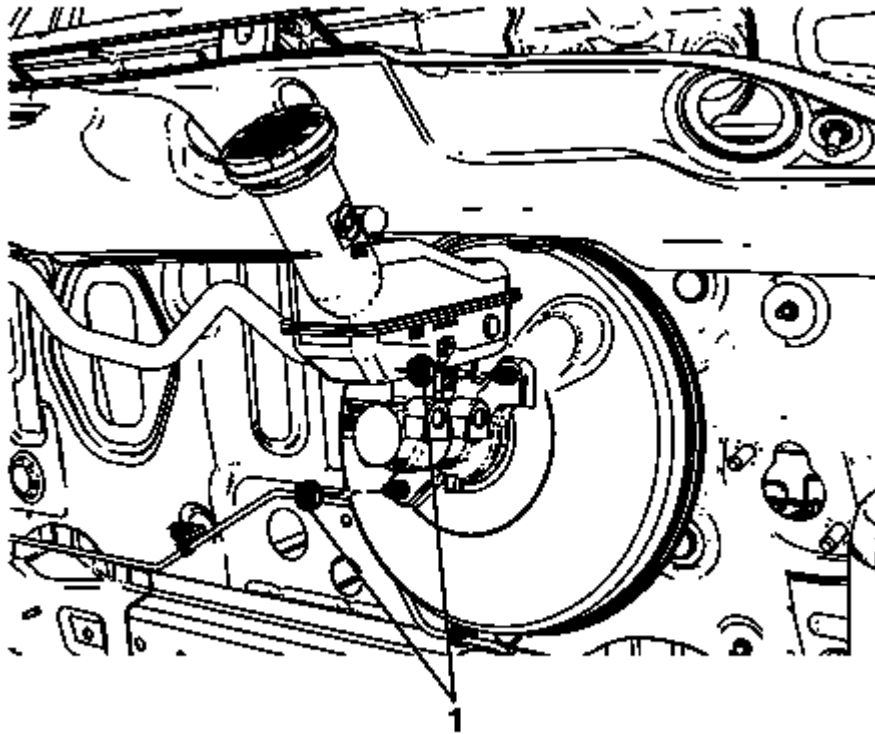


Fig. 27: Master Cylinder Nuts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

5. Install the master cylinder nuts (1) and tighten to 13 N.m (115 lb in).

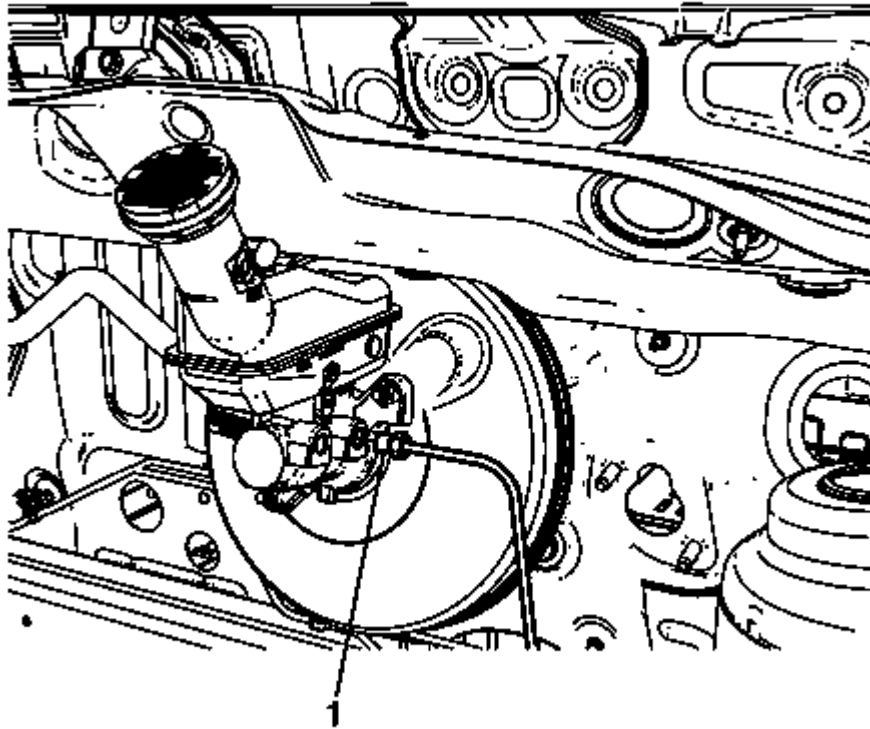


Fig. 28: Master Cylinder Primary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

6. Connect the master cylinder primary brake pipe fitting (1) and tighten to 18 N.m (13 lb ft).

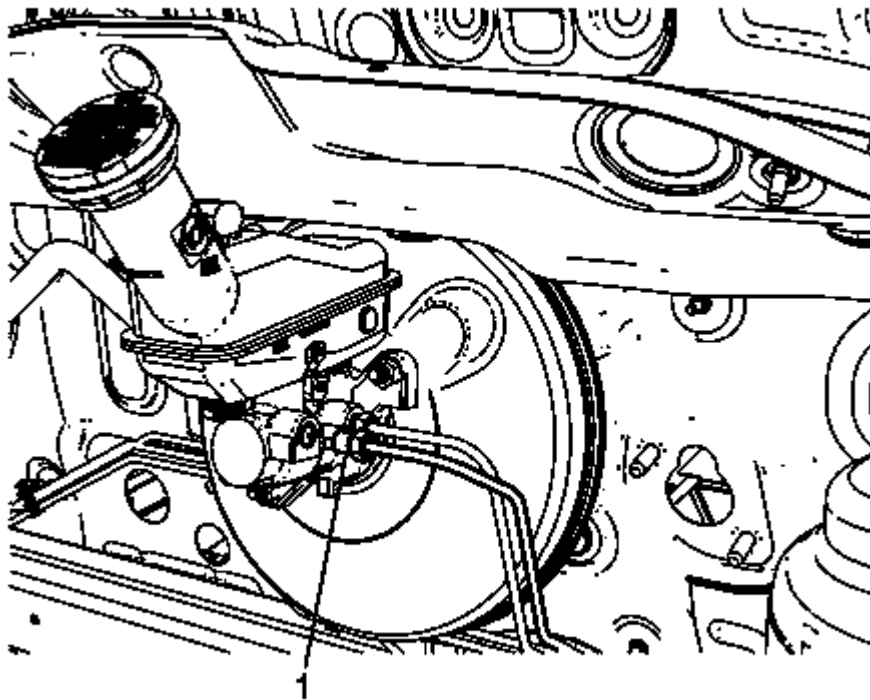


Fig. 29: Master Cylinder Secondary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

7. Connect the master cylinder secondary brake pipe fitting (1) and tighten to 18 N.m (13 lb ft).
8. Connect the brake fluid level indicator switch electrical connector.

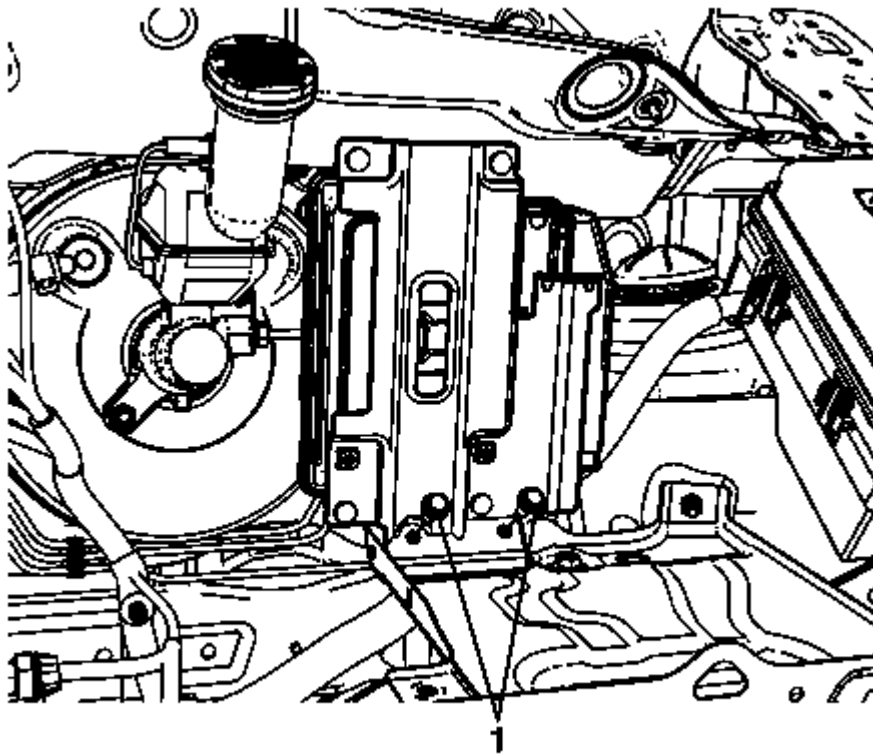


Fig. 30: Engine Control Module (ECM) Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

9. Position the ECM and ECM bracket to the original place and install the ECM bracket bolts (1). Refer to **Engine Control Module Replacement** .
10. Install the air cleaner and air inlet hose as an assembly. Refer to **Air Cleaner Assembly Replacement** .
11. Install the battery. Refer to **Battery Replacement** .
12. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)**, **Hydraulic Brake System Bleeding (Pressure)**.

MASTER CYLINDER BENCH BLEEDING

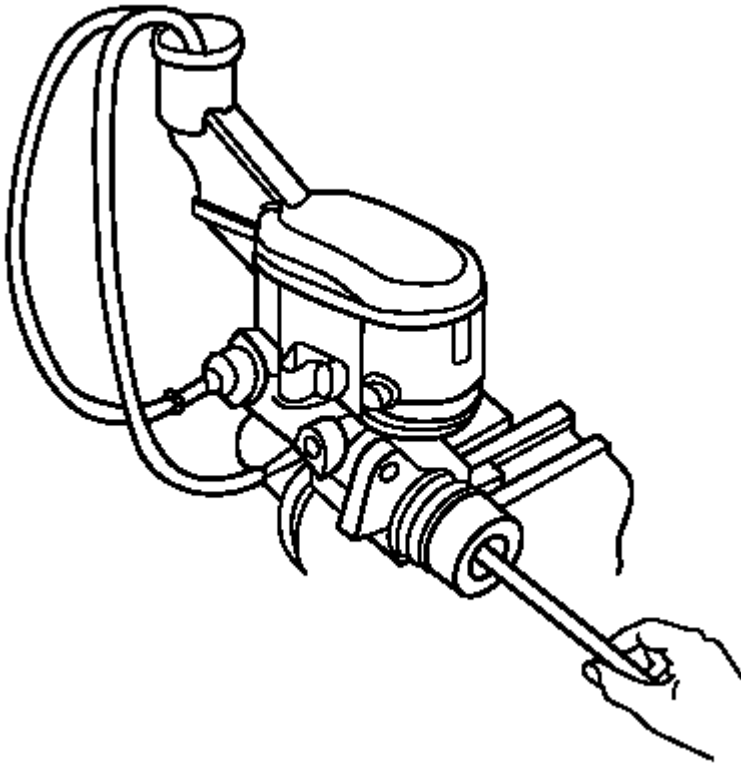


Fig. 31: Depressing And Releasing Primary Piston
Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to Brake Fluid Irritant Warning .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

1. Secure the mounting flange of the brake master cylinder in a bench vice so that the rear of the primary piston is accessible.
2. Remove the master cylinder reservoir cap and diaphragm.
3. Install suitable fittings to the master cylinder ports that match the type of flare seat required and also provide for hose attachment.
4. Install transparent hoses to the fittings installed to the master cylinder ports, then route the hoses into the master cylinder reservoir.
5. Fill the master cylinder reservoir to the maximum fill level with brake fluid from a clean, sealed brake fluid container. Refer to **Master Cylinder Reservoir Filling**.
6. Ensure that the ends of the transparent hoses running into the master cylinder reservoir are fully submerged in the brake fluid.

7. Using a smooth, round-ended tool, depress and release the primary piston as far as it will travel, a depth of about 25 mm (1 in), several times. Observe the flow of fluid coming from the ports.

As air is bled from the primary and secondary pistons, the effort required to depress the primary piston will increase and the amount of travel will decrease.

8. Continue to depress and release the primary piston until fluid flows freely from the ports with no evidence of air bubbles.
9. Remove the transparent hoses from the master cylinder reservoir.
10. Install the master cylinder reservoir cap and diaphragm.
11. Remove the fittings with the transparent hoses from the master cylinder ports. Wrap the master cylinder with a clean shop cloth to prevent brake fluid spills.
12. Remove the master cylinder from the vice.

BRAKE FLUID LEVEL INDICATOR SWITCH REPLACEMENT

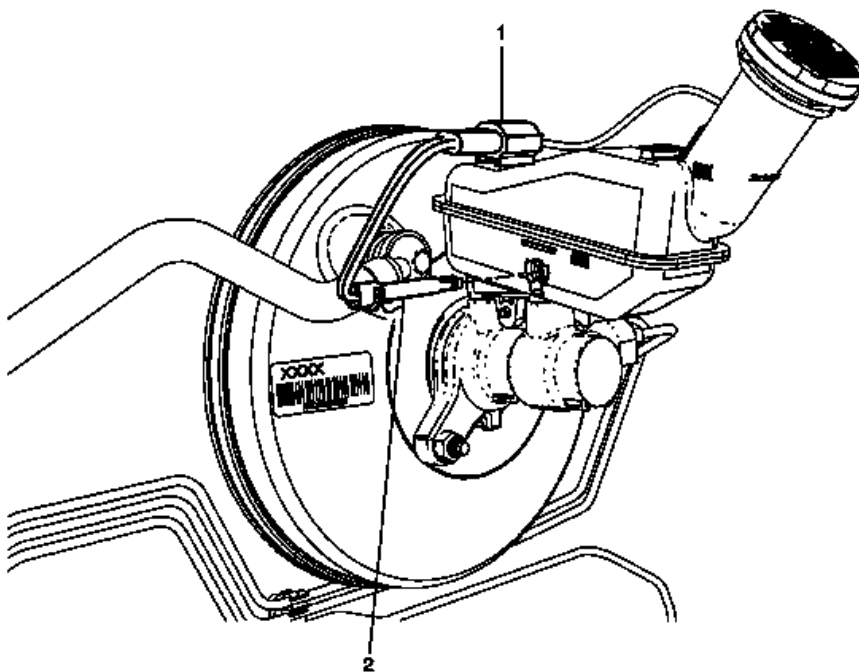


Fig. 32: Brake Fluid Level Indicator Switch
Courtesy of GENERAL MOTORS COMPANY

Brake Fluid Level Indicator Switch Replacement

Callout	Component Name
1	Brake Fluid Indicator Switch Connector
2	Brake Fluid Level Indicator Switch TIP: Using needle nose pliers, carefully depress the retaining tab on the indicator switch

and remove indicator switch from the reservoir.

BRAKE PEDAL ASSEMBLY REPLACEMENT (LEFT HAND DRIVE)

Removal Procedure

1. Remove the inflatable restraint instrument panel lower module in drive side if equipped. Refer to **Instrument Panel Lower Airbag Replacement - Driver Side** .
2. Remove the steering column opening filler. Refer to **Steering Column Opening Filler Replacement** .
3. Remove the left floor air outlet duct. Refer to **Floor Air Outlet Duct Replacement - Left Side (Left Hand Drive)** .
4. Remove the steering column lower trim cover. Refer to **Steering Column Lower Trim Cover Replacement** .
5. Remove the intermediate steering shaft if the electrical power steering is not equipped or remove the steering column if the electrical power steering is equipped. Refer to **Intermediate Steering Shaft Replacement** and **Steering Column Replacement (Electric Power Steering)** .

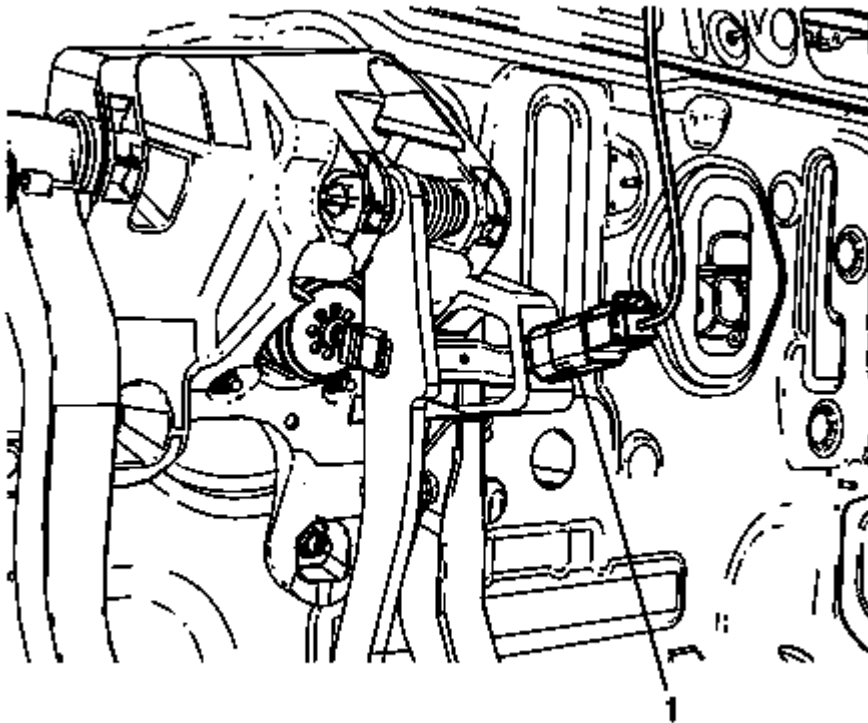


Fig. 33: Electrical Connector Of Stop Lamp Switch
Courtesy of GENERAL MOTORS COMPANY

6. Disconnect the electrical connector of the stop lamp switch (1).

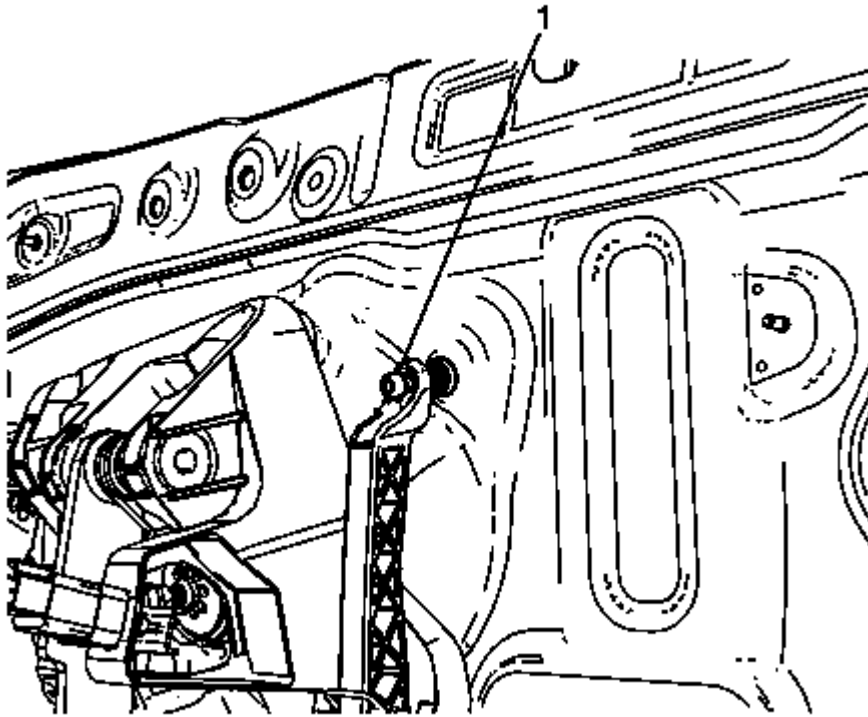


Fig. 34: Accelerator Cable And Accelerator Pedal
Courtesy of GENERAL MOTORS COMPANY

7. Disconnect the accelerator cable from the accelerator pedal by pulling and raising the cable end (1).

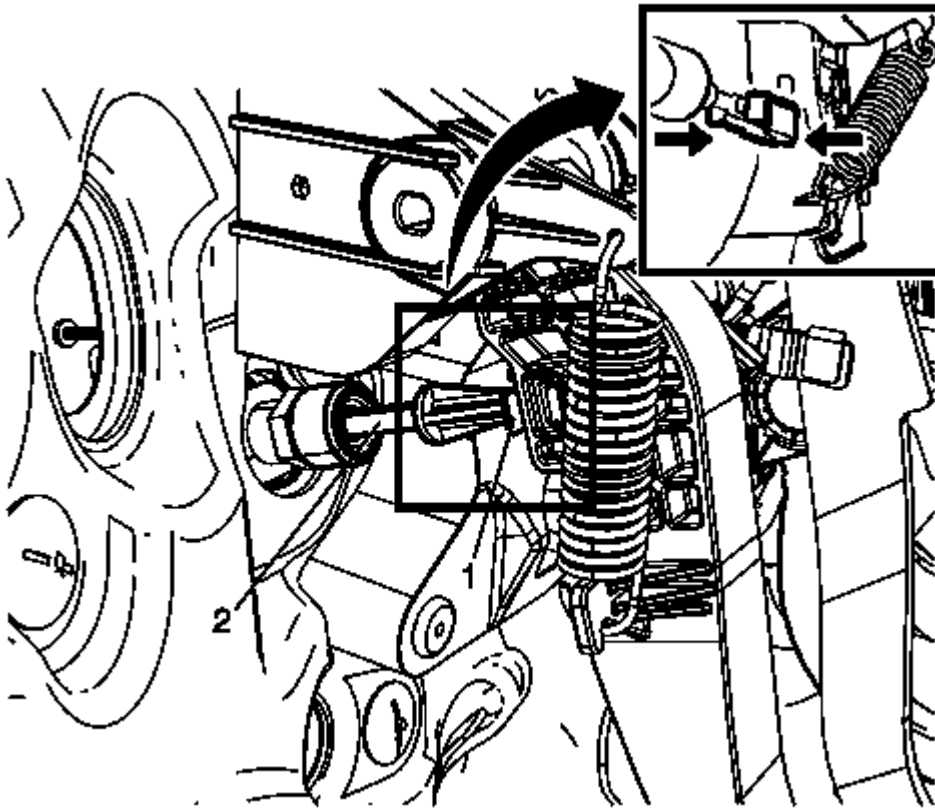


Fig. 35: Push Rod Retainer

Courtesy of GENERAL MOTORS COMPANY

8. If equipped, disconnect the push rod retainer (1) from the clutch pedal.

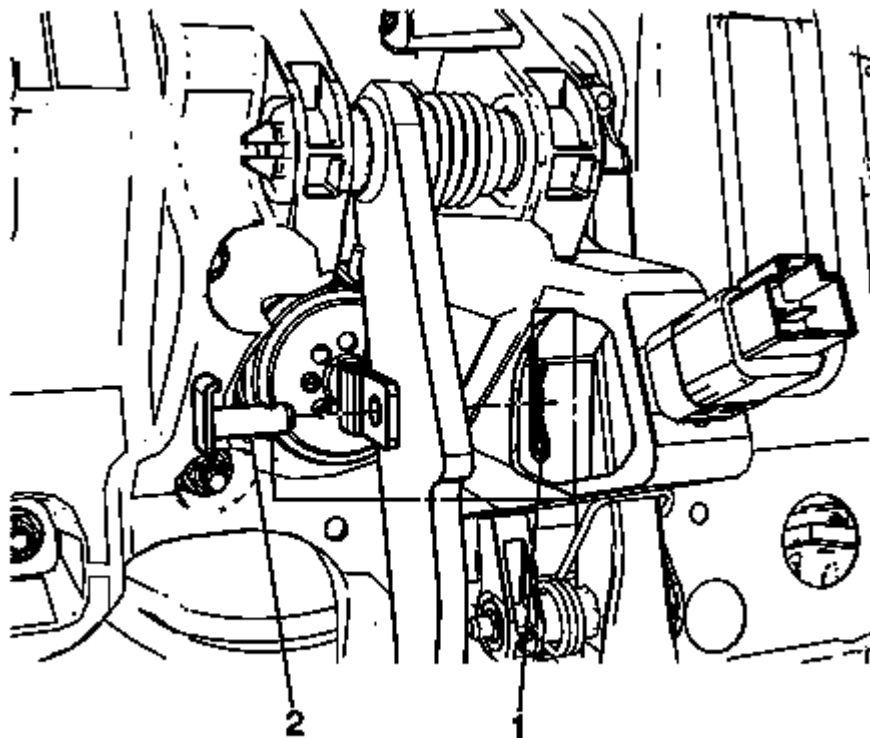


Fig. 36: Retaining Clip And Pin

Courtesy of GENERAL MOTORS COMPANY

9. Remove the retaining clip (1) and pin (2) from the brake pedal.
10. Release the brake booster pushrod from the brake pedal.

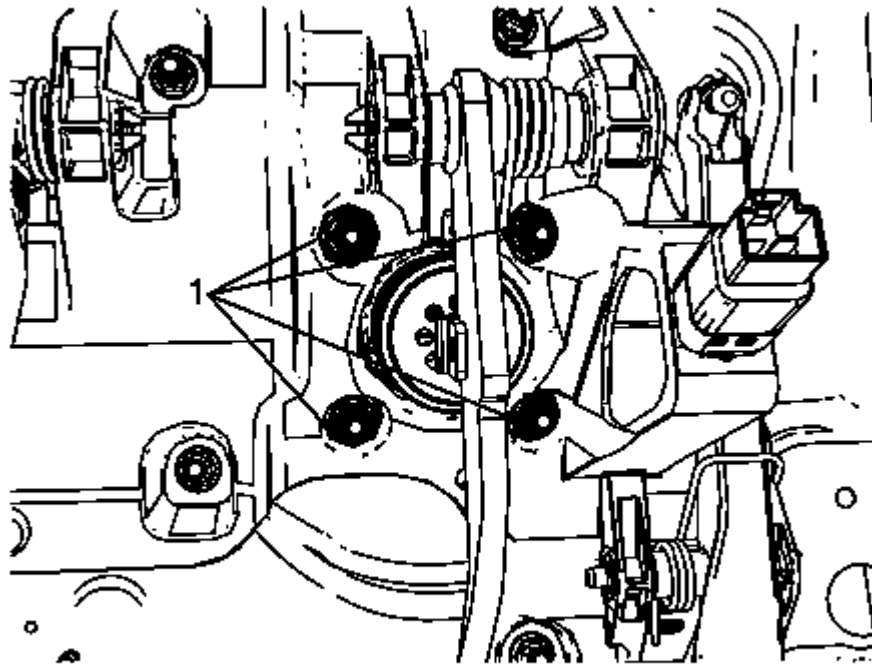


Fig. 37: Clutch (ABC) Pedal Module Retaining Nuts
Courtesy of GENERAL MOTORS COMPANY

11. Remove the brake booster-to-accelerator, brake and clutch (ABC) pedal module retaining nuts (1) from the ABC pedal module.

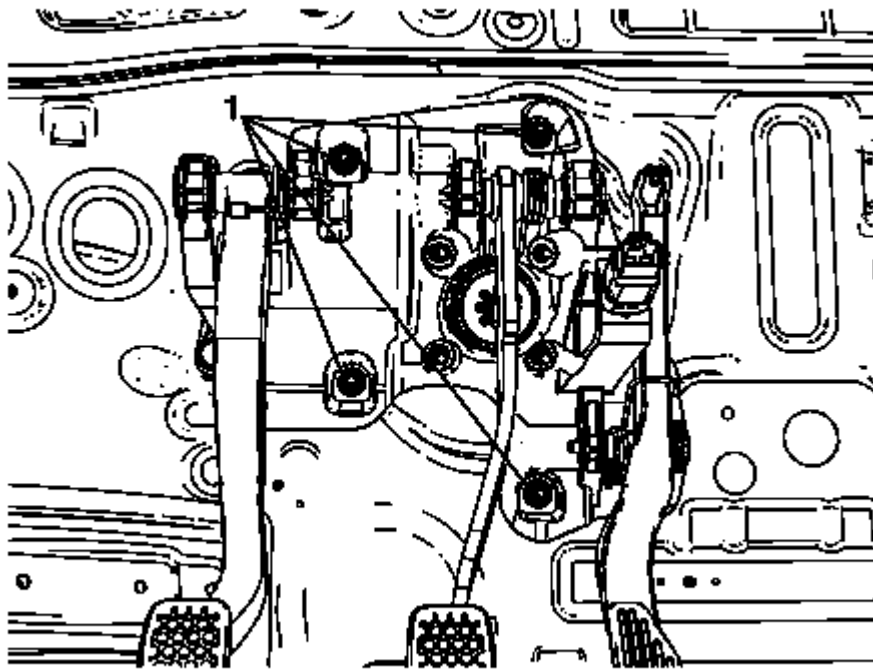


Fig. 38: ABC Module-To-Dash Panel Retaining Nuts
Courtesy of GENERAL MOTORS COMPANY

12. Remove the ABC module-to-dash panel retaining nuts (1) from the ABC pedal module.
13. Remove the ABC pedal module from the vehicle.
14. Remove the accelerator pedal from the ABC pedal module, if necessary.

Installation Procedure

1. Install the accelerator pedal to the ABC pedal module, if necessary.
2. Install the ABC pedal module into the vehicle.

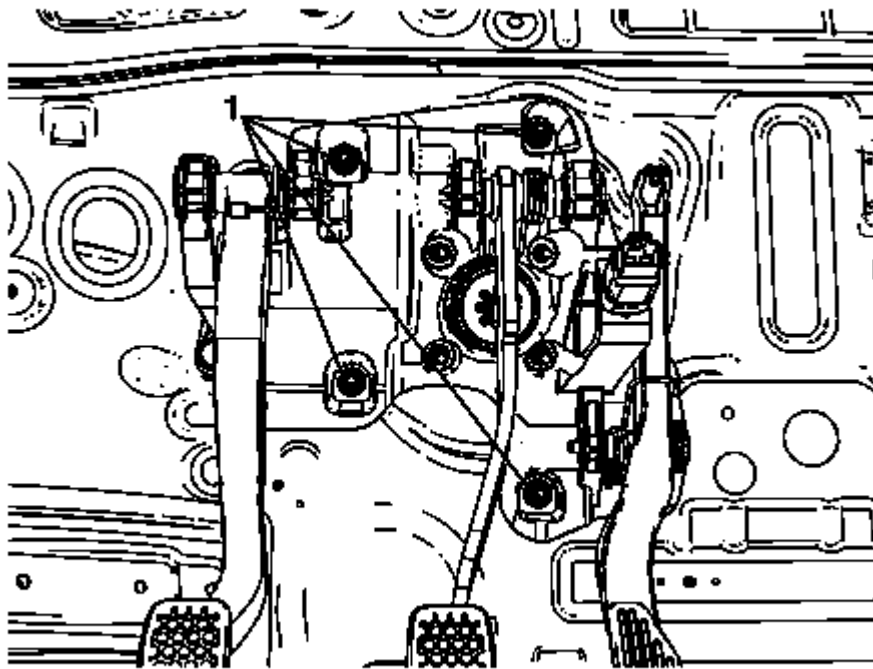


Fig. 39: ABC Module-To-Dash Panel Retaining Nuts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

3. Install the ABC module-to-dash panel retaining nuts (1) and tighten to 22 (16 lb ft).

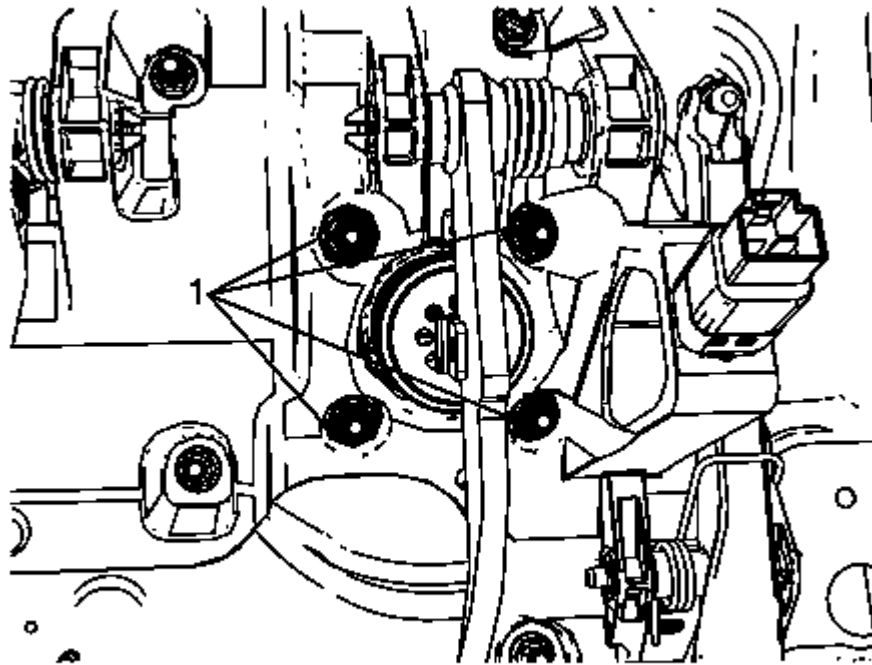


Fig. 40: Clutch (ABC) Pedal Module Retaining Nuts
Courtesy of GENERAL MOTORS COMPANY

4. Loosely install the brake booster-to-ABC pedal module retaining nuts (1).

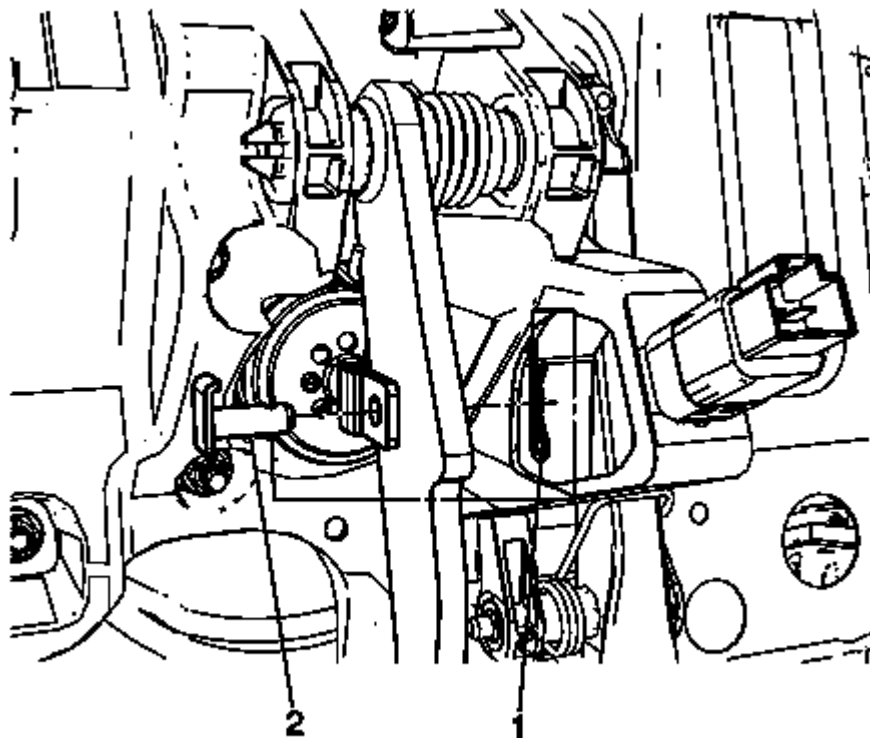


Fig. 41: Retaining Clip And Pin

Courtesy of GENERAL MOTORS COMPANY

5. Connect the brake booster pushrod to the brake pedal.
6. Install the pushrod pin (2) to the brake pedal and insert the retaining clip (1) to the pin (2).

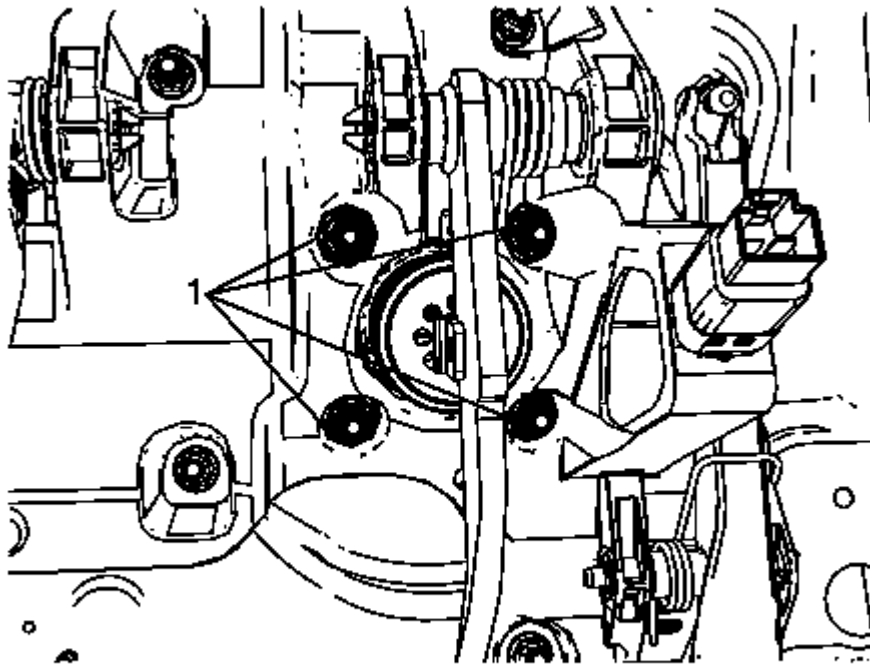


Fig. 42: Clutch (ABC) Pedal Module Retaining Nuts
Courtesy of GENERAL MOTORS COMPANY

7. Completely tighten the brake booster-to-ABC pedal module retaining nuts (1) and tighten to 22 (16 lb ft).
8. Connect the push rod retainer to the clutch pedal, if equipped.
9. Connect the accelerator cable to the accelerator pedal.
10. Connect the electrical connector of the stop lamp switch.
11. Install the intermediate steering shaft or the steering column as necessary. Refer to **Intermediate Steering Shaft Replacement** and **Steering Column Replacement (Electric Power Steering)** .
12. Install the steering column lower trim cover. Refer to **Steering Column Lower Trim Cover Replacement** .
13. Install the left floor air outlet duct. Refer to **Floor Air Outlet Duct Replacement - Left Side (Left Hand Drive)** .
14. Install the steering column opening filler. Refer to **Steering Column Opening Filler Replacement** .
15. Install the inflatable restraint instrument panel lower module in drive side as necessary. Refer to **Instrument Panel Lower Airbag Replacement - Driver Side** .

BRAKE PEDAL ASSEMBLY REPLACEMENT (RIGHT HAND DRIVE)

Removal Procedure

1. Remove the instrument panel (I/P) pad assembly. Refer to **Instrument Panel Assembly Replacement** .
2. Remove the I/P tie bar. Refer to **Instrument Panel Tie Bar Replacement** .

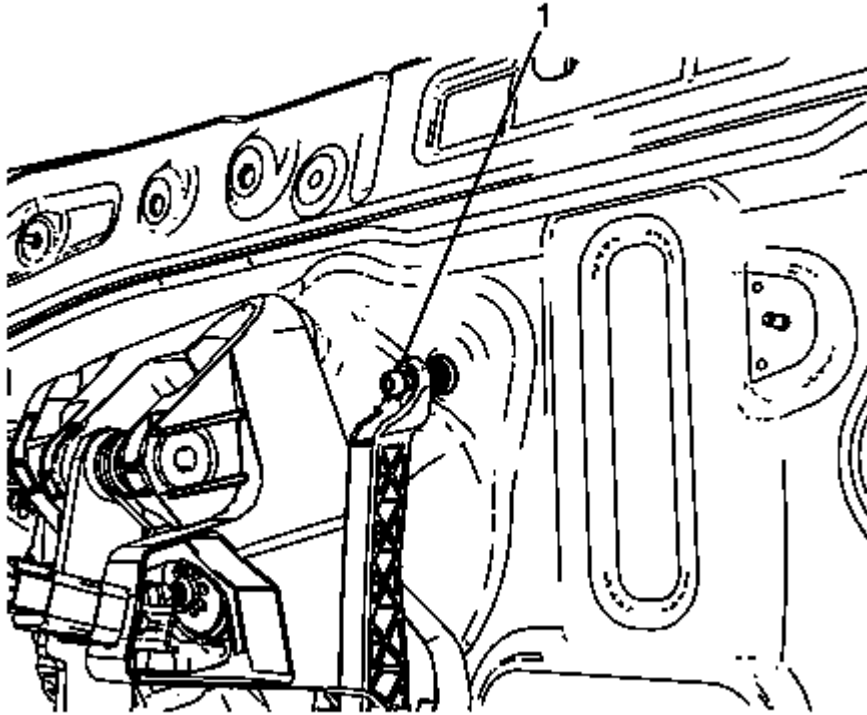


Fig. 43: Accelerator Cable And Accelerator Pedal
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the accelerator cable from the accelerator pedal by pulling and raising the cable end (1).

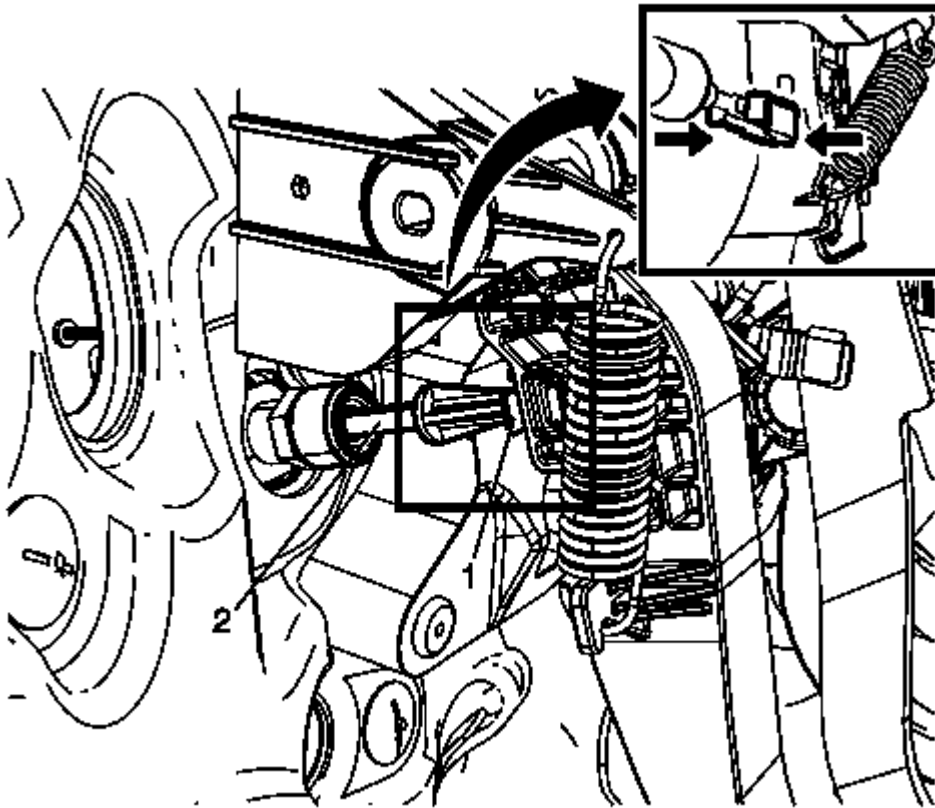


Fig. 44: Push Rod Retainer

Courtesy of GENERAL MOTORS COMPANY

4. If equipped, disconnect the push rod retainer (1) from the clutch pedal.

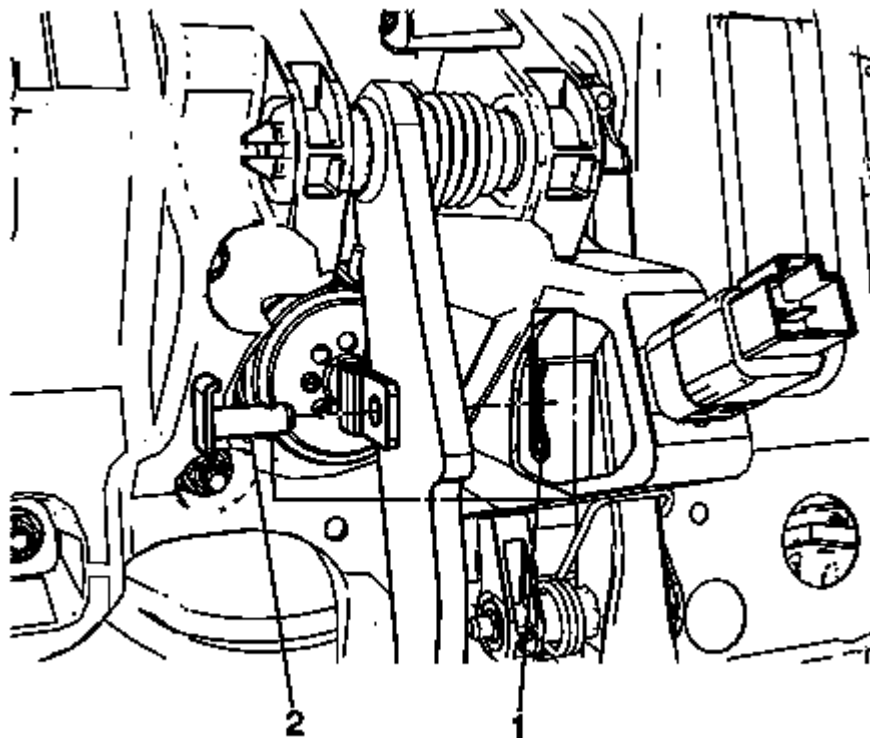


Fig. 45: Retaining Clip And Pin

Courtesy of GENERAL MOTORS COMPANY

5. Remove the retaining clip (1) and pin (2) from the brake pedal.
6. Release the brake booster pushrod from the brake pedal.

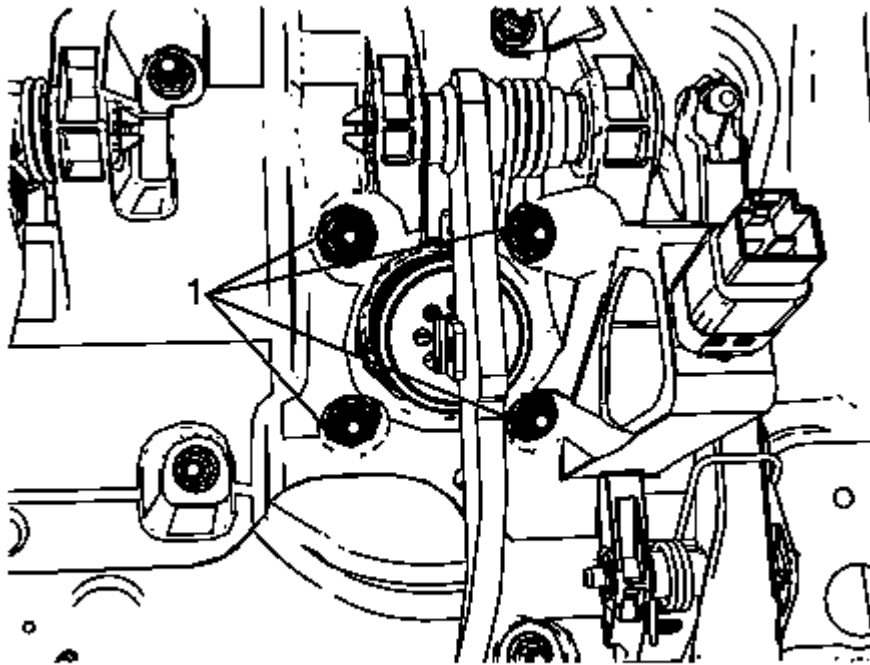


Fig. 46: Clutch (ABC) Pedal Module Retaining Nuts
Courtesy of GENERAL MOTORS COMPANY

7. Remove the brake booster-to-accelerator, brake and clutch (ABC) pedal module retaining nuts (1) from the ABC pedal module.

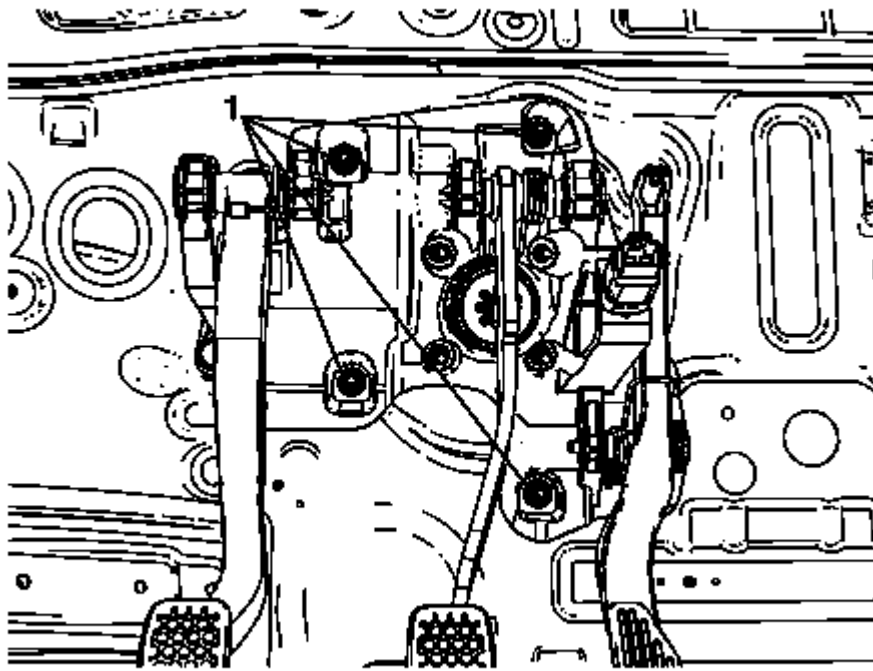


Fig. 47: ABC Module-To-Dash Panel Retaining Nuts
Courtesy of GENERAL MOTORS COMPANY

8. Remove the ABC module-to-dash panel retaining nuts (1) from the ABC pedal module.
9. Remove the ABC pedal module from the vehicle.
10. Remove the accelerator pedal from the ABC pedal module, if necessary.

Installation Procedure

1. Install the accelerator pedal to the ABC pedal module, if necessary.
2. Install the ABC pedal module into the vehicle.

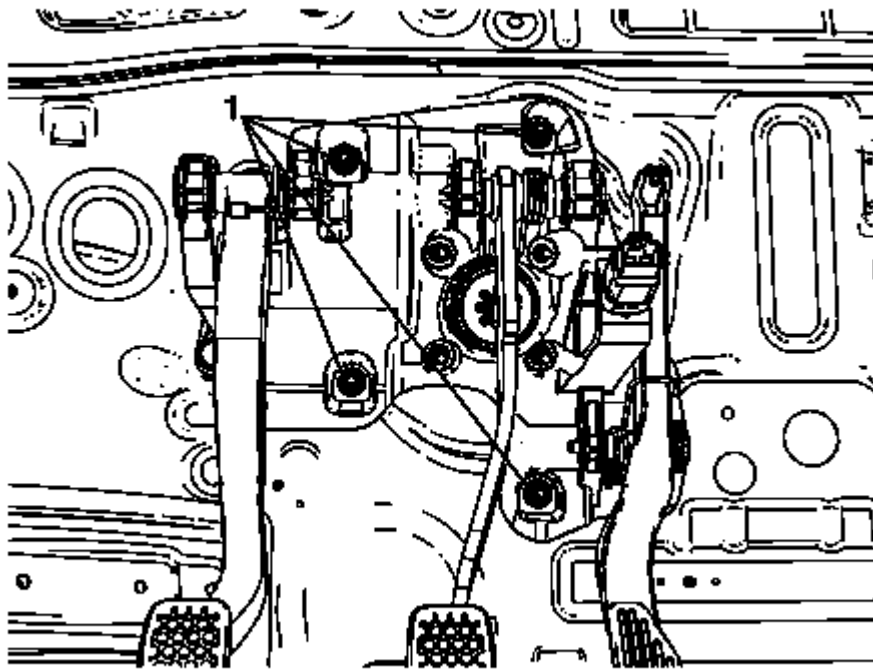


Fig. 48: ABC Module-To-Dash Panel Retaining Nuts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

3. Install the ABC module-to-dash panel retaining nuts (1) and tighten to 22 (16 lb ft).

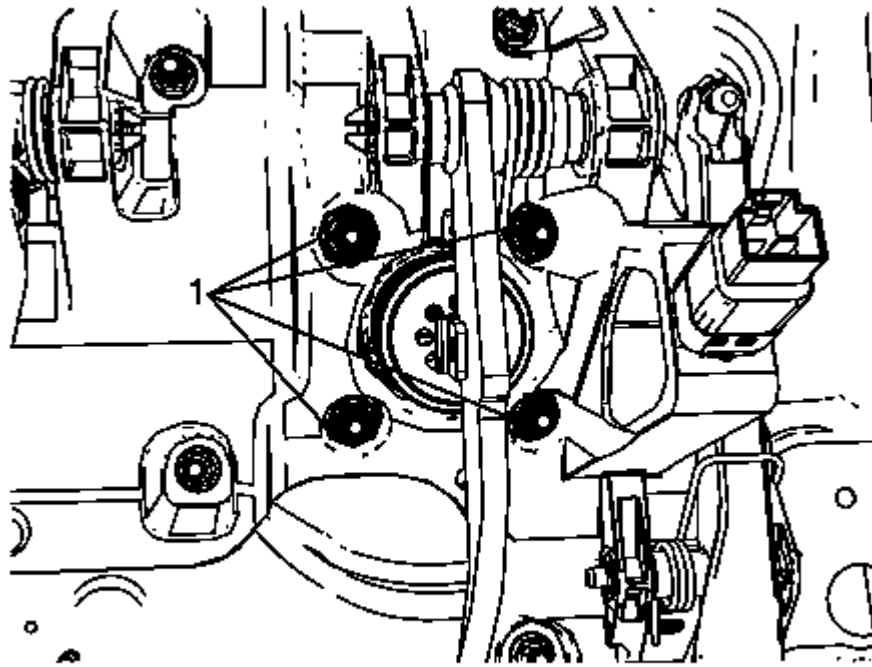


Fig. 49: Clutch (ABC) Pedal Module Retaining Nuts
Courtesy of GENERAL MOTORS COMPANY

4. Loosely install the brake booster-to-ABC pedal module retaining nuts (1).

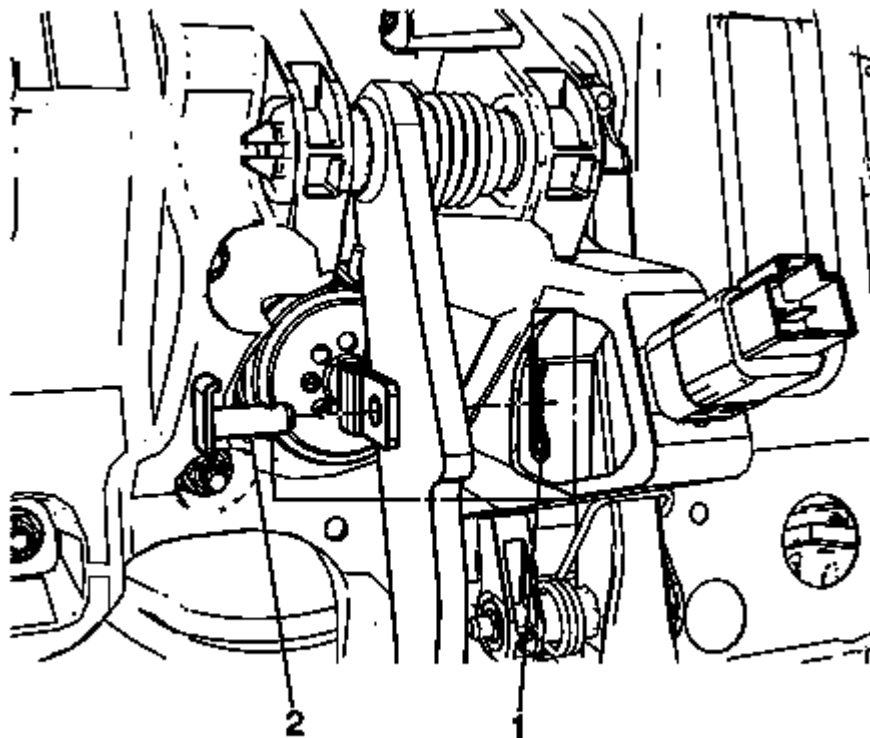


Fig. 50: Retaining Clip And Pin

Courtesy of GENERAL MOTORS COMPANY

5. Connect the brake booster pushrod to the brake pedal.
6. Install the pushrod pin (2) to the brake pedal and insert the retaining clip (1) to the pin (2).

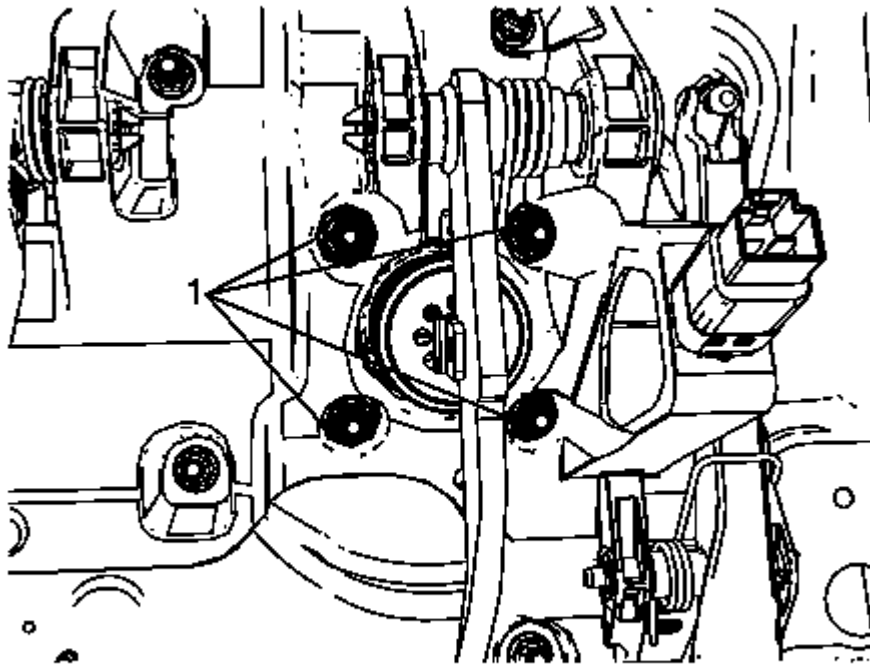


Fig. 51: Clutch (ABC) Pedal Module Retaining Nuts
Courtesy of GENERAL MOTORS COMPANY

7. Completely tighten the brake booster-to-ABC pedal module retaining nuts (1) to 22 (16 lb ft).
8. Connect the push rod retainer to the clutch pedal.
9. Connect the accelerator cable to the accelerator pedal.
10. Install the I/P pad assembly. Refer to **Instrument Panel Assembly Replacement** .
11. Install the I/P tie bar. Refer to **Instrument Panel Tie Bar Replacement** .

BRAKE PROPORTION VALVE REPLACEMENT (LEFT HAND DRIVE)

Removal Procedure

WARNING: Refer to **Brake Fluid Irritant Warning** .

CAUTION: Refer to **Brake Fluid Effects on Paint and Electrical Components Caution** .

1. Apply and release the brake pedal several times until the pedal becomes firm to deplete the power vacuum brake booster vacuum reserve.

2. Thoroughly clean the master cylinder reservoir and the master cylinder body to remove any dirt and debris.
3. Disconnect the brake fluid indicator switch electrical connector.

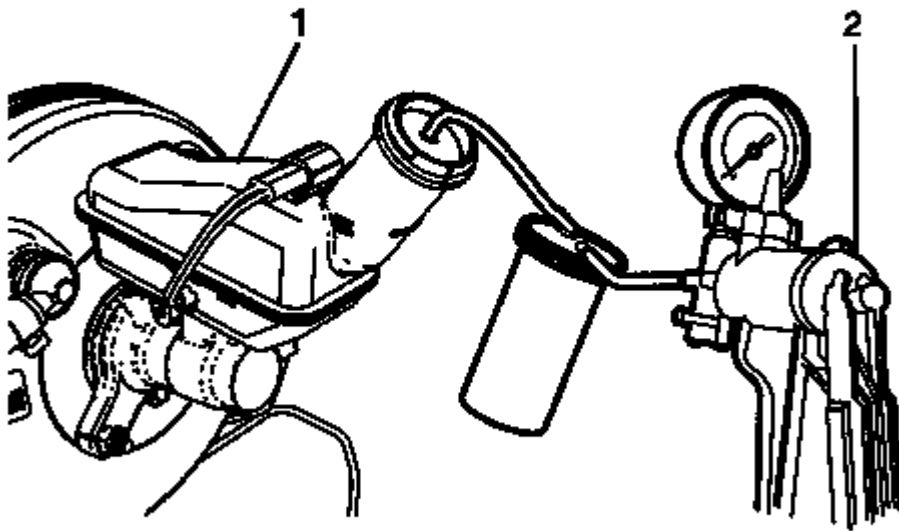


Fig. 52: Master Cylinder Reservoir
Courtesy of GENERAL MOTORS COMPANY

4. Siphon the brake fluid out of the master cylinder reservoir (1) using an air vacuum pump or a hand vacuum pump (2).

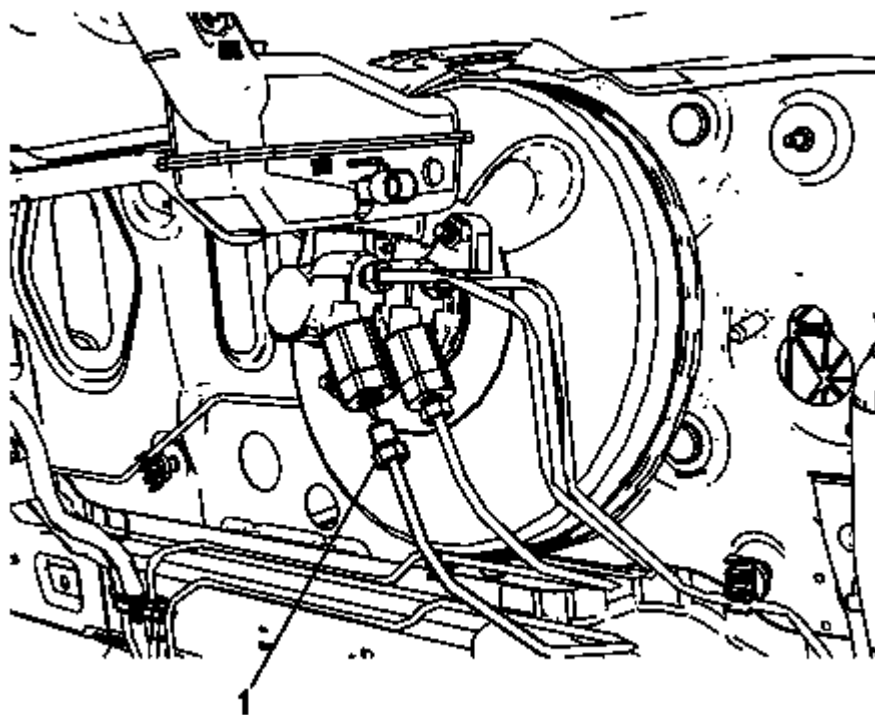


Fig. 53: Brake Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

5. Disconnect the proportion valve outlet brake pipe fitting (1).

Cap the brake pipe fitting to prevent brake fluid loss and contamination.

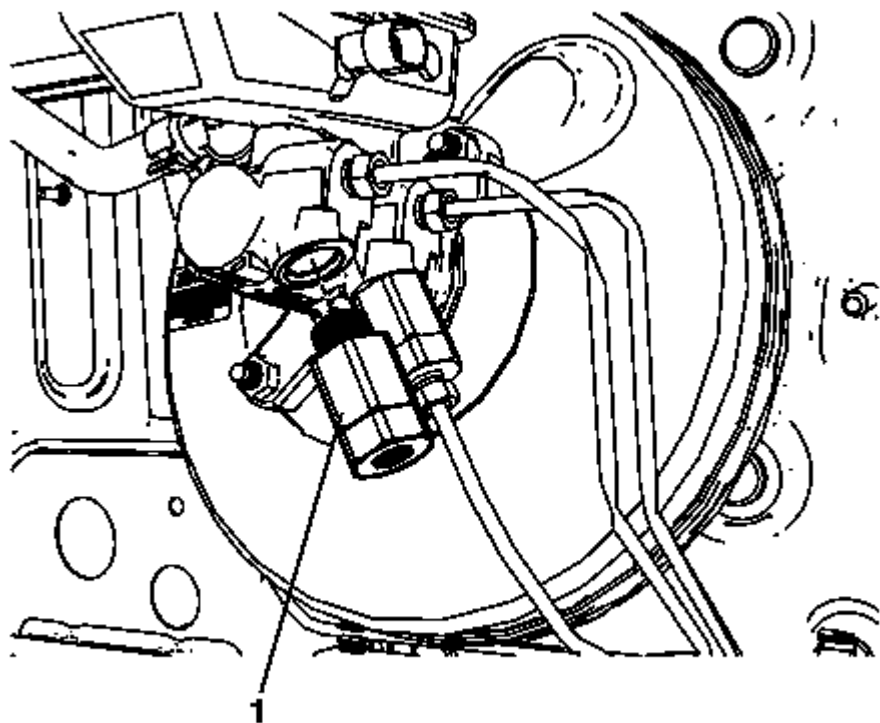


Fig. 54: Removing Proportion Valve
Courtesy of GENERAL MOTORS COMPANY

6. Remove the proportion valve (1) from the master cylinder.

Installation Procedure

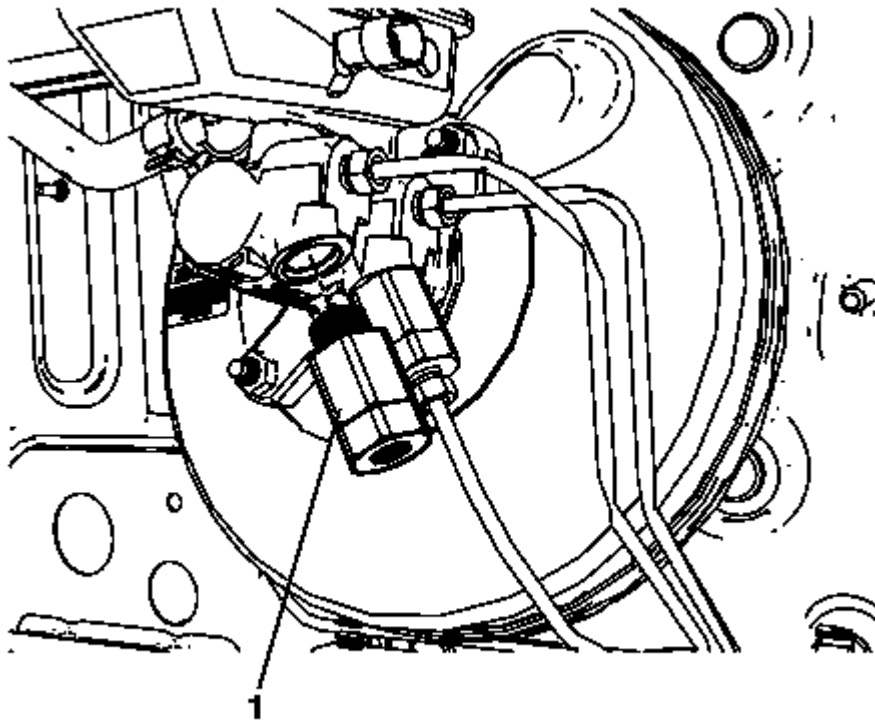


Fig. 55: Removing Proportion Valve
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

1. Install the brake proportion valve (1) to the master cylinder and tighten to 35 N.m (26 lb ft).

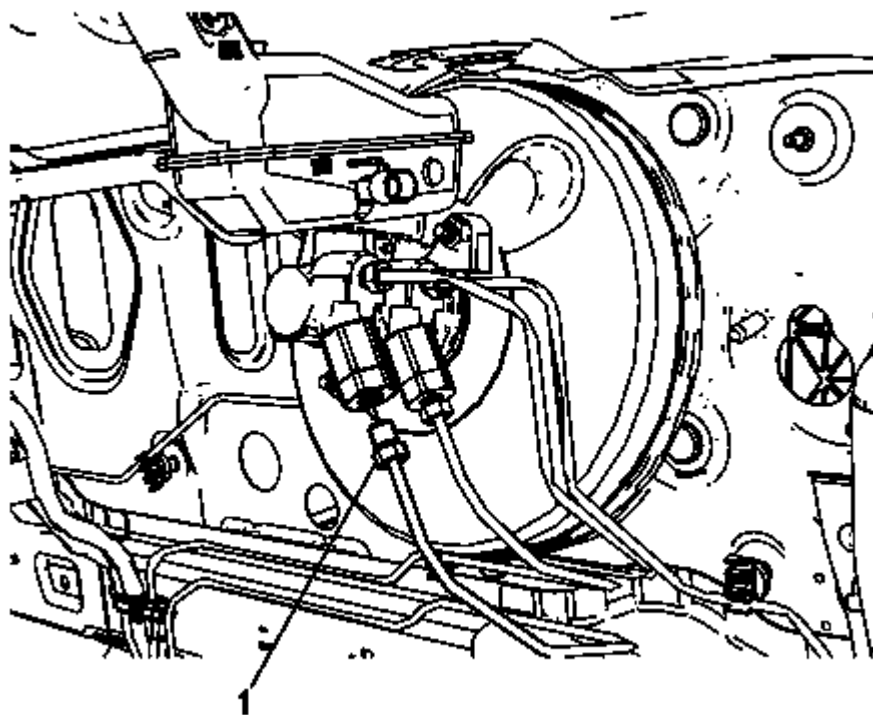


Fig. 56: Brake Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

2. Connect the proportion valve outlet brake pipe fitting (1) and tighten to 18 N.m (13 lb ft).
3. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)**, **Hydraulic Brake System Bleeding (Pressure)**.

BRAKE PROPORTION VALVE REPLACEMENT (RIGHT HAND DRIVE)

Removal Procedure

WARNING: Refer to **Brake Fluid Irritant Warning** .

CAUTION: Refer to **Brake Fluid Effects on Paint and Electrical Components Caution** .

1. Place the ignition switch in the OFF position.
2. Remove the battery. Refer to **Battery Replacement** .
3. Remove the air cleaner and air inlet hose as an assembly to get easy tool access. Refer to **Air Cleaner Assembly Replacement** .

4. Remove the engine control module (ECM) bolts and position the ECM and ECM bracket aside to get easy tool access. Refer to **Engine Control Module Replacement** .
5. Apply and release the brake pedal several times until the pedal becomes firm to deplete the power vacuum brake booster vacuum reserve.
6. Thoroughly clean the master cylinder reservoir and the master cylinder body to remove any dirt and debris.
7. Disconnect the brake fluid indicator switch electrical connector.

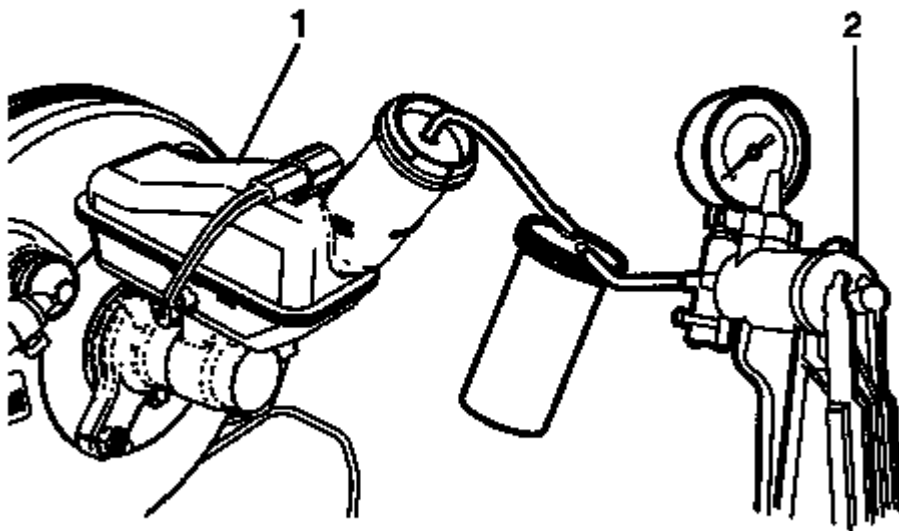


Fig. 57: Master Cylinder Reservoir
Courtesy of GENERAL MOTORS COMPANY

8. Siphon the brake fluid out of the master cylinder reservoir (1) using an air vacuum pump or a hand vacuum pump (2).

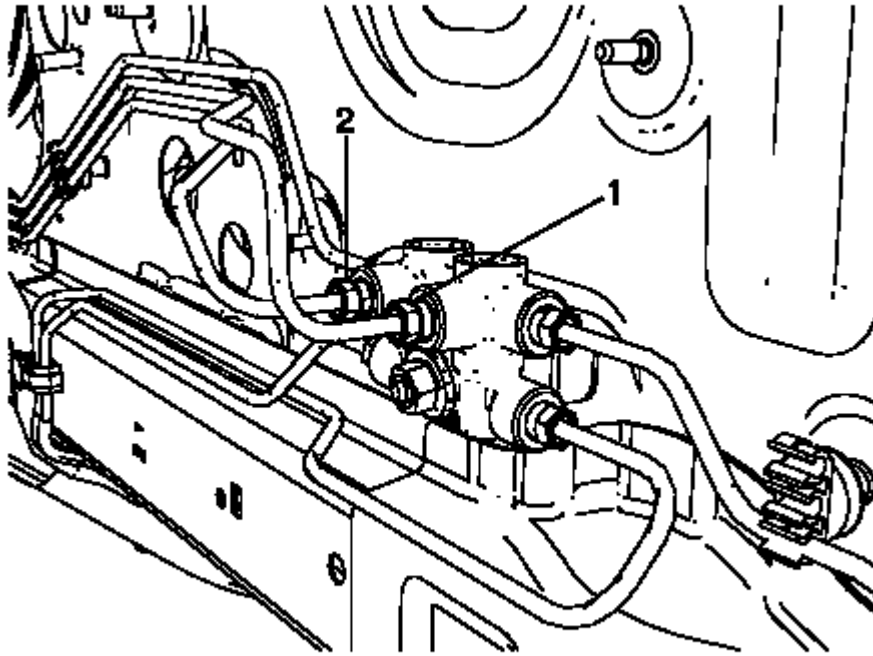


Fig. 58: Master Cylinder Primary Inlet Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

9. Disconnect the master cylinder primary inlet brake pipe fitting (1).
Cap the brake pipe fitting to prevent brake fluid loss and contamination.
10. Disconnect the master cylinder secondary inlet brake pipe fitting (2).
Cap the brake pipe fitting to prevent brake fluid loss and contamination.

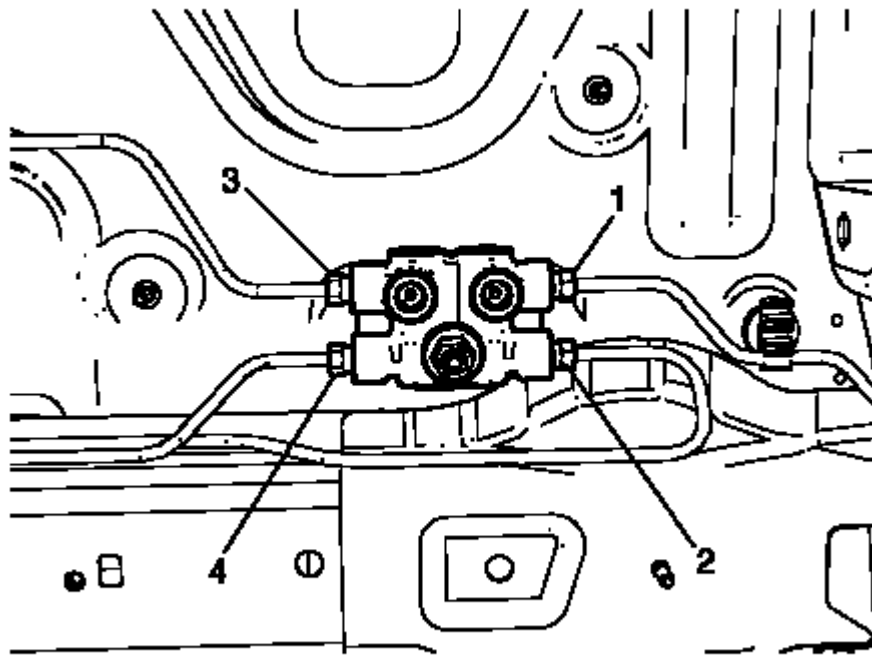


Fig. 59: Lf Brake Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

11. Disconnect the LF brake pipe fitting (1).

Cap the brake pipe fitting to prevent brake fluid loss and contamination.

12. Disconnect the RR brake pipe fitting (2).

Cap the brake pipe fitting to prevent brake fluid loss and contamination.

13. Disconnect the RF brake pipe fitting (3).

Cap the brake pipe fitting to prevent brake fluid loss and contamination.

14. Disconnect the LR brake pipe fitting (4).

Cap the brake pipe fitting to prevent brake fluid loss and contamination.

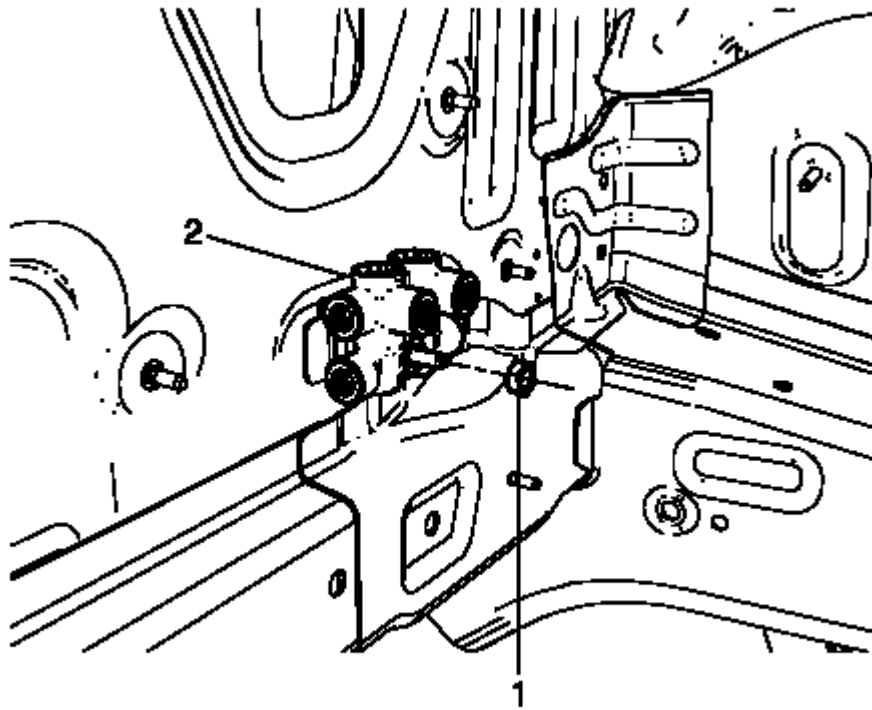


Fig. 60: Brake Proportion Valve Retaining Nut
Courtesy of GENERAL MOTORS COMPANY

15. Remove the brake proportion valve retaining nut (1).
16. Remove the brake proportioning valve (2) from the vehicle.

Installation Procedure

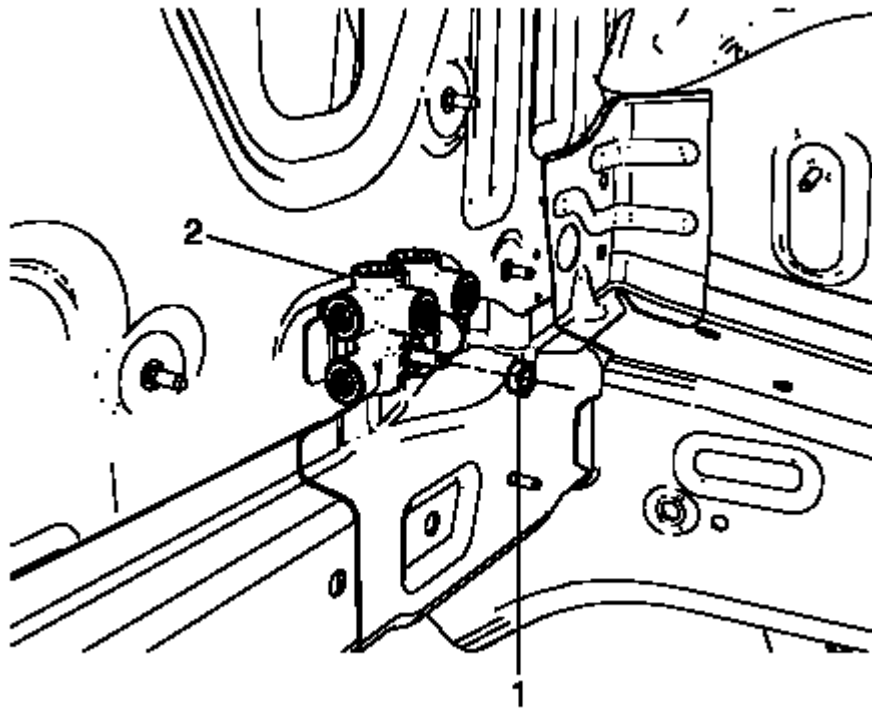


Fig. 61: Brake Proportion Valve Retaining Nut
Courtesy of GENERAL MOTORS COMPANY

1. Install the brake proportion valve (2) to the vehicle.

CAUTION: Refer to Fastener Caution .

2. Install the brake proportion valve retaining nut (1) and tighten to 9 N.m (80 lb in).

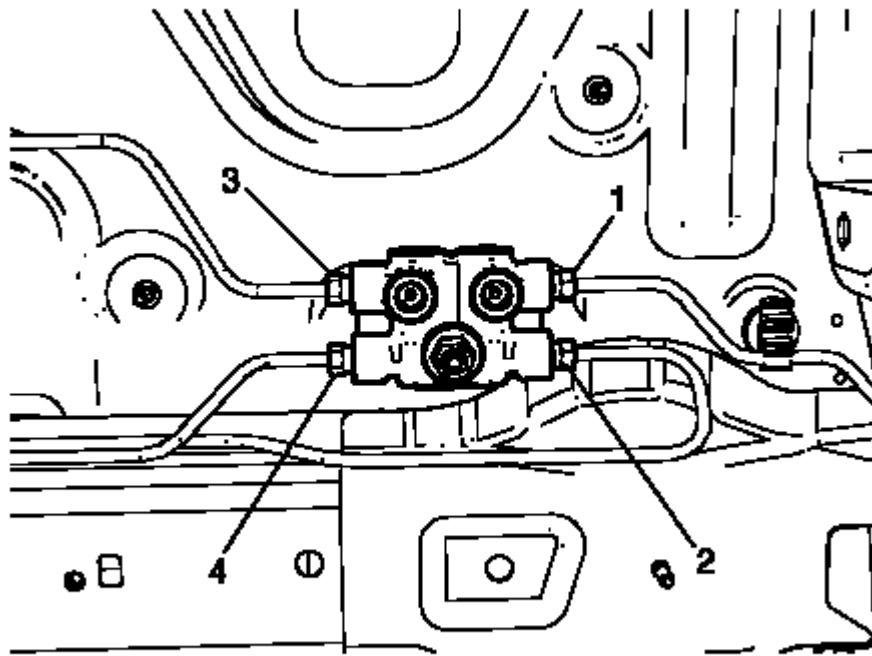


Fig. 62: Lf Brake Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

3. Connect the LR brake pipe fitting (4) and tighten to 18 N.m (13 lb ft).
4. Connect the RF brake pipe fitting (3) and tighten to 18 N.m (13 lb ft).
5. Connect the RR brake pipe fitting (2) and tighten to 18 N.m (13 lb ft).
6. Connect the LF brake pipe fitting (1) and tighten to 18 N.m (13 lb ft).

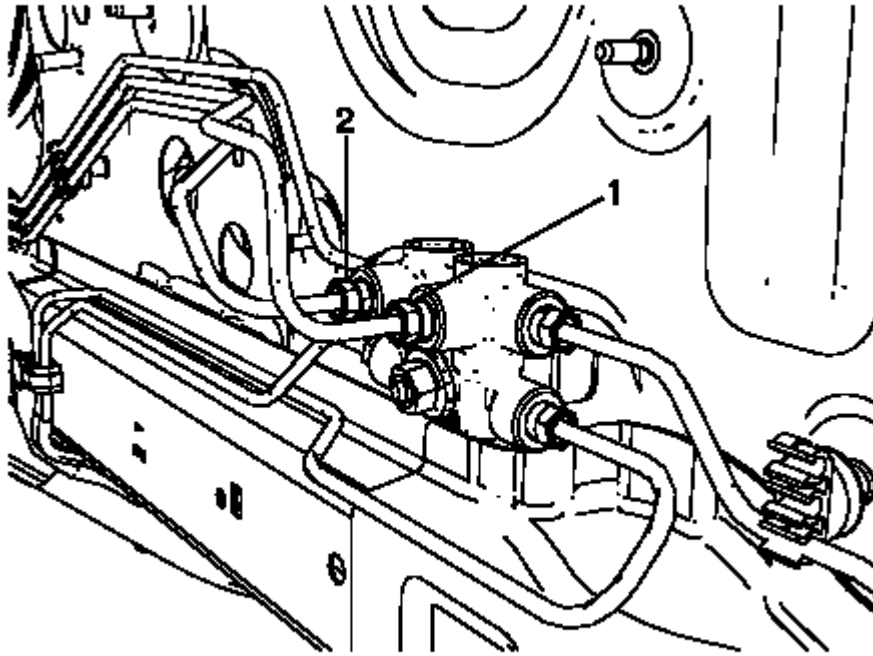


Fig. 63: Master Cylinder Primary Inlet Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

7. Connect the master cylinder secondary inlet brake pipe fitting (2) and tighten to 18 N.m (13 lb ft).
8. Connect the master cylinder primary inlet brake pipe fitting (1) and tighten to 18 N.m (13 lb ft).
9. Connect the brake fluid indicator switch electrical connector.
10. Put the ECM and ECM bracket to the original position and install the ECM bracket bolts. Refer to **Engine Control Module Replacement** .
11. Install the air cleaner and inlet hose as an assembly. Refer to **Air Cleaner Assembly Replacement** .
12. Install the battery. Refer to **Battery Replacement** .
13. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)**, **Hydraulic Brake System Bleeding (Pressure)**.

BRAKE PIPE REPLACEMENT

Brake pipe is provided as the whole completed component. If the brake pipe is defective, replace with the completed component. For the specified torque of the brake pipe fasteners, refer to **Fastener Tightening Specifications**.

FRONT BRAKE HOSE REPLACEMENT

Removal Procedure

WARNING: Refer to Brake Dust Warning .

WARNING: Refer to Brake Fluid Irritant Warning .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
2. Remove the tire and wheel assembly. Refer to Tire and Wheel Removal and Installation .
3. Clean all dirt and foreign material from the brake hose and the brake pipe fittings.

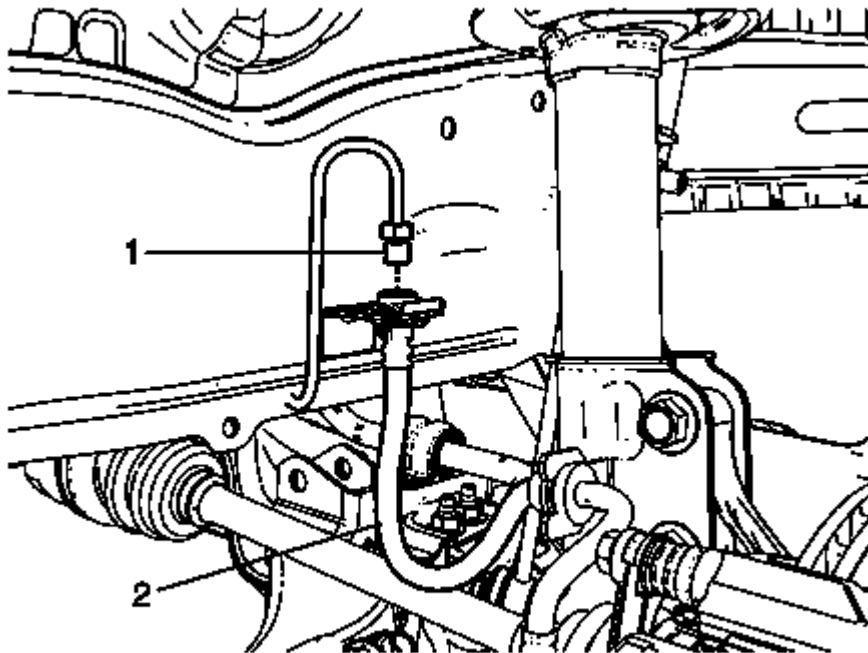


Fig. 64: Brake Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the brake pipe fitting (1) from the brake hose (2).

Cap the brake pipe fitting to prevent brake fluid loss and contamination.

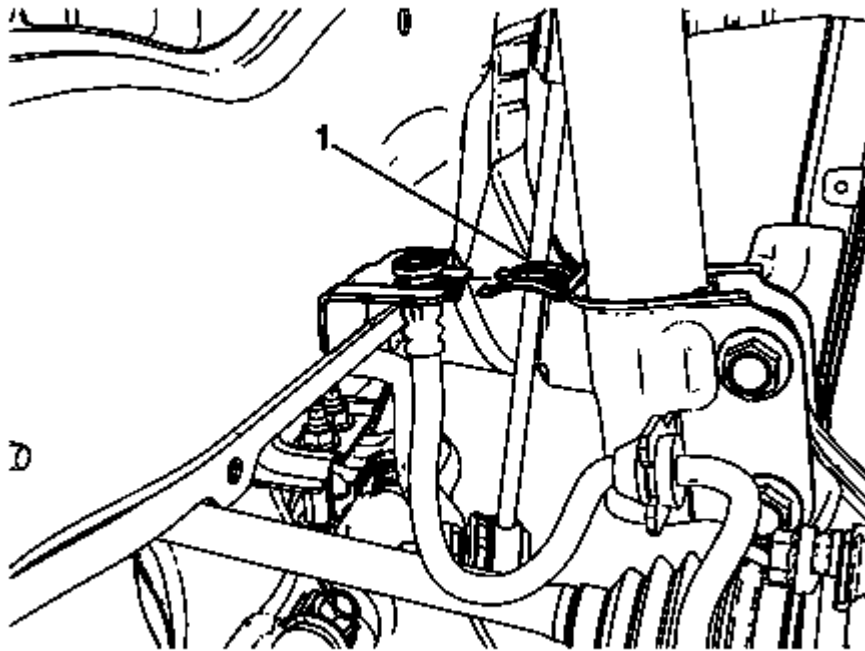


Fig. 65: Brake Hose Retaining Clip
Courtesy of GENERAL MOTORS COMPANY

5. Remove the brake hose retaining clip (1) from the brake hose mounting bracket on the body frame.
6. Detach the brake hose from the brake hose mounting bracket.

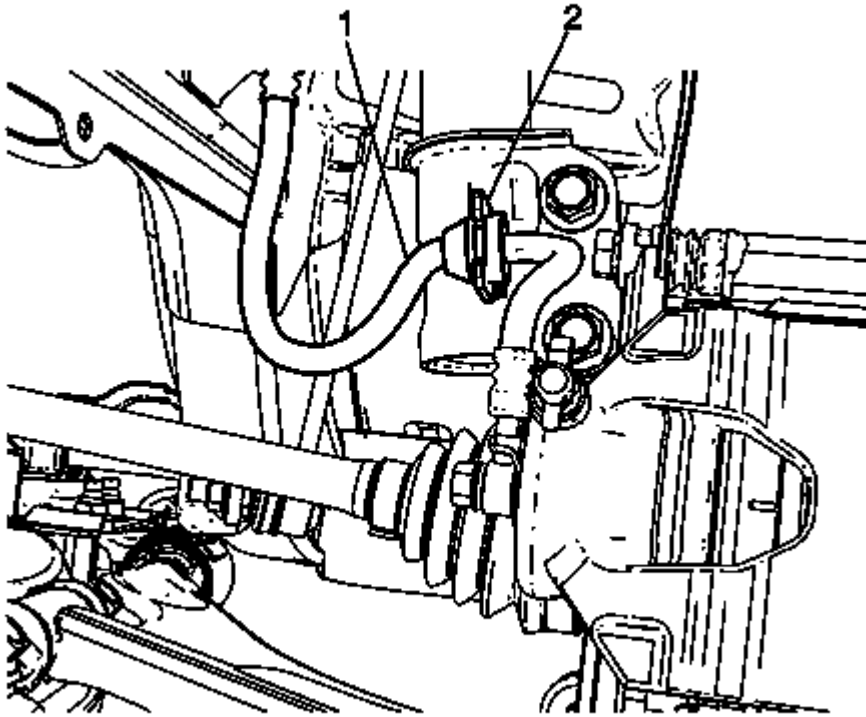


Fig. 66: Brake Hose

Courtesy of GENERAL MOTORS COMPANY

7. Detach the brake hose (1) from the strut mounted brake hose retaining bracket (2).

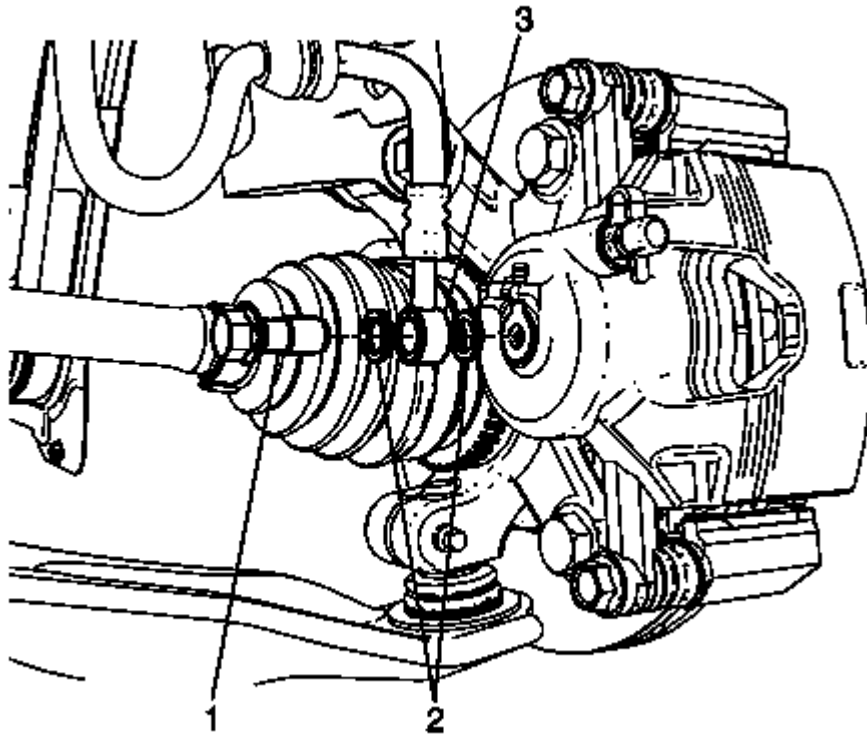


Fig. 67: Copper Brake Hose Sealing Washers And Brake Hose
Courtesy of GENERAL MOTORS COMPANY

8. Remove the brake hose-to-brake caliper banjo retaining bolt (1).
9. Remove the two copper brake hose sealing washers (2) from the brake hose (3).

Discard the two copper brake hose sealing washers.

10. Remove the brake hose (3) from the vehicle.

Installation Procedure

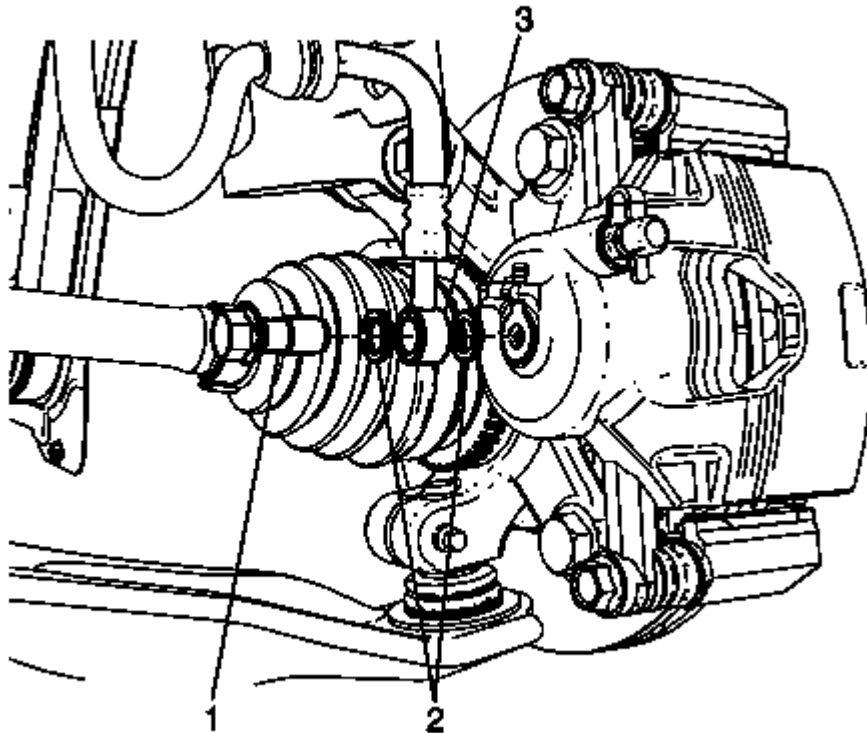


Fig. 68: Copper Brake Hose Sealing Washers And Brake Hose
Courtesy of GENERAL MOTORS COMPANY

1. Assemble the brake hose-to-brake caliper banjo retaining bolt (1) with 2 new copper brake hose sealing washers (2) to the brake hose (3).

CAUTION: Refer to Fastener Caution .

2. Install the brake hose assembly to the caliper and tighten the banjo retaining bolt to 40 N.m (30 lb ft).

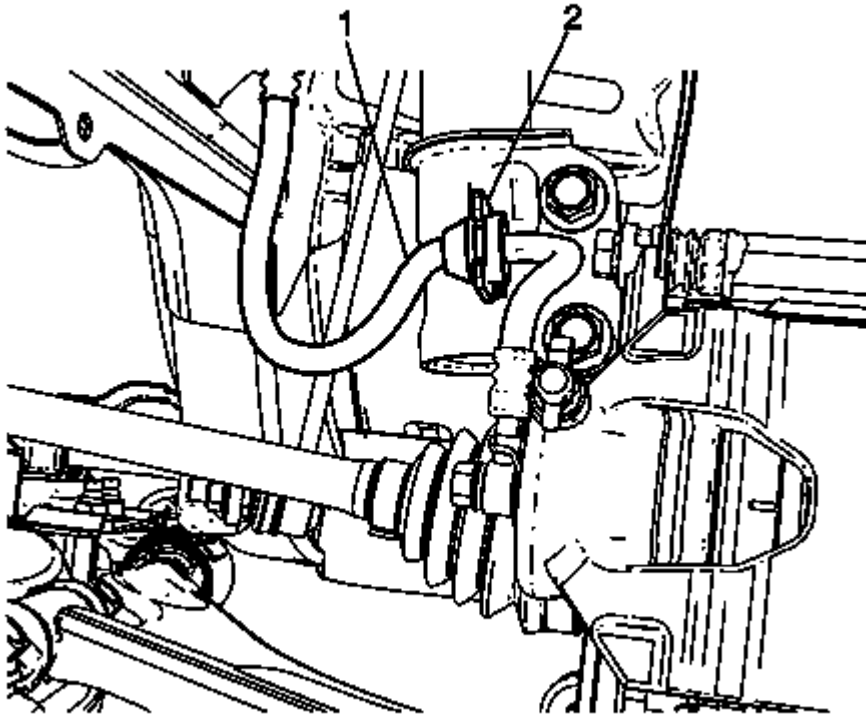


Fig. 69: Brake Hose

Courtesy of GENERAL MOTORS COMPANY

3. Install the brake hose (1) to the strut mounted brake hose retaining bracket (2).

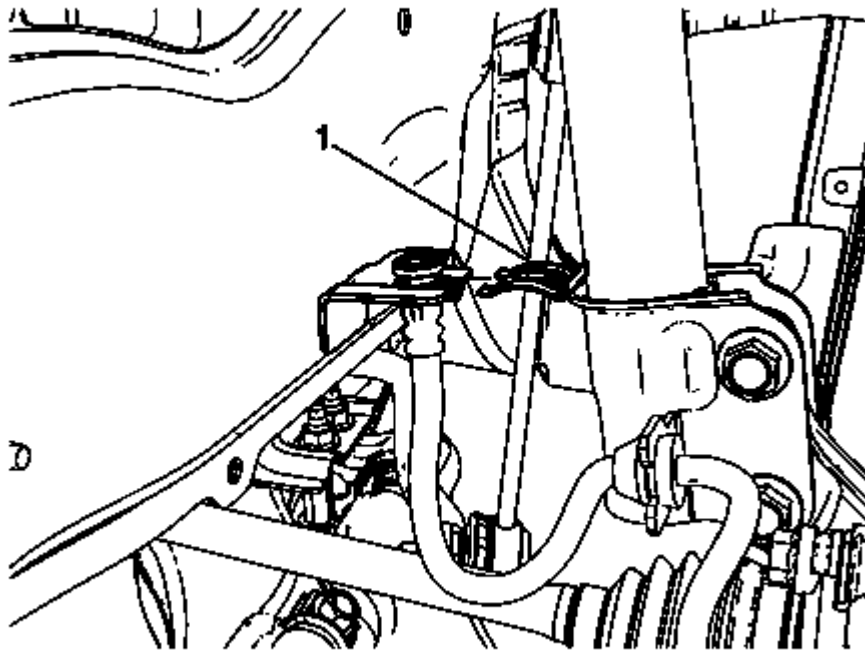


Fig. 70: Brake Hose Retaining Clip

Courtesy of GENERAL MOTORS COMPANY

4. Install the brake hose to the brake hose mounting bracket on the body frame.
5. Install the brake hose retaining clip (1) to the brake hose mounting bracket.

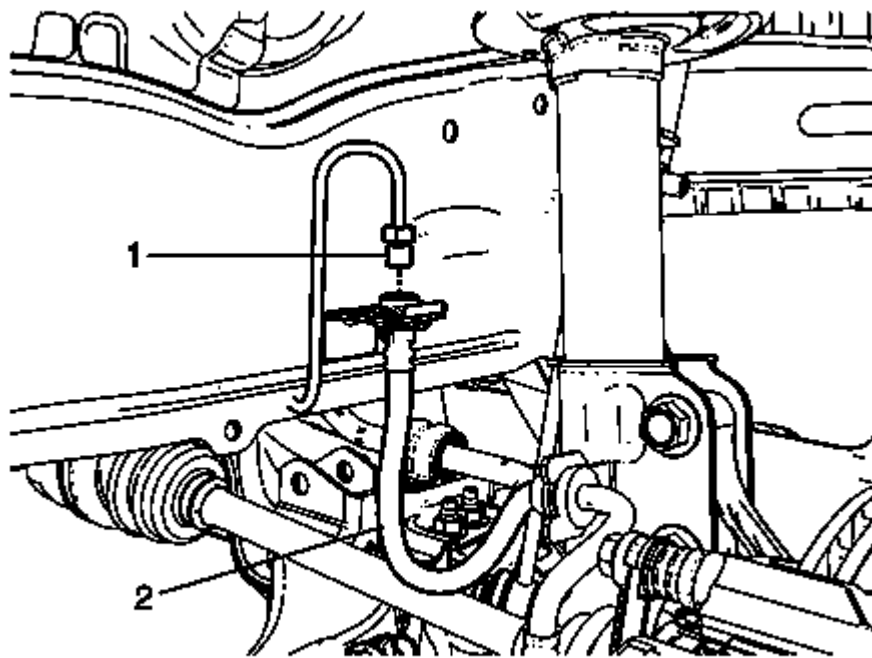


Fig. 71: Brake Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

6. Connect the brake pipe fitting (1) to the brake hose (2) and tighten to 18 N.m (13 lb ft).
7. Bleed the hydraulic brake system. Refer to Hydraulic Brake System Bleeding (Manual), Hydraulic Brake System Bleeding (Pressure).
8. Install the tire and wheel assembly. Refer to Tire and Wheel Removal and Installation .

REAR BRAKE HOSE REPLACEMENT

Removal Procedure

WARNING: Refer to Brake Fluid Irritant Warning .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
2. Remove the tire and wheel assembly. Refer to Tire and Wheel Removal and Installation .
3. Clean all dirt and foreign material from the brake hose ends and brake pipe fittings.

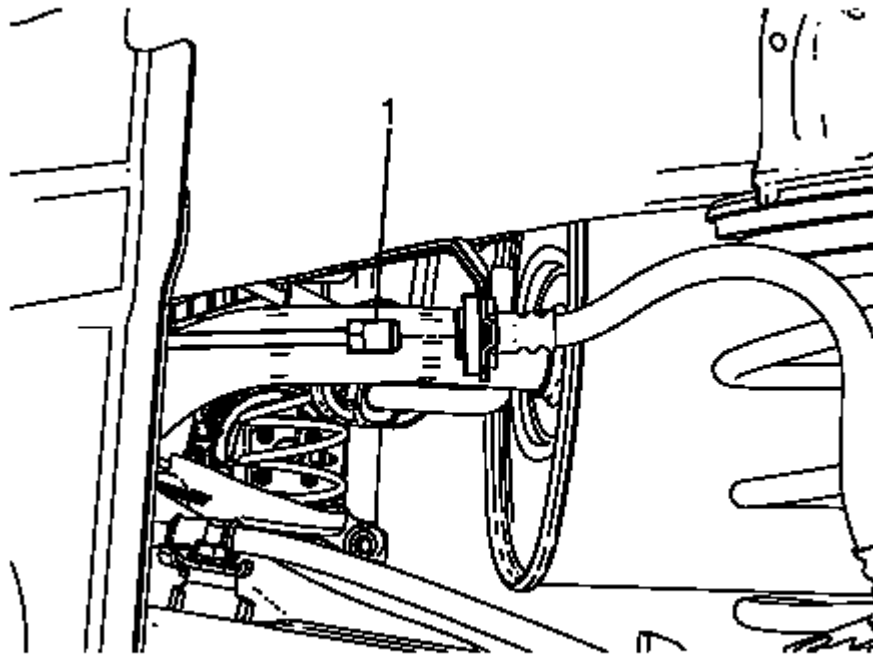


Fig. 72: Brake Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the brake pipe fitting (1) from the brake hose at the rear brake pipe side.
Cap or plug the brake pipe fitting end to prevent brake fluid loss and contamination.

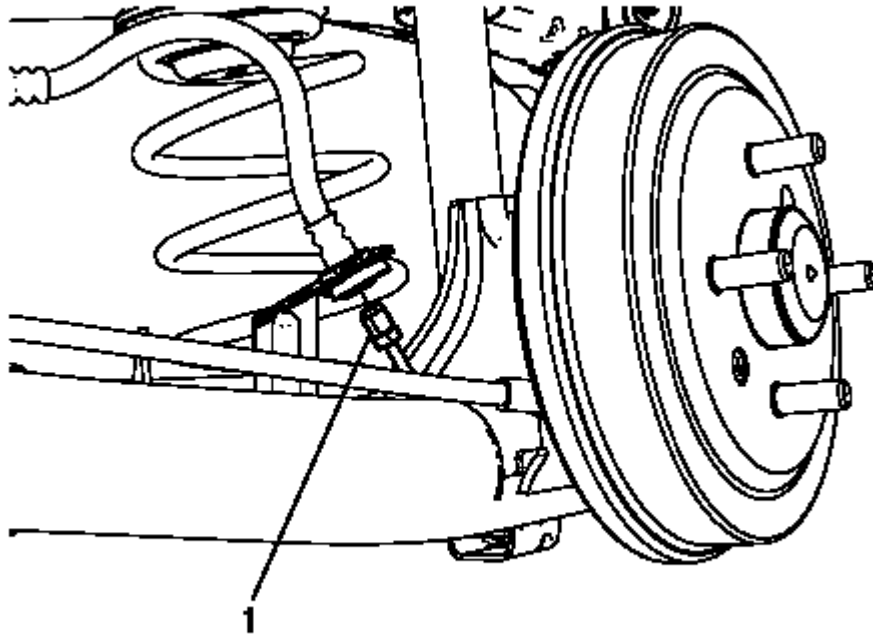


Fig. 73: Brake Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

5. Disconnect the brake pipe fitting (1) from the brake hose at the wheel cylinder side.
Cap or plug the brake pipe fitting end to prevent brake fluid loss and contamination.

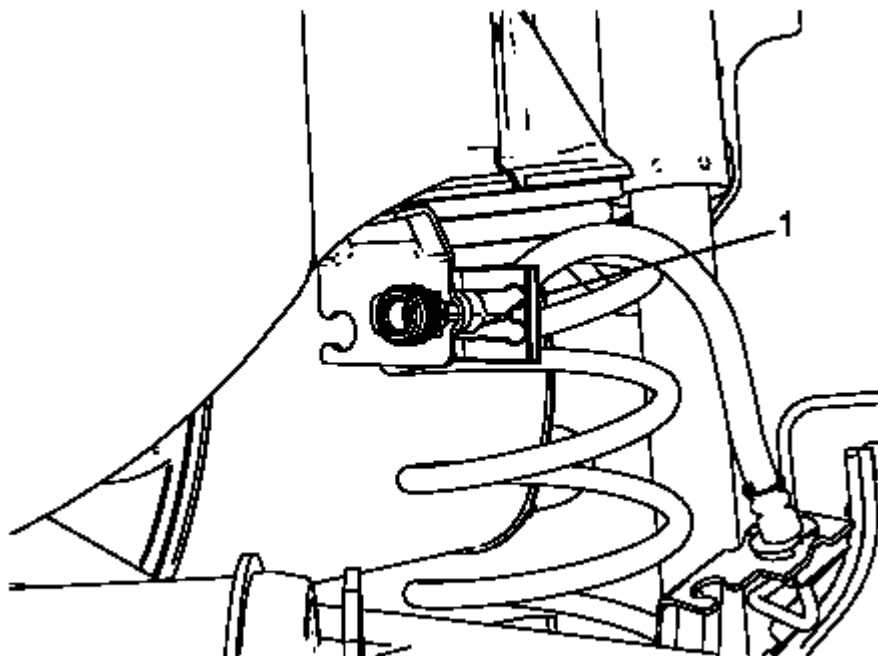


Fig. 74: Brake Hose Retaining Clip

Courtesy of GENERAL MOTORS COMPANY

6. Remove the brake hose retaining clip (1) from the brake hose mounting bracket on the body frame.
7. Detach the brake hose from the brake hose mounting bracket.

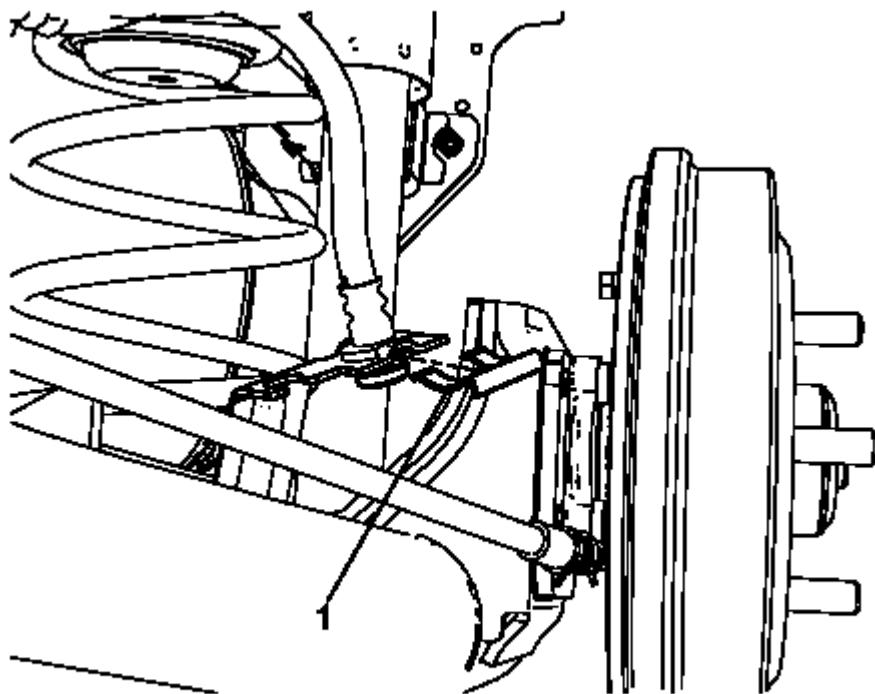


Fig. 75: Brake Hose Retaining Clip
Courtesy of GENERAL MOTORS COMPANY

8. Remove the brake hose retaining clip (1) from the brake hose mounting bracket on the rear axle.
9. Remove the brake hose from the brake hose mounting bracket.

Installation Procedure

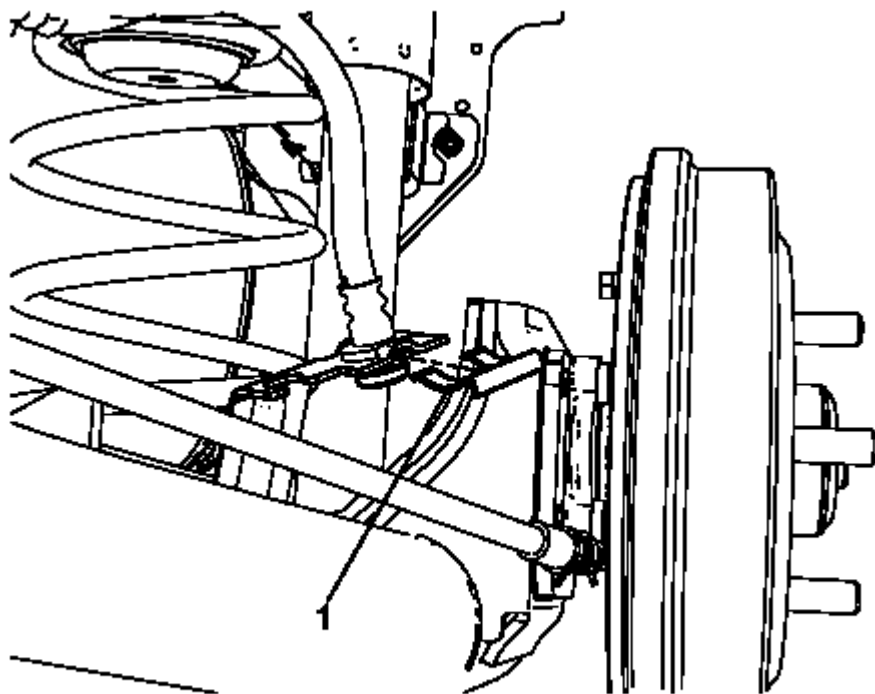


Fig. 76: Brake Hose Retaining Clip

Courtesy of GENERAL MOTORS COMPANY

1. Install the brake hose to the brake hose mounting bracket on the rear axle.
2. Install the brake hose retaining clip (1) onto the hose fitting at the brake hose mounting bracket.

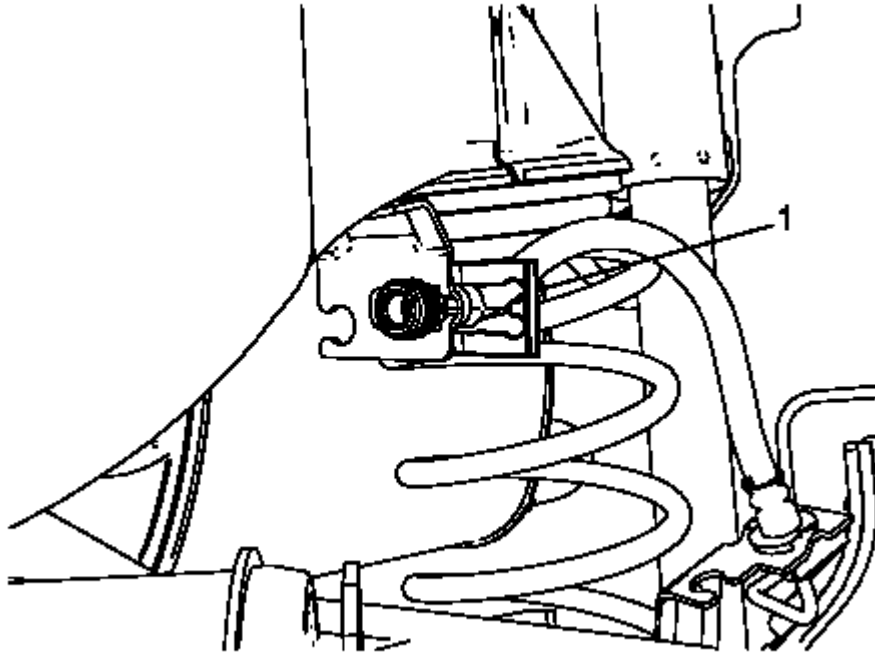


Fig. 77: Brake Hose Retaining Clip
Courtesy of GENERAL MOTORS COMPANY

3. Install the brake hose to the brake hose mounting bracket on the body frame.
4. Install the brake hose retaining clip (1) onto the hose fitting at the brake hose mounting bracket.

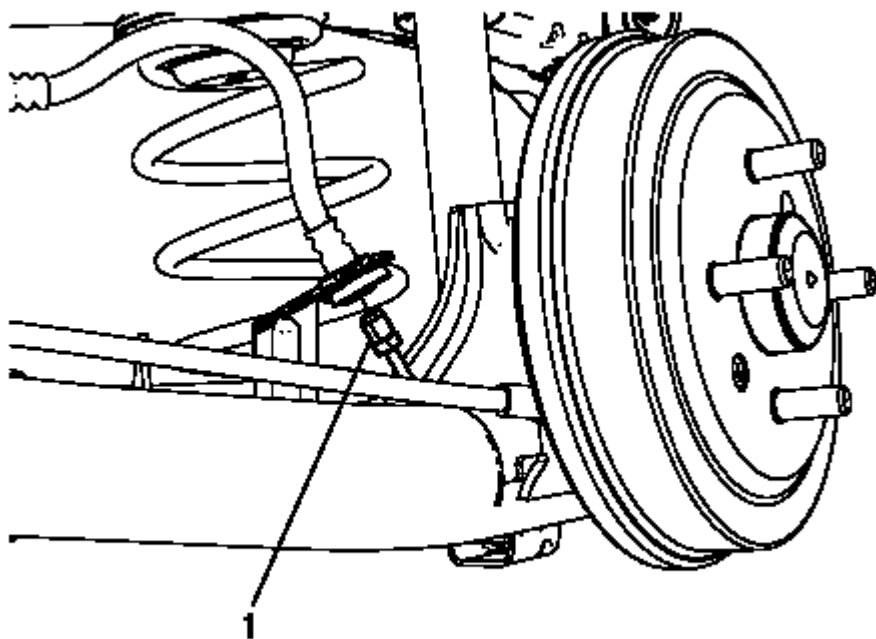


Fig. 78: Brake Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

5. Connect the brake pipe fitting (1) to the brake hose at the wheel cylinder side and tighten to 18 N.m (13 lb ft).

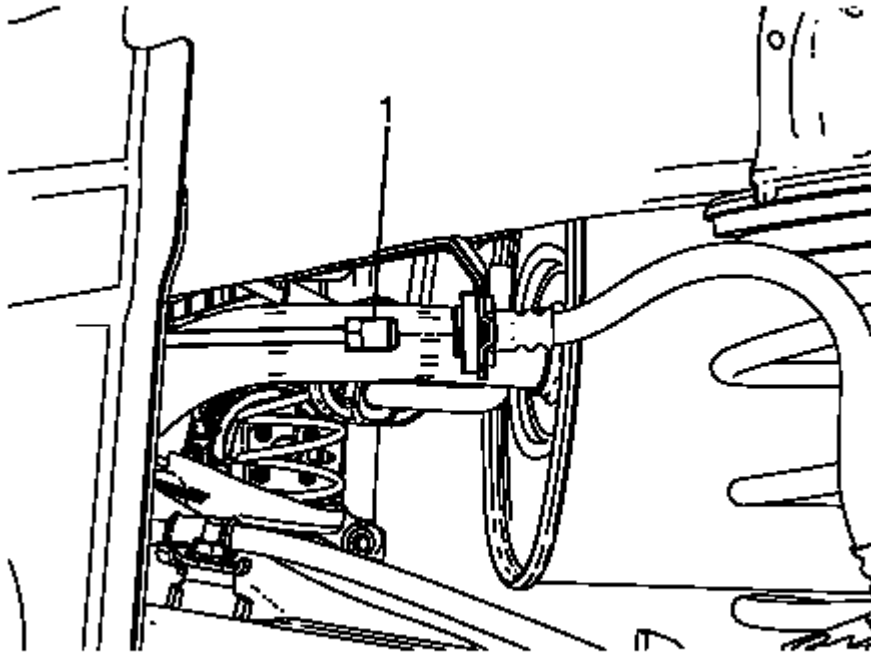


Fig. 79: Brake Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

6. Connect the brake pipe fitting (1) to the brake hose at the rear brake pipe side and tighten to 18 Y (13 lb ft).
7. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)**, **Hydraulic Brake System Bleeding (Pressure)**.
8. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
9. Lower the vehicle.

HYDRAULIC BRAKE SYSTEM BLEEDING (MANUAL)

WARNING: Refer to **Brake Fluid Irritant Warning** .

CAUTION: Refer to **Brake Fluid Effects on Paint and Electrical Components Caution** .

1. Place a clean shop cloth beneath the brake master cylinder to catch brake fluid spills.
2. With the ignition OFF and the brakes cool, apply the brakes 3-5 times and until the brake pedal effort

increases significantly, to deplete the brake booster power reserve.

3. If you have performed a brake master cylinder bench bleeding on this vehicle and if you have disconnected the brake pipes from the proportioning valve assembly or the brake pressure modulator assembly, you **MUST** perform the following steps to bleed air at the ports of the hydraulic component.
 1. Fill the master cylinder reservoir to the maximum-full level with the approved brake fluid from a clean, sealed brake fluid container.

If removal of the reservoir cap and diaphragm is necessary, clean the outside of the reservoir on and around the cap prior to removal.

2. With the brake pipes installed securely to the master cylinder, proportioning valve assembly and brake pressure modulator valve assembly, loosen and separate one of the brake pipes from the port of the component.

NOTE: **For the proportioning valve assembly or the brake pressure modulator valve assembly, perform these steps in the sequence of system flow; begin with the fluid feed pipes on the master cylinder.**

3. Allow a small amount of brake fluid to gravity bleed from the open port of the component.
 4. Connect the brake pipe fitting to the component and tighten securely.
 5. Have an assistant slowly depress the brake pedal fully and maintain steady pressure on the pedal.
 6. Loosen the same brake pipe fitting to purge air from the open port of the component.
 7. Tighten the brake pipe fitting, then have the assistant slowly release the brake pedal.
 8. Wait 15 seconds, then repeat steps 3.3-3.7 until all air is purged from the same port of each component.
 9. With the brake pipe fitting installed securely to the master cylinder, proportioning valve assembly and brake pressure modulator valve assembly after all air has been purged from the first port of the component that was bled, loosen and separate the next brake pipe from the component and repeat steps 3.3-3.8 until each of the ports on the component has been bled.
 10. After completing the final component port bleeding procedure, ensure that each of the brake pipe fittings is properly tightened.
4. Fill the master cylinder reservoir to the maximum-full level with the approved brake fluid from a clean, sealed brake fluid container. Ensure the master cylinder reservoir remains at least half-full during this bleeding procedure. Add fluid as needed to maintain the proper level.

Clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm.

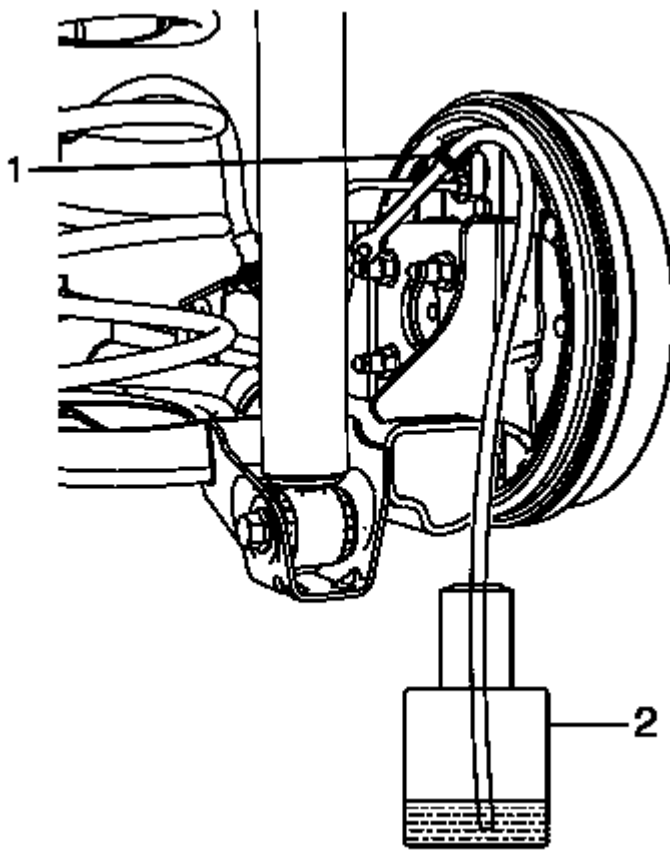


Fig. 80: Wheel Hydraulic Circuit Bleeder Valve & Draining Container
 Courtesy of GENERAL MOTORS COMPANY

5. Install a proper box-end wrench onto the RIGHT REAR wheel hydraulic circuit bleeder valve (1).
6. Install a transparent hose over the end of the wheel hydraulic circuit bleeder valve (1).
7. Submerge the open end of the transparent hose into a transparent container partially filled with the approved brake fluid from a clean, sealed brake fluid container.
8. Have an assistant slowly depress the brake pedal fully and maintain steady pressure on the pedal.
9. Loosen the bleeder valve to purge air from the wheel hydraulic circuit.
10. Tighten the bleeder valve, then have the assistant slowly release the brake pedal.
11. Wait 15 seconds, then repeat steps 8-10 until all air is purged from the wheel hydraulic circuit.
12. Tighten the wheel circuit bleeder valve securely.
13. Install a proper box-end wrench onto the LEFT FRONT wheel hydraulic circuit bleeder valve.
14. Install a transparent hose over the end of the bleeder valve, then repeat steps 7-12.
15. Install a proper box-end wrench onto the LEFT REAR wheel hydraulic circuit bleeder valve.
16. Install a transparent hose over the end of the bleeder valve, then repeat steps 7-12.
17. Install a proper box-end wrench onto the RIGHT FRONT wheel hydraulic circuit bleeder valve.
18. Install a transparent hose over the end of the bleeder valve, then repeat steps 7-12.
19. After completing the final wheel hydraulic circuit bleeding procedure, ensure that each of the 4 wheel

hydraulic circuit bleeder valves is properly tightened.

20. Fill the brake master cylinder reservoir to the maximum-full level with the approved brake fluid from a clean, sealed brake fluid container.
21. Slowly depress and release the brake pedal. Observe the brake pedal feel.
22. If the brake pedal feels spongy, repeat the bleeding procedure again. If the brake pedal still feels spongy after repeating the bleeding procedure, perform the following steps:
 1. Inspect the brake system for external leaks. Refer to **Brake System External Leak Inspection**.
 2. Pressure bleed the hydraulic brake system in order to purge any air that may still be trapped in the system.
23. Turn the ignition ON, with the engine OFF. Check to see if the brake system warning lamp remains illuminated.

NOTE: **DO NOT allow the vehicle to be driven until it is diagnosed and repaired.**

24. If the brake system warning lamp remains illuminated, refer to **Symptoms - Hydraulic Brakes**.

HYDRAULIC BRAKE SYSTEM BLEEDING (PRESSURE)

Special Tools

- **CH-29532** Diaphragm Type Brake Pressure Bleeder
- **CH-50253** Brake Pressure Bleeder Adapter

WARNING: Refer to **Brake Fluid Irritant Warning** .

CAUTION: Refer to **Brake Fluid Effects on Paint and Electrical Components Caution** .

1. Place a clean shop cloth beneath the brake master cylinder reservoir to catch brake fluid spills.
2. With the ignition OFF and the brakes cool, apply the brakes 3-5 times and until the brake pedal effort increases significantly, to deplete the brake booster power reservoir.
3. If you have performed a master cylinder bench bleeding on this vehicle and if you have disconnected the brake pipes from the proportioning valve assembly or the brake modulator assembly, you must perform the following steps to bleed air at the ports of the hydraulic components.
 1. Fill the master cylinder reservoir to the maximum-full level with the approved brake fluid from a clean, sealed brake fluid container.

If removal of the reservoir cap and diaphragm is necessary, clean the outside of the reservoir on and around the cap prior to removal.

2. With the brake pipes installed securely to the master cylinder, proportioning valve assembly and the brake pressure modulator valve assembly, loosen and separate one of the brake pipes from the

port of the component.

NOTE: For the proportioning valve assembly or the brake pressure modulator valve assembly, perform these steps in the sequence of system flow; begin with the fluid feed pipes on the master cylinder.

3. Allow a small amount of brake fluid to gravity bleed from the open port of the component.
 4. Connect the brake pipe fitting to the component and tighten securely.
 5. Have an assistant slowly depress the brake pedal fully and maintain steady pressure on the pedal.
 6. Loosen the same brake pipe fitting to purge air from the open port of the component.
 7. Tighten the brake pipe fitting, then have the assistant slowly release the brake pedal.
 8. Wait 15 seconds, then repeat steps 3.3-3.7 until all air is purged from the same port of each component.
 9. With the brake pipe fitting installed securely to the master cylinder, proportioning valve assembly and brake pressure modulator assembly after all air has been purged from the first port of the component that was bled, loosen and separate the next brake pipe from the component and repeat steps 3.3-3.8 until each of the ports on the component has been bled.
 10. After completing the final component port bleeding procedure, ensure that each of the brake pipe fittings is properly tightened.
4. Fill the brake master cylinder reservoir to the maximum-fill level with the approved brake fluid from a clean, sealed brake fluid container. Ensure the master cylinder reservoir remains at least half-full during this bleeding procedure. Add fluid as needed to remain the proper level.

Clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm.

5. Set up the brake pressure bleeder following the manufacturer's instructions.
6. Open the brake pressure bleeder fluid valve to allow pressurized brake fluid to enter the brake system.
7. Wait approximately 30 seconds and then inspect the entire hydraulic brake system in order to ensure that there are no existing external brake fluid leaks.

Any brake fluid leaks identified require repair prior to completing this procedure.

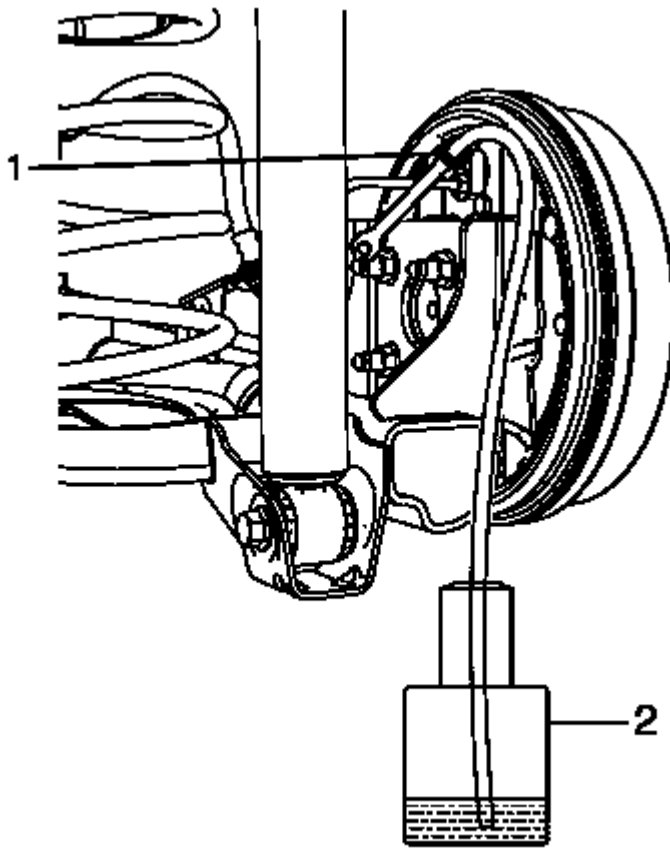


Fig. 81: Wheel Hydraulic Circuit Bleeder Valve & Draining Container
Courtesy of GENERAL MOTORS COMPANY

8. Install a proper box-end wrench onto the RIGHT REAR wheel hydraulic circuit bleeder valve (1).
9. Install a transparent hose over the end of the wheel hydraulic circuit bleeder valve (1).
10. Submerge the open end of the transparent hose into a transparent container (2) partially filled with the approved brake fluid from a clean, sealed brake fluid container.
11. Loosen the bleeder valve to purge air from the wheel hydraulic circuit. Allow fluid to flow until air bubbles stop flowing from the bleeder, then tighten the bleeder valve.
12. Tighten the wheel circuit bleeder valve securely.
13. Install a proper box-end wrench onto the LEFT FRONT wheel hydraulic circuit bleeder valve.
14. Install a transparent hose over the end of the wheel hydraulic circuit bleeder valve, then repeat steps 10-12.
15. Install a proper box-end wrench onto the LEFT REAR wheel hydraulic circuit bleeder valve.
16. Install a transparent hose over the end of the wheel hydraulic circuit bleeder valve, then repeat steps 10-12.
17. Install a proper box-end wrench onto the RIGHT FRONT wheel hydraulic circuit bleeder valve.
18. Install a transparent hose over the end of the wheel hydraulic circuit bleeder valve, then repeat steps 10-12.
19. After completing the final wheel hydraulic circuit bleeding procedure, ensure that each of the 4 wheel

hydraulic circuit bleeder valves is properly tightened.

20. Close the brake pressure bleeder fluid valve.
21. Remove the brake pressure bleeder from the brake master cylinder reservoir.
22. Fill the brake master cylinder reservoir to the maximum-full level with the approved brake fluid from a clean, sealed brake fluid container.
23. Slowly depress and release the brake pedal. Observe the feel of the brake pedal.
24. If the brake pedal feels spongy, repeat the bleeding procedure again. If the brake pedal still feels spongy after repeating the bleeding procedure, perform the following step:
 1. Inspect the brake system for external leaks. Refer to **Brake System External Leak Inspection**.
 2. If equipped with antilock brakes, using a scan tool, perform the antilock brake system automated bleeding procedure to remove any air that may have been trapped in the brake pressure modulator valve (BPMV). Refer to **Antilock Brake System Automated Bleed**
25. Turn the ignition ON, with the engine OFF. Check to see if the brake system warning lamp is illuminated.

NOTE: DO NOT allow the vehicle to be driven until it is diagnosed and repaired.

26. If the brake system warning lamp remains illuminated, refer to **Symptoms - Hydraulic Brakes**.

HYDRAULIC BRAKE SYSTEM FLUSHING

WARNING: Refer to Brake Fluid Irritant Warning .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

1. Inspect the brake fluid for the following conditions, indicating brake fluid contamination:
 - Fluid separation, indicating 2 types of fluid are present. A substance other than the recommended brake fluid has been introduced into the brake hydraulic system.
 - Swirled appearance - oil-based substance
 - Layered appearance - silicone-based substance
 - Fluid discoloration, indicating the presence of moisture or particles that have been introduced into the brake hydraulic system.
 - Cloudy appearance - moisture
 - Dark appearance/suspended particles in fluid - dirt, rust, corrosion and/or brake dust
2. Inspect the master cylinder reservoir cap diaphragm and the reservoir-to-master cylinder grommets for swelling, indicating brake fluid contamination.
3. If the brake fluid WAS contaminated with an oil-based or a silicone-based substance, indicated by fluid separation and/or a swollen master cylinder reservoir cap diaphragm and/or swollen reservoir-to-master cylinder grommets, perform the following:
 1. Remove ALL of the following components listed from the vehicle. Each component contains

internal rubber seals/linings which have been contaminated by the contaminated brake fluid in the brake hydraulic system.

Refer to the procedures indicated:

- **Master Cylinder Replacement (Right Hand Drive), Master Cylinder Replacement (Left Hand Drive)**
 - **Front Brake Hose Replacement**
 - **Rear Brake Hose Replacement**
 - **Front Brake Caliper Replacement**
 - **Rear Brake Cylinder Replacement**
 - **Brake Proportion Valve Replacement (Left Hand Drive), Brake Proportion Valve Replacement (Right Hand Drive)**, if equipped
 - **Brake Pressure Modulator Valve Replacement** , if equipped
2. Clean out all the hydraulic brake pipes using denatured alcohol and equivalent.
 3. Dry the brake pipes using non-lubricated, filtered air.
 4. Repair or replace ALL of the following components listed and install them to the vehicle. Each component contains internal rubber seals/linings which have been contaminated by the contaminated brake fluid in the brake hydraulic system.

Refer to the procedures indicated:

- **Master Cylinder Replacement (Right Hand Drive), Master Cylinder Replacement (Left Hand Drive)** ; also perform the following:
 - Clean the brake master cylinder reservoir using denatured alcohol and equivalent, then dry the reservoir using non-lubricated, filtered air. Inspect the reservoir for cracks and/or damage and replace if necessary. Refer to [Master Cylinder Reservoir Replacement](#).
 - **Front Brake Hose Replacement**
 - **Rear Brake Hose Replacement**
 - **Front Brake Caliper Replacement**
 - **Rear Brake Cylinder Replacement**
 - **Brake Proportion Valve Replacement (Left Hand Drive), Brake Proportion Valve Replacement (Right Hand Drive)**, if equipped
 - **Brake Pressure Modulator Valve Replacement** , if equipped
4. If the brake fluid WAS NOT contaminated with an oil-based or a silicone-based substance, but WAS contaminated with water or dirt, rust, corrosion, and/or brake dust, replace the brake master cylinder reservoir cap diaphragm which may have allowed the moisture or particles to enter the hydraulic system.
 5. Fill the brake master cylinder reservoir to the maximum-fill level with the approved brake fluid from a clean, sealed brake fluid container.
 6. Pressure bleed the hydraulic brake system. Begin the procedure with the pressure bleeder reservoir filled to the maximum-fill level with the correct brake fluid as indicated. Refer to [**Hydraulic Brake System Bleeding \(Manual\), Hydraulic Brake System Bleeding \(Pressure\)**](#).

POWER VACUUM BRAKE BOOSTER REPLACEMENT (LEFT HAND DRIVE)

Removal Procedure

WARNING: Refer to Brake Fluid Irritant Warning .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

1. Apply and release the brake pedal several times until it becomes firm to deplete the brake booster vacuum reserve.
2. Remove the master cylinder. Refer to Master Cylinder Replacement (Right Hand Drive), Master Cylinder Replacement (Left Hand Drive).
3. Remove the power vacuum brake booster check valve and hose assembly from the brake booster grommet.
4. Remove the steering column opening filler. Refer to Steering Column Opening Filler Replacement .

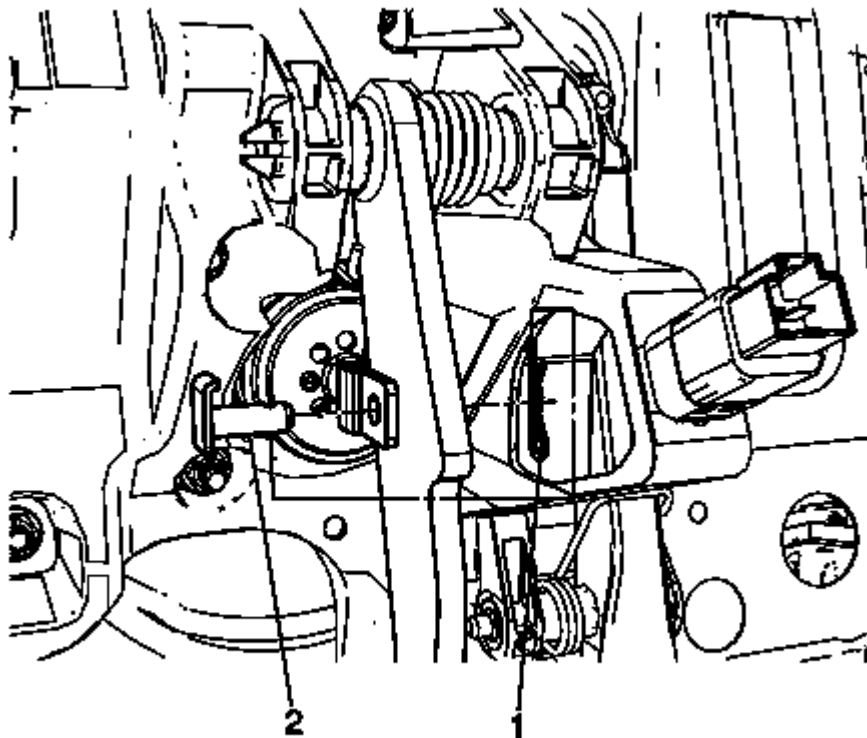


Fig. 82: Retaining Clip And Pin

Courtesy of GENERAL MOTORS COMPANY

5. Remove the retaining clip (1) and pin (2) from brake pedal.
6. Separate the brake booster pushrod from the brake pedal.

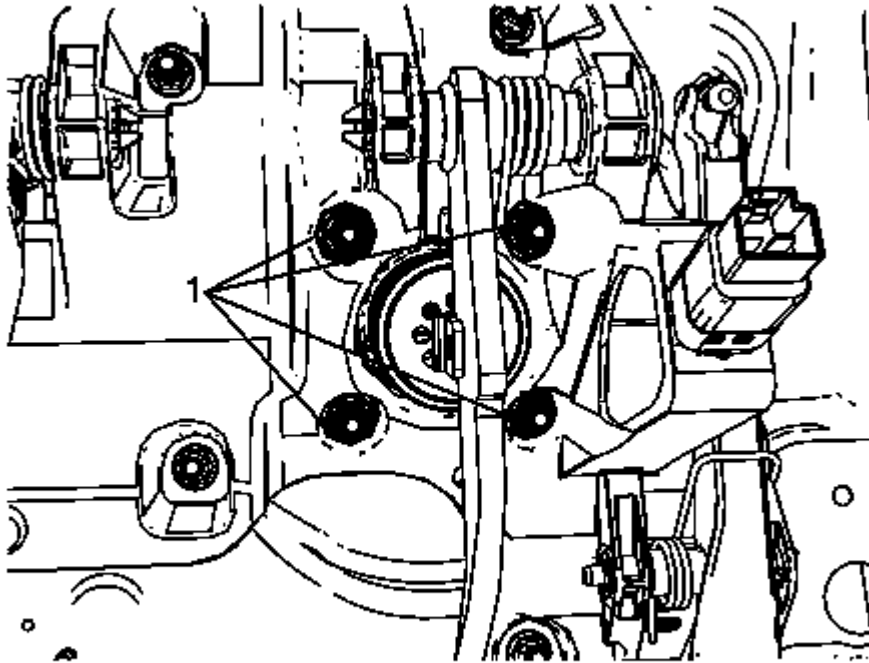


Fig. 83: Clutch (ABC) Pedal Module Retaining Nuts
Courtesy of GENERAL MOTORS COMPANY

7. Remove the brake booster to accelerator, brake and clutch (ABC) pedal module retaining nuts (1) from the ABC pedal module.

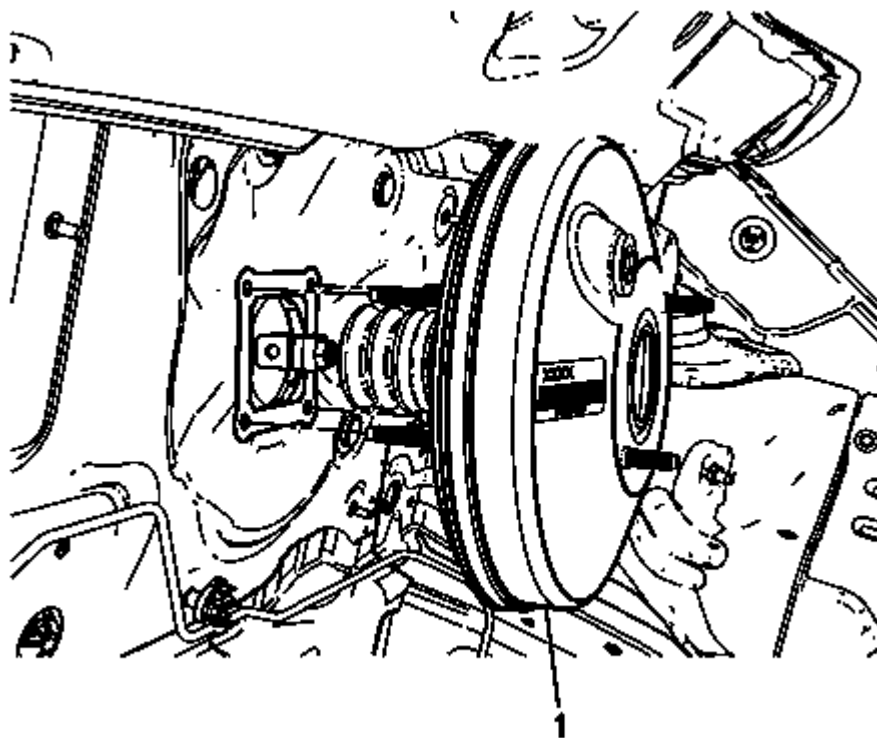


Fig. 84: Power Vacuum Brake Booster
Courtesy of GENERAL MOTORS COMPANY

8. Remove the power vacuum brake booster (1).

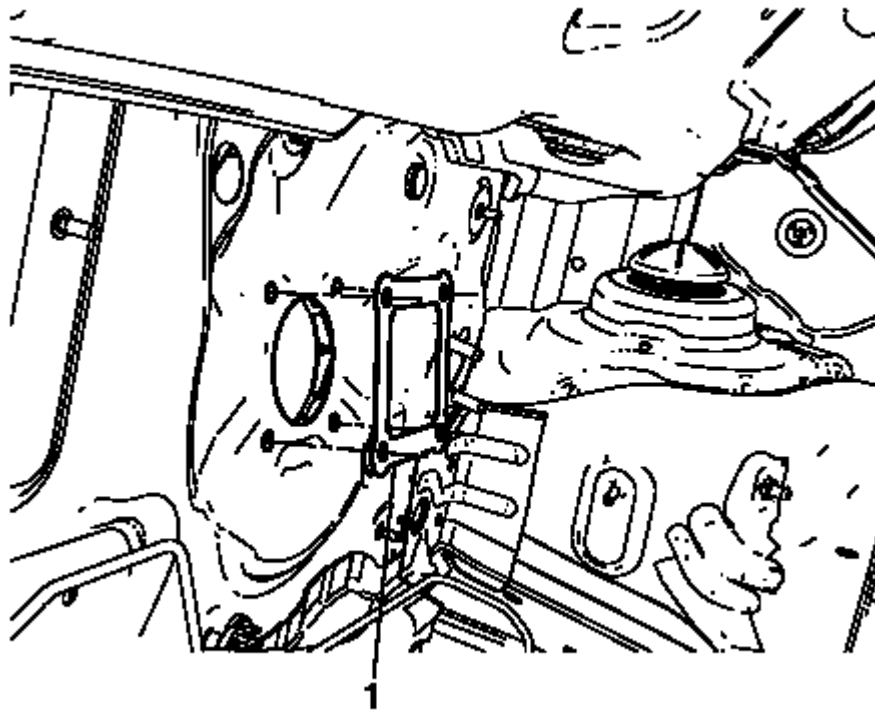


Fig. 85: Power Vacuum Brake Booster Gasket
Courtesy of GENERAL MOTORS COMPANY

9. Remove the power vacuum brake booster gasket (1).

Inspect the power vacuum brake booster gasket for damage and replace if necessary.

Installation Procedure

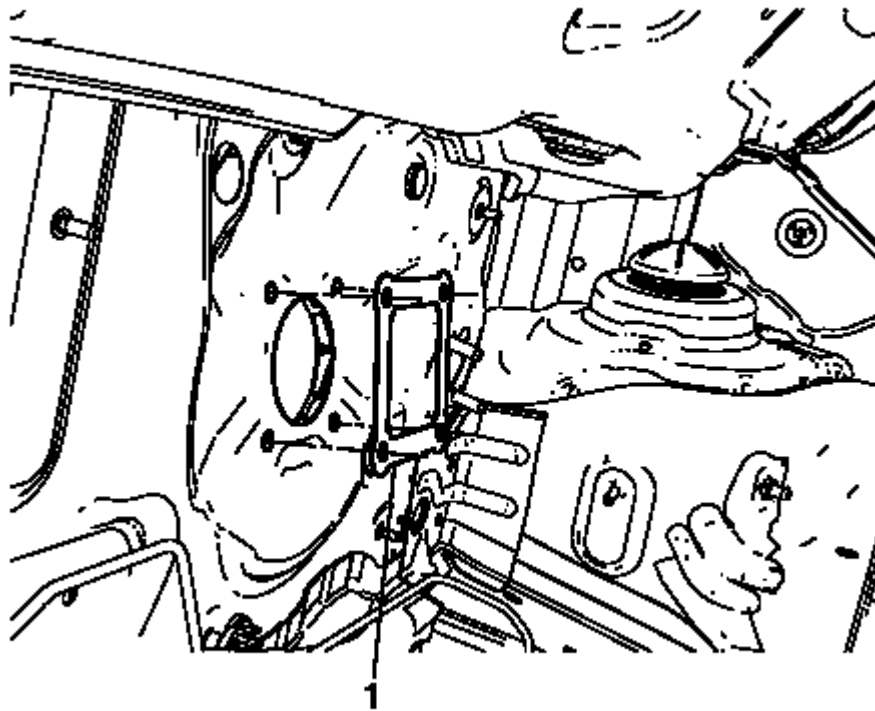


Fig. 86: Power Vacuum Brake Booster Gasket
Courtesy of GENERAL MOTORS COMPANY

1. Install the power vacuum brake booster gasket (1).

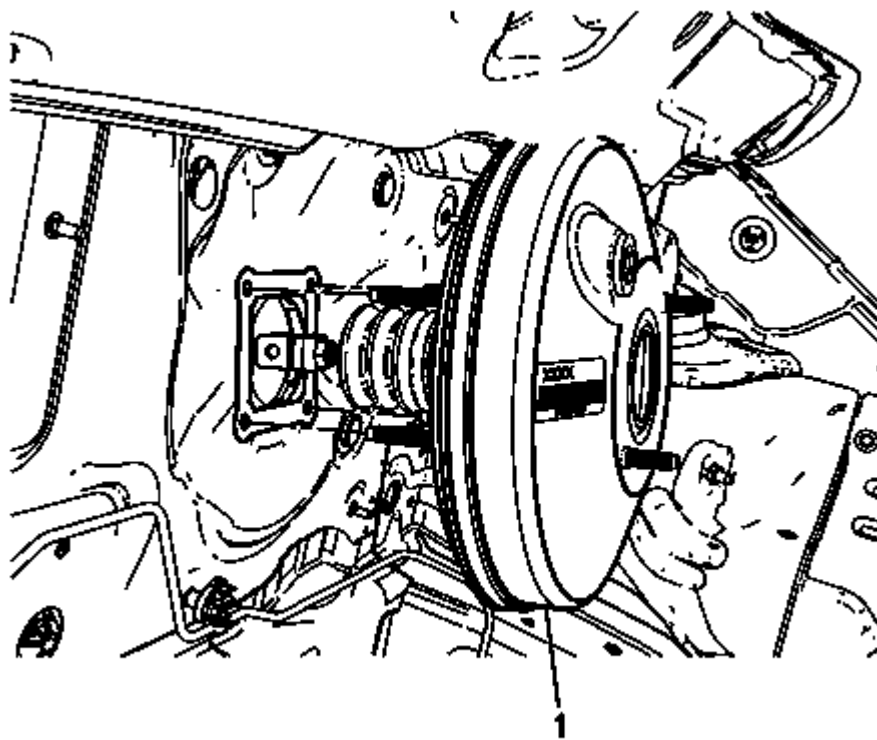


Fig. 87: Power Vacuum Brake Booster
Courtesy of GENERAL MOTORS COMPANY

2. Install the power vacuum brake booster (1).

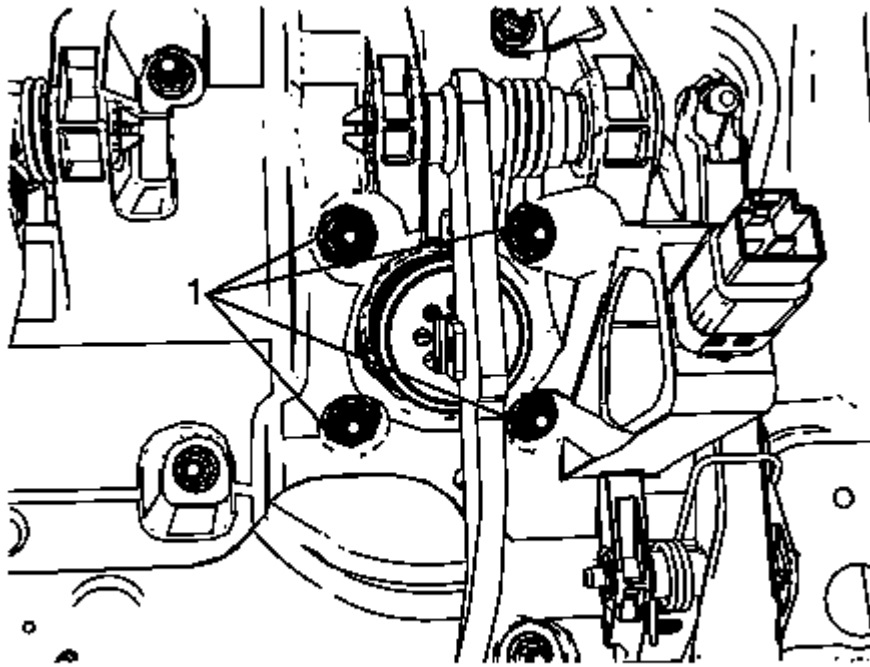


Fig. 88: Clutch (ABC) Pedal Module Retaining Nuts
Courtesy of GENERAL MOTORS COMPANY

3. Loosely install the brake booster to ABC pedal module retaining nuts (1).

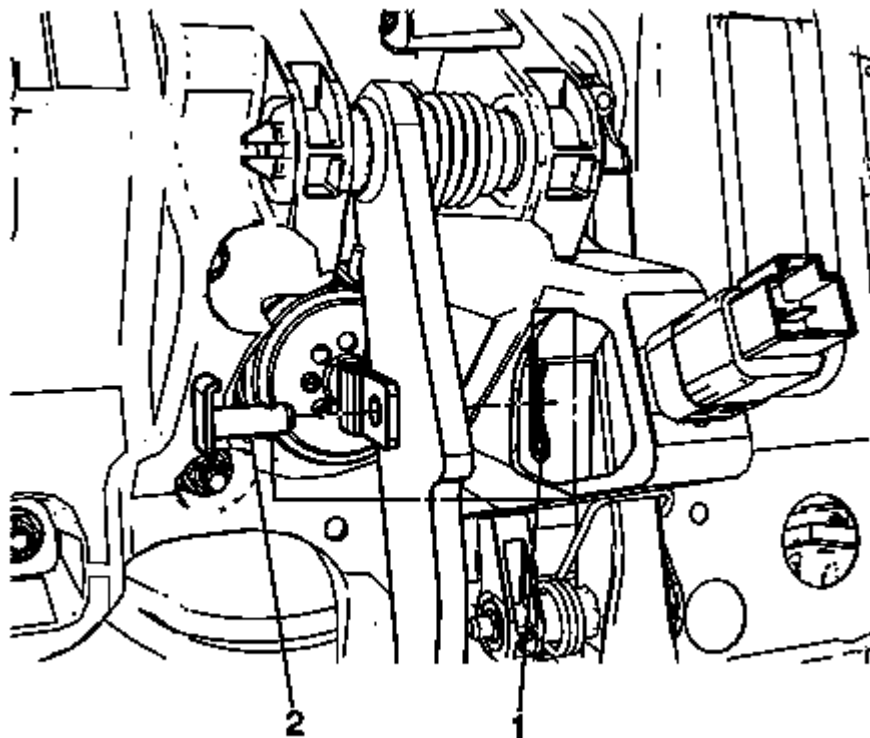


Fig. 89: Retaining Clip And Pin

Courtesy of GENERAL MOTORS COMPANY

4. Connect the brake booster pushrod to the brake pedal.
5. Install the pushrod pin (2) to the brake pedal and insert the retaining clip (1) to the pin (2).

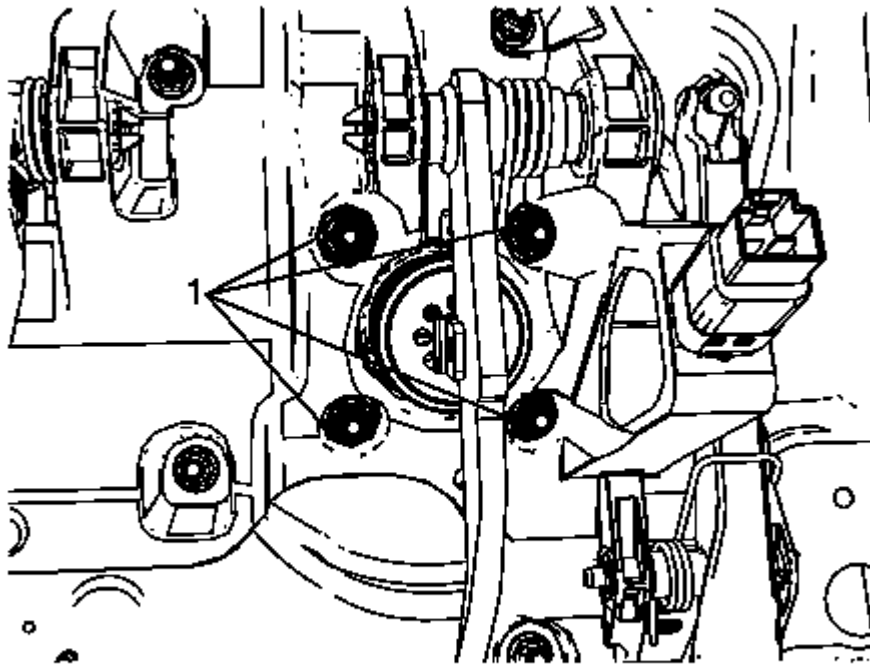


Fig. 90: Clutch (ABC) Pedal Module Retaining Nuts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

6. Completely tighten the brake booster to ABC pedal module retaining nuts (1) and tighten to 22 N.m (16 lb ft).
7. Install the steering column opening filler. Refer to Steering Column Opening Filler Replacement .
8. Install the power vacuum brake booster check valve and hose assembly to the brake booster grommet.
9. Install the master cylinder. Refer to Master Cylinder Replacement (Right Hand Drive), Master Cylinder Replacement (Left Hand Drive).

POWER VACUUM BRAKE BOOSTER REPLACEMENT (RIGHT HAND DRIVE)

Removal Procedure

WARNING: Refer to Brake Fluid Irritant Warning .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

1. Apply and release the brake pedal several times until it becomes firm to deplete the brake booster vacuum reserve.
2. Remove the plenum lower panel. Refer to **Plenum Lower Panel Replacement** .
3. Remove the master cylinder. Refer to **Master Cylinder Replacement (Right Hand Drive)**, **Master Cylinder Replacement (Left Hand Drive)**.
4. Remove the power vacuum brake booster check valve and hose assembly from the brake booster grommet.
5. Remove the steering column opening filler. Refer to **Steering Column Opening Filler Replacement** .

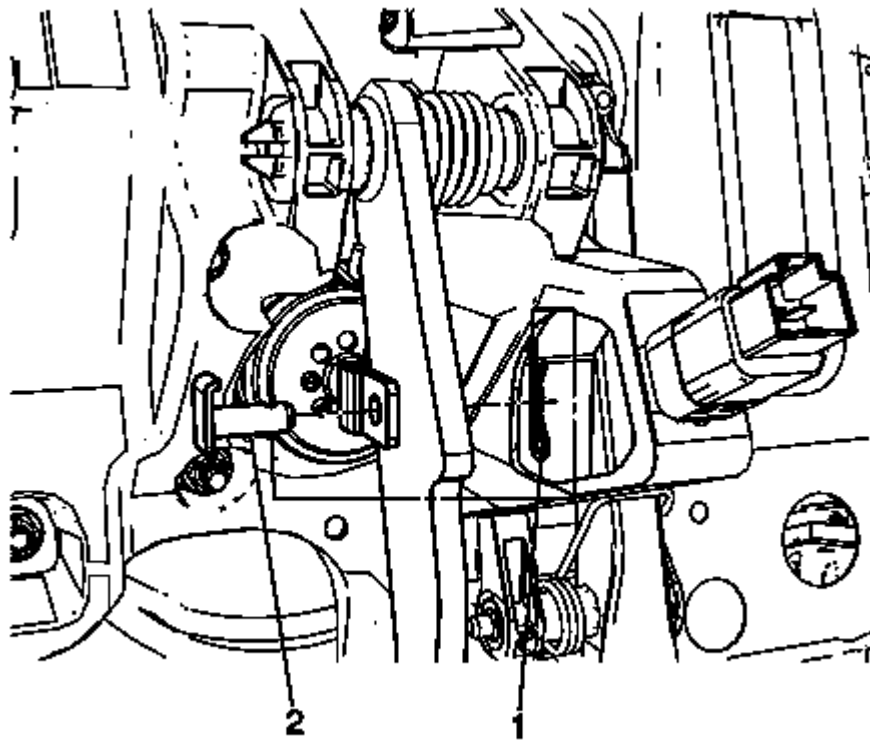


Fig. 91: Retaining Clip And Pin

Courtesy of GENERAL MOTORS COMPANY

6. Remove the retaining clip (1) and pin (2) from brake pedal.
7. Separate the brake booster pushrod from the brake pedal.

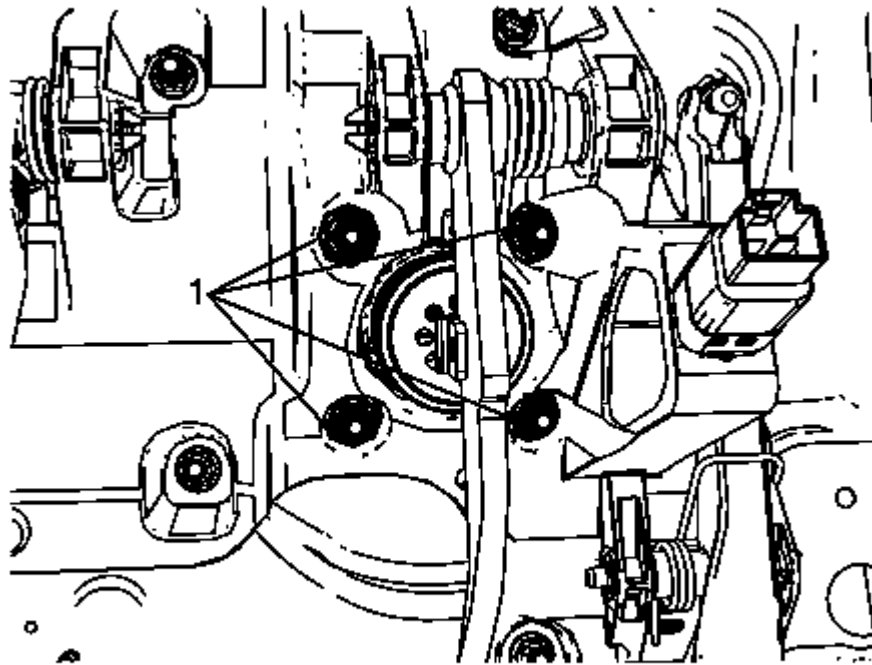


Fig. 92: Clutch (ABC) Pedal Module Retaining Nuts
Courtesy of GENERAL MOTORS COMPANY

8. Remove the brake booster to accelerator, brake and clutch (ABC) pedal module retaining nuts (1) from the ABC pedal module.

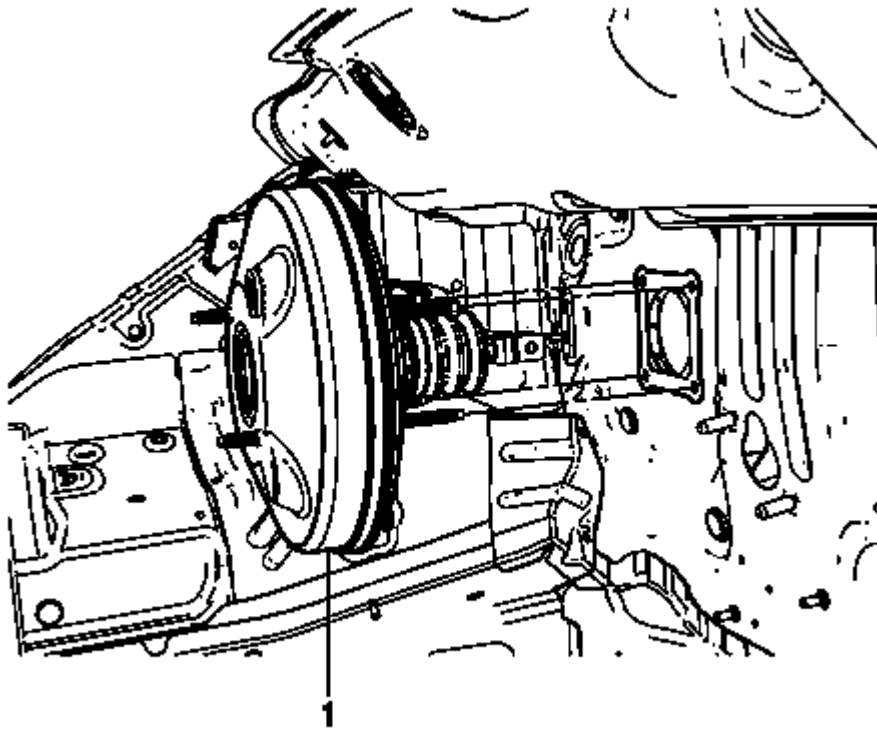


Fig. 93: Power Vacuum Brake Booster
Courtesy of GENERAL MOTORS COMPANY

9. Remove the power vacuum brake booster (1).

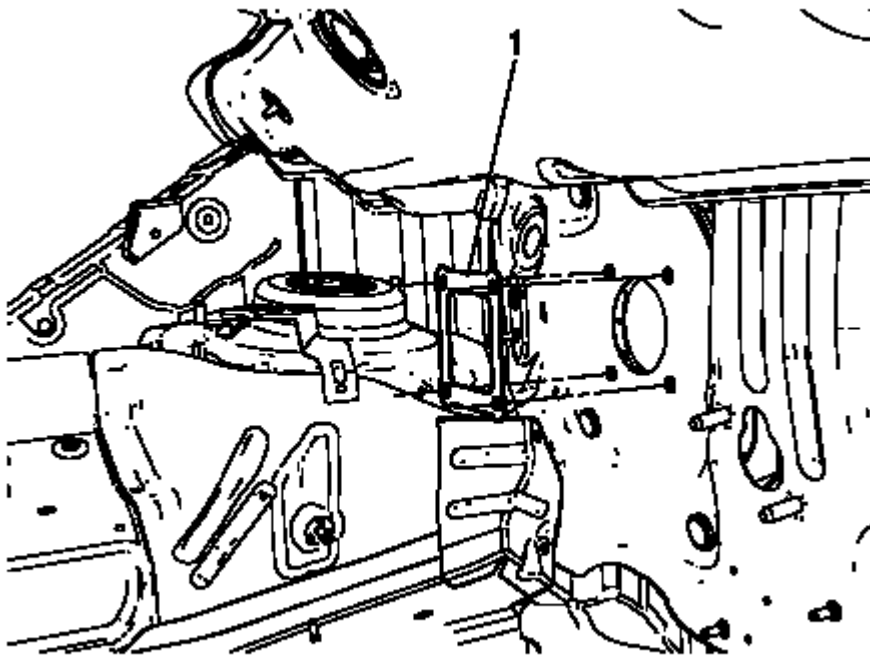


Fig. 94: Power Vacuum Brake Booster Gasket
Courtesy of GENERAL MOTORS COMPANY

10. Remove the power vacuum brake booster gasket (1).

Inspect the power vacuum brake booster gasket for damage and replace if necessary.

Installation Procedure

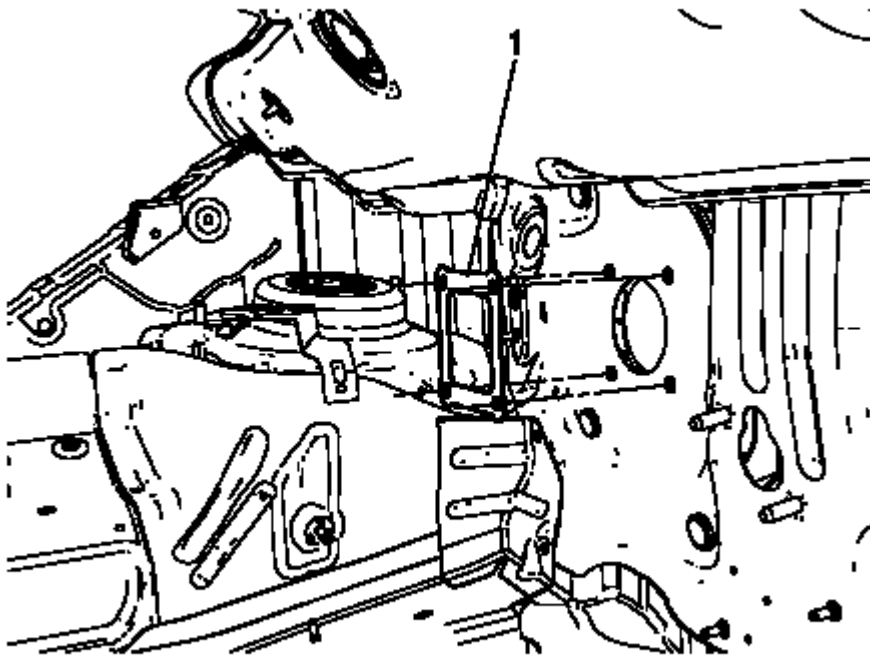


Fig. 95: Power Vacuum Brake Booster Gasket
Courtesy of GENERAL MOTORS COMPANY

1. Install the power vacuum brake booster gasket (1).

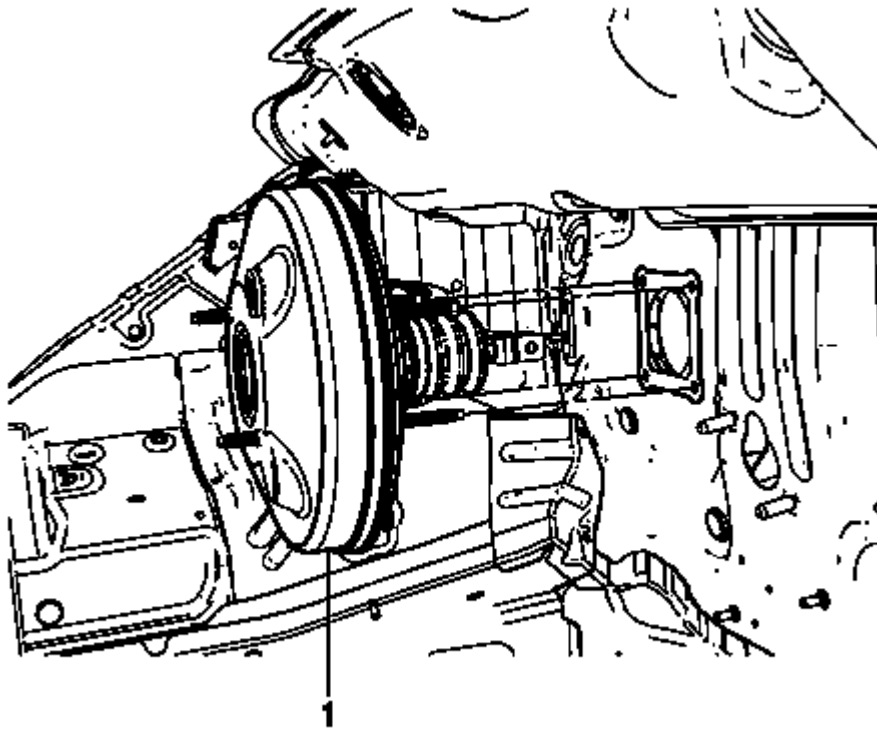


Fig. 96: Power Vacuum Brake Booster
Courtesy of GENERAL MOTORS COMPANY

2. Install the power vacuum brake booster (1).

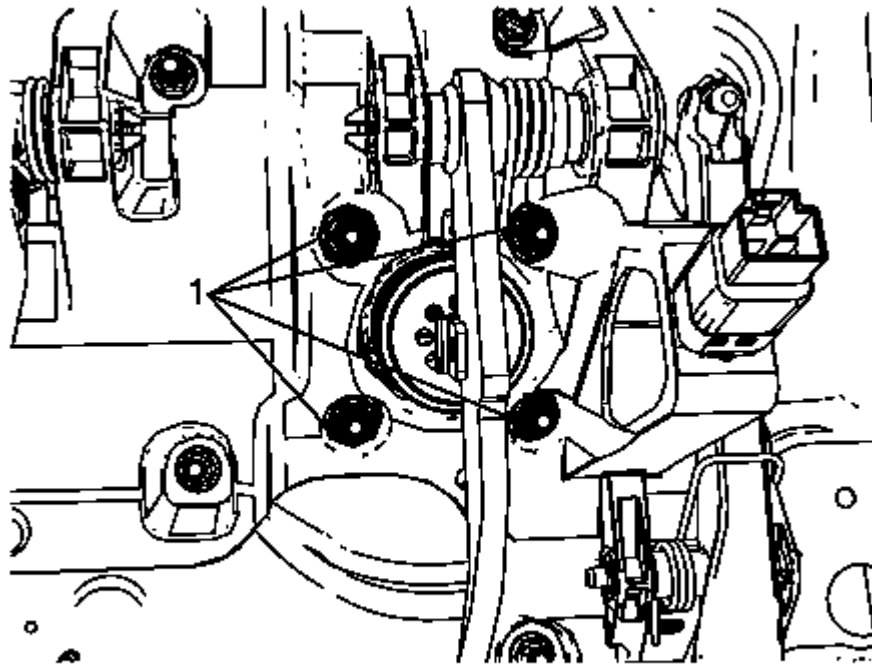


Fig. 97: Clutch (ABC) Pedal Module Retaining Nuts
Courtesy of GENERAL MOTORS COMPANY

3. Loosely install the brake booster to ABC pedal module retaining nuts (1).

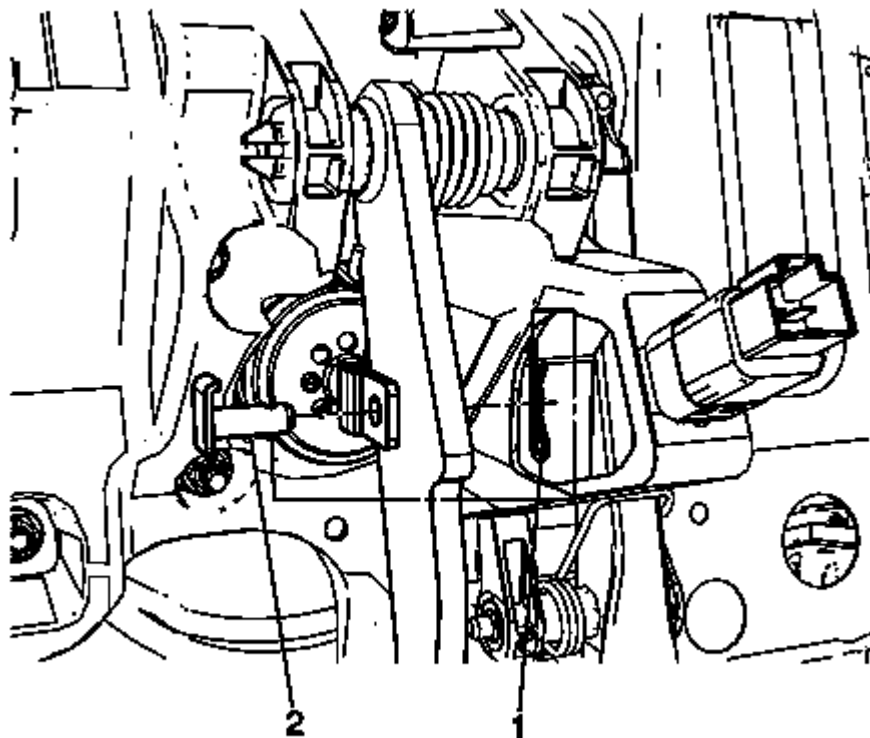


Fig. 98: Retaining Clip And Pin

Courtesy of GENERAL MOTORS COMPANY

4. Connect the brake booster pushrod to the brake pedal.
5. Install the pushrod pin (2) to the brake pedal and insert the retaining clip (1) to the pin (2).

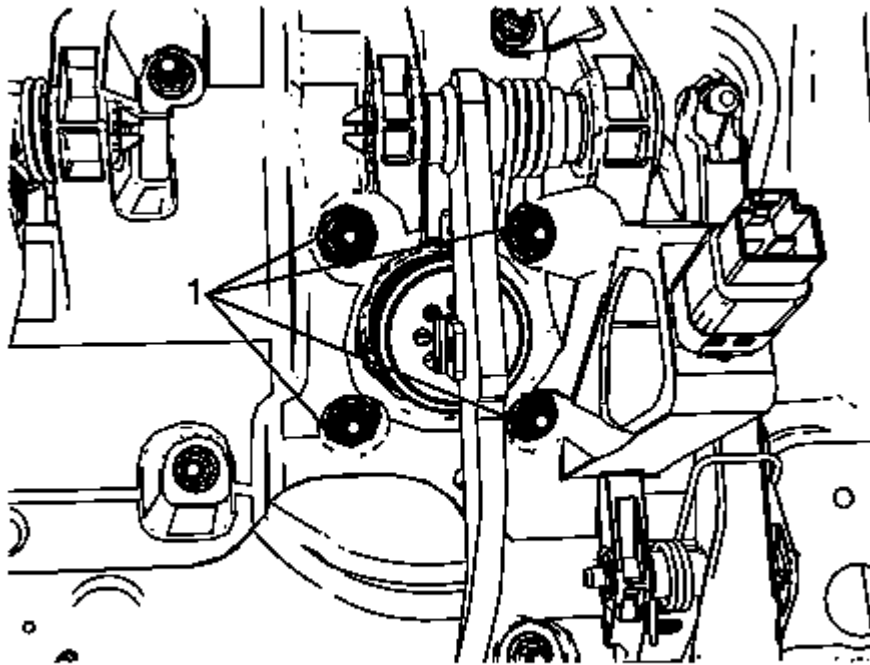


Fig. 99: Clutch (ABC) Pedal Module Retaining Nuts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

6. Completely tighten the brake booster to ABC pedal module retaining nuts (1) to 22 N.m (16 lb ft).
7. Install the steering column opening filler. Refer to Steering Column Opening Filler Replacement .
8. Install the power vacuum brake booster check valve and hose assembly to the brake booster grommet.
9. Install the master cylinder. Refer to Master Cylinder Replacement (Right Hand Drive), Master Cylinder Replacement (Left Hand Drive).
10. Install the plenum lower panel. Refer to Plenum Lower Panel Replacement .

POWER BRAKE BOOSTER VACUUM CHECK VALVE AND HOSE REPLACEMENT (LEFT HAND DRIVE)

Removal Procedure

1. Apply and release the brake pedal several times until the pedal becomes firm to deplete the power brake booster vacuum reserve.

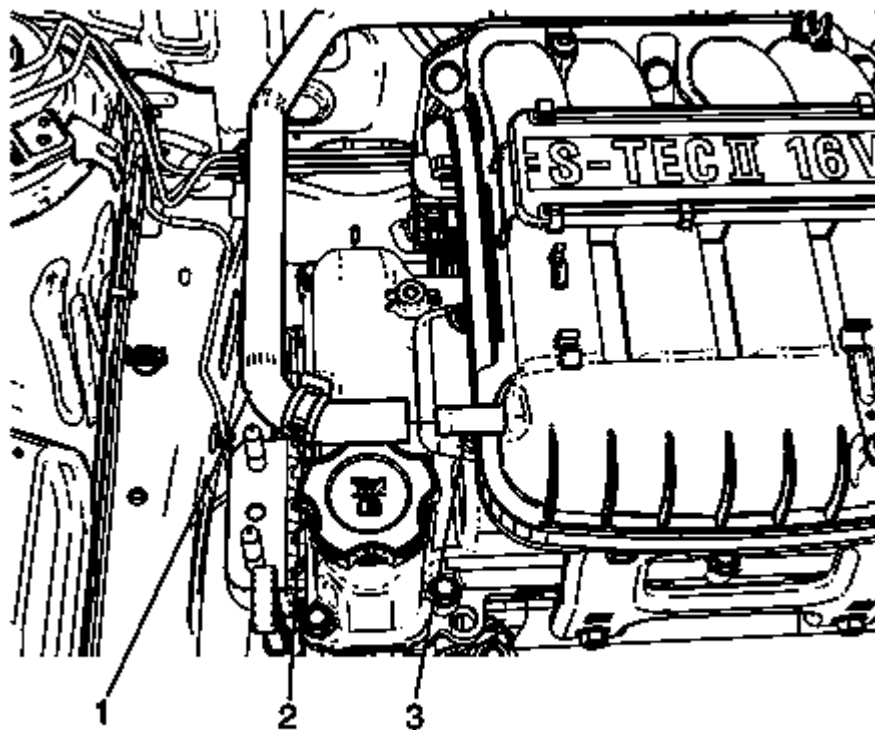


Fig. 100: Vacuum Hose Retaining Clamp And Vacuum Hose
Courtesy of GENERAL MOTORS COMPANY

2. Compress the vacuum hose retaining clamp (2) at the intake manifold vacuum port (3) and slide 50 mm (2 in) along the vacuum hose (1).
3. Disconnect the vacuum hose (1) from the intake manifold vacuum port (3).

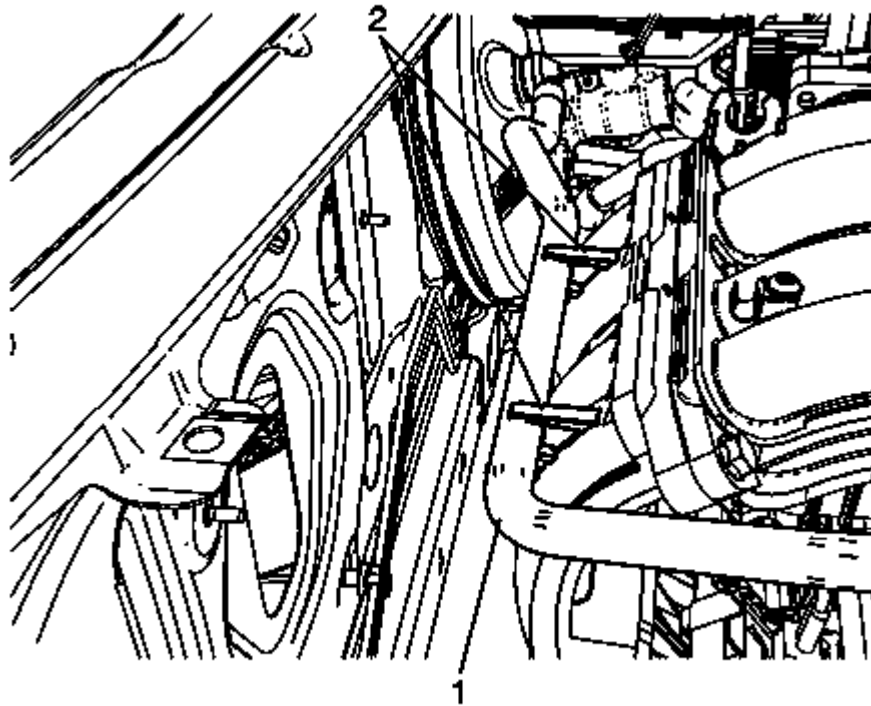


Fig. 101: Vacuum Hose

Courtesy of GENERAL MOTORS COMPANY

4. Detach the vacuum hose (1) from the intake manifold mounted vacuum hose retaining brackets (2).

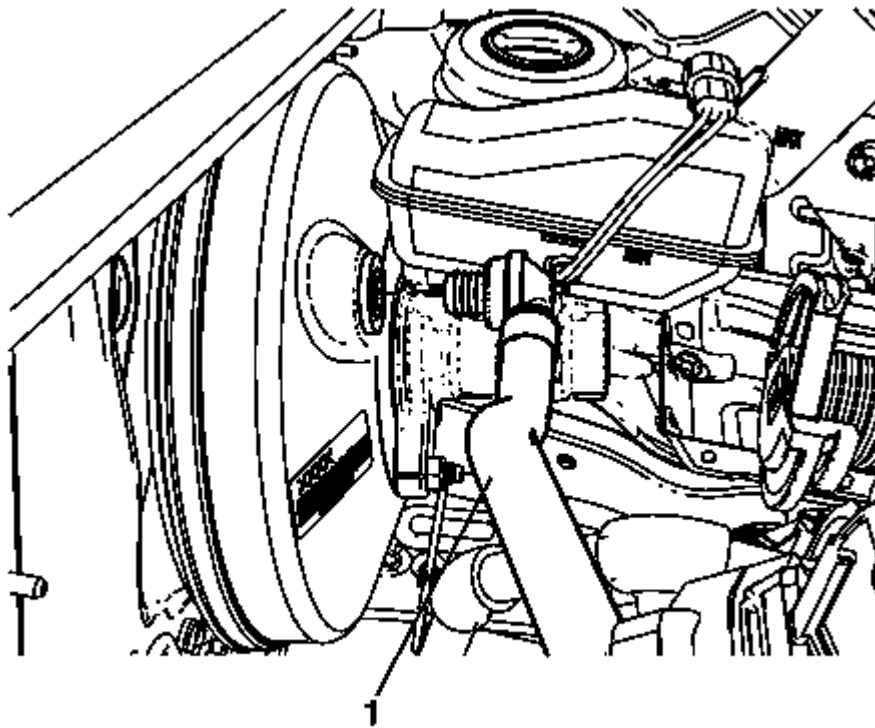


Fig. 102: Vacuum Brake Booster Check Valve
Courtesy of GENERAL MOTORS COMPANY

5. Remove the vacuum hose and the vacuum brake booster check valve (1) from the vacuum brake booster.

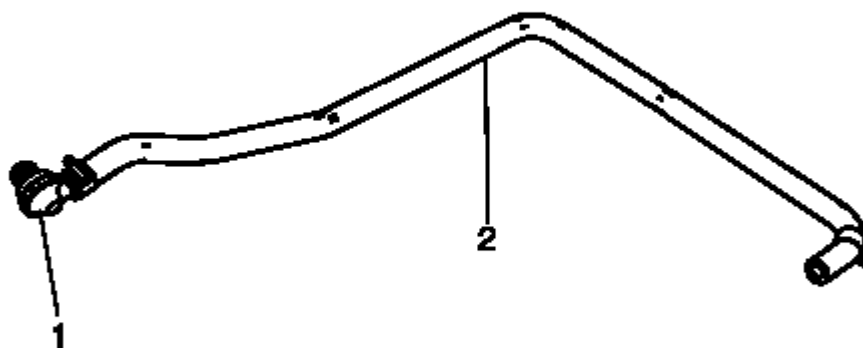


Fig. 103: Vacuum Brake Booster Check Valve
Courtesy of GENERAL MOTORS COMPANY

6. Remove the vacuum brake booster check valve (1) from the vacuum hose (2), if necessary.

Installation Procedure

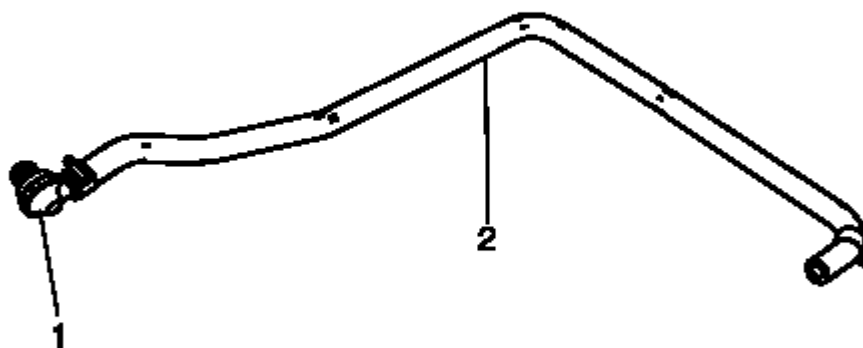


Fig. 104: Vacuum Brake Booster Check Valve
Courtesy of GENERAL MOTORS COMPANY

1. Install the vacuum brake booster check valve (1) to the vacuum hose (2).

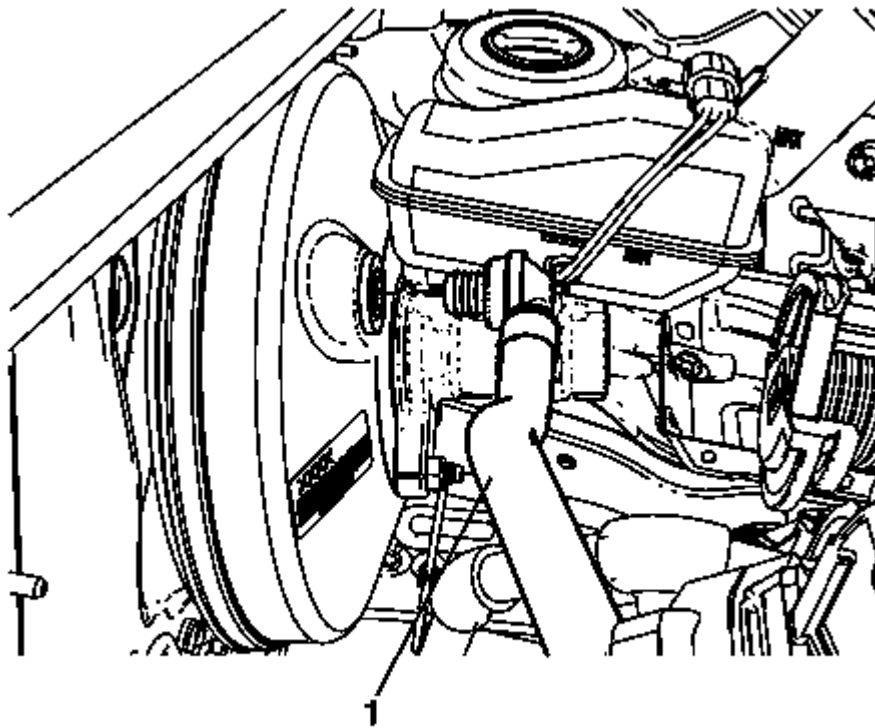


Fig. 105: Vacuum Brake Booster Check Valve
Courtesy of GENERAL MOTORS COMPANY

2. Install the vacuum hose and the vacuum brake booster check valve (1) to the vacuum brake booster.

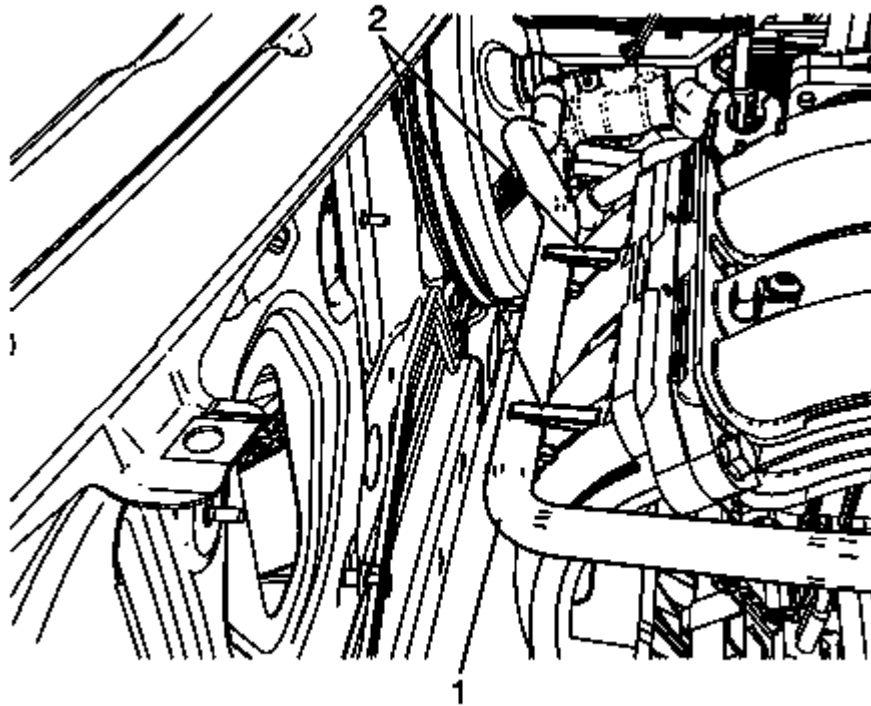


Fig. 106: Vacuum Hose

Courtesy of GENERAL MOTORS COMPANY

3. Attach the vacuum hose (1) to the intake manifold mounted vacuum hose retaining brackets (2).

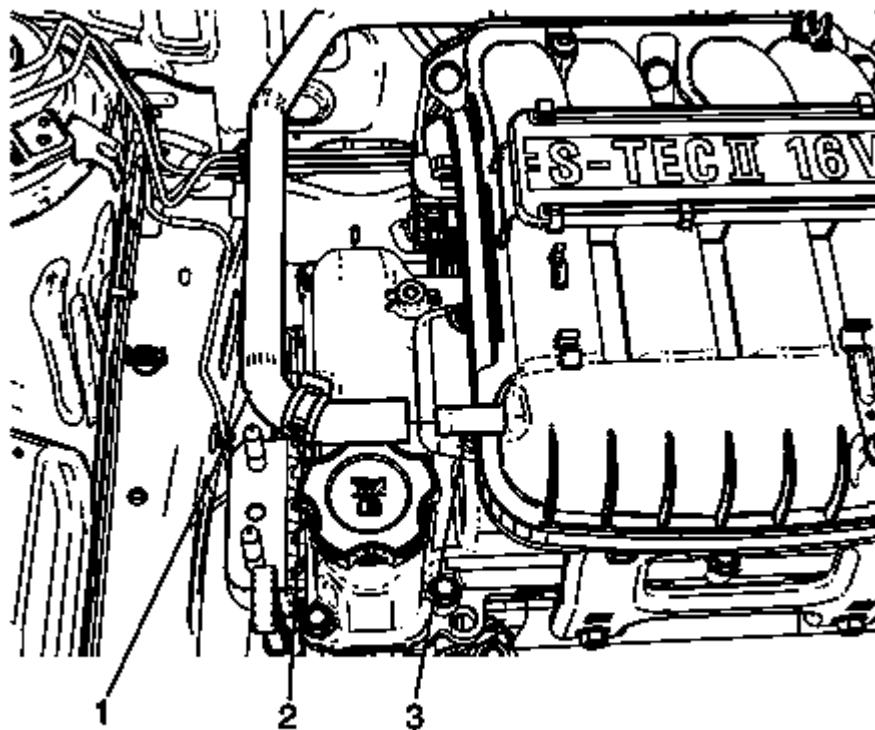


Fig. 107: Vacuum Hose Retaining Clamp And Vacuum Hose
Courtesy of GENERAL MOTORS COMPANY

4. Connect the vacuum hose (1) to the intake manifold vacuum port (3).
5. Compress the vacuum hose retaining clamp (2) and slide along the vacuum hose (1) to the correct location, to secure the vacuum hose (1) to the intake manifold vacuum port (3).

POWER BRAKE BOOSTER VACUUM CHECK VALVE AND HOSE REPLACEMENT (RIGHT HAND DRIVE)

Removal Procedure

1. Apply and release the brake pedal several times until the pedal becomes firm to deplete the power brake booster vacuum reserve.

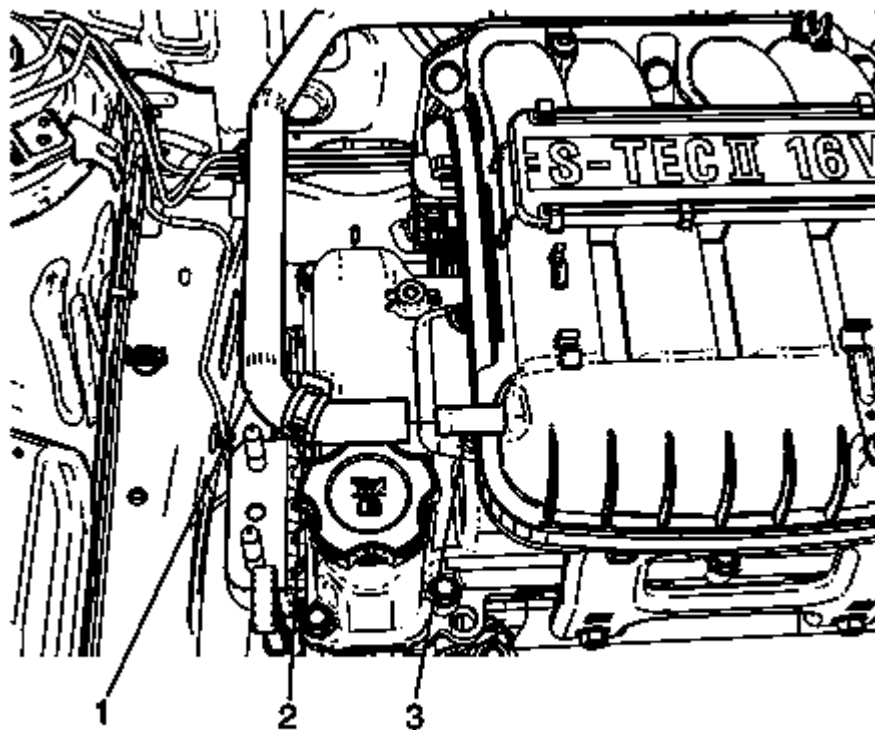


Fig. 108: Vacuum Hose Retaining Clamp And Vacuum Hose
Courtesy of GENERAL MOTORS COMPANY

2. Compress the vacuum hose retaining clamp (2) at the intake manifold vacuum port (3) and slide 50 mm (2 in) along the vacuum hose (1).
3. Disconnect the vacuum hose (1) from the intake manifold vacuum port (3).

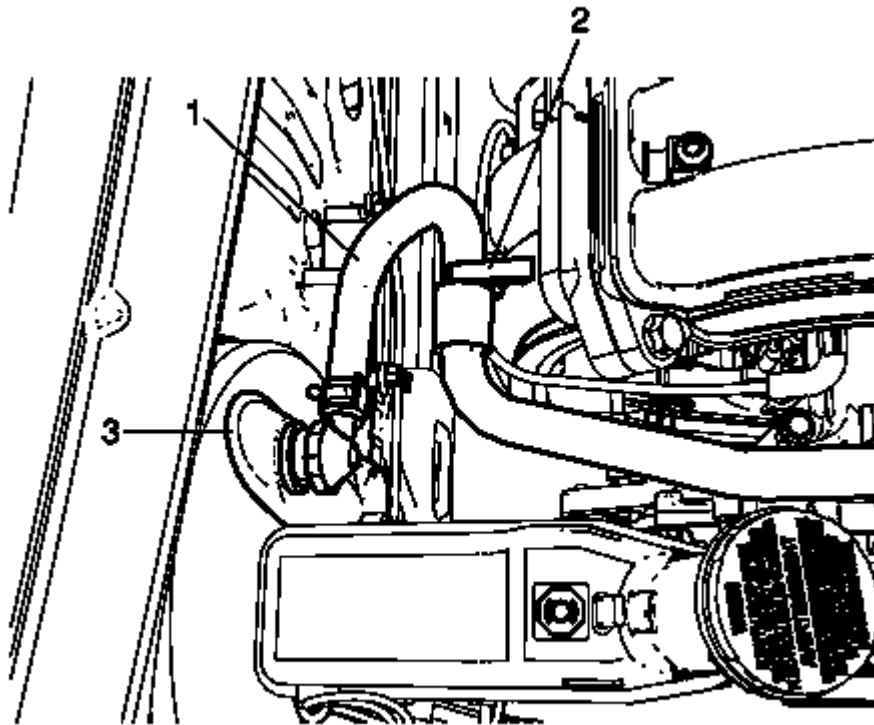


Fig. 109: Vacuum Hose

Courtesy of GENERAL MOTORS COMPANY

4. Detach the vacuum hose (1) from the intake manifold mounted vacuum hose retaining brackets (2).
5. Remove the vacuum hose and the vacuum brake booster check valve (1) from the vacuum brake booster (3).

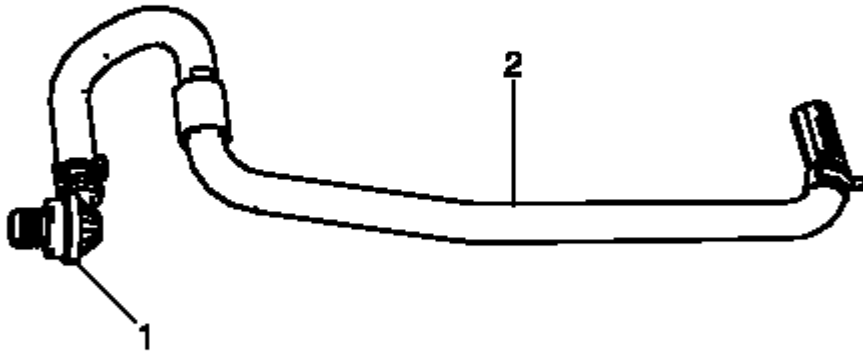


Fig. 110: Vacuum Brake Booster Check Valve
Courtesy of GENERAL MOTORS COMPANY

6. Remove the vacuum brake booster check valve (1) from the vacuum hose (2), if necessary.

Installation Procedure

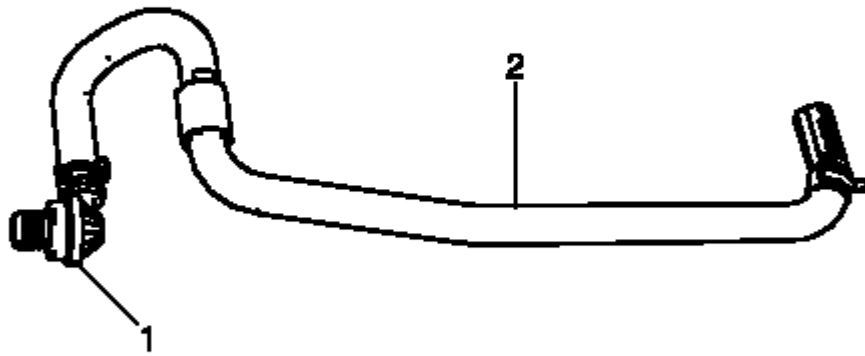


Fig. 111: Vacuum Brake Booster Check Valve
Courtesy of GENERAL MOTORS COMPANY

1. Install the vacuum brake booster check valve (1) to the vacuum hose (2).

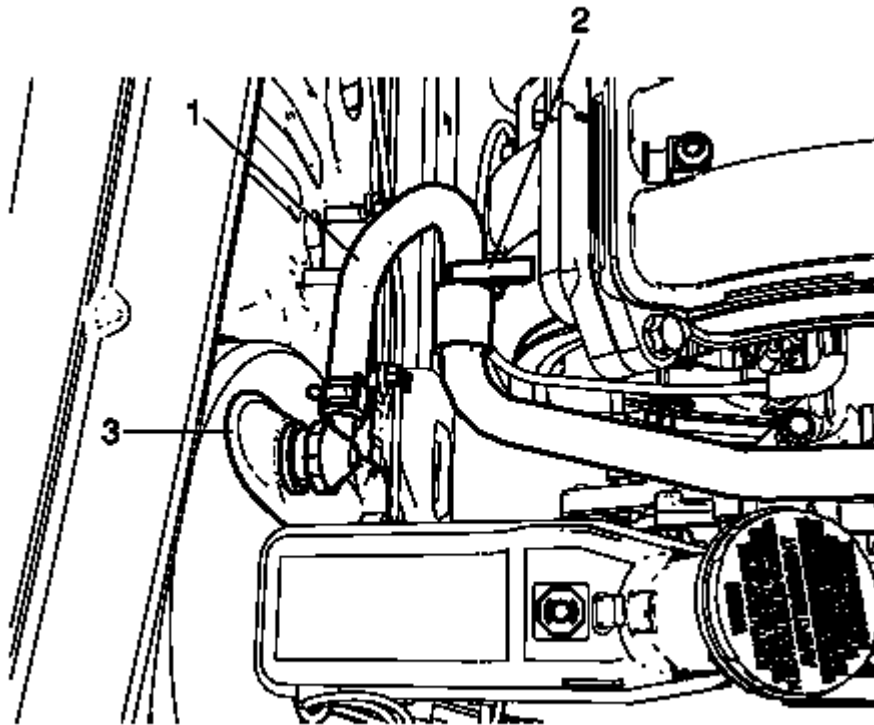


Fig. 112: Vacuum Hose

Courtesy of GENERAL MOTORS COMPANY

2. Install the vacuum hose and the vacuum brake booster check valve (1) to the vacuum brake booster (3).
3. Attach the vacuum hose (1) to the intake manifold mounted vacuum hose retaining brackets (2).

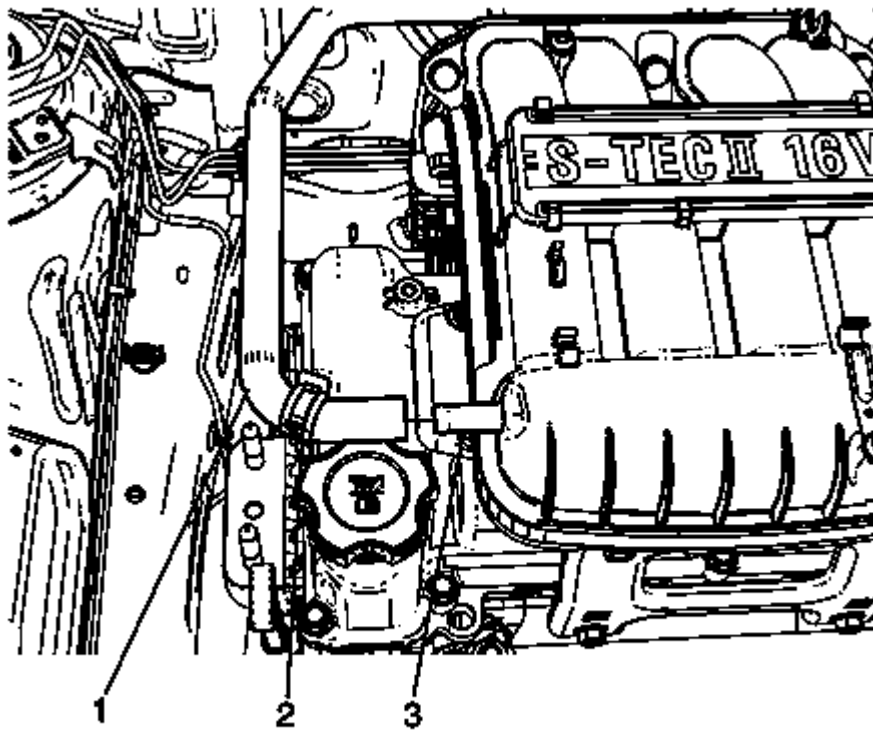


Fig. 113: Vacuum Hose Retaining Clamp And Vacuum Hose
Courtesy of GENERAL MOTORS COMPANY

4. Connect the vacuum hose (1) to the intake manifold vacuum port (3).
5. Compress the vacuum hose retaining clamp (2) and slide along the vacuum hose (1) to the correct location, to secure the vacuum hose (1) to the intake manifold vacuum port (3).

POWER BRAKE BOOSTER VACUUM SENSOR REPLACEMENT

Removal Procedure

1. With the engine OFF, apply and release the brake pedal several times to deplete the power vacuum brake booster vacuum reserve.
2. Remove the battery. Refer to **Battery Replacement** .
3. Remove the ECM bracket bolts and then position the ECM and ECM bracket aside. Refer to **Engine Control Module Replacement** .
4. Disconnect the power brake booster pump electrical connector.

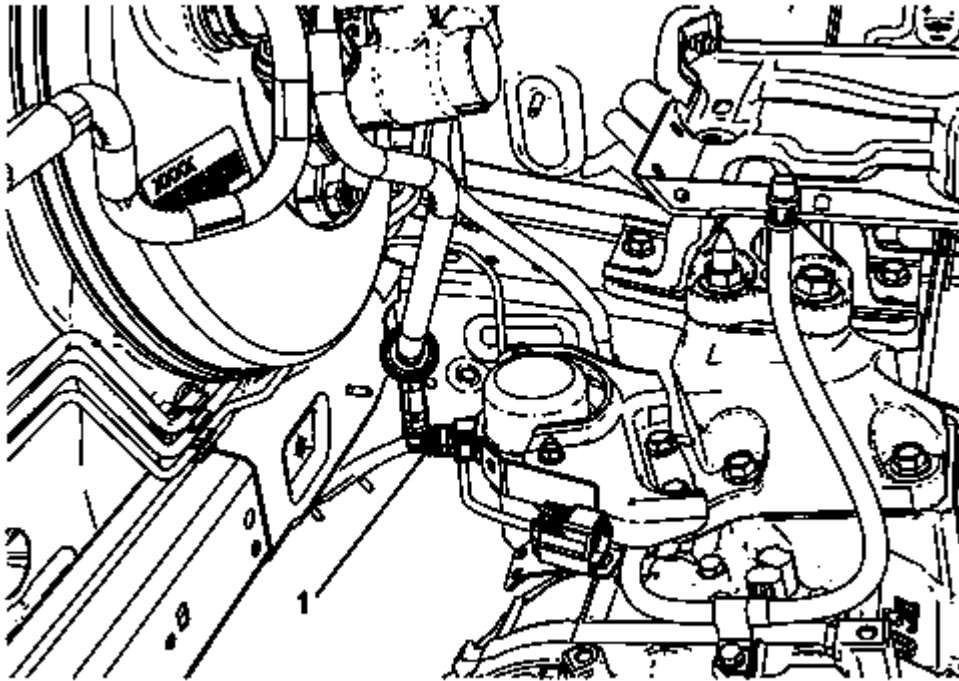


Fig. 114: Power Brake Booster Vacuum Hose Quick Connector
Courtesy of GENERAL MOTORS COMPANY

5. Remove the power brake booster vacuum hose quick connector (1) from the power brake booster pump.

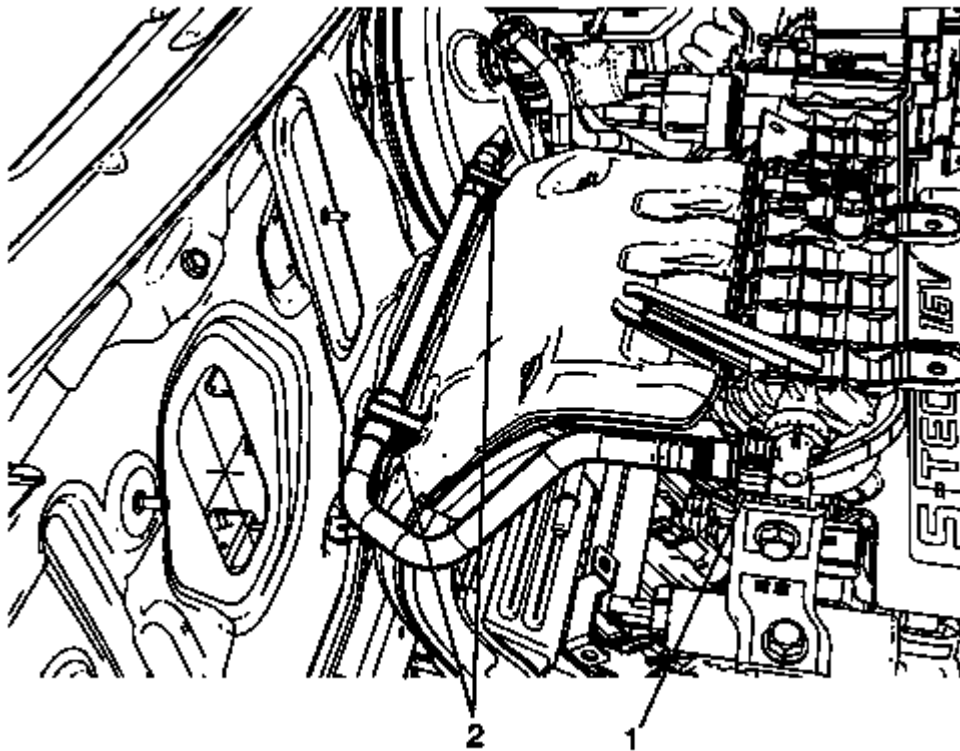


Fig. 115: Power Brake Booster Vacuum Hose Quick Connector
Courtesy of GENERAL MOTORS COMPANY

6. Disconnect the power brake booster vacuum hose quick connector (1) from the intake manifold fitting.
7. Disconnect the power brake booster vacuum hose from the brackets (2) on the intake manifold.
8. Disconnect and remove the power brake booster vacuum hose and vacuum switch assembly (1) from the power vacuum brake booster grommet.

Installation Procedure

1. Install and connect the power brake booster vacuum hoses and switch assembly to the power vacuum brake booster grommet.

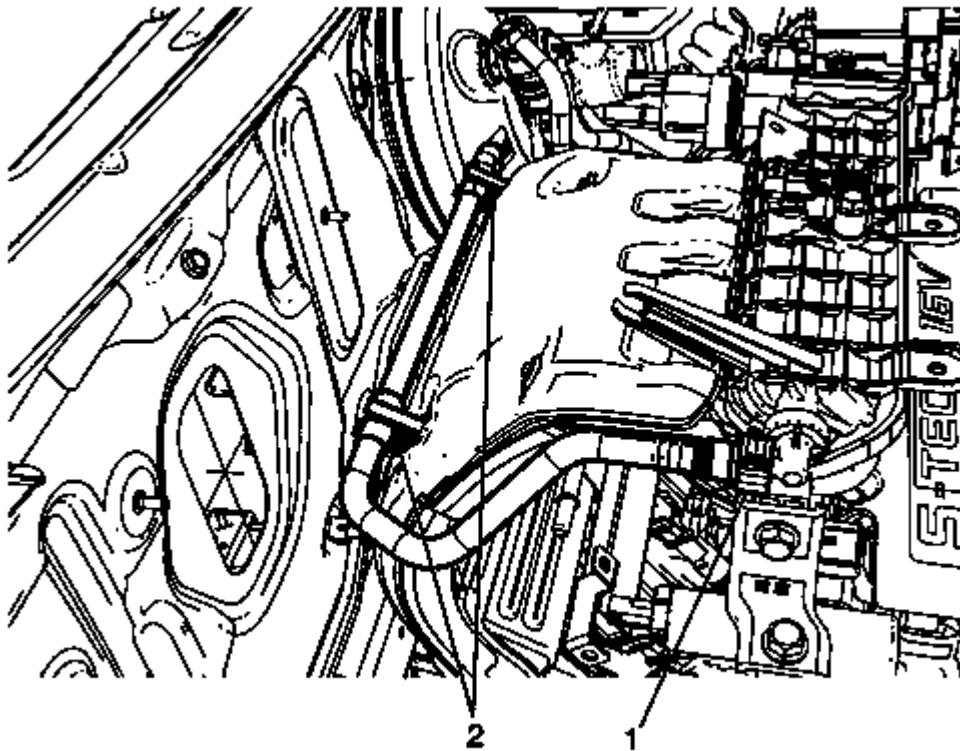


Fig. 116: Power Brake Booster Vacuum Hose Quick Connector
Courtesy of GENERAL MOTORS COMPANY

2. Connect the power brake booster vacuum hose to the brackets (2) on the intake manifold.
3. Connect the power brake booster vacuum pipe quick connector (1) to the intake manifold fitting.

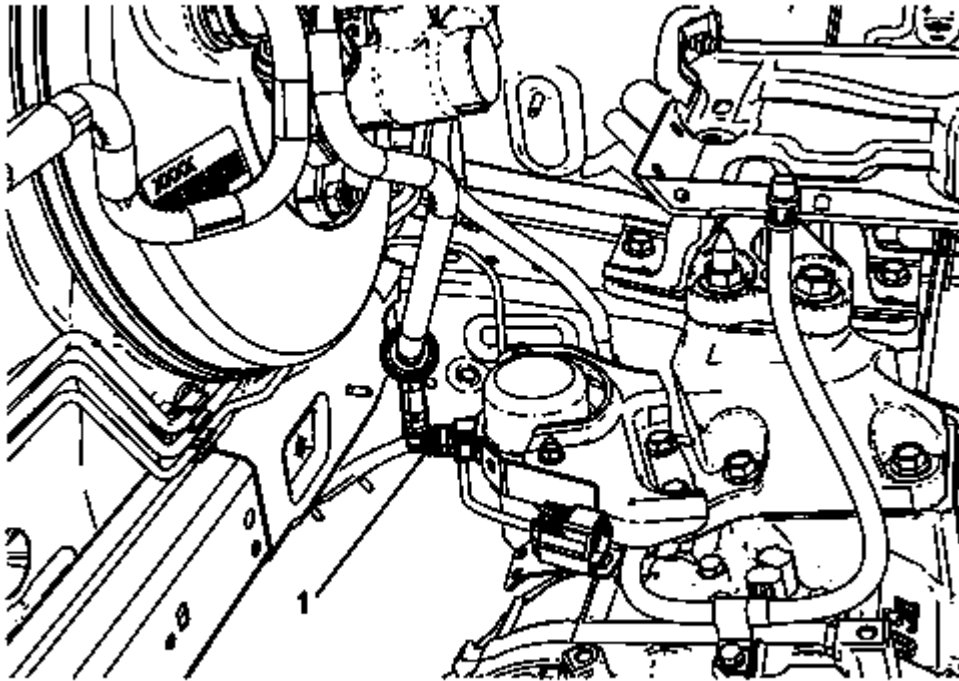


Fig. 117: Power Brake Booster Vacuum Hose Quick Connector
Courtesy of GENERAL MOTORS COMPANY

4. Connect the power brake booster vacuum hose quick connect (1) to the power brake booster pump.
5. Connect the power brake booster vacuum switch electrical connector.
6. Install the ECM and ECM bracket. Refer to **Engine Control Module Replacement** .
7. Install the battery. Refer to **Battery Replacement** .

POWER BRAKE BOOSTER VACUUM HOSE REPLACEMENT

Removal Procedure

1. With the engine OFF, apply and release the brake pedal several times to deplete the power vacuum brake booster vacuum reserve.
2. Remove the battery. Refer to **Battery Replacement** .

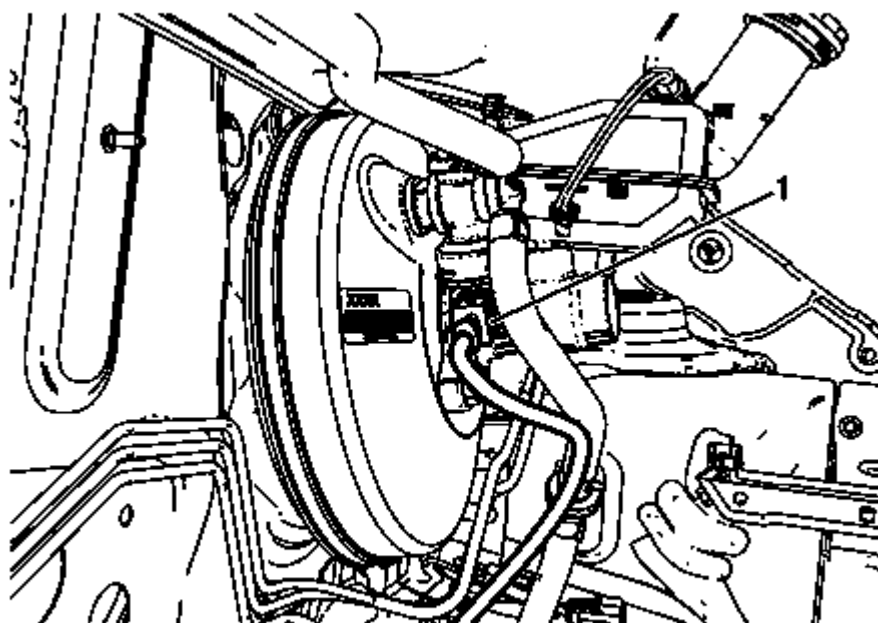


Fig. 118: ECM Bracket Bolts

Courtesy of GENERAL MOTORS COMPANY

3. Remove the ECM bracket bolts (1) and then position the ECM and ECM bracket aside. Refer to **Engine Control Module Replacement** .
4. Disconnect the power brake booster vacuum switch electrical connector (1).

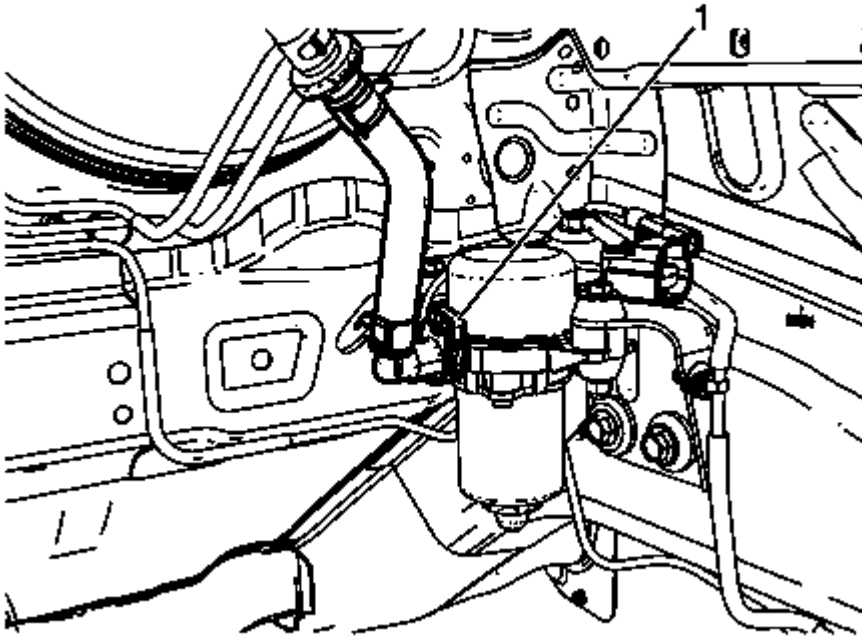


Fig. 119: Power Brake Booster Vacuum Hose Quick Connect
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect the power brake booster vacuum hose quick connect (1) from the power brake booster pump.

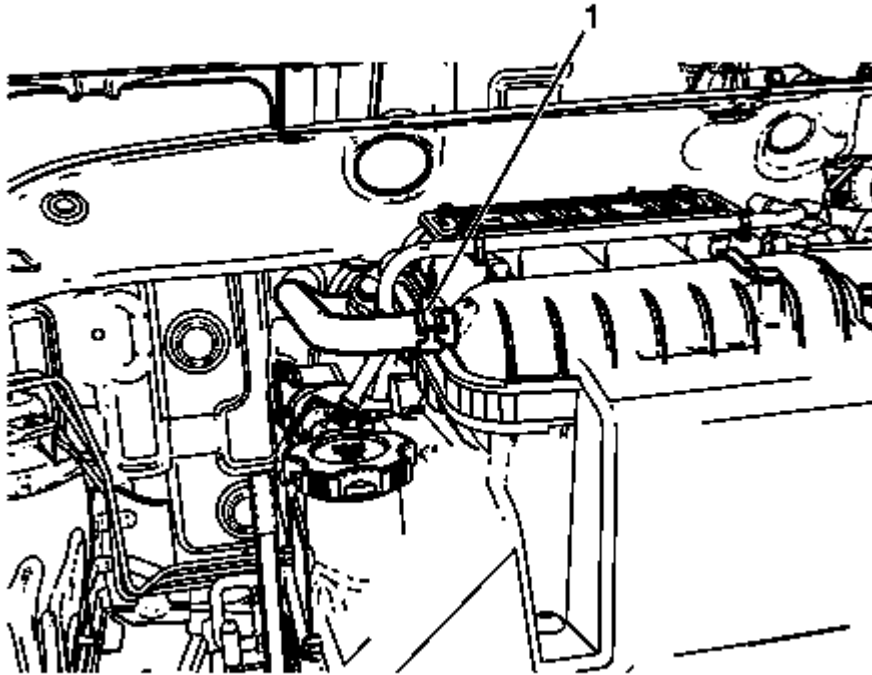


Fig. 120: Power Brake Booster Vacuum Hose Quick Connect
Courtesy of GENERAL MOTORS COMPANY

6. Disconnect the power brake booster vacuum hose quick connect (1) from the intake manifold fitting.

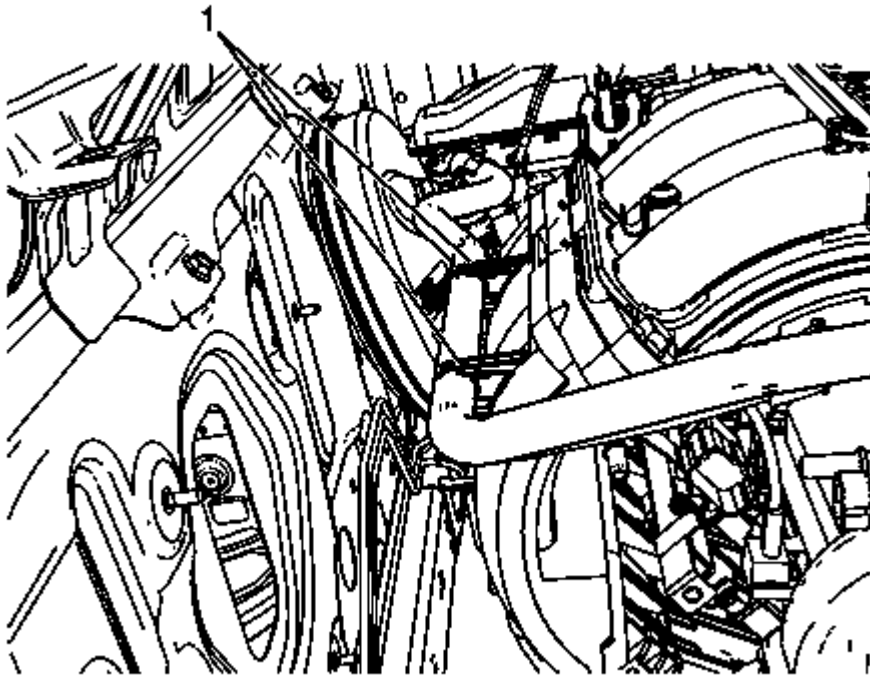


Fig. 121: Power Brake Booster Vacuum Hose And Brackets
Courtesy of GENERAL MOTORS COMPANY

7. Disconnect the power brake booster vacuum hose from the brackets (1) on the intake manifold.

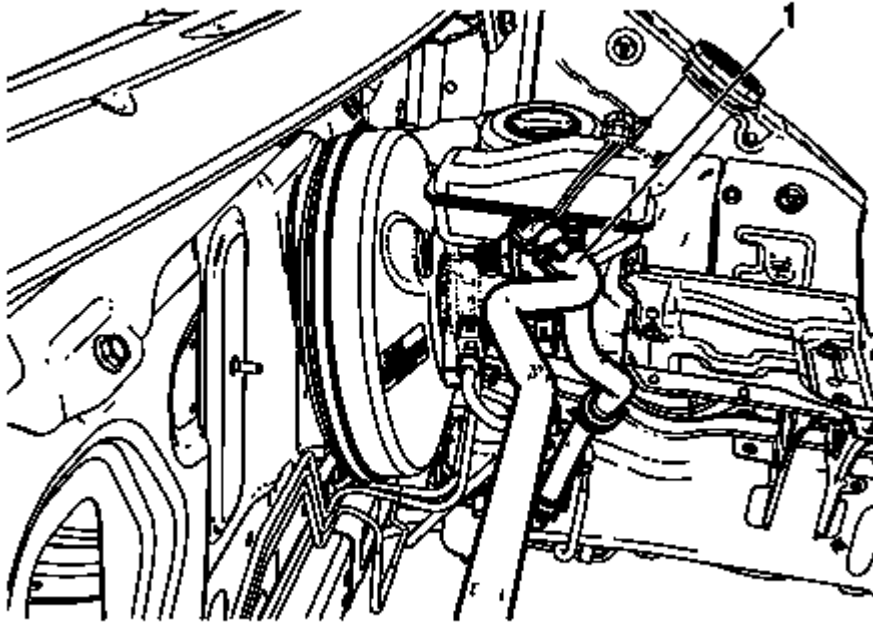


Fig. 122: Power Brake Booster Vacuum Hose And Vacuum Switch Assembly
Courtesy of GENERAL MOTORS COMPANY

8. Disconnect the power brake booster vacuum hose and vacuum switch assembly (1) from the power vacuum brake booster grommet.
9. Remove the power brake booster vacuum hose and vacuum switch assembly (1).

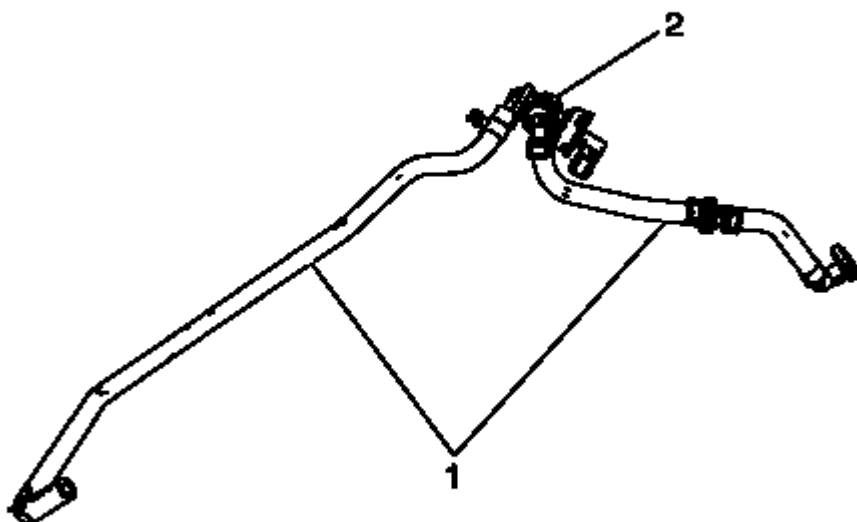


Fig. 123: Power Brake Booster Vacuum Hoses
Courtesy of GENERAL MOTORS COMPANY

10. Remove the power brake booster vacuum hoses (1) from the vacuum switch (2), if necessary.

Installation Procedure

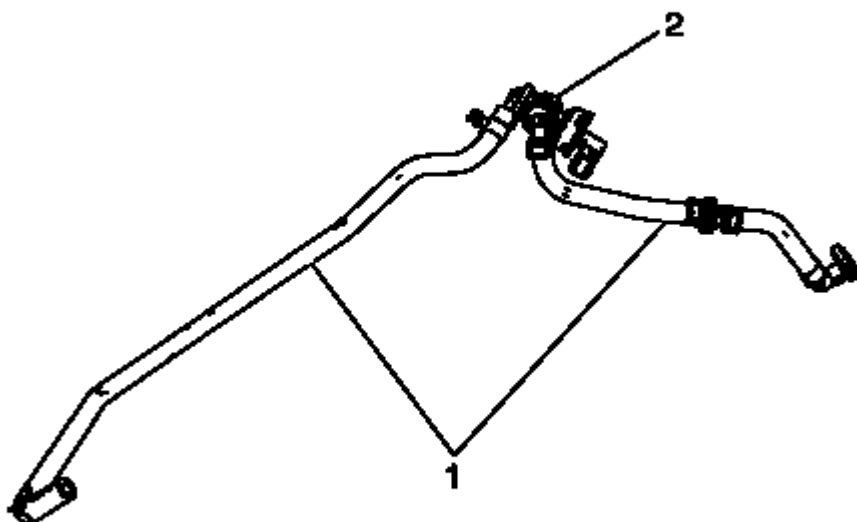


Fig. 124: Power Brake Booster Vacuum Hoses
Courtesy of GENERAL MOTORS COMPANY

1. Install the power brake booster vacuum hoses (1) to the vacuum switch (2), if necessary.

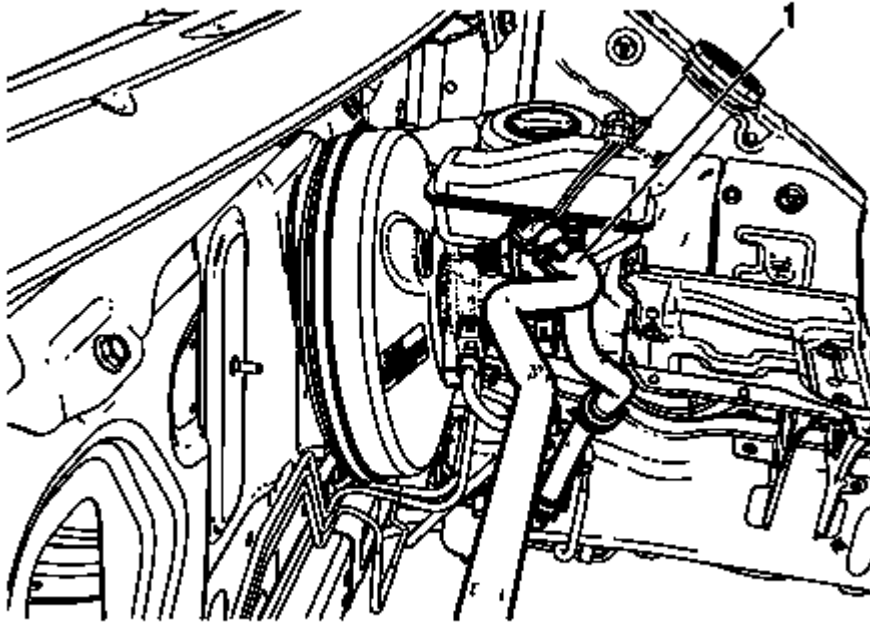


Fig. 125: Power Brake Booster Vacuum Hose And Vacuum Switch Assembly
Courtesy of GENERAL MOTORS COMPANY

2. Install the power brake booster vacuum hoses and vacuum switch assembly (1).

NOTE: **A small amount of denatured alcohol may be used to lubricate the power vacuum brake booster grommet.**

3. Connect the power brake booster vacuum hoses and switch assembly (1) to the power vacuum brake booster grommet.

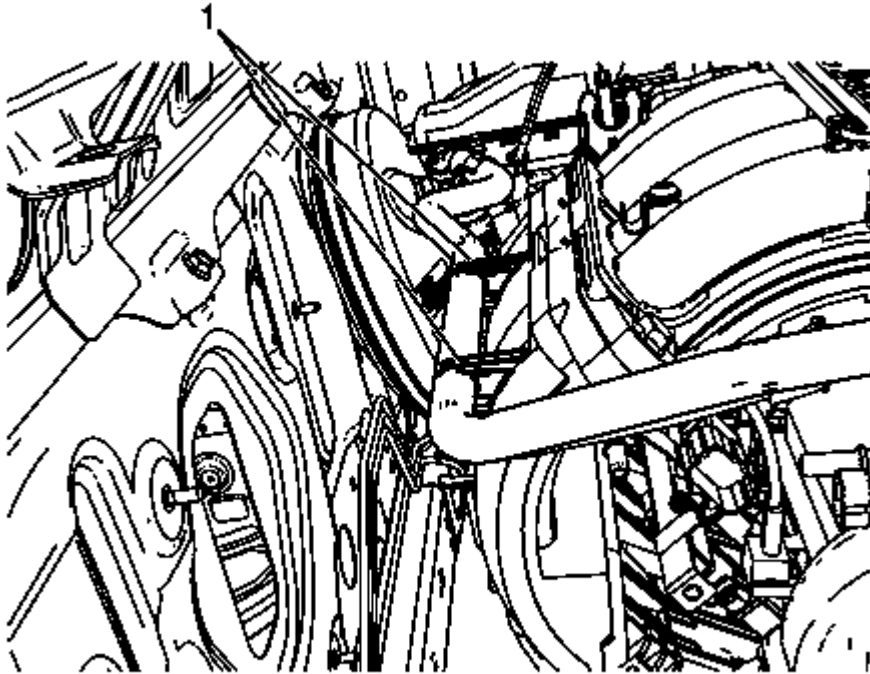


Fig. 126: Power Brake Booster Vacuum Hose And Brackets
Courtesy of GENERAL MOTORS COMPANY

4. Connect the power brake booster vacuum hose to the brackets (1) on the intake manifold.

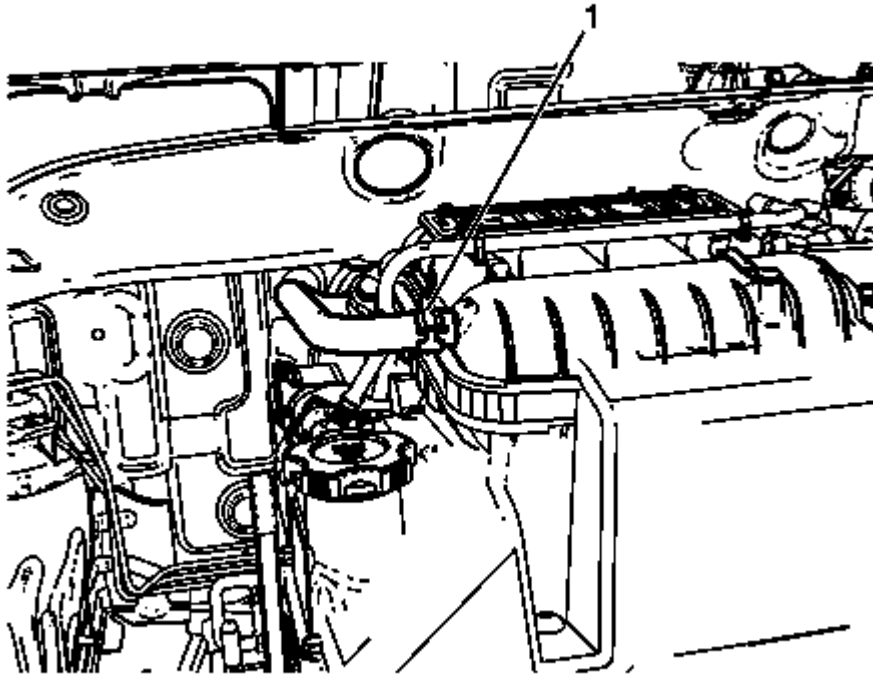


Fig. 127: Power Brake Booster Vacuum Hose Quick Connect
Courtesy of GENERAL MOTORS COMPANY

5. Connect the power brake booster vacuum pipe quick connect (1) to the intake manifold fitting.

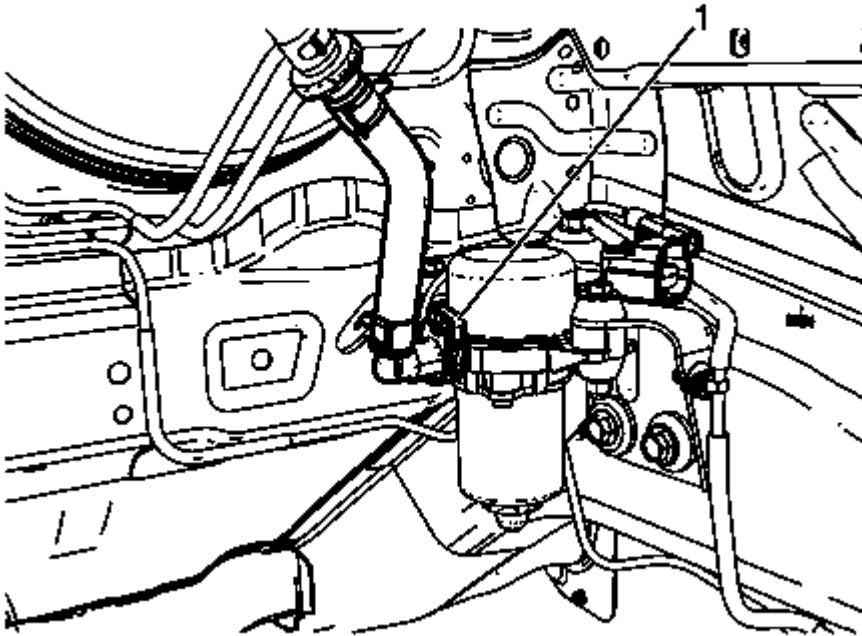


Fig. 128: Power Brake Booster Vacuum Hose Quick Connect
Courtesy of GENERAL MOTORS COMPANY

6. Connect the power brake booster vacuum hose quick connect (1) to the power brake booster pump.

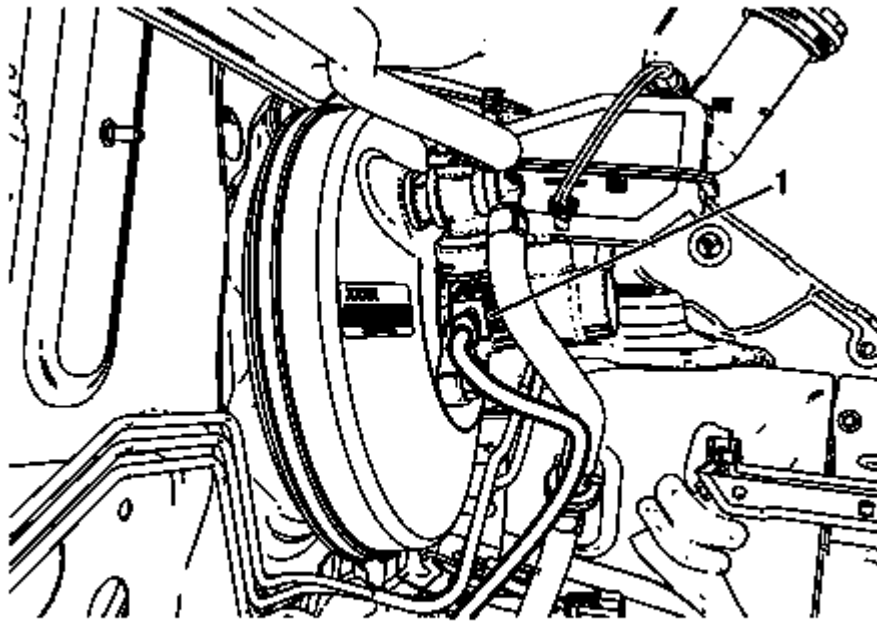


Fig. 129: ECM Bracket Bolts

Courtesy of GENERAL MOTORS COMPANY

7. Connect the power brake booster vacuum switch electrical connector (1).
8. Install the ECM and ECM bracket. Refer to **Engine Control Module Replacement** .
9. Install the battery. Refer to **Battery Replacement** .

POWER BRAKE BOOSTER PUMP REPLACEMENT (AUTOMATIC TRANSMISSION)

Removal Procedure

1. With the engine OFF, apply and release the brake pedal several times to deplete the power vacuum brake booster vacuum reserve.
2. Remove the battery. Refer to **Battery Replacement** .
3. Remove the ECM bracket bolts (1) and then position the ECM and ECM bracket aside. Refer to **Engine Control Module Replacement** .
4. Remove the battery tray. Refer to **Battery Tray Replacement** .
5. Disconnect the power brake booster pump electrical connector.

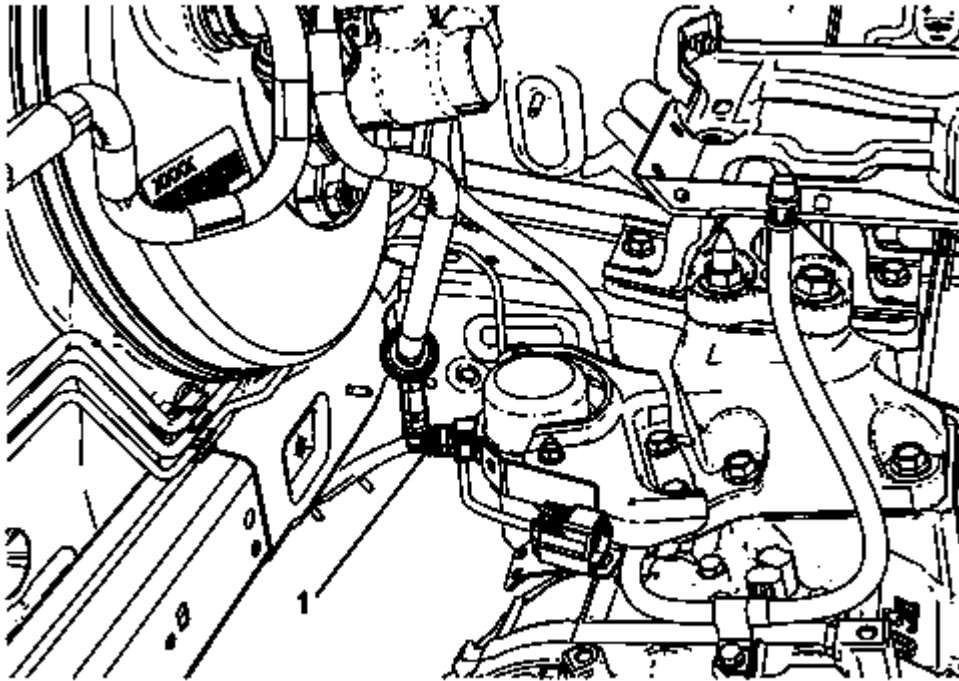


Fig. 130: Power Brake Booster Vacuum Hose Quick Connector
Courtesy of GENERAL MOTORS COMPANY

6. Remove the power brake booster vacuum hose quick connector (1) from the power brake booster pump.

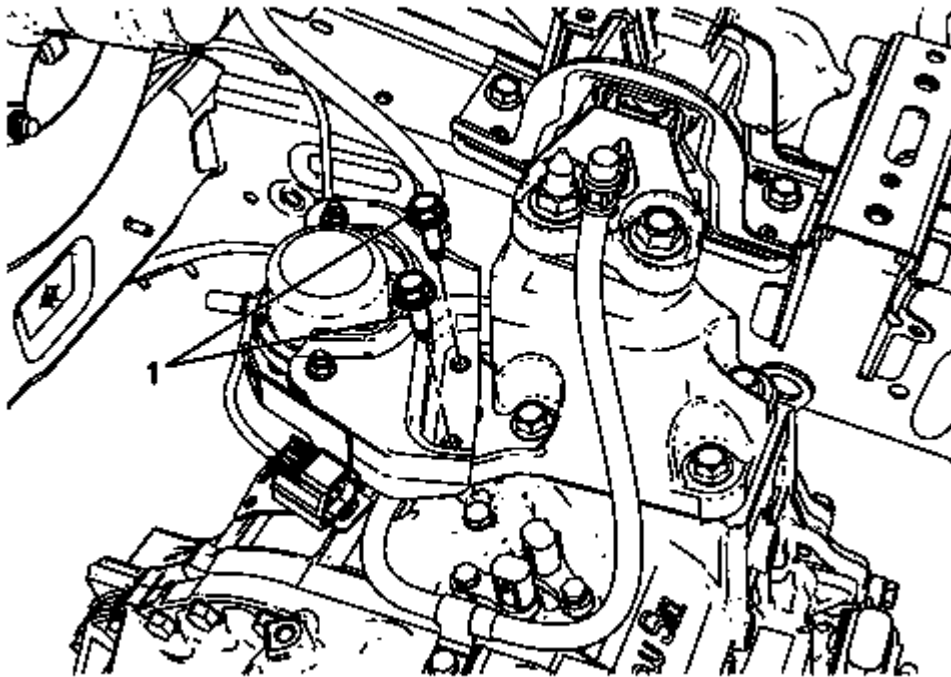


Fig. 131: Power Brake Booster Pump Bracket And Transmission Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Remove the power brake booster pump bracket to transmission bracket bolts (1).
8. Remove the power brake booster pump and bracket assembly from the vehicle.

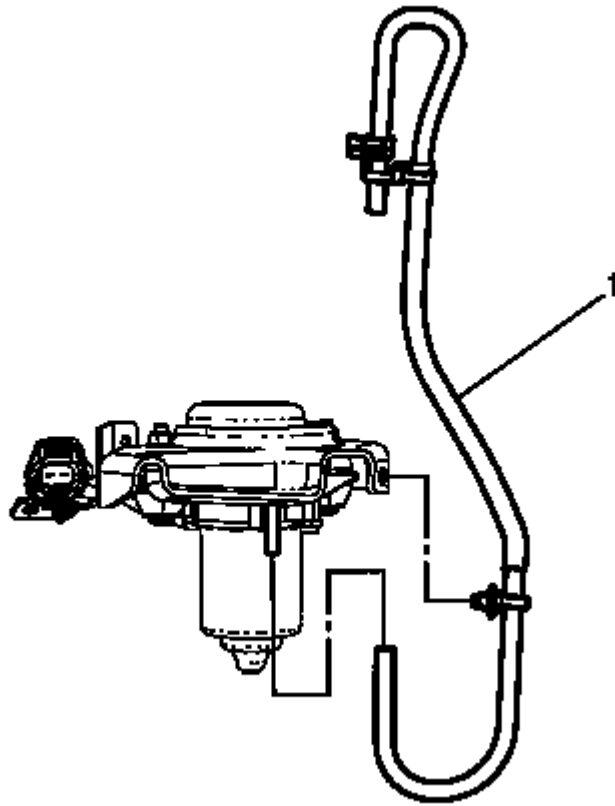


Fig. 132: Power Brake Booster Pump Ventilation Hose
Courtesy of GENERAL MOTORS COMPANY

9. Remove the power brake booster pump ventilation hose (1) from the pump and bracket assembly.

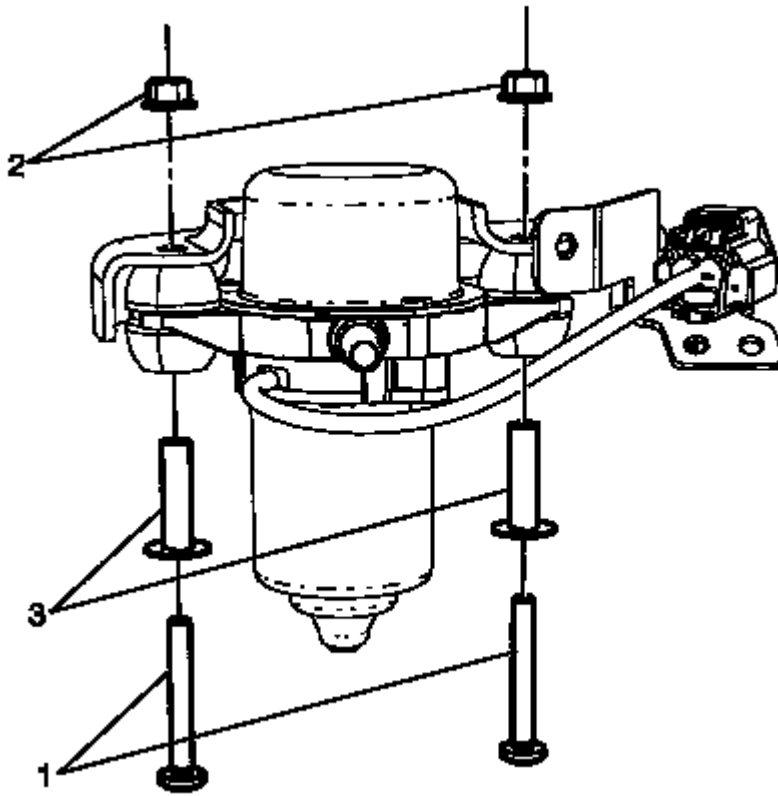


Fig. 133: Power Brake Booster Pump And Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

10. Remove the power brake booster pump to bracket bolts (1), nuts (2) and bushings (3).

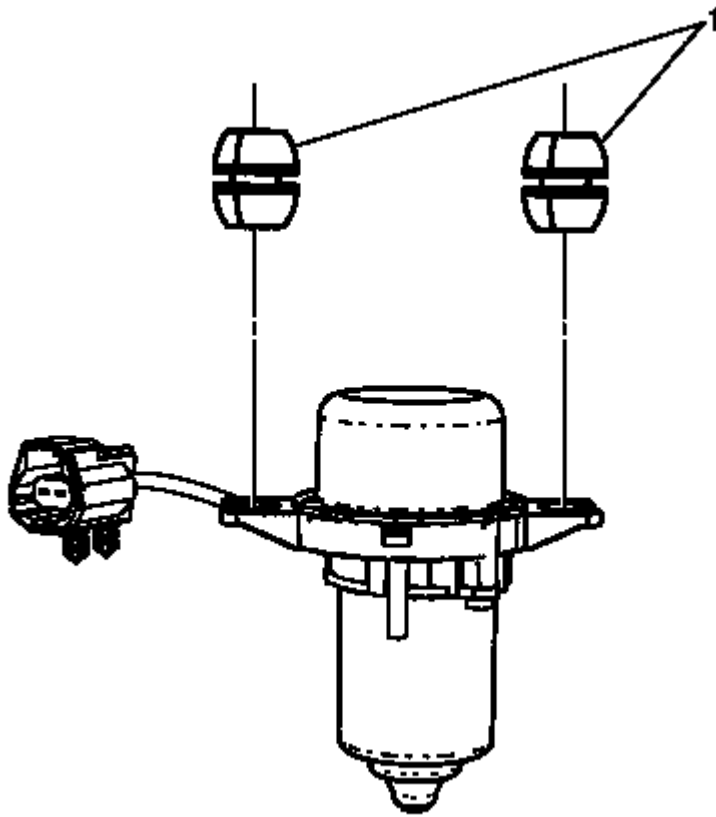


Fig. 134: Power Brake Booster Pump
Courtesy of GENERAL MOTORS COMPANY

11. Remove the power brake booster pump from the bracket.
12. Remove the power brake booster pump dampeners (1) from the power brake booster pump.

Installation Procedure

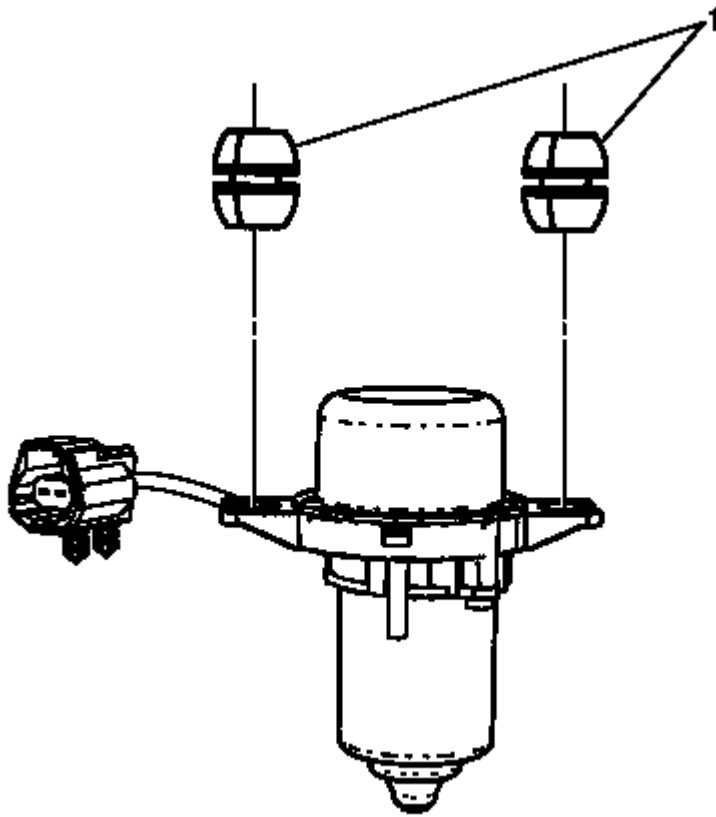


Fig. 135: Power Brake Booster Pump
Courtesy of GENERAL MOTORS COMPANY

1. Install the power brake booster pump dampeners (1) to the power brake booster pump.
2. Install the power brake booster pump to the bracket.

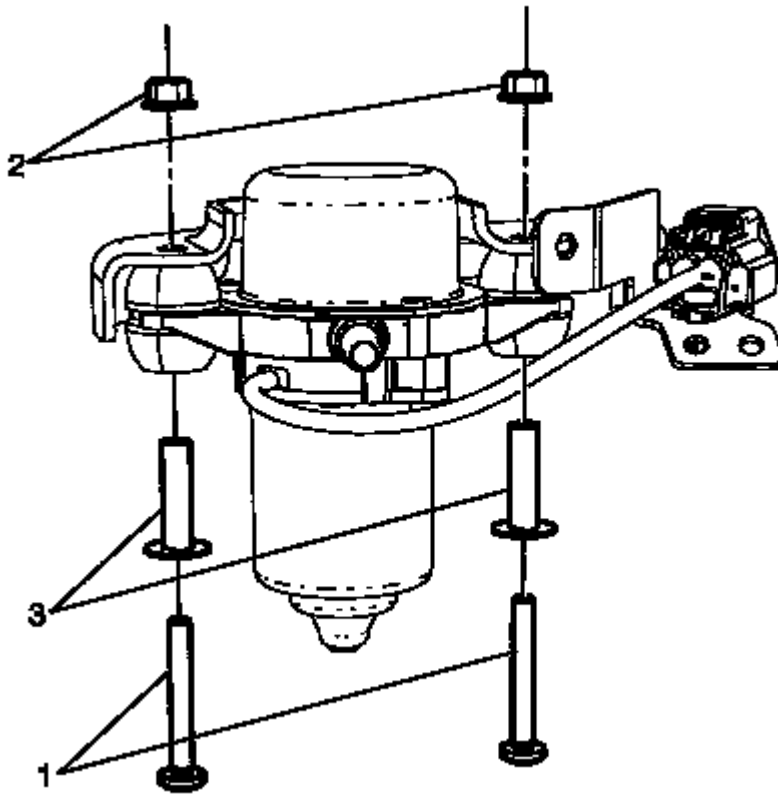


Fig. 136: Power Brake Booster Pump And Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

3. Install the power brake booster pump dampener bushing (3) and install the power brake booster pump to bracket bolts (1) and nuts (2) and tighten to 7 (62 lb in).

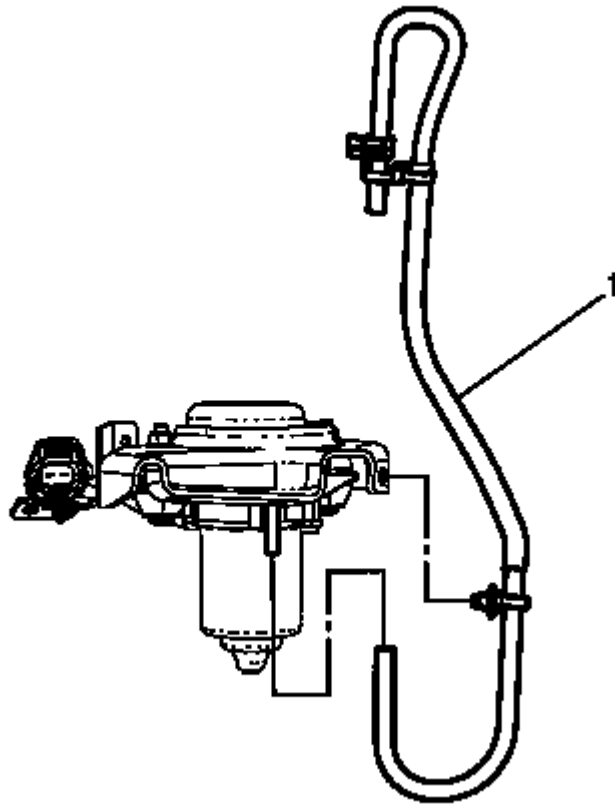


Fig. 137: Power Brake Booster Pump Ventilation Hose
Courtesy of GENERAL MOTORS COMPANY

4. Install the power brake booster pump ventilation hose (1) to the pump and bracket assembly.
5. Install the power brake booster pump and bracket assembly to the vehicle.

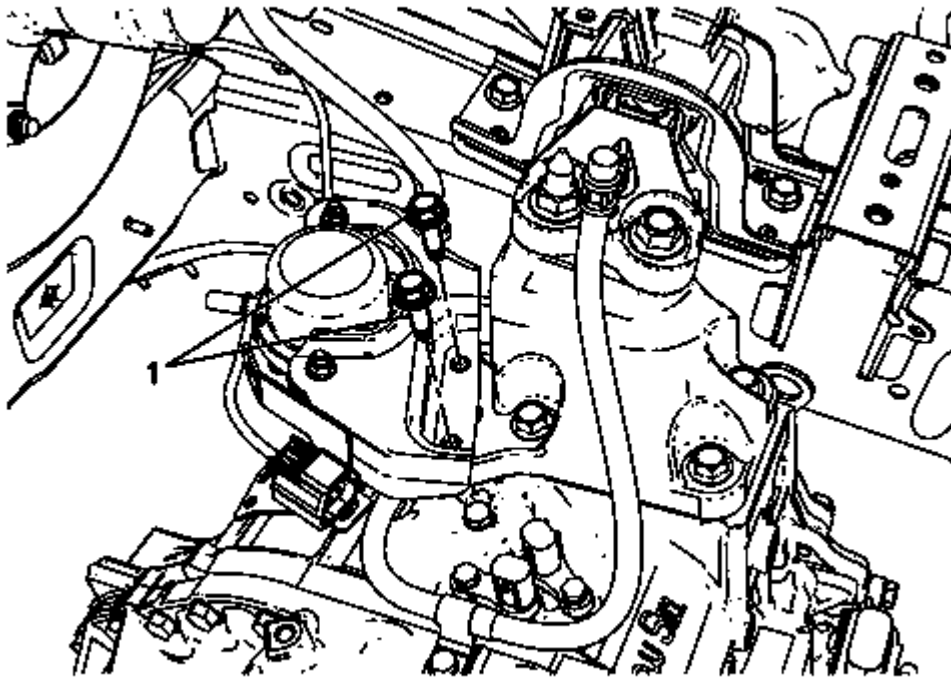


Fig. 138: Power Brake Booster Pump Bracket And Transmission Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Install the power brake booster pump bracket to transmission bracket bolts (1) and tighten to 22 (16 lb ft).

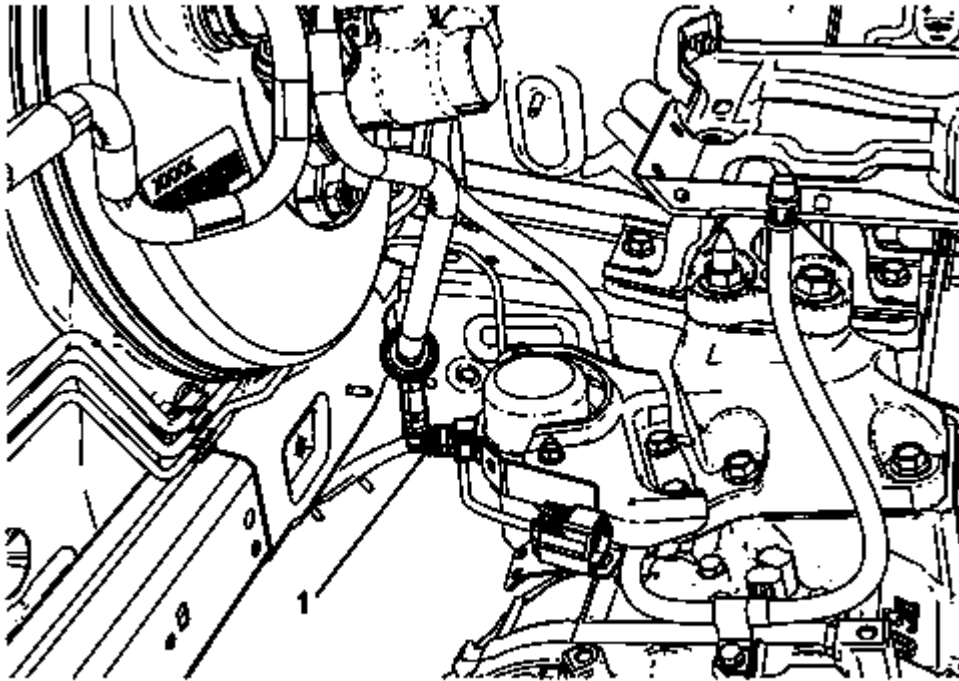


Fig. 139: Power Brake Booster Vacuum Hose Quick Connector
Courtesy of GENERAL MOTORS COMPANY

7. Install the power brake booster vacuum hose quick connector (1).
8. Connect the power brake booster pump electrical connector.
9. Install the battery tray. Refer to **Battery Tray Replacement** .
10. Install the ECM and ECM bracket. Refer to **Engine Control Module Replacement** .
11. Install the battery. Refer to **Battery Replacement** .

POWER BRAKE BOOSTER PUMP REPLACEMENT (MANUAL TRANSMISSION)

Removal Procedure

1. With the engine OFF, apply and release the brake pedal several times to deplete the power vacuum brake booster vacuum reserve.
2. Remove the battery. Refer to **Battery Replacement** .
3. Remove the ECM bracket bolts (1) and then position the ECM and ECM bracket aside. Refer to **Engine Control Module Replacement** .
4. Remove the battery tray. Refer to **Battery Tray Replacement** .
5. Disconnect the power brake booster pump electrical connector.

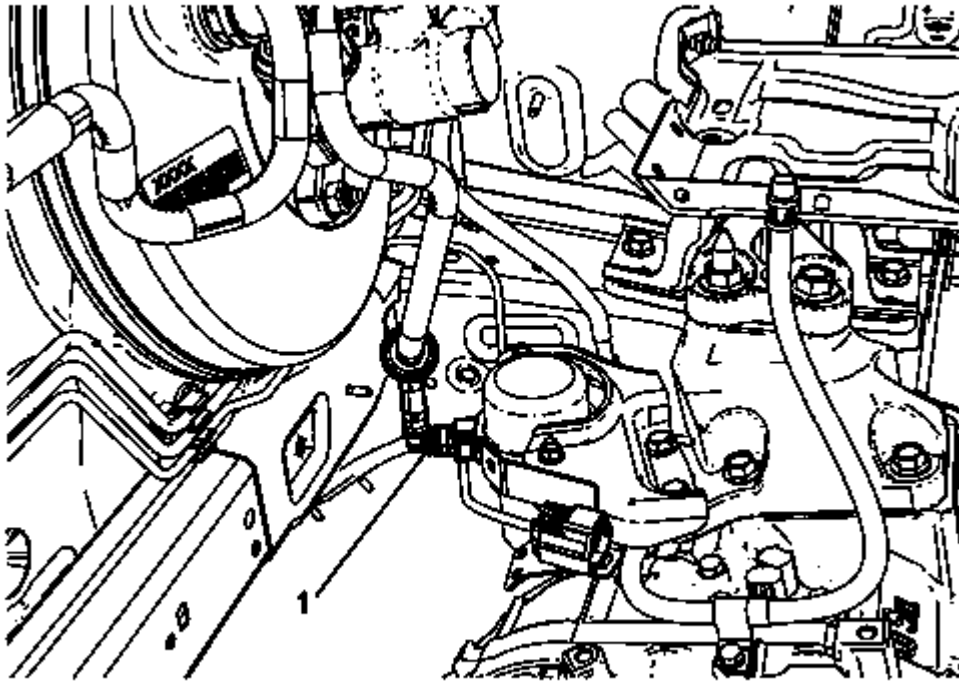


Fig. 140: Power Brake Booster Vacuum Hose Quick Connector
Courtesy of GENERAL MOTORS COMPANY

6. Remove the power brake booster vacuum hose quick connector (1) from the power brake booster pump.

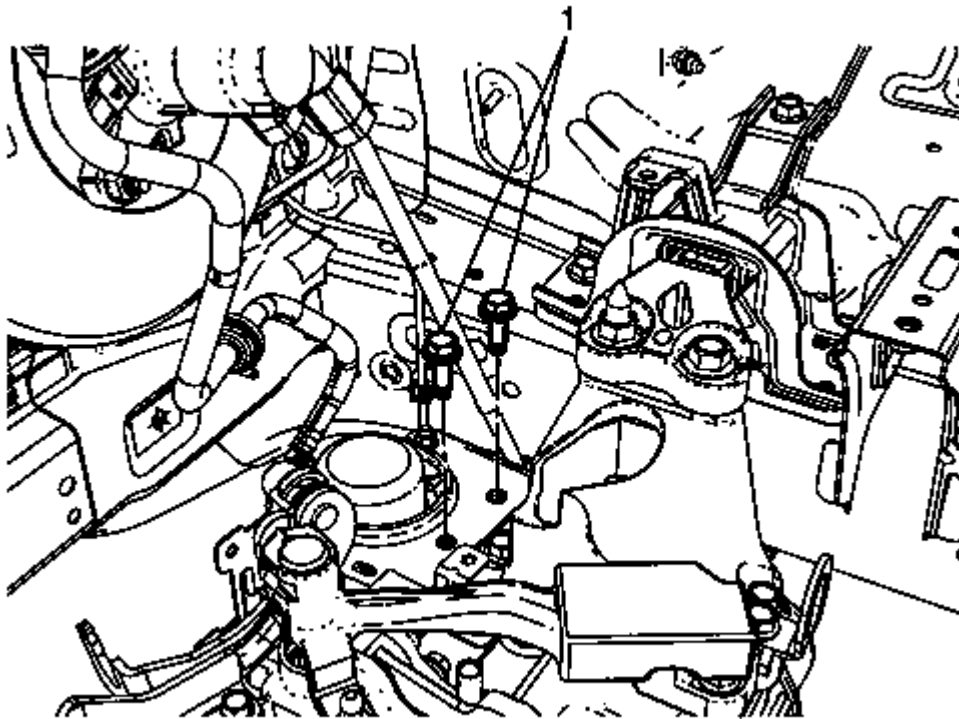


Fig. 141: Power Brake Booster Pump Bracket
Courtesy of GENERAL MOTORS COMPANY

7. Remove the power brake booster pump bracket to transmission bracket bolts (1).

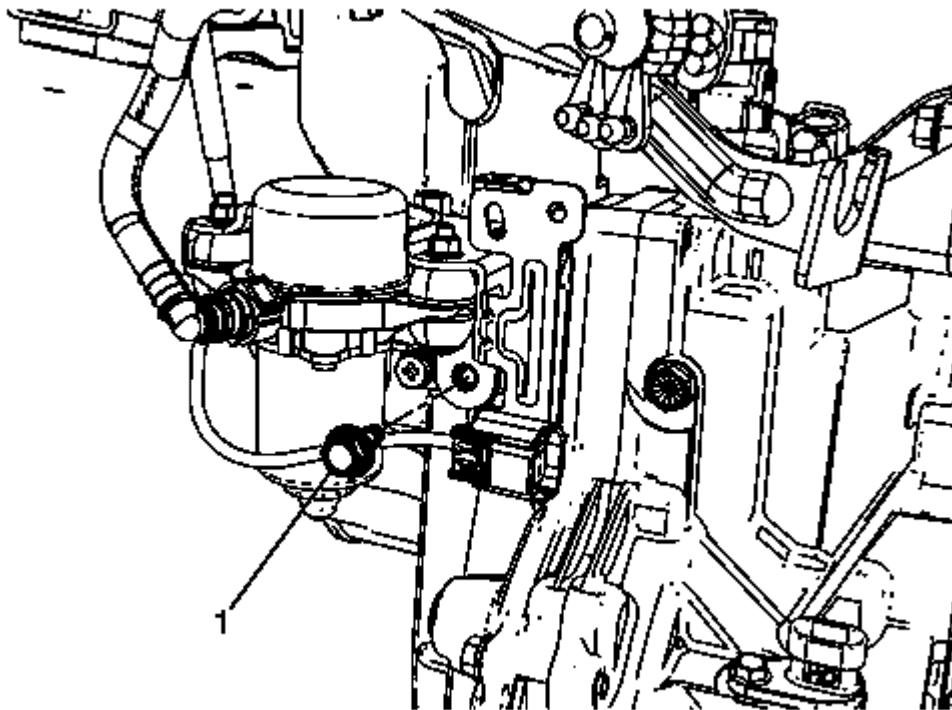


Fig. 142: Power Brake Booster Pump Bracket And Transmission Case Bolt
Courtesy of GENERAL MOTORS COMPANY

8. Remove the power brake booster pump bracket to transmission case bolt (1).
9. Remove the power brake booster pump and bracket assembly from the vehicle.

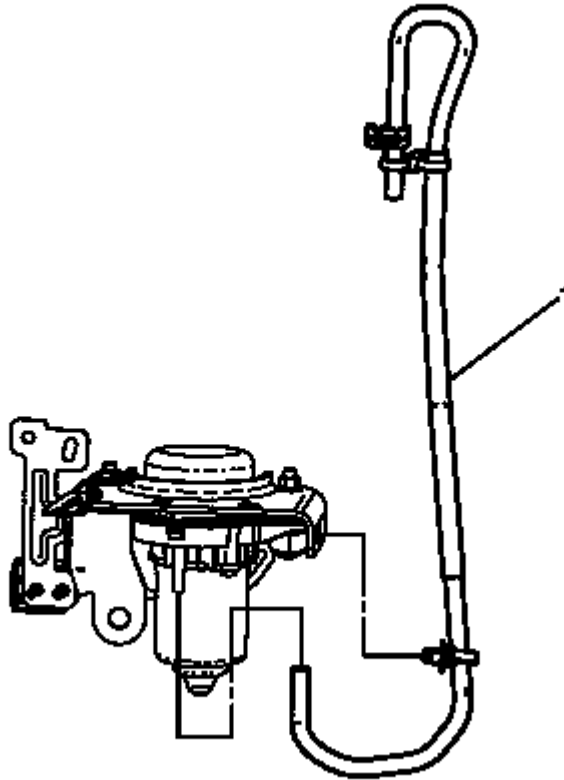


Fig. 143: Power Brake Booster Pump Ventilation Hose And Bracket Assembly
Courtesy of GENERAL MOTORS COMPANY

10. Remove the power brake booster pump ventilation hose (1) from the pump and bracket assembly.

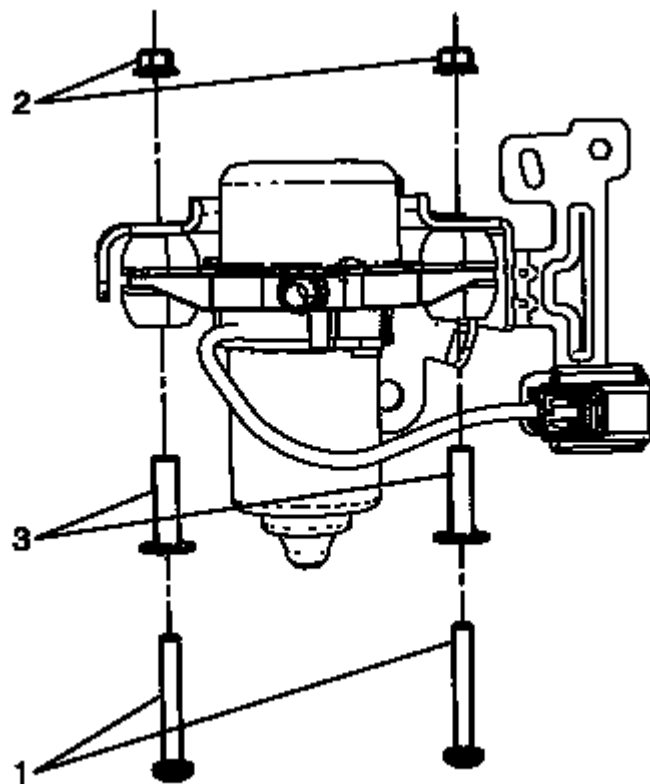


Fig. 144: Power Brake Booster Pump To Bracket Bolts And Nuts
Courtesy of GENERAL MOTORS COMPANY

11. Remove the power brake booster pump to bracket bolts (1), nuts (2) and bushings (3).

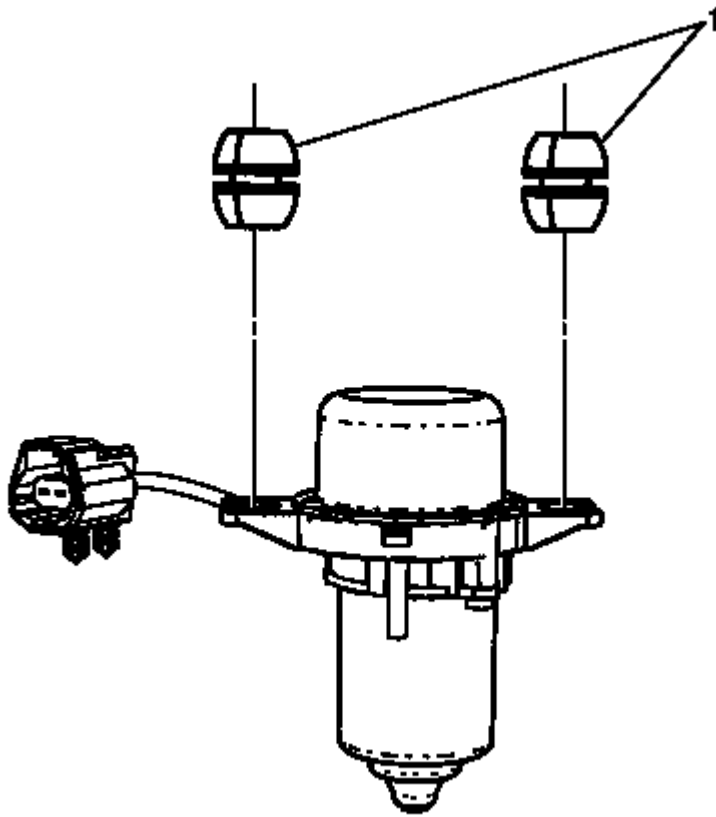


Fig. 145: Power Brake Booster Pump
Courtesy of GENERAL MOTORS COMPANY

12. Remove the power brake booster pump from the bracket.

Remove the power brake booster pump dampeners (1) from the power brake booster pump.

Installation Procedure

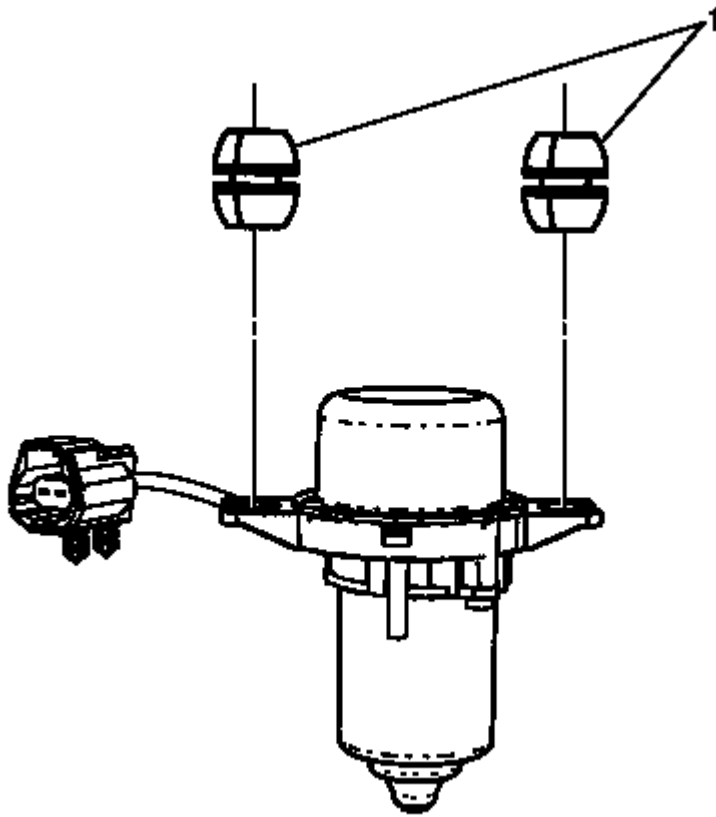


Fig. 146: Power Brake Booster Pump
Courtesy of GENERAL MOTORS COMPANY

1. Install the power brake booster pump dampeners (1) to the power brake booster pump.
2. Install the power brake booster pump to the bracket.

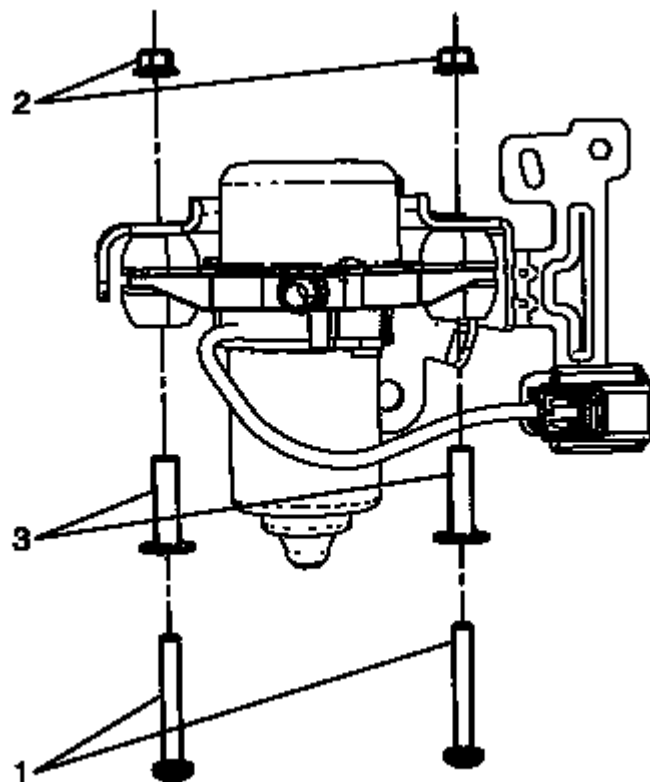


Fig. 147: Power Brake Booster Pump To Bracket Bolts And Nuts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

3. Install the power brake booster pump dampener bushing (3) and install the power brake booster pump to bracket bolts (1) and nuts (2) and tighten to 7 (62 lb in).

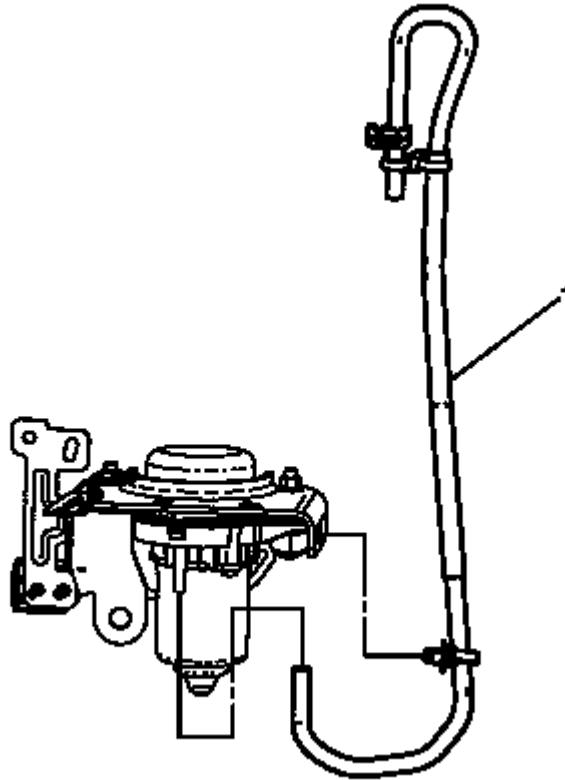


Fig. 148: Power Brake Booster Pump Ventilation Hose And Bracket Assembly
Courtesy of GENERAL MOTORS COMPANY

4. Install the power brake booster pump ventilation hose (1) to the pump and bracket assembly.
5. Install the power brake booster pump and bracket assembly to the vehicle.

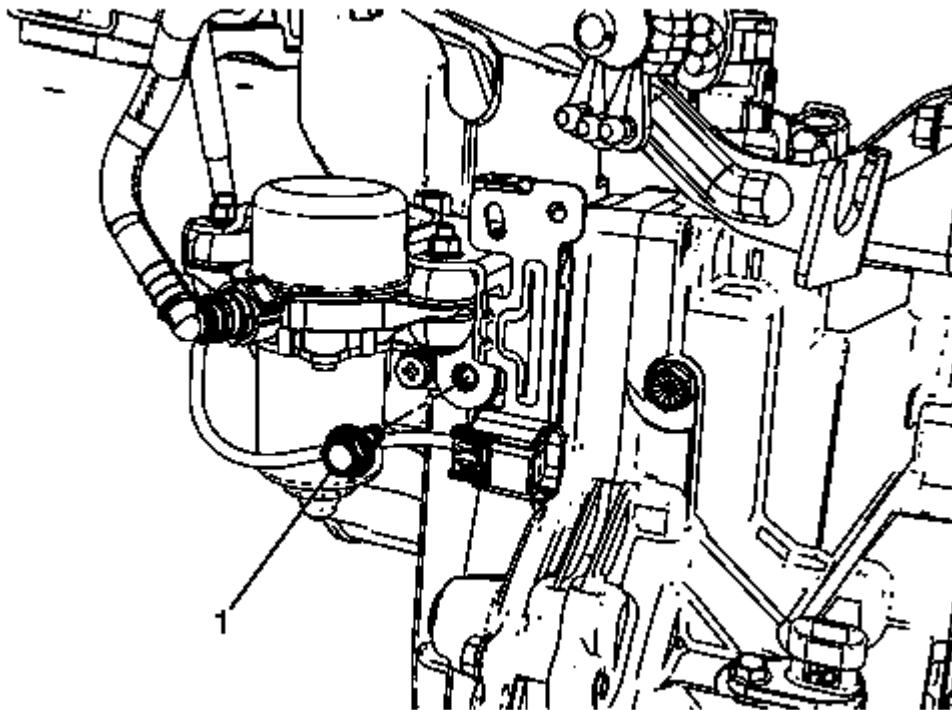


Fig. 149: Power Brake Booster Pump Bracket And Transmission Case Bolt
Courtesy of GENERAL MOTORS COMPANY

6. Install the power brake booster pump bracket to transmission case bolt (1) and tighten to 22 (16 lb ft).

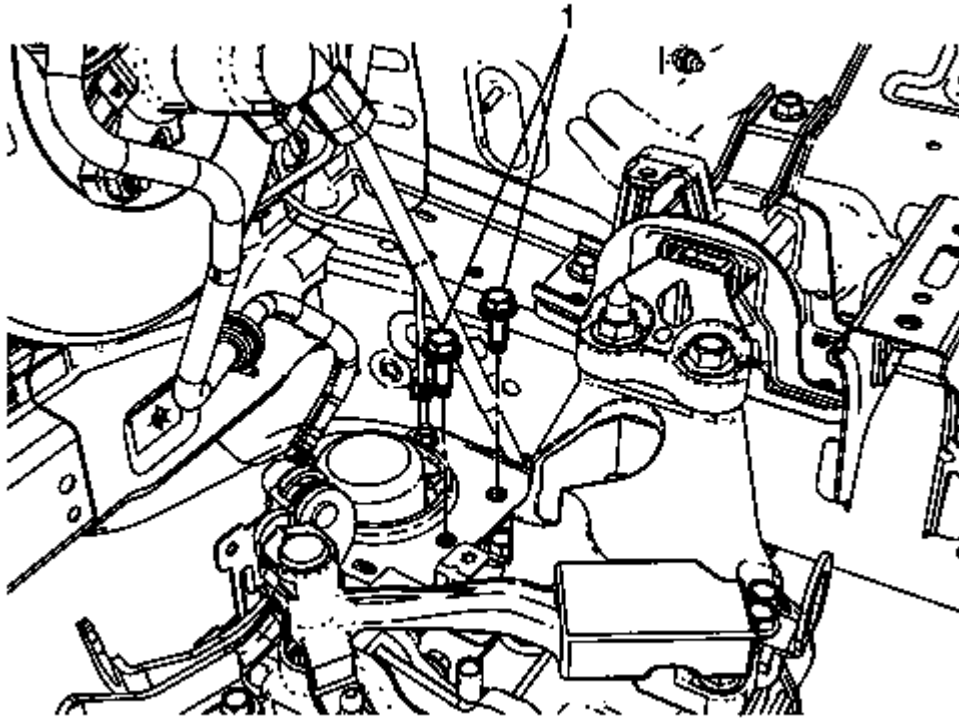


Fig. 150: Power Brake Booster Pump Bracket
Courtesy of GENERAL MOTORS COMPANY

7. Install the power brake booster pump bracket to transmission bracket bolts (1) and tighten to 22 (16 lb ft).

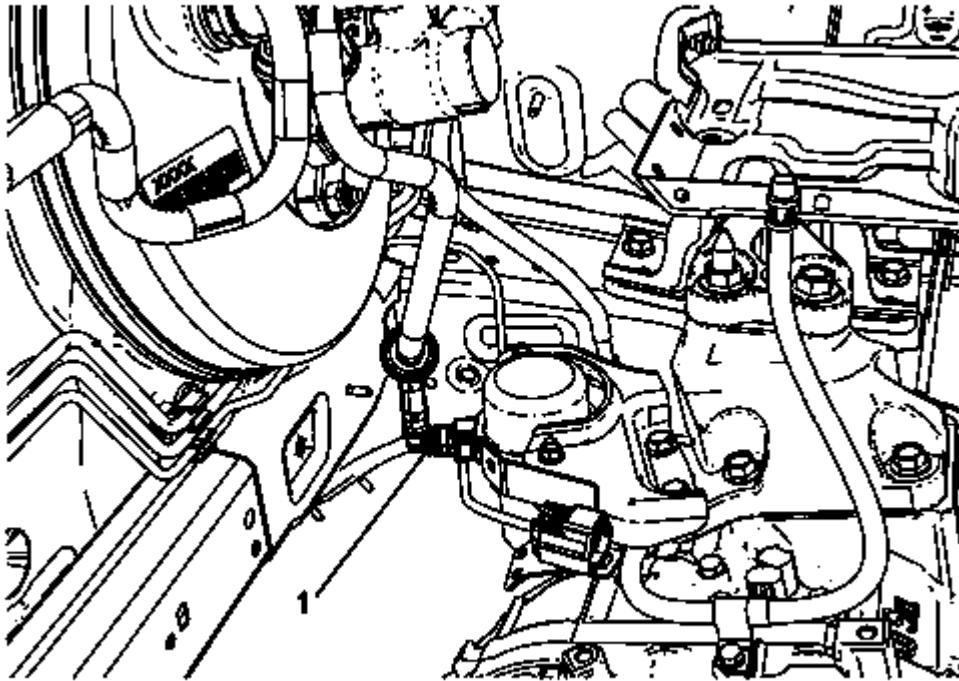


Fig. 151: Power Brake Booster Vacuum Hose Quick Connector
Courtesy of GENERAL MOTORS COMPANY

8. Install the power brake booster vacuum hose quick connector (1).
9. Connect the power brake booster pump electrical connector.
10. Install the battery tray. Refer to **Battery Tray Replacement** .
11. Install the ECM and ECM bracket. Refer to **Engine Control Module Replacement** .
12. Install the battery. Refer to **Battery Replacement** .

POWER BRAKE BOOSTER PUMP REPLACEMENT (CVT)

Removal Procedure

1. With the engine OFF, apply and release the brake pedal several times to deplete the power vacuum brake booster vacuum reserve.
2. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
3. Remove the heated oxygen sensor - 1. Refer to **Heated Oxygen Sensor Replacement - Sensor 1** .
4. Remove the exhaust manifold heat shield. Refer to **Exhaust Manifold Heat Shield Replacement** .
5. Disconnect the power brake booster pump electrical connector.

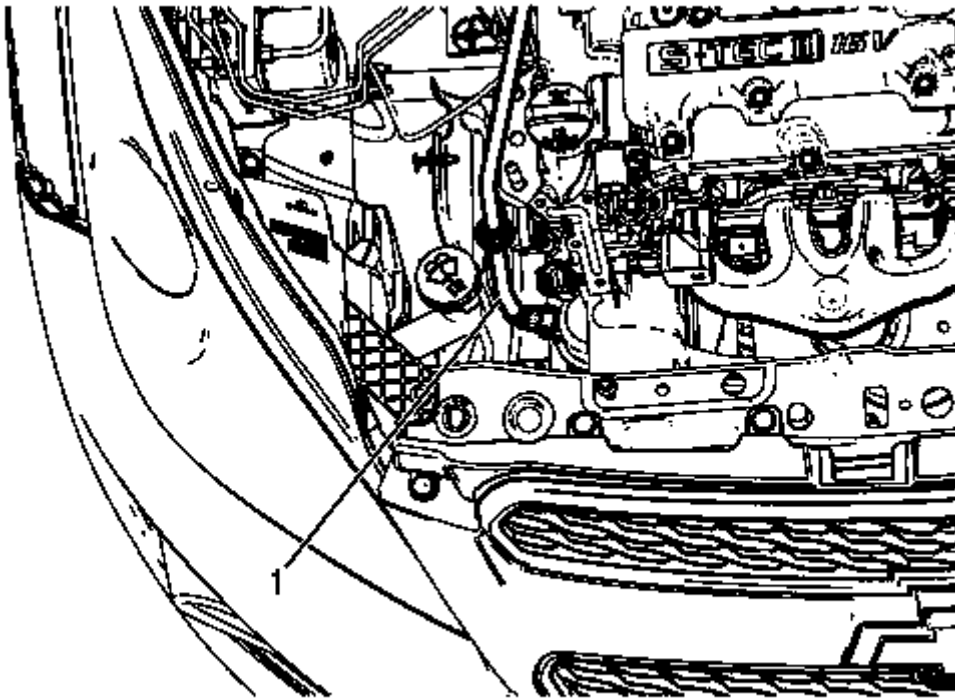


Fig. 152: Power Brake Booster Vacuum Hose Quick Connector
Courtesy of GENERAL MOTORS COMPANY

6. Remove the power brake booster vacuum hose quick connector (1) from the power brake booster pump.

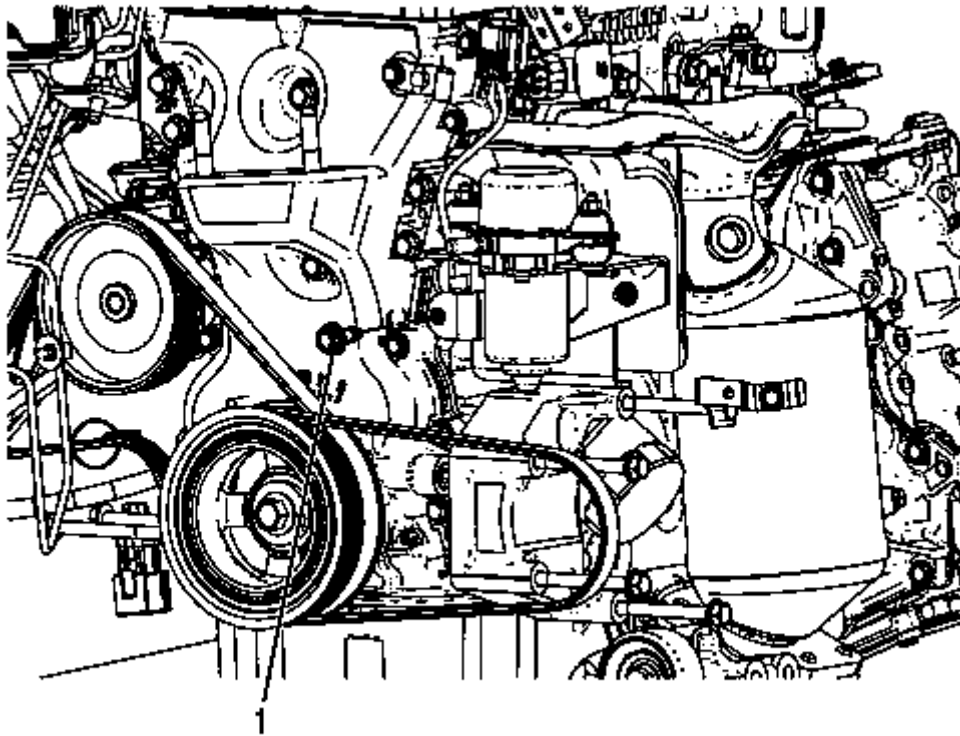


Fig. 153: Power Brake Booster Pump Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

7. Remove the power brake booster pump bracket bolt (1).

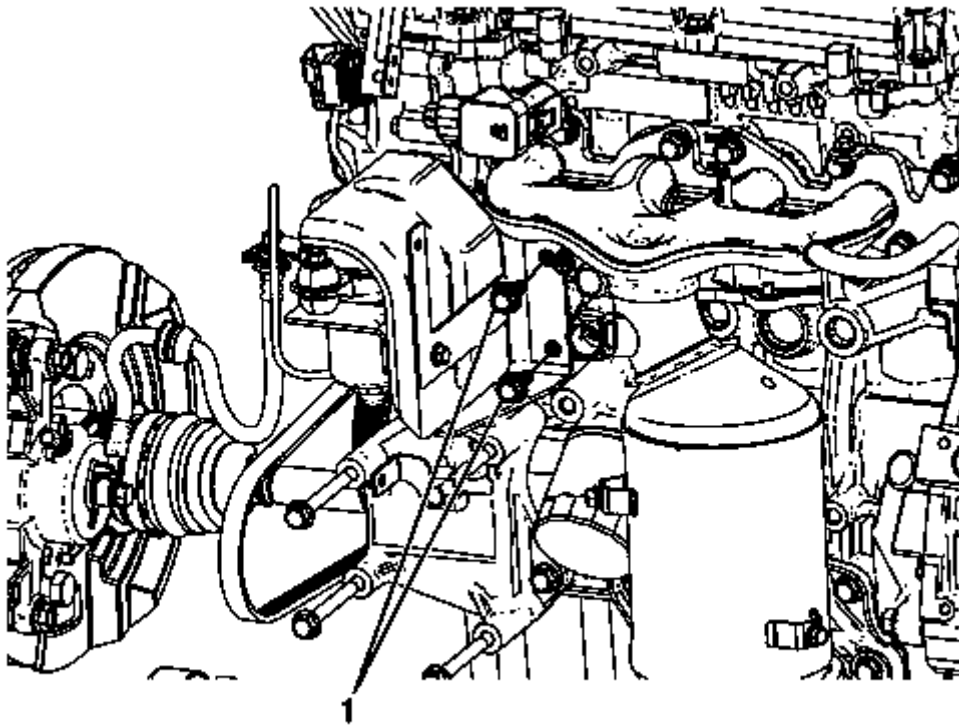


Fig. 154: Power Brake Booster Pump Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

8. Remove the power brake booster pump bracket bolts (1).
9. Remove the power brake booster pump and bracket assembly from the vehicle.

Installation Procedure

1. Install the power brake booster pump and bracket assembly to the vehicle.

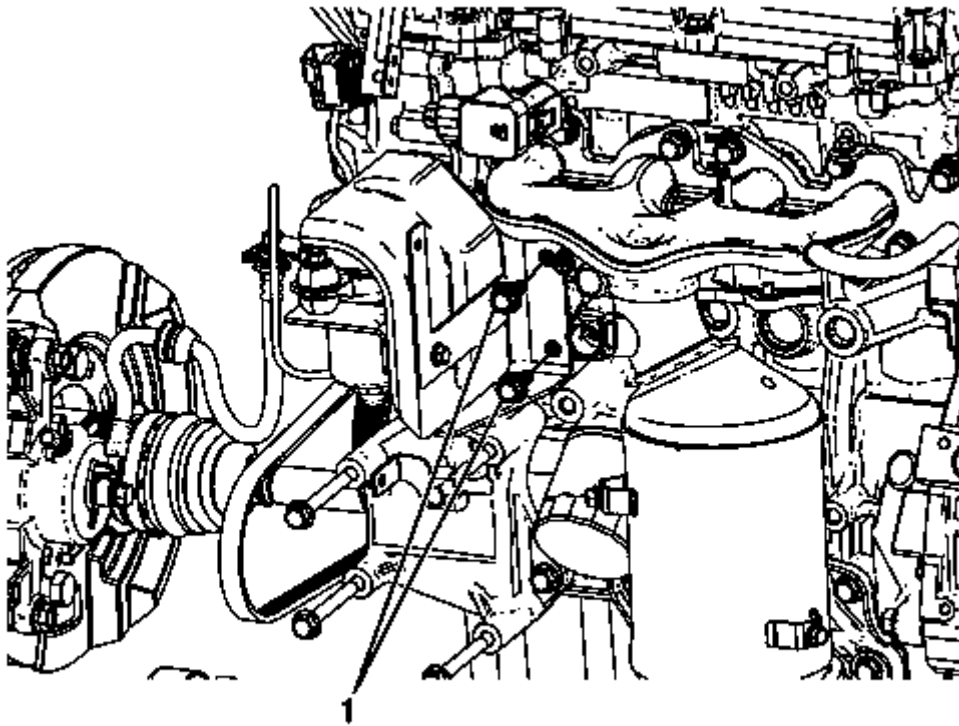


Fig. 155: Power Brake Booster Pump Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

2. Install the power brake booster pump bracket bolts (1) and tighten to 22 (16 lb ft).

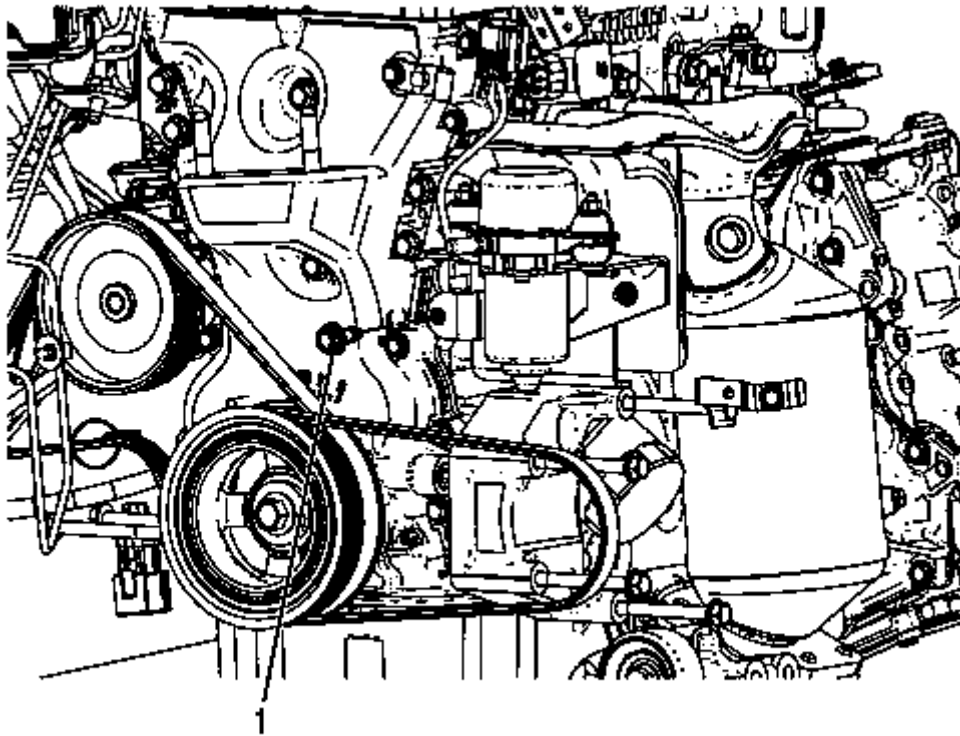


Fig. 156: Power Brake Booster Pump Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Install the power brake booster pump bracket bolt (1) and tighten to 22 (16 lb ft).

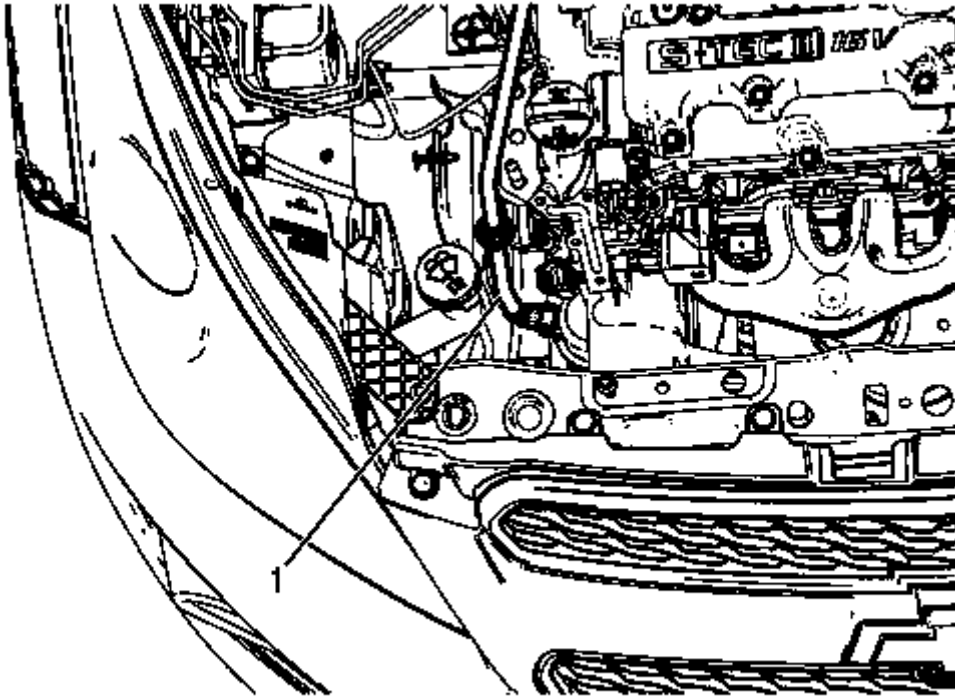


Fig. 157: Power Brake Booster Vacuum Hose Quick Connector
Courtesy of GENERAL MOTORS COMPANY

4. Install the power brake booster vacuum hose quick connector (1).
5. Connect the power brake booster pump electrical connector.
6. Install the exhaust manifold heat shield. Refer to **Exhaust Manifold Heat Shield Replacement** .
7. Install the heated oxygen sensor - 1. Refer to **Heated Oxygen Sensor Replacement - Sensor 1** .
8. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .

DESCRIPTION AND OPERATION

BRAKE ASSIST SYSTEM DESCRIPTION AND OPERATION

System Component Description

The brake assist system consists of the following:

Brake Pedal

Receives, multiplies and transfers brake system input force from driver.

Brake Pedal Pushrod

Transfers multiplied input force received from the brake pedal to the vacuum brake booster.

Vacuum Brake Booster

Uses source vacuum to decrease effort required by driver when applying brake system input force. At rest, source vacuum is applied to both sides of the vacuum diaphragm for single booster. Return springs maintain the booster in a rest position. When brake system input force is applied, vacuum to the rear of the diaphragm is cut off and air at atmospheric pressure is admitted in its place. This provides a decrease in brake pedal effort required. When input force is removed, vacuum again replaces atmospheric pressure within the booster.

Vacuum Source

Supplies force used by vacuum brake booster to decrease brake pedal effort. The source vacuum for a spark ignition engine is normally derived from the intake manifold.

Vacuum Source Delivery System

Enables delivery and retention of source vacuum for vacuum brake booster.

System Operation

Under normal driving conditions, without the brakes applied, vacuum is allowed to act on both sides of the diaphragm within the vacuum brake booster. When the brake pedal is applied, the effort by the driver is multiplied due to the relative length of the brake pedal in relationship to its pivot point and the point at which the push rod to the vacuum brake booster is attached.

Movement of the push rod causes a valve within the vacuum brake booster to close between the two sides of the diaphragm, thus isolating each side. It also allows a valve to open that allows atmospheric pressure to act on the pedal side of the vacuum brake booster while maintaining vacuum on the vacuum source side of the diaphragm. The movement of the brake pedal pushrod is transferred to the hydraulic brake master cylinder via the vacuum brake booster. The pressure differential within the vacuum brake booster reduces the effort required by the driver in applying the brakes.

BRAKE BOOSTER VACUUM ASSIST DESCRIPTION AND OPERATION

System Component Description

The brake booster vacuum assist system consists of the following:

Brake Booster Auxiliary Vacuum Pump

The brake booster vacuum pump is a secondary vacuum supply to the brake booster to maintain sufficient vacuum for brake assist.

Vacuum Brake Booster

Uses source vacuum to decrease effort required by driver when applying the brake. When brake system

input force is applied, air at atmospheric pressure is admitted to the rear of both vacuum diaphragms, providing a decrease in brake pedal effort required. When input force is removed, vacuum replaces atmospheric pressure within the booster.

Vacuum Source

Vacuum is supplied by engine vacuum or by the brake booster vacuum pump.

System Operation

The brake booster vacuum switch is activated by the amount of vacuum available to the power brake booster. When the ignition switch is at the ON position and the vacuum within the system drops, the switch within the brake booster vacuum switch closes allowing voltage to be supplied to the brake booster pump motor.

BRAKE WARNING SYSTEM DESCRIPTION AND OPERATION

Brake Warning Indicator

Hydraulic Brakes Block Diagram

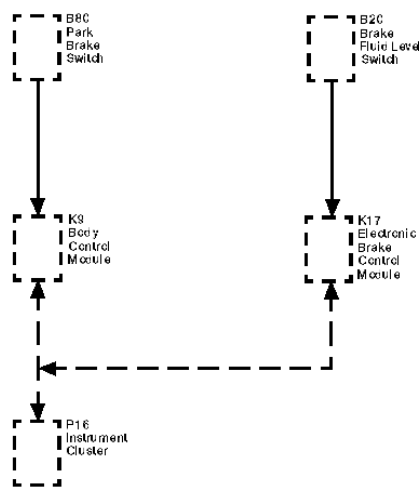


Fig. 158: Hydraulic Brake Warning System Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
HW	Hard-Wired

HW	Hard-Wired
DA	Serial Data
B80	B80 Park Brake Switch
B20	B20 Brake Fluid Level Switch
K9	K9 Body Control Module
K17	K17 Electronic Brake Control Module
P16	P16 Instrument Cluster

The instrument cluster turns the brake warning indicator ON when the following occurs:

- The instrument cluster performs the bulb check. The brake warning indicator illuminates for 5 s.
- When the Electronic Brake Control Module (EBCM) detects low brake fluid level it sets DTC C0267 and sends a serial data message to the instrument cluster, which will illuminate the red brake indicator.
- The Body Control Module (BCM) detects that the parking brake is engaged. The instrument cluster receives a serial data message from the BCM requesting illumination.

Driver Information Center Messages

When the Electronic Brake Control Module (EBCM) detects low brake fluid level it sets DTC C0267 and sends a serial data message to the Driver Information Center, which will display Brake Fluid Low message.

HYDRAULIC BRAKE SYSTEM DESCRIPTION AND OPERATION

System Component Description

The hydraulic brake system consists of the following:

Hydraulic Brake Master Cylinder Reservoir

Contains a supply of brake fluid for the hydraulic brake system.

Hydraulic Brake Master Cylinder

Converts mechanical input force into hydraulic output pressure.

Hydraulic output pressure is distributed from the master cylinder through two hydraulic circuits, supplying diagonally-opposed wheel apply circuits.

Hydraulic Brake Pressure Balance Control System

Regulates brake fluid pressure delivered to hydraulic brake wheel circuits, in order to control the distribution of braking force. Pressure balance control on non-ABS equipped vehicles, is achieved through a proportioning valve assembly. Pressure balance control on ABS equipped vehicles, is achieved through electronic brake distribution (EBD), which is a function of the ABS modulator.

Hydraulic Brake Pipes and Flexible Brake Hoses

Carries brake fluid to and from hydraulic brake system components.

Hydraulic Brake Wheel Apply Components

Converts hydraulic input pressure into mechanical output force.

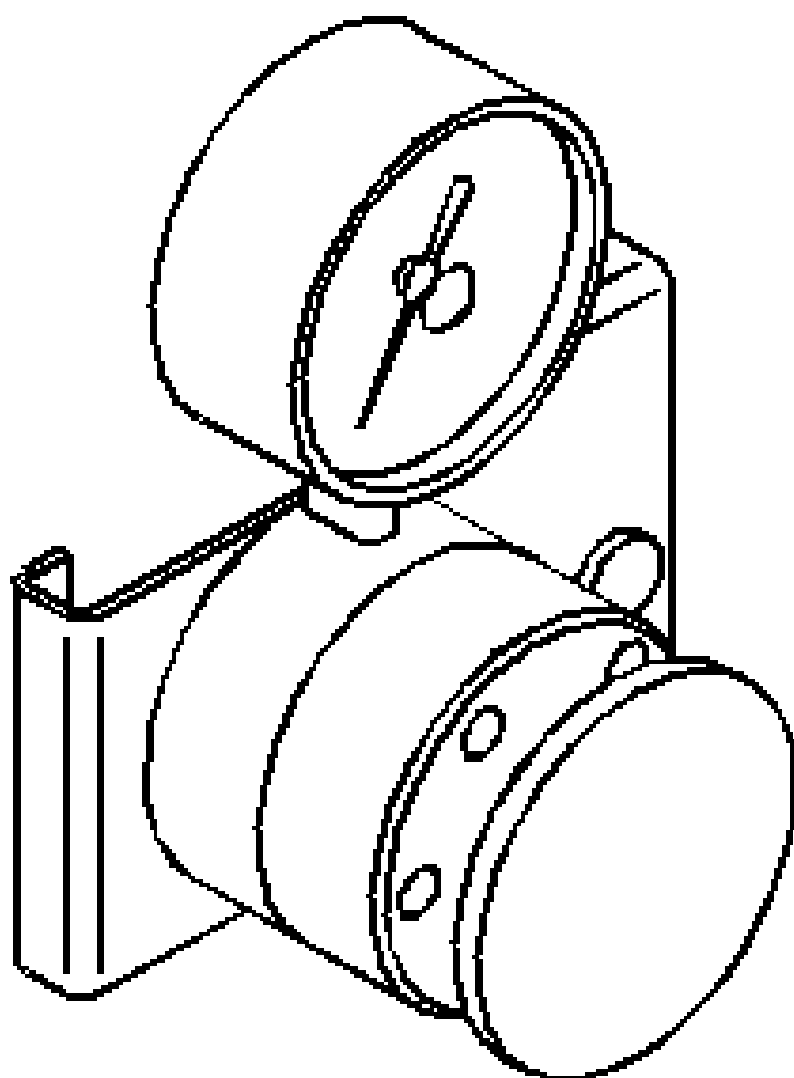
System Operation

Mechanical force is converted into hydraulic pressure by the master cylinder, regulated to meet braking system demands by the pressure balance control system and delivered to the hydraulic brake wheel circuits by the pipes and flexible hoses. The wheel apply components then convert the hydraulic pressure back into mechanical force which presses brake linings against rotating brake system components.

SPECIAL TOOLS AND EQUIPMENT

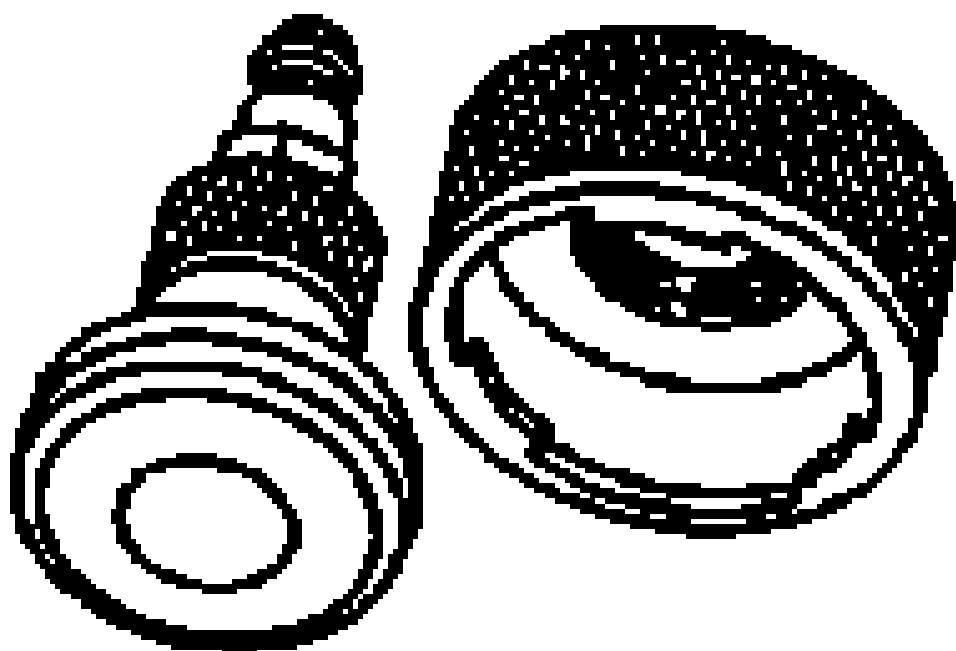
SPECIAL TOOLS

Illustration	Tool Number/ Description
	CH-28662 J-28662 Brake Pedal Effort Gauge



CH-29532
J-29532
Diaphragm
Pressure
Bleeder

CH-50253
Brake
Pressure
Bleeder
Adapter



	J-23738-A Hand Vacuum Pump
--	---

ACCESSORIES & EQUIPMENT

Immobilizer - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Theft Deterrent Module Screw	3 N.m	27 lb in

SCHEMATIC WIRING DIAGRAMS

IMMOBILIZER WIRING SCHEMATICS

Immobilizer Wiring Schematics

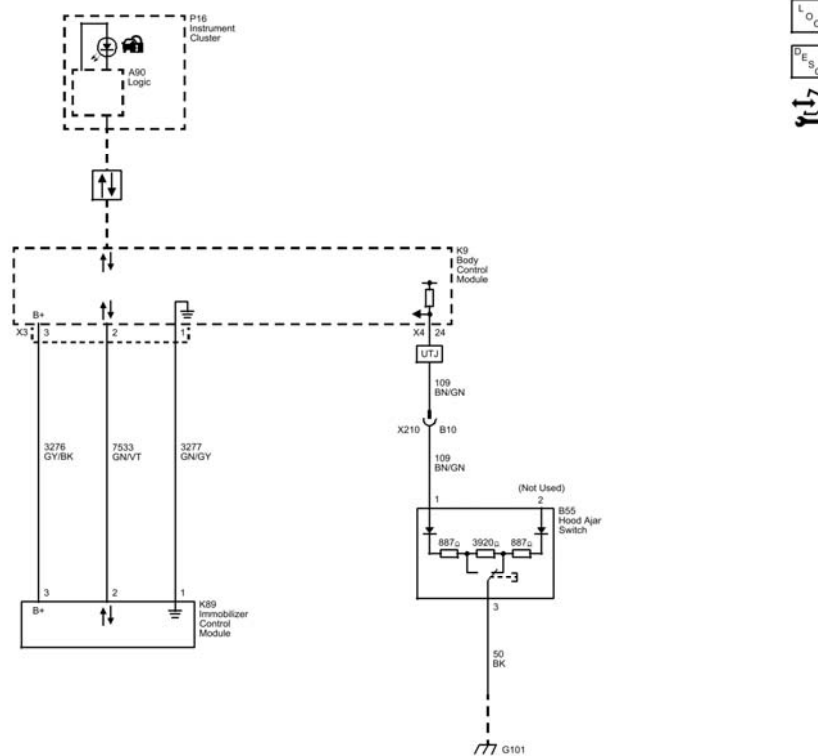


Fig. 1: Immobilizer Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC B2955</u>	DTC B2955 Security Sensor Data Circuit
<u>DTC B302A</u>	DTC B302A Mobile Telephone Communications Interface Requested Immobilization
<u>DTC B3031</u>	DTC B3031 Security Controller In Learn Mode
<u>DTC B3055</u>	DTC B3055 No Transponder Modulation or No Transponder
<u>DTC B305C</u>	DTC B305C Immobilizer Transponder of Wrong Type Programmed
<u>DTC B3060</u>	DTC B3060 Unprogrammed Transponder Identification Code Received
<u>DTC B389A</u>	DTC B389A Environment Identification
<u>DTC B3902</u>	DTC B3902 Incorrect Immobilizer Identifier Received
<u>DTC B3935</u>	DTC B3935 Transponder Authentication
<u>DTC B3976</u>	DTC B3976 Unconfigured Transponder
<u>DTC B3984</u>	DTC B3984 Device 1 Environment Identifier Not Programmable
<u>DTC P0513</u>	DTC P0513 Immobilizer Key Incorrect
<u>DTC P0633</u>	DTC P0633 Immobilizer Key Not Programmed
<u>DTC P162B</u>	DTC P162B Remote Vehicle Speed Limiting Signal Message Counter Incorrect
<u>DTC P1631</u>	DTC P1631 Immobilizer Fuel Enable Signal Not Correct
<u>DTC P1649</u>	DTC P1649 Immobilizer Security Code Not Programmed

DTC B2955: SECURITY SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B2955

Security Sensor Data Circuit

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	B2955 00	B2955 00	-	-
Serial Data	B2955 00	B2955 00	B2955 00	B2955 00
Low Reference	-	B2955 00	-	-

Circuit/System Description

When an ignition key is inserted into the ignition lock cylinder and the ignition is switched ON, the transponder embedded in the key is energized by the exciter coil surrounding the ignition lock cylinder. The transponder transmits a signal to the immobilizer control module. The immobilizer control module translates this signal to a serial data message which is sent to the body control module (BCM). The BCM then compares this value to a value stored in memory. If the value is correct, the BCM will send the prerelease password via the serial data circuit to the engine control module (ECM). If the learned key code does not match or a transponder value is not received, the BCM will send the start disable password to the ECM.

Conditions for Running the DTC

Ignition is in the Accessory or Run position.

Conditions for Setting the DTC

The BCM detects a circuit fault on the immobilizer antenna circuits.

Action Taken When the DTC Sets

- Vehicle starting will be disabled.
- The security indicator in the instrument cluster will be illuminated. A service message will be displayed in the driver information center.

Conditions for Clearing the DTC

- A current DTC will be cleared when the condition for setting the DTC are no longer present.
- A history DTC will be cleared after 100 malfunction-free ignition cycles.

Diagnostic Aids

Because of how the key information is stored in the BCM and the ECM, it may be necessary to begin immobilizer programming with a new vehicle key if DTC B2955 sets immediately after attempting to program a new BCM. This will allow the key information to be transferred between the BCM and the ECM. DTC P0633 may also be set in the ECM and a "No Communication with driver ID Device" error may be displayed during the BCM programming. After programming has begun with the new vehicle key, the existing vehicle keys may then be programmed.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Verify DTC B2955 did not set immediately after the replacement or programming of the K9 Body Control Module or after performing the Immobilizer System Component Programming procedure.
 - **If the DTC set immediately after the replace or programming of the K9 Body Control Module or after performing the Immobilizer System Component Programming procedure.**

Perform the Immobilizer System Component Programming procedure using a new vehicle key. After the new key has been learned, the existing vehicle keys may be learned to the vehicle.

- **If the DTC did not set immediately after the replace or programming of the K9 Body Control Module or after performing the Immobilizer System Component Programming procedure.**
2. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the K89 Immobilizer Control Module. It may take up to 2 min for all vehicle systems to power down.
3. Verify a test lamp illuminates between the low reference circuit terminal 1 and B+.
 - **If the test lamp does not illuminate**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.

- **If the test lamp illuminates**

4. Ignition ON.

NOTE: In some instances, the K9 Body Control Module may only apply voltage for 3 s immediately after the ignition is turned ON. It may be necessary to monitor the DMM while turning the ignition ON to observe the voltage.

5. Test for greater than 9 V between the B+ circuit terminal 3 and ground.

- **If 9 V or less**

1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.

- **If greater than 9 V**

6. Test for greater than 4 V between the serial data circuit terminal 2 and ground.

- **If 4 V or less**

1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
2. Test for infinite resistance between the serial data circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 ohms in the serial data circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.

- **If greater than 4 V**

7. Ignition OFF, disconnect the X3 harness connector at the K9 Body Control Module, ignition ON.

8. Test for less than 1 V between the K89 Immobilizer Control Module serial data circuit terminal 2 and ground.

- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

9. Replace the K89 Immobilizer Control Module.

10. Verify DTC B2955 does not set while operating the vehicle under the conditions for running the DTC.

- **If DTC B2955 is set**

Replace the K9 Body Control Module.

- If DTC B2955 is not set

11. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for body control module or immobilizer control module replacement, programming and setup.

DTC B302A: MOBILE TELEPHONE COMMUNICATIONS INTERFACE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B302A

Mobile Telephone Communications Interface Requested Immobilization

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

As part of the vehicle telematics enhanced services, a request may be sent to the body control module (BCM) to disable vehicle starting. If a valid message is received by the BCM requesting that starting be disabled, the start enable message will not be sent to the engine control module (ECM).

Conditions for Running the DTC

The BCM continuously monitors for this DTC.

Conditions for Setting the DTC

A start disable message has been received from the telematics module.

Action Taken When the DTC Sets

Vehicle starting will be suspended and the security indicator will be illuminated.

Conditions for Clearing the DTC

- A current DTC will clear when the telematics start disable request is no longer received.

- A history DTC will clear after 100 ignition cycles in which the telematic start disable request is not seen.

Diagnostic Aids

- DTC B302A is only an indicator that a start disable request has been received from the vehicle telematics system and does not indicate a fault in the immobilizer or telematics system.
- To remove the start disable request, the vehicle account must be updated with the OnStar stolen vehicle team. This will require that a law enforcement agency or the customer contact OnStar to indicate that the vehicle has been successfully and safely recovered.
- If the OnStar system has been disabled or damaged during a theft attempt, the system will not be able to communicate and the start disable request will not be removed. OnStar must be functioning properly for the start disable request to be removed.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the OnStar system is not damaged and is operating properly, with no DTCs set.
 - **If the OnStar system is damaged, inoperative or any OnStar DTCs are set**

These concerns must be corrected before the start disable can be removed.

- **If the OnStar system is not damaged and is operating properly**

2. Press the blue OnStar button and ask the advisor to be transferred to the stolen vehicle team to verify the vehicle account has been updated.
3. Verify that OnStar is aware the vehicle has been recovered and that the vehicle account has been updated.
 - **If OnStar has not been notified that the vehicle has been recovered**

Contact the customer and advise them that for security purposes, they must contact OnStar and the law enforcement agency to update the vehicle account.

- **If the account has been properly updated**

4. Once the vehicle account has been updated and the start disable request has been removed, DTC B302A will transition to a history DTC. Clear the history DTC.

DTC B3031: SECURITY CONTROLLER IN LEARN MODE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B3031

Security Controller In Learn Mode

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

When learning a coded key, the body control module (BCM) is placed in learn mode. DTC B3031 will set automatically as an indicator that the system is in learn mode and not as a fault indicator. Once the coded key is learned, learn mode will be exited and the DTC cleared. If the BCM does not exit learn mode, DTC B3031 will remain current and indicate a fault. The instrument cluster security indicator will illuminate and the driver information center will display a message.

Conditions for Running the DTC

The immobilizer system is the learn coded keys state.

Conditions for Setting the DTC

The DTC will set any time the BCM enters the learn coded keys state.

Action Taken When the DTC Sets

The security indicator will illuminate. The driver information center will display a message.

Conditions for Clearing the DTC

- A current DTC B3031 will be cleared upon the successful exit of learn mode.
- A history DTC will be cleared after 100 malfunction-free ignition cycles.

Reference Information

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify all available keys are correct for the vehicle. This can be accomplished by comparing the part number that is laser etched on the key to the part number listed in the parts catalog.
 - **If a key is not correct**

Replace the key
 - **If all keys are correct**
2. Perform the Replacing Keys procedure. Refer to **Key with Integrated Transmitter Programming**.
3. Verify the K9 Body Control Module learns the vehicle key and exits the learn coded key state. The scan tool Master Keys Learned parameter should increment to 1.
 - **If the K9 Body Control Module does not exit the learn coded key state after the programming**

attempt

Replace the K9 Body Control Module

- **If the K9 Body Control Module exits the learn coded key state after the programming attempt**

4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for body control module replacement, programming and setup.

DTC B3055: NO TRANSPONDER MODULATION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B3055

No Transponder Modulation or No Transponder

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

Without BTM and/or ATH/ATS

When an ignition key is inserted into the ignition lock cylinder and the ignition is switched ON, the transponder embedded in the key is energized by the exciter coil surrounding the ignition lock cylinder. The transponder transmits a signal to the immobilizer control module. The immobilizer control module translates this signal to a serial data message which is sent to the body control module (BCM). The BCM then compares this value to a value stored in memory. If the value is correct, the BCM will send the prerelease password via the serial data circuit to the engine control module (ECM). If the learned key code does not match or a transponder value is not received, the BCM will send the start disable password to the ECM.

With BTM and/or ATH/ATS

When a ignition key is inserted into the key pocket/slot and the ignition mode switch is pressed, the transponder embedded in the key is energized by the immobilizer antenna exciter coil. The transponder transmits a signal to the immobilizer control module. The immobilizer control module translates this signal to a serial data message

which is sent to the body control module (BCM). The BCM then compares this value to a value stored in memory. If the value is correct, the BCM will send the prerelease password via the serial data circuit to the engine control module (ECM). If the learned key code does not match or a transponder value is not received, the BCM will send the start disable password to the ECM.

Conditions for Running the DTC

Ignition is in the Accessory or Run position.

Conditions for Setting the DTC

The BCM is unable to measure the ignition key transponder value.

Action Taken When the DTC Sets

- Vehicle starting will be disabled.
- The security indicator will illuminate. A service message will be displayed in the driver information center.

Conditions for Clearing the DTC

- A current DTC will be cleared when the BCM detects a valid transponder value from the ignition key.
- A history DTC will be cleared after 100 malfunction-free ignition cycles.

Diagnostic Aids

- Because DTC B3055 may be caused by a malfunctioning vehicle key, it is necessary to have all available vehicle keys at the time of diagnosis. A possible scenario would be a customer leaving the vehicle with a spare key during the service visit, but the key which they use everyday, not the spare key, is the cause of the DTC. Not having all available keys in this instance would result in the customer concern not being duplicate or a misdiagnosis.
- Ensure that the immobilizer control module is properly installed and fully seated. An audible and/or tactile click will indicate that the immobilizer control module is fully seated. To ensure proper transponder communication, the key must be in a specific location in relation to the immobilizer control module. If the immobilizer control module is not fully seated, transponder communication may not occur and DTC B3055 will set.
- For vehicle without BTM and/or ATH/ATS, verify the customer is not attempting to turn the ignition with the vehicle key partially folded. To ensure proper transponder communication, the key must be in a specific location in relation to the immobilizer control module. Attempting to start the vehicle with the key in the ignition and partially folded will result in no transponder communication and DTC B3055 will set.

Reference Information

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Without BTM and/or ATH/ATS

1. Ignition ON.
2. Verify that DTC B1370, B1380 or B1441 is not set.
 - **If any of the DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If none of the DTCs are set**
3. Verify the scan tool body control module Accessory parameter changes between Active and Inactive when turning the ignition ON and OFF.
 - **If the parameter does not change**

Refer to **Vehicle Will Not Change Power Mode** .

- **If the parameter changes**
4. Verify all available keys are correct for the vehicle. This can be accomplished by comparing the part number that is laser etched on the key to the part number listed in the parts catalog.
 - **If a key is not correct**

Replace the appropriate key.

- **If all keys are correct**
5. Verify that DTC B3055 does not set while attempting to start the vehicle with each available key.

- **If DTC B3055 sets when attempting to start the vehicle with only one of the available keys**

Replace the appropriate key.

- **If DTC B3055 sets when attempting to start the vehicle with all of the available keys**

Replace the K89 Immobilizer Control Module.

- **If DTC B3055 does not set**

6. All OK.

With BTM and/or ATH/ATS

1. Ignition ON.

2. Verify that DTC B1370, B1380 or B1441 is not set.

- **If any of the DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If none of the DTCs are set**

3. Verify the scan tool body control module Accessory parameter changes between Active and Inactive when turning the ignition ON and OFF.

- **If the parameter does not change**

Refer to **Power Mode Mismatch** .

- **If the parameter changes**

4. Verify all available keys are correct for the vehicle. This can be accomplished by comparing the part number that is laser etched on the key to the part number listed in the parts catalog.

- **If a key is not correct**

Replace the appropriate key.

- **If all keys are correct**

5. Remove the battery from each of the available vehicle keys.

6. Verify that DTC B3055 does not set while attempting to start the vehicle with each available key. To start the vehicle with the key battery removed, the key must be placed in the key pocket/slot.

- **If DTC B3055 sets when attempting to start the vehicle with only one of the available keys**

Replace the appropriate key.

- **If DTC B3055 sets when attempting to start the vehicle with all of the available keys**

Replace the K89 Immobilizer Control Module.

- If DTC B3055 does not set

7. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for immobilizer control module replacement, programming and setup.

DTC B305C: IMMOBILIZER TRANSPONDER OF WRONG TYPE PROGRAMMED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B305C

Immobilizer Transponder of Wrong Type Programmed

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

Without BTM and/or ATH/ATS

When an ignition key is inserted into the ignition lock cylinder and the ignition is switched ON, the transponder embedded in the key is energized by the exciter coil surrounding the ignition lock cylinder. The transponder transmits a signal to the immobilizer control module. The immobilizer control module translates this signal to a serial data message which is sent to the body control module (BCM). The BCM then compares this value to a value stored in memory. If the value is correct, the BCM will send the prerelease password via the serial data circuit to the engine control module (ECM). If the learned key code does not match or a transponder value is not received, the BCM will send the start disable password to the ECM.

With BTM and/or ATH/ATS

When a ignition key is inserted into the key pocket/slot and the ignition mode switch is pressed, the transponder embedded in the key is energized by the immobilizer antenna exciter coil. The transponder transmits a signal to the immobilizer control module. The immobilizer control module translates this signal to a serial data message which is sent to the body control module (BCM). The BCM then compares this value to a value stored in memory. If the value is correct, the BCM will send the prerelease password via the serial data circuit to the engine control module (ECM). If the learned key code does not match or a transponder value is not received, the BCM will send the start disable password to the ECM.

Conditions for Running the DTC

- Ignition is in the Accessory or Run position
- Battery voltage is greater than 9 volts
- Transponder authentication has occurred

Conditions for Setting the DTC

- The programmed transponder type does not match the equipped system on the vehicle.
- A transponder used for vehicles without BTM and/or ATH/ATS has been programmed to a vehicle with BTM and/or ATH/ATS.
- A transponder used for vehicles with BTM and/or ATH/ATS has been programmed to a vehicle without BTM and/or ATH/ATS.

Action Taken When the DTC Sets

No action is taken.

Conditions for Clearing the DTC

- A current DTC will be cleared when the BCM detects a programmed transponder type that matches the equipped system on the vehicle.
- A history DTC will be cleared after 100 malfunction-free ignition cycles.

Reference Information

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify all available keys/transmitters are correct for the vehicle. This can be accomplished by comparing the part number that is laser etched on the key to the part number listed in the parts catalog.
 - **If a key is not correct**

Replace the appropriate key.
 - **If all keys are correct**
3. Verify the scan tool Key Part Number parameter displays a Key Part Number when turning the ignition ON with each key.
 - **If a Key Part Number is not read**

Replace the appropriate key.
 - **If a Key Part Number is read for each key**
4. All OK.

DTC B3060: UNPROGRAMMED TRANSPONDER IDENTIFICATION CODE RECEIVED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B3060

Unprogrammed Transponder Identification Code Received

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

Without BTM and/or ATH/ATS

When an ignition key is inserted into the ignition lock cylinder and the ignition is switched ON, the transponder embedded in the key is energized by the exciter coil surrounding the ignition lock cylinder. The transponder transmits a signal to the body control module (BCM). The BCM then compares this value to a value stored in memory. If the value is correct, the BCM will send the prerelease password via the serial data circuit to the engine control module (ECM). If the learned key code does not match or a transponder value is not received,

the BCM will send the start disable password to the ECM.

With BTM and/or ATH/ATS

When a keyless entry transmitter is inserted into the transmitter pocket/slot and the ignition mode switch is pressed, the transponder embedded in the transmitter is energized by the immobilizer antenna exciter coil. The transponder transmits a signal to the body control module (BCM). The BCM then compares this value to a value stored in memory. If the value is correct, the BCM will send the prerelease password via the serial data circuit to the engine control module (ECM). If the learned key code does not match or a transponder value is not received, the BCM will send the start disable password to the ECM.

Conditions for Running the DTC

Ignition is in the Accessory or Run position.

Conditions for Setting the DTC

The transponder value measured by the BCM is incorrect or not learned to the vehicle.

Action Taken When the DTC Sets

- Vehicle starting will be disabled.
- The security indicator in the instrument cluster will be illuminated. The driver information center will display a service message.

Conditions for Clearing the DTC

- A current DTC will be cleared when the BCM detects a valid transponder value from the ignition key.
- A history DTC will be cleared after 100 malfunction-free ignition cycles.

Reference Information

Schematic Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Perform the Replacing Keys procedure. Refer to **Key with Integrated Transmitter Programming**.
2. Verify the K9 Body Control Module learns the vehicle key. The scan tool Master Keys Learned parameter should increment to indicate another key has been learned.
 - **If the BCM does not learn the key**

Replace the key.
 - **If the BCM learns the key**
3. All OK.

DTC B389A: ENVIRONMENT IDENTIFICATION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B389A

Environment Identification

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

When certain modules are programmed and configured during installation, the module learns a specific environment identifier which is unique to the vehicle. The environment identifier is used to prevent the swapping modules between vehicles. The body control module (BCM) is the keeper of the environment identifier. The Instrument Cluster, Electronic Brake Control Module, HVAC Control Module, Inflatable Restraint Sensing and Diagnostic Module, engine control module (ECM) and Steering Column Lock Module (if equipped) each learn the environment identifier during their configuration process. During vehicle operation, the BCM sends the immobilizer identifier as a challenge and each module responds to the challenge by sending the environment identifier back to the BCM. If the BCM sends an incorrect immobilizer identifier or a specific

number of incorrect environment identifiers are received, vehicle starting is disabled.

Conditions for Running the DTC

Ignition is in the ACCESSORY or RUN position.

Conditions for Setting the DTC

An incorrect immobilizer identifier was broadcast by the BCM.

Action Taken When the DTC Sets

- The security indicator in the instrument cluster will illuminate.
- Vehicle starting will be disabled.

Conditions for Clearing the DTC

A current DTC will be cleared when the BCM broadcasts a correct immobilizer identifier.

Diagnostic Aids

If BCM programming is not completed after BCM replacement, the immobilizer identifier will not be learned. If DTC B389A sets immediately after the replacement and programming of a BCM, perform the programming procedure again.

Reference Information

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC B389A did not set immediately following the replacement and programming of the K9 Body Control Module.

- **If the DTC set immediately after the replacement and programming of the K9 Body Control Module**

The immobilizer learn procedure was not properly completed. Perform the BCM immobilizer learn using the body control module IMMO Function with Existing Transponder or Remote Key in SPS. Refer to **Immobilizer System Component Programming**.

- **If the DTC did not set immediately after the replacement and programming of the K9 Body Control Module**

2. Verify DTC B3902 is not set in any of the control modules listed below:

- K20 Engine Control Module
- K36 Inflatable Restraint Sensing and Diagnostic Module
- K17 Electronic Brake Control Module
- K33 HVAC Control Module
- P16 Instrument Cluster
- K60 Steering Column Lock Module (if equipped)
- **If DTC B3902 is set in any of the modules**

Refer to **DTC B3902**.

- **If DTC B3902 is not set in any of the modules**

3. Perform the K9 Body Control Module immobilizer learn using body control module IMMO Function with Existing Transponder or Remote Key in SPS. Refer to **Immobilizer System Component Programming**.

4. Verify DTC B389A does not set after programming.

- **If the DTC sets after programming**

Replace the K9 Body Control Module.

- **If the DTC does not set after programming**

5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for body control module replacement, programming and setup.

DTC B3902: INCORRECT IMMOBILIZER IDENTIFIER RECEIVED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B3902

Incorrect Immobilizer Identifier Received

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

When certain modules are programmed and configured during installation, the module learns a specific environment identifier which is unique to the vehicle. The environment identifier is used to prevent the swapping modules between vehicles. The body control module (BCM) is the keeper of the environment identifier. The instrument cluster, electronic brake control module, HVAC control module, inflatable restraint sensing and diagnostic module, engine control module (ECM) and steering column lock module (if equipped) each learn the environment identifier during their configuration process. During vehicle operation, the BCM sends the immobilizer identifier as a challenge and each module responds to the challenge by sending the environment identifier back to the BCM. If the BCM sends an incorrect immobilizer identifier or a specific number of incorrect environment identifiers are received, vehicle starting is disabled.

Conditions for Running the DTC

Ignition is in the ACCESSORY or RUN position.

Conditions for Setting the DTC

The control module's environment identifier does not match the environment identifier stored by the BCM.

Action Taken When the DTC Sets

- The security indicator in the instrument cluster will illuminate.
- Vehicle starting will be disabled.

Conditions for Clearing the DTC

A current DTC will be cleared when the module learns a correct environment identifier.

Reference Information

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Perform the Programming and Setup procedure for the control module that set DTC B3902.
2. Verify DTC B3902 does not set after programming.
 - **If the DTC sets after programming**

Replace the control module that set the DTC.
 - **If the DTC does not set after programming**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for instrument cluster, electronic brake control module, HVAC control module, inflatable restraint sensing and diagnostic module, engine control module or steering column lock module replacement, programming and setup.

DTC B3935: TRANSPONDER AUTHENTICATION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B3935

Transponder Authentication

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

Without BTM and/or ATH/ATS

When an ignition key is inserted into the ignition lock cylinder and the ignition is switched ON, the transponder embedded in the key is energized by the exciter coil surrounding the ignition lock cylinder. The transponder transmits a signal to the immobilizer control module. The immobilizer control module translates this signal to a serial data message which is sent to the body control module (BCM). The BCM then compares this value to a value stored in memory. If the value is correct, the BCM will send the prerelease password via the serial data circuit to the engine control module (ECM). If the learned key code does not match or a transponder value is not received, the BCM will send the start disable password to the ECM.

With BTM and/or ATH/ATS

When a ignition key is inserted into the key pocket/slot and the ignition mode switch is pressed, the transponder embedded in the key is energized by the immobilizer antenna exciter coil. The transponder transmits a signal to the immobilizer control module. The immobilizer control module translates this signal to a serial data message which is sent to the body control module (BCM). The BCM then compares this value to a value stored in memory. If the value is correct, the BCM will send the prerelease password via the serial data circuit to the engine control module (ECM). If the learned key code does not match or a transponder value is not received, the BCM will send the start disable password to the ECM.

Conditions for Running the DTC

- Ignition is in the Accessory or Run position.
- A valid transponder value has been read.

Conditions for Setting the DTC

The transponder calculation of the challenge from the BCM does not match the BCM calculation.

Action Taken When the DTC Sets

- Vehicle starting will be disabled.
- The security indicator will illuminate. The driver information center will display a service message.

Conditions for Clearing the DTC

- A current DTC will be cleared when a valid transponder value has been read and authenticated.
- A history DTC will be cleared after 100 malfunction-free ignition cycles.

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- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Replace the suspected inoperative or malfunctioning key.
2. Verify DTC B3935 does not set while operating the vehicle under the conditions for running the DTC.
 - **If the DTC is set**

Replace the K9 Body Control Module.
 - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for body control module replacement, programming and setup.

DTC B3976: UNCONFIGURED TRANSPONDER

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B3976

Unconfigured Transponder

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

Without BTM and/or ATH/ATS

When an ignition key is inserted into the ignition lock cylinder and the ignition is switched ON, the transponder embedded in the key is energized by the exciter coil surrounding the ignition lock cylinder. The transponder transmits a signal to the immobilizer control module. The immobilizer control module translates this signal to a serial data message which is sent to the body control module (BCM). The BCM then compares this value to a value stored in memory. If the value is correct, the BCM will send the prerelease password via the serial data circuit to the engine control module (ECM). If the learned key code does not match or a transponder value is not received, the BCM will send the start disable password to the ECM.

With BTM and/or ATH/ATS

When a ignition key is inserted into the key pocket/slot and the ignition mode switch is pressed, the transponder embedded in the key is energized by the immobilizer antenna exciter coil. The transponder transmits a signal to the immobilizer control module. The immobilizer control module translates this signal to a serial data message which is sent to the body control module (BCM). The BCM then compares this value to a value stored in memory. If the value is correct, the BCM will send the prerelease password via the serial data circuit to the engine control module (ECM). If the learned key code does not match or a transponder value is not received, the BCM will send the start disable password to the ECM.

Conditions for Running the DTC

- Ignition is in the Accessory or Run position.
- The BCM is in the learn coded key state.

Conditions for Setting the DTC

The BCM has determined the current key is not configured as a proper vehicle key.

Action Taken When the DTC Sets

- Vehicle starting will be disabled.
- The security indicator in the instrument cluster will be illuminated. A service message will be displayed in the driver information center.

Conditions for Clearing the DTC

- A current DTC will be cleared when the BCM detects a properly configured vehicle key.
- A history DTC will be cleared after 100 malfunction-free ignition cycles.

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the engine starts with each available key.
 - **If the engine does not start with a key**

Replace the key.
 - **If the engine starts with all keys**
2. All OK.

DTC B3984: DEVICE 1 ENVIRONMENT IDENTIFIER

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B3984

Device 1 Environment Identifier Not Programmable

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

When certain modules are programmed and configured during installation, the module learns a specific environment identifier which is unique to the vehicle. The environment identifier is used to prevent the swapping modules between vehicles. The body control module (BCM) is the keeper of the environment identifier. The instrument cluster, electronic brake control module, HVAC control module, inflatable restraint sensing and diagnostic module, engine control module (ECM) and steering column lock module (if equipped) each learn the environment identifier during their configuration process. During vehicle operation, the BCM sends the immobilizer identifier as a challenge and each module responds to the challenge by sending the environment identifier back to the BCM. If the BCM sends an incorrect immobilizer identifier or a specific number of incorrect environment identifiers are received, vehicle starting is disabled.

Conditions for Running the DTC

Ignition is in the ACCESSORY or RUN position.

Conditions for Setting the DTC

An incorrect environment identifier is programmed or no environment identifier is programmed.

Action Taken When the DTC Sets

- The security indicator in the instrument cluster will illuminate.
- Vehicle starting will be disabled.

Conditions for Clearing the DTC

A current DTC will be cleared when the module learns a correct environment identifier.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Perform the Programming and Setup procedure for the control module that set DTC B3984.
2. Verify DTC B3984 does not set after programming.
 - **If the DTC sets after programming**

Replace the control module that set the DTC.
 - **If the DTC does not set after programming**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for instrument cluster, electronic brake control module, HVAC control module, inflatable restraint sensing and diagnostic module, engine control module and steering column lock module replacement, programming and setup.

DTC P0513: IMMOBILIZER KEY INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0513

Immobilizer Key Incorrect

Circuit/System Description

The body control module (BCM) sends the pre-release information to the engine control module (ECM) via the serial data circuit. The ECM then sends a challenge to the BCM. Both the ECM and BCM perform a calculation on this challenge. If the calculated response from the BCM equals the calculation performed by the ECM, the ECM will allow vehicle starting.

Conditions for Running the DTC

Ignition is in the ACCESSORY or RUN position.

Conditions for Setting the DTC

The calculated response from the BCM does not equal the calculation performed by the ECM.

Action Taken When the DTC Sets

- The security indicator in the instrument cluster will illuminate.
- Vehicle starting will be disabled.

Conditions for Clearing the DTC

- A current DTC will be cleared when a valid calculation is received.
- A history DTC will be cleared after 40 malfunction-free ignition cycles.

Diagnostic Aids

DTC P0513 may be caused by a loose connection or intermittent poor continuity on the ECM ground or at the negative battery cable. Be sure to check the ECM ground(s) and negative battery cable if normal system diagnosis does not correct the concern.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify there are no immobilizer DTCs set in the K9 Body Control Module.
 - **If any immobilizer DTCs are set in the K9 Body Control Module**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

○ **If no immobilizer DTCs are set in the K9 Body Control Module**
2. Perform the K9 Body Control Module immobilizer learn using the body control module IMMO Function with Existing Transponder or Remote Key in SPS. Refer to **Immobilizer System Component Programming**.
3. Verify the engine starts after the K9 Body Control Module completes the learn procedure.
 - **If the engine does not start**

Perform the K20 Engine Control Module immobilizer learn using the engine control module IMMO Learn in SPS. Refer to **Immobilizer System Component Programming**.

○ **If the engine starts**
4. All OK.

DTC P0633: IMMOBILIZER KEY NOT PROGRAMMED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.

- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0633

Immobilizer Key Not Programmed

Circuit/System Description

When learning the immobilizer data, as well as the challenge and response sequence, the engine control module (ECM) is placed in learn mode. DTC P0633 will set automatically as an indicator that the system is in learn mode and not as a fault indicator. Once the immobilizer data and challenge/response are learned, learn mode will be exited when the engine is successfully started. If the ECM does not exit learn mode, DTC P0633 will remain current and indicate a fault.

Conditions for Running the DTC

The ECM is in learn mode.

Conditions for Setting the DTC

DTC P0633 will set any time the ECM enters learn mode.

Action Taken When the DTC Sets

The security indicator in the instrument cluster will illuminate.

Conditions for Clearing the DTC

- A current DTC will be cleared upon a successful engine start after exit of learn mode.
- A history DTC will be cleared after 100 malfunction-free ignition cycles.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: DTC P0633 will clear upon a successful engine start. Any malfunction that will cause a no-start condition will prevent DTC P0633 from clearing. Prior to diagnosing DTC P0633, ensure that all power moding and engine control systems are operating properly and all conditions that may cause a no-start have been corrected. Do not replace the K20 Engine Control Module. Replacing the K20 Engine Control Module will not correct the no-start condition.

1. Verify there are no immobilizer DTCs set in the K9 Body Control Module.
 - **If any immobilizer DTCs are set in the K9 Body Control Module**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If no immobilizer DTCs are set in the K9 Body Control Module**
2. Perform the K20 Engine Control Module immobilizer learn using the engine control module IMMO Learn in SPS. Refer to **Immobilizer System Component Programming**.
 3. Verify the engine starts after the K20 Engine Control Module completes the learn procedure.
 - **If the engine does not start**

An undiagnosed no-start condition exists. Refer to the appropriate subsection and diagnostic to correct the no-start condition.

- **If the engine starts**
4. All OK.

DTC P162B: REMOTE VEHICLE SPEED LIMITING SIGNAL MESSAGE COUNTER

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P162B

Remote Vehicle Speed Limiting Signal Message Counter Incorrect

Circuit/System Description

When a remote slow-down request is sent from OnStar, the vehicle communication interface control module sends a serial data message to the engine control module (ECM) indicating that reduced vehicle speed has been requested. Once the request is active, the ECM begins reducing engine torque to match the requested vehicle speed and the REDUCED ENGINE POWER message is displayed.

Conditions for Running the DTC

- The engine run time is greater than 5 s
- A remote slow-down request is sent from OnStar

Conditions for Setting the DTC

- The VIN embedded in the slow-down request does not match the VIN stored in the ECM.
- The rolling code counter embedded in the slow-down request does not increment for ten consecutive messages.

Action Taken When the DTC Sets

- ECM ignores all reduced vehicle speed request messages from the vehicle communication interface module.
- The ECM stores DTC P162B in history.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear after 40 malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Remote Vehicle Speed Limiting Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Perform the Stolen Vehicle Slow-Down Clear procedure with the scan tool.
2. Verify DTC P162B is not set.
 - **If DTC P162B is set**
 1. Replace the K73 Telematics Communication Interface Control Module.
 2. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.
 - If the DTC sets, replace the K20 Engine Control Module.
 - If the DTC does not set
 - 3. All OK.
 - **If DTC P162B is not set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for telematics communication interface control module or engine control module replacement, programming and setup

DTC P1631: IMMOBILIZER FUEL ENABLE SIGNAL

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P1631

Immobilizer Fuel Enable Signal Not Correct

Circuit/System Description

The body control module (BCM) sends the pre-release information to the engine control module (ECM) via the serial data circuit. The ECM then sends a challenge to the BCM. Both the ECM and BCM perform a calculation on this challenge. If the calculated response from the BCM equals the calculation performed by the ECM, the ECM will allow vehicle starting. The BCM follows this action by sending the remaining immobilizer data to the ECM. If the immobilizer data sent by the BCM matches that stored by the ECM, the ECM will allow the engine to remain running.

Conditions for Running the DTC

Ignition is in the ACCESSORY or RUN position.

Conditions for Setting the DTC

The ECM receives incorrect immobilizer data from the BCM.

Action Taken When the DTC Sets

- The security indicator in the instrument cluster will illuminate.
- Vehicle starting will be disabled.

Conditions for Clearing the DTC

- A current DTC will be cleared when correct immobilizer data is received.
- A history DTC will be cleared after 40 malfunction-free ignition cycles.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify there are no immobilizer DTCs set in the K9 Body Control Module.
 - **If any immobilizer DTCs are set in the K9 Body Control Module**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
 - **If no immobilizer DTCs are set in the K9 Body Control Module**
2. Perform the K9 Body Control Module immobilizer learn using the body control module IMMO Function with Existing Transponder or Remote Key in SPS. Refer to **Immobilizer System Component Programming**.
3. Verify the engine starts after the K9 Body Control Module completes the learn procedure.
 - **If the engine does not start**

Perform the K20 Engine Control Module immobilizer learn using the engine control module IMMO Learn in SPS. Refer to **Immobilizer System Component Programming**.
 - **If the engine starts**
4. All OK.

DTC P1649: IMMOBILIZER SECURITY CODE NOT PROGRAMMED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P1649

Immobilizer Security Code Not Programmed

Circuit/System Description

When learning the security code, as well as the challenge and response sequence, the engine control module (ECM) is placed in learn mode. Once the security code and challenge/response are learned, learn mode will be exited when the engine is successfully started.

Conditions for Running the DTC

The ECM is in learn mode.

Conditions for Setting the DTC

The ECM has not learned a security code.

Action Taken When the DTC Sets

The security indicator in the instrument cluster will illuminate.

Conditions for Clearing the DTC

- A current DTC will be cleared upon a successful engine start after exit of learn mode.
- A history DTC will be cleared after 100 malfunction-free ignition cycles.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Verify there are no immobilizer DTCs set in the K9 Body Control Module.
 - **If any immobilizer DTCs are set in the K9 Body Control Module**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If no immobilizer DTCs are set in the K9 Body Control Module**
2. Perform the K20 Engine Control Module immobilizer learn using the engine control module IMMO Learn in SPS. Refer to **Immobilizer System Component Programming**.
 3. Verify the engine starts after the K20 Engine Control Module completes the learn procedure.
 - **If the engine does not start**

Replace the K20 Engine Control Module.

- **If the engine starts**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for engine control module replacement, programming and setup.

SYMPTOMS - IMMOBILIZER

IMPORTANT: The following steps must be completed before using the symptom tables.

1. Perform the **Diagnostic System Check - Vehicle** before using the symptom tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data links.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Immobilizer Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the systems. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to **OnStar Stolen Vehicle Slowdown Active** to diagnose the symptom.

ONSTAR STOLEN VEHICLE SLOWDOWN ACTIVE

Diagnostic Instructions

NOTE: **This procedure is not used in Brazil.**

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

When a remote slow-down request is sent from OnStar, the Telematics Communication Interface Control Module sends a serial data message to the engine control module (ECM) indicating that reduced vehicle speed has been requested. Once the request is active, the ECM begins reducing engine torque to match requested vehicle speed and the REDUCED ENGINE POWER message is displayed.

Reference Information

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Remote Vehicle Speed Limiting Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the vehicle is not in the OnStar initiated Stolen Vehicle Slowdown mode. This can be accomplished by verifying the scan tool Telematics Enhanced Service Immobilization parameter is No.
 - **If the scan tool Telematics Enhanced Service Immobilization parameter is Yes**
 1. Perform the Remote Vehicle Speed Limiting Reset procedure with the scan tool.
 2. Press the blue OnStar button and inform the advisor that you need to be transferred to the stolen vehicle team to update the vehicle account.
 - **If the scan tool BCM Telematics Enhanced Service Immobilization parameter is No**
2. All OK.

REPAIR INSTRUCTIONS

THEFT DETERRENT MODULE REPLACEMENT

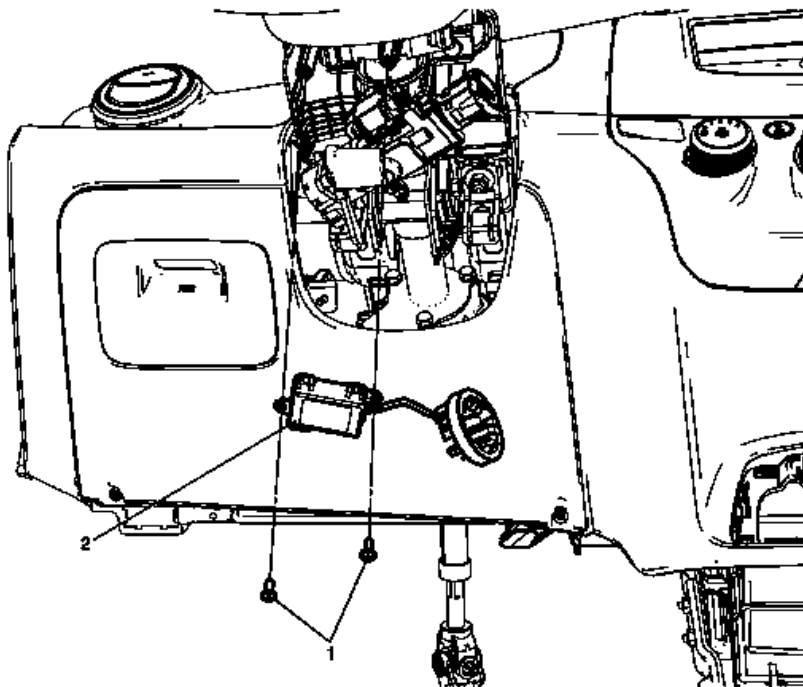


Fig. 2: Theft Deterrent Module
Courtesy of GENERAL MOTORS COMPANY

Theft Deterrent Module Replacement

Callout	Component Name
WARNING: Refer to <u>Battery Disconnect Warning</u> .	
Preliminary Procedure	

1. Remove the steering column lower trim cover. Refer to **Steering Column Lower Trim Cover Replacement** .
2. Disconnect battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection** .

1	Theft Deterrent Module Screw (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 3 (27 lb in)
2	Theft Deterrent Module Procedure 1. Disconnect the electrical connector. 2. Carefully unclip the bracket from ignition key housing.

IMMOBILIZER SYSTEM COMPONENT PROGRAMMING

This procedure will learn the immobilizer function. If the battery voltage is low, charge the battery before proceeding with the learn. If the body control module (BCM) or engine control module (ECM) have been replaced, they must be programmed before performing this learn procedure.

Depending on the immobilizer function being learned or the component replaced, different learn functions are required to be performed. These learn functions are as follows:

Immobilizer System Component Programming

Function name on SPS tool:	Function description:	When the function should be used:	Notes:
Body Control Module IMMO Function with Existing Transponder or Remote Key	The BCM will relearn the immobilizer passwords and data while reusing the existing vehicle keys	The BCM has been replaced and the existing vehicle keys are being reused or a diagnostic has instructed to perform the learn	-
Body Control Module IMMO Function with New Transponder or Remote Key	The BCM will relearn the immobilizer passwords and data while using new vehicle keys	The BCM has been replaced and new vehicle keys are being reused	-
Engine Control Module IMMO Learn	The ECM will relearn the immobilizer passwords and data	The ECM has been replaced or a diagnostic has instructed to perform the learn	-

Engine Control Module and Body Control Module IMMO Learn	The ECM and BCM will learn new immobilizer passwords and data	Both the ECM and BCM have been replaced (this selection will REQUIRE new vehicle keys be used)	Because both the ECM and BCM have been replaced and are learning new immobilizer passwords and data, all vehicle keys must also be replaced
Program Transponder or Remote Key (Add)	A new vehicle key will learn the immobilizer passwords and data	A new vehicle key is being added (does not affect other vehicle keys)	This function may not be available in all sales regions. Refer to the SPS application to determine if a particular vehicle is able to add keys using this method.
Program Transponder or Remote Key (Delete)	All existing vehicle keys will be invalidated and any desired keys are relearned	All vehicle keys are desired to be invalidated and certain keys relearned or a diagnostic has instructed to perform the learn	This procedure may be used if a customer has had their keys lost or stolen and wishes to invalidate the keys, making them unable to start the vehicle

1. Connect a scan tool to the vehicle and access SPS.
2. Turn ON the ignition, with the engine OFF.
3. Ensure that all power consuming devices are turned OFF on the vehicle.
4. Select SPS application and follow the on-screen instructions.
5. Select Reprogram ECU.
6. Select IMMO Immobilizer Learn - Setup.
7. Select the appropriate programming function based on the component that was replaced or is being programmed. Refer to the table at the top of this document for assistance in choosing the correct programming function.
8. Follow the on-screen instructions.
9. After programming all keys "Programming Complete" is displayed.
10. Press the lock and unlock button on each transmitter that was programmed. This will awaken each transmitter and allow keyless entry functions to be established.
11. With a scan tool, clear any DTCs.
12. Verify each key is operating properly. Operate each of the keyless entry functions using the buttons on the transmitter and then start the vehicle. When verifying operation, make sure that no other keys are near the vehicle.

KEY WITH INTEGRATED TRANSMITTER PROGRAMMING

Keys can be programming in various ways using the procedures outlined below. Using the Replacing Keys procedures will first erase all the known keys from the vehicle. Any existing keys and any new keys will then

be programmed. This procedure should be used any time a key is required to be unlearned or erased from a vehicle. If a new key is being learned to a vehicle to replace a damaged, inoperative or stolen key, the Replacing Keys procedure must be used. This ensures that the old key cannot be used to access or start the vehicle after programming.

The Adding Keys procedure does not erase any keys prior to programming. The procedure will simply program the key into the next available slot. The Adding Keys procedure should only be used when adding an additional key to the vehicle. The Adding Keys procedure should never be used to program a key to a vehicle that is having a key replaced, regardless of the cause for the replacement.

Replacing Keys (With SPS)

NOTE:

- **This procedure may be used with or without existing learned keys being present.**
- **A total of eight keys maybe be learned to a single vehicle.**
- **This procedure will only learn the vehicle key information. This procedure will not learn any immobilizer information between the body control module (BCM) and engine control module (ECM).**
- **If the battery voltage is low, charge the battery before continuing with the procedure.**

1. Connect a scan tool to the vehicle and access SPS.
2. Ensure that all power consuming devices are turned OFF on the vehicle.
3. Select the SPS application and follow the on-screen instructions.
4. Select Reprogram ECU.
5. Select IMMO Immobilizer Learn - Setup.
6. Select the Program Transponder or Remote Key (Delete) function.
7. Follow the on-screen instructions.
8. After programming all keys, "Programming Complete" is displayed.
9. Press the lock and unlock button on each key that was programmed. This will awaken each key and allow keyless entry functions to be established.
10. With a scan tool, clear any DTCs.
11. Verify each key is operating properly. Operate each of the keyless entry functions using the buttons on the key and then start the vehicle. When verifying operation, make sure that no other keys are near the vehicle.

Replacing Keys (Without SPS) - United States only

NOTE:

- **This procedure should be used without existing learned keys being present.**
- **A total of eight keys maybe be learned to a single vehicle.**
- **This procedure will only learn the vehicle key information. This procedure will not learn any immobilizer information between the body control**

module (BCM) and engine control module (ECM).

- **If the battery voltage is low, charge the battery before continuing with the procedure.**

1. With an unlearned master vehicle key, turn ON the ignition, with the engine OFF.
2. Observe the security indicator, after approximately 10 min the indicator will turn off.
3. Turn OFF the ignition and wait 5 s.
4. Repeat steps 1 - 3 two more times for a total of 3 cycles or 30 min.

NOTE: **The body control module learns the key transponder information upon the ignition transition from OFF to ON. You must turn the ignition OFF before attempting to start the vehicle.**

5. Start the vehicle. The vehicle has now learned the key transponder information.
6. Additional keys may be learned using the Adding Keys procedure.
7. Clear all DTCs.

Adding Keys (Without SPS) - North America, except Canada

- NOTE:**
- **To initiate, this procedure requires that 1 learned key be available.**
 - **A total of eight keys maybe be learned to a single vehicle.**
 - **This procedure adds keys only. The procedure does not erase previously learned keys.**
 - **The keys to be learned must duplicate the mechanical cut of the current key.**

1. With a previously learned key, turn the ignition ON.
2. Turn the ignition OFF and remove the key.
3. Within 10 seconds of turning OFF the ignition, insert the key to be learned and turn ON the ignition. The vehicle has now learned the new key and key.

Adding Keys (Without SPS) - Canada, Europe, South America, Asia and Middle East

- NOTE:**
- **To initiate, this procedure requires that 2 learned key be available.**
 - **A total of eight keys maybe be learned to a single vehicle.**
 - **This procedure adds keys only. The procedure does not erase previously learned keys.**
 - **The keys to be learned must duplicate the mechanical cut of the current key.**

1. With a previously learned key, turn the ignition ON.
2. Turn the ignition OFF and remove the key.

3. With a second previously learned key, turn the ignition ON.
4. Turn the ignition OFF and remove the key.
5. Within 10 seconds of turning OFF the ignition, insert the key to be learned and turn ON the ignition. The vehicle has now learned the new key and key.

Adding Keys (With SPS) - North America

NOTE:

- **This procedure may be used with or without existing learned keys being present.**
- **A total of eight keys maybe be learned to a single vehicle.**
- **This procedure will only learn the vehicle key information. This procedure will not learn any immobilizer information between the body control module (BCM) and engine control module (ECM).**
- **If the battery voltage is low, charge the battery before continuing with the procedure.**

1. Connect a scan tool to the vehicle and access SPS.
2. Ensure that all power consuming devices are turned OFF on the vehicle.
3. Select the SPS application and follow the on-screen instructions.
4. Select Reprogram ECU.
5. Select IMMO Immobilizer Learn - Setup.
6. Select the Program Transponder or Remote Key (Add) function.
7. Follow the on-screen instructions.
8. After programming all keys, "Programming Complete" is displayed.
9. Press the lock and unlock button on each key that was programmed. This will awaken each key and allow keyless entry functions to be established.
10. With a scan tool, clear any DTCs.
11. Verify each key is operating properly. Operate each of the keyless entry functions using the buttons on the key and then start the vehicle. When verifying operation, make sure that no other keys are near the vehicle.

DESCRIPTION AND OPERATION

IMMOBILIZER DESCRIPTION AND OPERATION

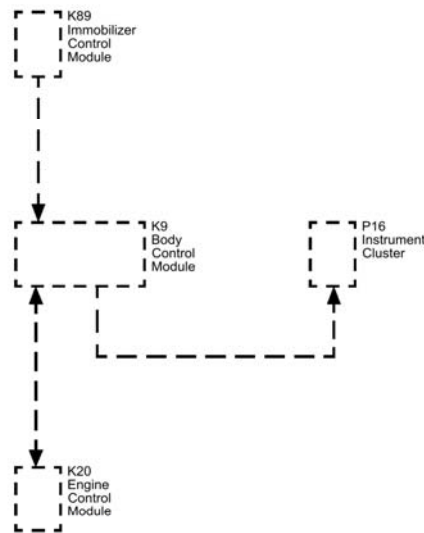


Fig. 3: Immobilizer Diagram Without BTM
 Courtesy of GENERAL MOTORS COMPANY

The immobilizer system functions are provided by the body control module (BCM) and the engine control module (ECM), as well as any control modules which store and report the environment identifier.

When an ignition key is inserted into the ignition lock cylinder and the ignition is switched ON, the transponder in the key is energized by the immobilizer coil surrounding the ignition lock cylinder. This immobilizer coil is part of the immobilizer control module. The transponder transmits a signal that contains its unique value, which is received by the BCM through the immobilizer coil. The BCM then compares this value to a value stored in memory. The BCM also monitors various control modules to determine if the stored environment identifiers match.

If both the environment identifier and the value received from the transponder match, the BCM will send the prerelease password via serial data to the ECM. If the encrypted code's unique value is incorrect or the environment identifier does not match, the BCM will send the start disable message to the ECM.

When the ECM receives the BCM prerelease password, the ECM will challenge the password. The ECM sends this challenge to the BCM via serial data. Both the ECM and BCM perform a calculation on this challenge. If the BCM calculated response to the challenge equals the calculation performed by the ECM, the ECM will allow vehicle starting.

The components of the theft system are as follows:

- BCM

- ECM
- Immobilizer control module
- Ignition key
- Security indicator
- Various control modules which store and report the environment identifier

Body Control Module (BCM)

The immobilizer system is an integral part of the BCM and is controlled internally within the BCM. The BCM can learn up to 8 keys (transponder values).

The BCM uses the following inputs:

- Environment identifier exchange with various modules
- Encrypted code from the vehicle key, received by the immobilizer control module

The BCM uses the following outputs:

- Prerelease password communication with ECM
- Challenge/response with ECM

When an ignition key is inserted into the ignition lock cylinder and the ignition is switched ON, the encrypted code in the key is energized by the immobilizer control module surrounding the ignition lock cylinder. The energized transponder transmits a signal that contains its unique value, which is received by the BCM. The BCM then compares this value to the learned key code stored in memory. The BCM then performs one of the following functions:

- If the encrypted code value matches the values stored in the BCM memory, the BCM will send the prerelease password to the ECM via serial data.
- If the encrypted code unique value does not match the value stored in the BCM, the BCM will send the start disable message to the ECM via serial data.
- If the BCM is unable to measure the ignition key encrypted code value, the BCM will not send any messages to the ECM.

Engine Control Module (ECM)

When the ECM receives the BCM prerelease password, the ECM will challenge the password. The ECM sends this challenge to the BCM via the serial data circuit. Both the ECM and BCM perform a calculation on this challenge. If the calculated response from the BCM equals the calculation performed by the ECM, the ECM will allow vehicle starting.

The ECM will disable vehicle starting if any of the following immobilization conditions occur:

- The prerelease password is invalid.
- The start disable password is sent by the BCM.

- No passwords are received. There is no communication with the BCM.
- The BCM calculated response to the challenge does not equal the calculation performed by the ECM.

Immobilizer Control Module

The immobilizer control module contains an immobilizer coil which surrounds the ignition cylinder. The coil passively powers the transponder located in the ignition key when the key is in the ignition. When powered, the key transmits its unique value to the immobilizer control module, which is then relayed to the BCM via a discrete serial data circuit. The immobilizer control module also receives B+ and ground from the BCM.

The immobilizer control module is used to:

1. Learn keys
2. To start the vehicle

Ignition Key

Each ignition key contains a transponder with a unique encrypted value. The transponder's encrypted value is fixed and unable to be changed. The immobilizer system uses the ignition key transponder value to determine if a valid ignition key is being used to start the vehicle.

Environment Identifier

Various modules throughout the vehicle learn a specific environment identifier during the module programming process. The environment identifier is learned by each individual module and matches the environment identifier stored in the BCM. Prior to starting after a battery disconnect, each of the modules which store a environment identifier will compare their identifier to that of the identifier stored in the BCM. If all the identifiers match, the engine starting process will continue. If the environment identifiers do not match, engine starting will be disabled.

Security Indicator

The BCM will command the instrument cluster to illuminate the security indicator when the ignition is in the ON position to indicate a fault has occurred within the immobilizer system and when the engine starting is disabled.

REMOTE VEHICLE SPEED LIMITING DESCRIPTION AND OPERATION

Certain vehicles equipped with OnStar® now have an additional feature that allows for remote limiting of the vehicle's speed. This OnStar® feature is called Stolen Vehicle Slow-Down and is now part of the OnStar® Stolen Vehicle Assistance service. This feature, when used in conjunction with local law enforcement and strict guidelines at the OnStar® Call Center, will slow the vehicle by interacting with the engine control system.

When the engine control system receives a valid request from the OnStar® telematics communications interface module, it will enter into a reduced engine power/vehicle speed limiting mode, which will decelerate the vehicle. Once the request is active the engine control module begins reducing engine torque to match requested vehicle speed and a REDUCED ENGINE POWER indication is displayed. No DTCs will be set during this

process.

ACCESSORIES & EQUIPMENT

Displays and Gauges - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Instrument Cluster Nut	10 N.m	89 lb in

AMBIENT AIR TEMPERATURE SENSOR RESISTANCE

Ambient Air Temperature Sensor Resistance

Temperature		Ambient Air Temp Sensor	Ambient Air Temp Sensor (Min)	Ambient Air Temp Sensor (Max)
°C	°F	(kohms)	(kohms)	(kohms)
-40	-40	333.6	313.75	353.38
-30	-22	176.08	167.22	184.94
-20	-4	96.81	92.82	100.8
-10	14	55.25	53.38	57.13
0	32	32.64	31.74	33.54
10	50	19.9	19.6	20.2
20	68	12.49	12.35	12.64
30	86	8.06	7.96	10.1
40	104	5.32	5.25	8.15
50	122	3.6	3.54	5.4
60	140	2.49	2.44	2.54

SCHEMATIC WIRING DIAGRAMS

INSTRUMENT CLUSTER WIRING SCHEMATICS

Power, Ground, Serial Data and Gauges Wiring Schematics

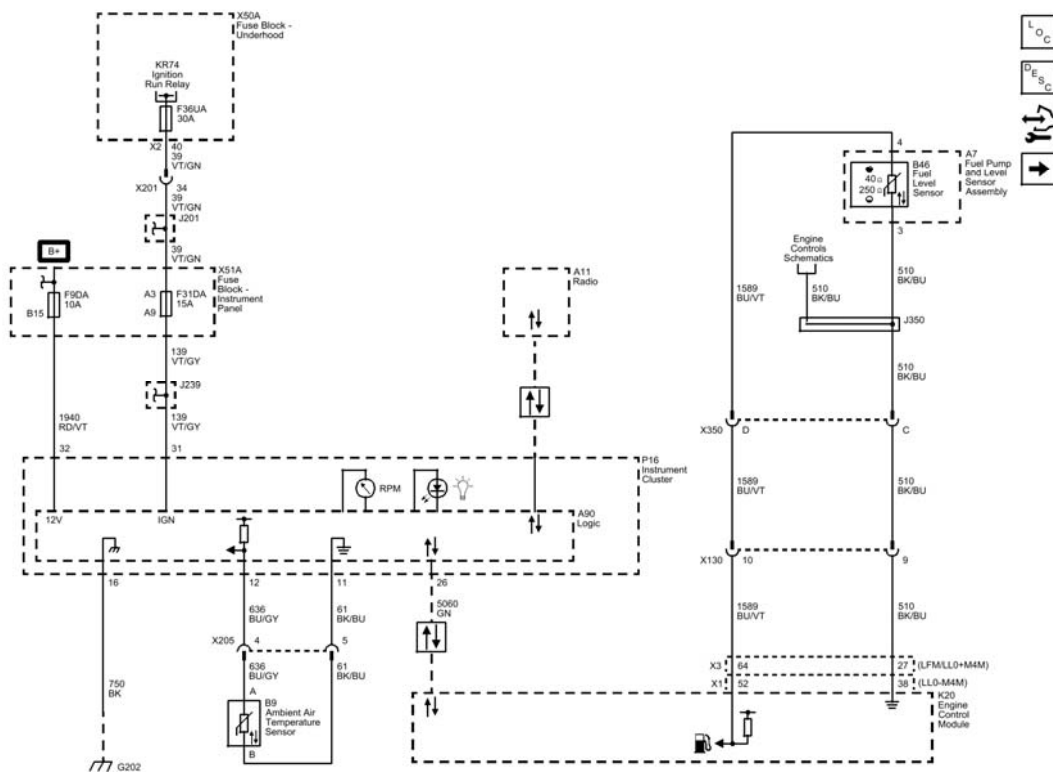


Fig. 1: Power, Ground, Serial Data and Gauges Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

Indicators Wiring Schematics

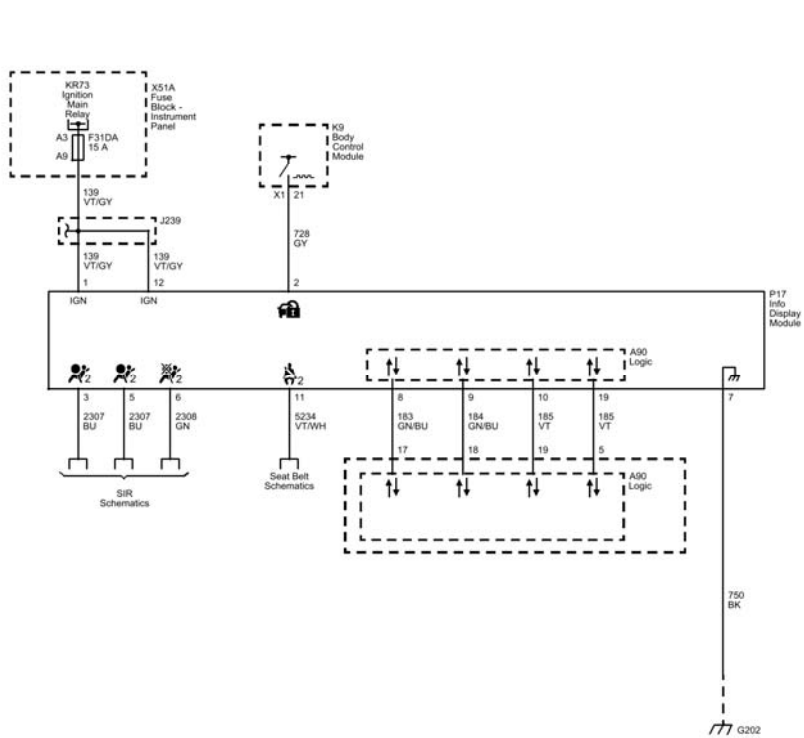


Fig. 3: Driver Information Center Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

AUDIBLE WARNINGS WIRING SCHEMATICS

Audible Warnings Wiring Schematics

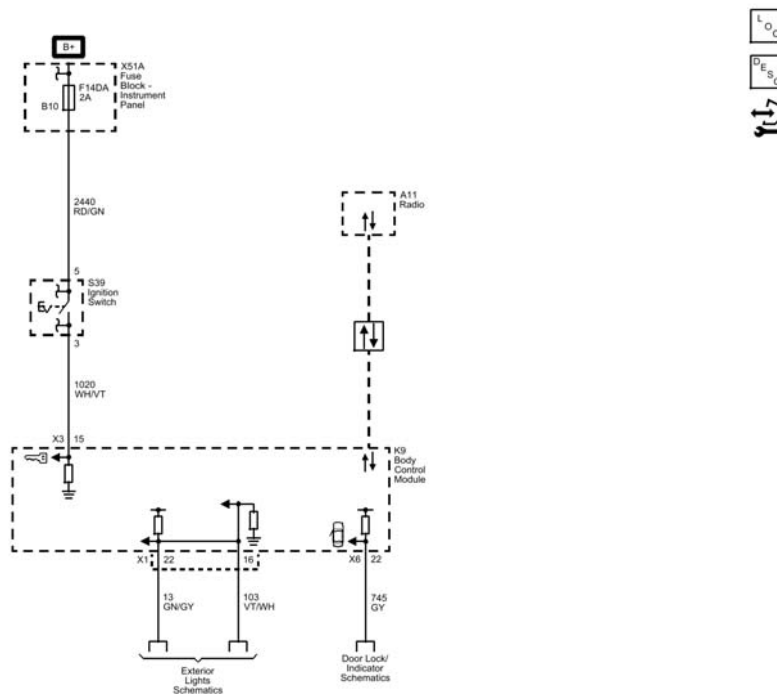


Fig. 4: Audible Warnings Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC B0158</u>	DTC B0158: Outside Air Temperature Display Malfunction
<u>DTC B0550</u>	DTC B0550 32 Odometer Circuit General Memory Malfunction
<u>DTC B1370</u>	DTC B1370 01 Control Module Ignition On and Start Circuit Short to Battery DTC B1370 06 Control Module Ignition On and Start Circuit Open
<u>DTC P0461-P0464</u>	DTC P0461-P0464: Fuel Gauge Malfunction
<u>DTC P0520</u>	DTC P0520 Engine Oil Pressure Switch Circuit Malfunction
<u>DTC P0521</u>	DTC P0521 Engine Oil Pressure Sensor Performance Malfunction

DTC B0158: OUTSIDE AIR TEMPERATURE DISPLAY MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0158 02

Ambient Air Temperature Sensor Circuit Short to Ground

DTC B0158 05

Ambient Air Temperature Sensor Circuit High Voltage/Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ambient Air Temperature Sensor Signal	B0158 02	B0158 05	B0158 05	-
Low Reference	-	B0158 05	-	-

Circuit/System Description

The instrument cluster monitors the ambient air temperature sensor with a low reference circuit and 5 V signal circuit. The instrument cluster monitors the voltage drop across the sensor, which is proportional to temperature. When the ambient air temperatures are cold, the resistance of the sensor is high and the voltage signals are high. When the ambient air temperatures are hot, the resistance of the sensors is low and the voltage signals are low. The instrument cluster converts the voltage value to a temperature value of Celsius or Fahrenheit that will be displayed by the driver information center.

Conditions for Running the DTC

The system voltage is between 9-16 V

Conditions for Setting the DTC

B0158 02

The instrument cluster detects the sensor signal circuit is more than 88°C (190°F).

B0158 05

The instrument cluster detects the sensor signal circuit is less than -40°C (-40°F).

Action Taken When the DTC Sets

The instrument cluster uses a default air temperature value for further calculations. The driver information center displays ---°C (---°F).

Conditions for Clearing the DTC

The DTC will become history if the instrument cluster no longer detects a malfunction.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- **Instrument Cluster Description and Operation**
- **Driver Information Center (DIC) Description and Operation**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Ambient Air Temperature parameter between -40°C (-40°F) to +88°C (+190°F) and changes with air temperature changes.
 - **If parameter is not between -40°C (-40°F) to +88°C (+190°F) or changes with air temperature changes**

Refer to Circuit/System Testing.

- **If parameter is between -40°C (-40°F) to +88°C (+190°F) and changes with air temperature changes**

3. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B9 Ambient Air Temperature Sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 1 V between the low reference circuit terminal B and ground.

- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

3. Test for less than 10 ohms between the low reference circuit terminal B and ground.

- **If 10 ohms or greater**

1. Ignition OFF, disconnect the harness connector at the P16 Instrument Cluster.
2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the P16 Instrument Cluster.

- **If less than 10 ohms**

4. Ignition ON.

5. Verify the scan tool Ambient Air Temperature parameter is greater than 98%.

- **If 98% or less**

1. Ignition OFF, disconnect the harness connector at the P16 Instrument Cluster.
2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the P16 Instrument Cluster.

- **If greater than 98%**

6. Install a 3 A fused jumper wire between the signal circuit terminal A and the low reference circuit terminal B.

7. Verify the scan tool Ambient Air Temperature parameter is less than 8%.

- **If 8% or greater**

1. Ignition OFF, disconnect the harness connector at the P16 Instrument Cluster, ignition ON.
2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V

3. Ignition OFF

4. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, replace the P16 Instrument Cluster.
 - **If less than 8%**
8. Test or replace the B9 Ambient Air Temperature Sensor.

Component Testing

Static Test

1. Test the B9 Ambient Air Temperature Sensor by varying the sensor temperature while monitoring the sensor resistance.
2. Compare the readings with the **Ambient Air Temperature Sensor Resistance**
 - **If not within the specified range**

Replace the B9 Ambient Air Temperature Sensor.

- **If within specified range**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Control Module References** for instrument cluster replacement, programming and setup.

DTC B0550: ODOMETER CIRCUIT GENERAL MEMORY

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B0550 32

Odometer Circuit General Memory Malfunction

Circuit/System Description

The Instrument Cluster is equipped with odometers that indicate the distance traveled by the vehicle. One type of odometer is the season odometer where the traveled distance can not be reset by the driver. This information is also stored in the Body Control Module (BCM). In addition to storing the season odometer value for the vehicle, the Instrument Cluster and the BCM store the VIN. Software checks are performed to ensure these modules and their stored season odometer information, can not be moved or transferred between different vehicles.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

The BCM has detected an internal memory malfunction.

Action Taken When the DTC Sets

DTC B0550 32 is stored in the BCM memory.

Conditions for Clearing the DTC

The BCM no longer detects a malfunction.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Driver Information Center (DIC) Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC B0550 32 is not set.
 - **If DTC B0550 32 is set**

1. Program the K9 Body Control Module.
2. Verify the DTC does not set.
 - If the DTC sets, replace the K9 Body Control Module.
 - If the DTC does not set
3. All OK.
 - **If DTC B0550 32 is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for BCM replacement, programming and setup

DTC B1370: CONTROL MODULE IGNITION ON AND START CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B1370 01

Control Module Ignition On and Start Circuit Short to Battery

DTC B1370 06

Control Module Ignition On and Start Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Instrument Cluster Ignition (Instrument Panel terminal 31)	B1370 06	B1370 06	B1370 01	-
Ignition Run/Crank Relay Ignition (Relay terminal 85)	B1370 06	B1370 06	-	-
Ignition Run/Crank Relay Ground (Relay terminal 86)	-	B1370 06	-	-
Ignition Run/Crank Relay B+ (Relay terminal 30)	-	B1370 06	-	-

Circuit/System Description

The vehicle power mode master is the body control module (BCM). The Ignition Switch is a low current switch with multiple discrete circuits to the BCM.

The power mode master will activate relays and other direct outputs of the power mode master as needed according to the calculated power mode. Some relays controlled by the BCM are switched ignition voltage outputs that are pass through circuits within the BCM directly from the Ignition Switch. If these circuits short to ground, the B+ circuit fuse to the Ignition Switch will open.

Conditions for Running the DTC

B1370 01

Ignition switch is in the Accessory position.

B1370 06

Ignition switch is in the Accessory, Run or Crank positions.

Conditions for Setting the DTC

B1370 01

Ignition circuit is shorted to voltage.

B1370 06

- Ignition circuit is open.
- Ignition or run/crank relay circuit is shorted to ground.
- B+ circuit of the ignition run/crank relay is open or shorted to ground.
- Ignition run/crank relay control circuit open, including relay coil and ground.

Action Taken When the DTC Sets

The Instrument Cluster still functions except check engine light is always off.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 50 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

- **Instrument Cluster Schematics**

- **Power Distribution Schematics**
- **Power Moding Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- **Instrument Cluster Description and Operation**
- **Power Mode Description and Operation**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that DTC B144B is not set.
 - **If DTC B144B is set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If DTC B144B is not set**
2. Refer to Circuit/System Testing.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the KR74 Ignition Run Relay. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 86 and ground.
 - **If 10 ohms or greater**
 1. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Verify a test lamp illuminates between the B+ circuit terminal 30 and ground.

- **If the test lamp does not illuminate and the circuit fuse is OK**
- 1. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is OK and there is voltage at the fuse.
- **If the test lamp does not illuminate and the circuit fuse is open**
- 1. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
- 2. Test for infinite resistance between the control circuit terminal 87 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the KR74 Ignition Run Relay.
- **If the test lamp illuminates**
- 4. Ignition ON.
- 5. Verify that a test lamp illuminates between the ignition circuit terminal 85 and ground.
 - **If the test lamp does not illuminate**
 - 1. Ignition OFF.
 - 2. Test the for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If the test lamp illuminates**
- 6. Ignition OFF, connect the KR74 Ignition Run Relay, disconnect the harness connector at the P16 Instrument Cluster.
- 7. Verify that a test lamp does not illuminate between the ignition circuit terminal 31 and ground.
 - **If the test lamp illuminates**
 - 1. Disconnect the KR74 Ignition Run Relay
 - 2. Test for less than 1 V between the ignition circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the KR74 Ignition Run Relay.
 - **If the test lamp does not illuminate**
- 8. Ignition ON.
- 9. Verify that a test lamp illuminates between the ignition terminal 31 and ground.
 - **If the test lamp does not illuminate and the Ignition fuse is good**
 - 1. Ignition OFF, disconnect the KR74 Ignition Run Relay.
 - 2. Test for less than 2 ohms in the ignition circuit end to end
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the KR74 Ignition Run Relay.
 - **If the test lamp does not illuminate and the Ignition fuse is open**
 - 1. Ignition OFF, disconnect the KR74 Ignition Run Relay.

2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the P16 Instrument Cluster.
 - **If the test lamp illuminates**

10. Replace the P16 Instrument Cluster.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Relay Replacement (Within an Electrical Center)** , **Relay Replacement (Attached to Wire Harness)**
- **Control Module References** for Body Control Module or Instrument Cluster replacement, programming and setup

DTC P0461-P0464: FUEL GAUGE MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0461

Fuel Level Sensor Performance

DTC P0462

Fuel Level Sensor Circuit Low Voltage

DTC P0463

Fuel Level Sensor Circuit High Voltage

DTC P0464

Fuel Level Sensor Circuit Intermittent

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Fuel Level Sensor 1 Signal	P0462	P0463	P0463	P0461

Low Reference	-	1	P0463, P0464	P0461
1. Fuel Gauge Malfunction				

Circuit/System Description

The fuel level sensor changes resistance based on fuel level. The engine control module (ECM) monitors the signal circuit of the fuel level sensor in order to determine the fuel level. When the fuel tank is full, the resistances of the fuel level sensor is low and the ECM senses a low signal voltage on the signal circuit of the fuel level sensor. When the fuel tank is empty, the resistance of the fuel level sensor is high and the ECM senses a high signal voltage. The ECM uses the signal circuit of the fuel level sensor in order to calculate the percentage of remaining fuel in the tank. The ECM sends the fuel level percentage via serial data to the body control module (BCM). The BCM then sends the fuel level percentage via serial data to the instrument cluster in order to control the fuel gauge.

Conditions for Running the DTC

- The engine is running
- The system voltage is between 11-16 V

Conditions for Setting the DTC

P0461 00

The ECM detects a change in fuel level of less than a specified amount (typically 3-10 L or 0.8-2.6 gal) over a specified driving distance (typically 240-320 km or 150-200 miles).

P0462

- The signal voltage is less than 0.25 V.
- The above conditions must be met for 5 seconds.

P0463

- The signal voltage is greater than 4.7 V.
- The above conditions must be met for 5 seconds.

P0464

- The fuel level change is greater than 10%.
- The above conditions must be met for 30 seconds.
- DTC P0464 runs and fails 2 out of 3 test cycles.

Action Taken When the DTC Sets

- P0461, P0462, P0463 and P0464 are Type B DTCs
- The fuel gauge defaults to empty

- The low fuel indicator illuminates

Conditions for Clearing the DTC

- P0461, P0462, P0463 and P0464 are Type B DTCs
- The DTC becomes history when the conditions for setting the DTC are no longer present.
- The history DTC clears after 40 malfunction-free warm-up cycles.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Fuel Remaining in Tank parameter is between 5-95% and varies with fuel level.
 - **If not between 5-95% or does not vary with fuel level**

Refer to Circuit/System Testing.

- **If between 5-95% and varies with fuel level**
- 3. Verify that all fuel level gauge segments illuminate when performing the scan tool Driver Information Center Segments control function.

- **If any fuel level gauge segments do not illuminate**

Replace the P16 Instrument Cluster.

- **If all fuel level gauge segments illuminate**
- 4. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the A7 Fuel Pump and Level Sensor Assembly. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the low reference circuit terminal 3 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If less than 10 ohms**
3. Ignition ON.
4. Test for less than 1 V between the low reference circuit and ground.
 - **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**
5. Verify the scan tool Remaining Fuel In Tank parameter is greater than 95%.
 - **If 95% or less**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If greater than 95%**
 6. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
 7. Test for infinite resistance between the signal circuit terminal 4 and ground.
 - **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

8. Ignition OFF

9. Test for less than 2 ohms in the signal circuit end to end.

- **If 2 ohms or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 ohms**

10. Test or replace the B46 Fuel Level Sensor.

Component Testing

1. Ignition OFF, remove the A7 Fuel Pump and Level Sensor Assembly.

2. Sweep the Fuel Level Sensor through its full range of motion while measuring resistance between the signal terminal 4 and the low reference terminal 3.

3. Test for a minimum resistance value of 37-43 ohms and a maximum value of 245-255 ohms without any spikes or dropouts.

- **If minimum resistance is not 37-43 ohms, maximum resistance is not 245-255 ohms or if there are any spikes or dropouts**

Replace the B46 Fuel Level Sensor.

- **If minimum resistance is 37-43 ohms, maximum resistance is 245-255 ohms and if there are no spikes or dropouts**

4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Control Module References** for the Engine Control Module replacement, programming and setup

DTC P0520: ENGINE OIL PRESSURE SWITCH

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0520

Engine Oil Pressure Switch Circuit Malfunction

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	1	P0520	1	-
1. Engine Oil Pressure Indicator Malfunction				

Typical Scan Tool Data

ECM - Engine Oil Pressure Switch

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine Running Parameter Normal Range: OK			
Signal	Low	OK	OK

Circuit/System Description

The Engine Oil Pressure Switch is a normally closed switch that opens with the proper oil pressure. With the ignition switch turned ON and the engine not running, the Engine Control Module (ECM) should detect a low signal voltage input. With the engine running, the Engine Oil Pressure Switch opens and the ECM should detect a high signal voltage input. When the oil pressure is low, the ECM sends a message via serial data to the Body Control Module (BCM). The BCM then sends a message via serial data to the Instrument Cluster requesting the engine oil pressure indicator turned ON.

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

- The ECM detects that the engine oil pressure switch signal circuit is pulled low.
- The above condition is present for greater than 10 seconds.

Action Taken When the DTC Sets

The Instrument Cluster illuminates the service vehicle soon indicator and the oil pressure low indicator.

Conditions for Clearing the DTC

The DTC becomes history when the conditions for setting the DTC are no longer present.

Diagnostic Aids

Low engine oil pressure will also cause this DTC to set. If low engine oil pressure is suspected, refer to **Oil Pressure Diagnosis and Testing** .

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- **Instrument Cluster Description and Operation**
- **Indicator/Warning Message Description and Operation**
- **Driver Information Center (DIC) Description and Operation**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Engine Oil Pressure parameter is Low.

- **If not Low**

Refer to Circuit/System Testing.

- **If Low**

3. Engine running.
4. Verify the scan tool Engine Oil Pressure parameter is OK.

- **If not OK**

Refer to Circuit/System Testing.

- **If OK**

5. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the B37 Engine Oil Pressure Switch, ignition ON.
2. Verify the scan tool Engine Oil Pressure Switch parameter is OK.
 - **If not OK**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If OK**
3. Install a 3 A fused jumper wire between the signal circuit terminal 1 and ground.
4. Verify the scan tool Engine Oil Pressure Switch parameter is Low.
 - **If not Low**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If Low**
5. Test or replace the B37 Engine Oil Pressure Switch.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Engine Oil Pressure Indicator Switch Replacement**
- **Control Module References** for ECM replacement, programming and setup

DTC P0521: ENGINE OIL PRESSURE SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0521

Engine Oil Pressure Sensor Performance Malfunction

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	1	P0521	1	P0521
1. Engine Oil Pressure Indicator Malfunction				

Typical Scan Tool Data

ECM - Engine Oil Pressure Switch

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine Running Parameter Normal Range: OK			
Signal	Low	OK	OK

Circuit/System Description

The engine oil pressure switch is a normally closed switch that opens with the proper oil pressure. With the ignition switch turned ON and the engine not running, the Engine Control Module (ECM) should detect a low signal voltage input. With the engine running, the Engine Oil Pressure Switch opens and the ECM should detect a high signal voltage input. When the oil pressure is low, the ECM sends a message via serial data to the body control module (BCM). The BCM then sends a message via serial data to the Instrument Cluster requesting the engine oil pressure indicator turned ON.

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

- The ECM detects that the engine oil pressure switch signal circuit is pulled low.
- The engine oil pressure is outside of a calculated working range determined by engine speed and temperature.
- The above condition is present for greater than 10 seconds.

Action Taken When the DTC Sets

The Instrument Cluster illuminates the service vehicle soon indicator and the oil pressure low indicator.

Conditions for Clearing the DTC

The DTC becomes history when the conditions for setting the DTC are no longer present.

Diagnostic Aids

DTC P0521 can set if engine oil pressure is outside the calculated engine oil pressure model stored in the engine control module. This can be an indication of mechanical engine issues causing lower than expected engine oil pressure.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- **Instrument Cluster Description and Operation**
- **Indicator/Warning Message Description and Operation**
- **Driver Information Center (DIC) Description and Operation**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Engine Oil Pressure parameter is Low.
 - **If not Low**

Refer to Circuit/System Testing.

- **If Low**

3. Engine running.
4. Verify the scan tool Engine Oil Pressure parameter is OK.
 - **If not OK**

Refer to Circuit/System Testing.

- **If OK**
5. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the B37 Engine Oil Pressure Switch, ignition ON.
2. Verify the scan tool Engine Oil Pressure Switch parameter is OK.
 - **If not OK**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If OK**
3. Install a 3 A fused jumper wire between the signal circuit terminal 1 and ground.
4. Verify the scan tool Engine Oil Pressure Switch parameter is Low.
 - **If not Low**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If Low**
5. Test or replace the B37 Engine Oil Pressure Switch.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Engine Oil Pressure Indicator Switch Replacement**
- **Control Module References** for ECM replacement, programming and setup

SYMPTOMS - DISPLAYS AND GAUGES

NOTE: The following steps must be completed before using the symptom diagnostic tables.

1. Before using the symptom diagnostic tables, perform the **Diagnostic System Check - Vehicle**
2. Review the system operation in order to understand the system functions. Refer to the following description and operations:
 - **Instrument Cluster Description and Operation**
 - **Indicator/Warning Message Description and Operation**
 - **Driver Information Center (DIC) Description and Operation**
 - **Audible Warnings Description and Operation**

Visual/Physical Inspection

- Inspect for aftermarket devices which can affect the operation of the instrument panel cluster or the audible warning systems. Refer to **Checking Aftermarket Accessories**
- Inspect the accessible system components or the visible system components for obvious damage or for obvious conditions which can cause the symptom.
- Inspect for the proper fluid levels.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections**

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

Gauges and Odometer

- **Fuel Gauge Malfunction - DTC P0461-P0464**
- **Odometer Trip/Reset Switch Malfunction**
- **Speedometer and/or Odometer Malfunction**
- **Tachometer Inaccurate or Inoperative**

Indicators

- **ABS Indicator Malfunction**
- **Airbag Indicator Malfunction (Driver) , Airbag Indicator Malfunction (Passenger)**
- **Brake Warning Indicator Malfunction**
- **Charge Indicator Malfunction**
- **Door Ajar Indicator Malfunction**
- **Engine Oil Pressure Indicator Malfunction**

- **Headlamps Malfunction**
- **Interior Backlighting Malfunction**
- **Malfunction Indicator Lamp (MIL) Diagnosis (LFM, LL0 with 3 Face Mounted ECM Connectors) , Malfunction Indicator Lamp (MIL) Diagnosis (LL0 with 2 Face Mounted ECM Connectors)**
- **Seat Belt Indicator Malfunction - Driver**
- **Turn Signal Lamps and/or Indicators Malfunction**
- **Washer Malfunction**

Driver Information Center

- **Driver Information Center Display Malfunction**
- **Outside Air Temperature Display Malfunction - DTC B0158**

Audible Warnings

Chime Malfunction

CHARGE INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The engine Control Module (ECM) uses the generator turn ON signal circuit to control the load of the generator on the engine. A high side driver in the ECM applies voltage to the voltage regulator. This signals the voltage regulator to turn the field circuit ON and OFF. The ECM monitors the state of the generator turn ON signal circuit. The ECM should detect low voltage on the generator turn on signal circuit when the ignition is ON and the engine is OFF or when the charging system malfunctions. With the engine running, the ECM should detect high voltage on the generator turn on signal circuit. The ECM performs key ON and RUN tests to determine the status of the generator turn on signal circuit. If a malfunction is detected the ECM will illuminate the charge indicator in the instrument cluster.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Indicator/Warning Message Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON, engine running.
2. Verify the scan tool Battery Voltage parameter is between 12.5-15.5 V.
 - **If not 12.5-15.5 V**

Refer to **Charging System Test** .

- **If 12.5-15.5 V**
3. Verify the charge indicator turns on and off when commanding the All Indicators test ON and OFF with the scan tool.
 - **If the charge indicator always stays on or always stays off**

Replace the P16 Instrument Cluster.

- **If the charge indicator turns on and off as commanded**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Instrument Cluster replacement, programming and setup

CHIME MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The radio generates the audible warnings. The instrument cluster, the body control module (BCM), the inflatable restraint sensing and diagnostic module (SDM) or the object alarm module request audible warnings via serial data.

Reference Information

Schematic Reference

Audible Warnings Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Audible Warnings Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: Before performing this diagnostics, make sure no indicators are illuminated after the instrument cluster performs a lamp test. If any indicators are illuminated after the bulb test, perform the indicator diagnostics before this diagnostics.

1. Ignition ON.
2. Verify all the radio speakers operate by adjust the radio balance and fade to each speaker.
 - If any speaker does not operate properly

Refer to **Speaker Malfunction** .

- **If the speakers operate properly**

3. Verify the scan tool Driver Seat Belt Status and Passenger Seat Belt Status parameters are Buckled when both front seat belts are buckled.

- **If not Buckled**

Refer to **Seat Belt Indicator Malfunction - Driver** .

- **If buckled**

4. Verify the scan tool Headlamp On Switch parameter is Inactive when the headlamps are OFF.

- **If not Inactive**

Refer to **Headlamps Malfunction** .

- **If Inactive**

5. Verify the scan tool Park Lamps Switch parameter is Inactive when the park lamp switch is OFF.

- **If not Inactive**

Refer to **Park, License, and/or Tail Lamps Malfunction** .

- **If Inactive**

6. Verify the scan tool Left Turn Signal Switch and Right Turn Signal Switch parameters are Inactive while the turn signal switch is OFF.

- **If not Inactive**

Refer to **Turn Signal Lamps and/or Indicators Malfunction** .

- **If Inactive**

7. Verify the scan tool Park Brake Switch parameter is Inactive when the park brake is OFF.

- **If not Inactive**

Refer to **Park Brake System Diagnosis** .

- **If Inactive**

8. Verify that all scan tool parameters listed below are Inactive when all the doors are closed.

- Driver Door Ajar Switch
- Passenger Door Ajar Switch
- Left Rear Door Ajar Switch
- Right Rear Door Ajar Switch

- **If not Inactive**

Refer to **Door Ajar Indicator Malfunction** .

- **If Inactive**

9. Verify the scan tool Key in Ignition Status parameter is Inactive when the key is out of the ignition.

- **If not Inactive**

Refer to Circuit/System Testing.

- **If Active**

10. All OK

Circuit/System Testing

1. Ignition ON, disconnect the harness connector at the S39 Ignition Switch while the ignition is ON.

2. Verify a test lamp illuminates between the B+ circuit terminal 5 and ground.

- **If the test lamp does not illuminate and the circuit fuse is OK**

1. Ignition OFF.

2. Test for less than 2 ohms in the B+ circuit end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance

2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance, replace the K9 Body Control Module.

- **If the test lamp illuminates**

3. Verify the scan tool Key in Ignition Status parameter is Inactive.

- **If not Inactive**

1. Disconnect the X3 harness connector at the K9 Body Control Module.

2. Test for less than 1 V between the signal circuit terminal 3 and ground.

- If 1 V or greater, repair the short to voltage on the circuit.

- If less than 1 V, replace the K9 Body Control Module.

- **If Inactive**

4. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the B+ circuit terminal 5.

5. Verify the scan tool Key in Ignition Status parameter is Active.

- **If not Active**

1. Connect harness connector at Ignition Switch, Ignition OFF, disconnect harness connector at Ignition Switch.

2. Disconnect the X3 harness connector at the K9 Body Control Module.

3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.

- **If Active**

6. Test or replace the S39 Ignition Switch.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for BCM or Radio replacement, programming and setup

DRIVER INFORMATION CENTER DISPLAY MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The Instrument Cluster contains a Driver Information Center which displays vehicle information such as the engine coolant temperature, fuel level, vehicle speed and other information based on the information received from various modules on the vehicle's serial data bus. The Driver Information Center illuminates a combination of indicators and messages to display the status of various vehicle systems.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify no DTC is set.
 - **If any DTC is set,**

Diagnose any DTCs first. Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
 - **If no DTCs are set**
3. Verify all indicators except the engine malfunction indicator illuminate and turn off as commanded when performing the All Indicators test with the scan tool.
 - **If any indicators do not illuminate and turn off as commanded**

Replace the P16 Instrument Cluster.
 - **If all indicators respond properly**
4. Verify all segments illuminate when performing the Driver Information Center Segments test with the scan tool.
 - **If any segments do not illuminate**

Replace the P16 Instrument Cluster.
 - **If all segments illuminate properly**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for instrument cluster or ECM replacement, programming and setup.

ENGINE OIL PRESSURE INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	1	P0520, P0521	1	P0521
1. Engine Oil Pressure Indicator Malfunction				

Circuit/System Description

The engine oil pressure switch is a normally closed switch that opens with the proper oil pressure. With the ignition switch turned ON and the engine not running, the engine control module (ECM) should detect a low signal voltage input. With the engine running, the engine oil pressure switch opens and the ECM should detect a high signal voltage input. When the oil pressure is low, the ECM sends a message via serial data to the body control module (BCM). The BCM then sends a message via serial data to the instrument cluster requesting the engine oil pressure indicator turned ON.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Indicator/Warning Message Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the engine oil pressure indicator turns on & off when commanding the All Indicators ON and OFF with a scan tool.

- **If the engine oil pressure Indicator does not turn on and off.**

Replace the P16 instrument cluster.

- **If the engine oil pressure Indicator turns on and off**

3. Verify the scan tool Engine Oil Pressure Switch parameter is Low.

- **If not Low**

Refer to Circuit/System Testing.

- **If Low**

4. Engine running.

5. Verify the scan tool Engine Oil Pressure Switch parameter is OK.

- **If not OK**

Refer to Circuit/System Testing.

- **If OK**

6. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the B37 Engine Oil Pressure Switch, ignition ON.

2. Verify the scan tool Engine Oil Pressure Switch parameter is OK.

- **If not OK**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the signal circuit terminal 1 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance, replace the K20 Engine Control Module.

- **If OK**

3. Install a 3 A fused jumper wire between the signal circuit terminal 1 and ground.

4. Verify the scan tool Engine Oil Pressure Switch parameter is Low.

- **If not Low**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.

- If less than 1 V

3. Test for less than 2 ohms in the signal circuit end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, replace the K20 Engine Control Module.

- **If Low**

5. Test or replace the B37 Engine Oil Pressure Switch.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Engine Oil Pressure Indicator Switch Replacement**
- **Control Module References** for Instrument Cluster or ECM replacement, programming and setup

ODOMETER TRIP/RESET SWITCH MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The instrument cluster displays the travelled distance based on the information from the engine control module (ECM). The ECM converts the data from the vehicle speed sensor to a distance signal. The ECM sends the distance information via serial data to the body control module (BCM). The BCM then sends the information via serial data to the instrument cluster to display the vehicle odometer and trip odometer. The instrument cluster detects the activation of the trip reset switch and a press and hold of the trip reset switch resets the trip odometer information to zero.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the odometer trip reset switch resets the trip odometer display when the switch is pressed.
 - **If the odometer trip reset switch does not reset the trip odometer**

Replace the P16 Instrument Cluster.

- **If the odometer trip reset switch resets the trip odometer**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for instrument cluster replacement, programming and setup.

SPEEDOMETER AND/OR ODOMETER MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The instrument cluster displays the engine coolant temperature, fuel level, vehicle speed and the engine speed based on the information from the engine control module (ECM). The ECM sends information via serial data to the body control module (BCM). The BCM then sends the information via serial data to the instrument cluster to display the engine coolant temperature, fuel level, the engine speed, the vehicle speed and the distance travelled, either in kilometers or miles, based on the vehicle requirements. The instrument cluster will display dashes when its VIN does not match the VIN received from the BCM.

Diagnostic Aids

If the VIN mismatch is corrected the odometer will once again be displayed in the instrument cluster. If the vehicle is driven for a calibrated distance with a VIN mismatch, it will cause the instrument cluster odometer to enter into an error mode and lock itself. When this occurs the dashes will remain on the display even after correcting the VIN mismatch. The vehicle odometer status data display on the scan tool can be used to identify a locked odometer. The only way to unlock the instrument cluster (clear the dashes from the display) is to perform an SPS programming event. Failure to follow the diagnostic and programming procedures may result in either an improper odometer value or a module replacement.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify no DTC is set.
 - **If any DTC is set**

Diagnose DTCs first. Refer to Diagnostic Trouble Code (DTC) List - Vehicle .
 - **If no DTCs are set**
2. Ignition ON.
3. Verify the speedometer sweeps from low to high position when performing the Speedometer Sweep Test with the scan tool.
 - **If speedometer does not sweep**

Replace the P16 Instrument Cluster.
 - **If speedometer sweeps properly**
4. Verify the speedometer gauge value matches the scan tool Vehicle Speed parameter while driving the vehicle.
 - **If the values do not match**

Replace the P16 Instrument Cluster.

- **If the speedometer value matches the scan tool parameter**

5. Verify the odometer display and the displayed distance counts up while driving the vehicle.

- **If the odometer displays only "----" (dashes)**

Refer to Circuit/System Testing.

- **If the odometer display does not count up**

Replace the P16 Instrument Cluster.

- **If speedometer sweeps and displays the correct value and the odometer display counts up**

6. All OK.

Circuit/System Testing

NOTE: If there are multiple modules not original to the vehicle and they are used or incorrectly configured service parts, SPS may not be able to properly read or recover the vehicle odometer value. Follow government rules and documentation (including vehicle identification) regarding inaccurate/unknown odometer values.

Perform circuit/system verification first.

Correcting VIN mismatch: Instrument Cluster is Showing "----" (Dashes), odometer is still unlocked

1. Verify the scan tool Odometer Status parameter is Unlocked.

- **If the reading is Locked**

Refer to correcting VIN mismatch - odometer locked.

- **If the reading is Unlocked**

2. Verify the scan tool BCM VIN parameter matches the vehicle's VIN placard.

- **If the VIN does not match**

Reprogram the BCM, then proceed to Step 3.

- **If the VIN matches**

3. Verify the scan tool Instrument Cluster VIN parameter matches the vehicle's VIN placard.

- **If the VIN does not match**

Reprogram the instrument cluster. Then proceed with step 4.

- **If the VIN matches**

4. Ignition ON.
5. Verify the instrument cluster is displaying the correct value.
 - **If the instrument cluster is still displaying "----" (dashes)**

Replace the P16 Instrument Cluster.

6. All OK.

Correcting VIN mismatch: Instrument Cluster is Showing "----" (Dashes), odometer is locked

1. Verify the scan tool Odometer Status parameter is Locked.
 - **If the reading is Unlocked**

Refer to Correcting VIN mismatch - odometer unlocked.

 - **If the reading is Locked**
2. Verify the scan tool Instrument Cluster VIN parameter matches the vehicle's VIN placard.
 - **If the VIN does not match**

Reprogram the Instrument Cluster. Then proceed with step 3.

- **If the VIN matches**
3. Perform the BCM setup procedure in SPS.
 4. Ignition ON.
 5. Verify the instrument cluster is displaying the correct value.
 - **If the instrument cluster is still displaying "----" (dashes)**

Replace the P16 Instrument Cluster.

 - **If instrument cluster is displaying the correct value**
 6. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for instrument cluster, BCM or ECM replacement, programming and setup.

TACHOMETER INACCURATE OR INOPERATIVE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.

- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The instrument cluster displays the engine coolant temperature, fuel level, vehicle speed and the engine speed based on the information from the engine control module (ECM). The ECM sends information via serial data to the body control module (BCM). The BCM then sends the information via a serial data to the instrument cluster to display the engine coolant temperature, fuel level, the engine speed, the vehicle speed and the distance travelled, either in kilometers or miles, based on the vehicle requirements.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify no DTC is set.
 - **If any DTC is set**

Diagnose DTCs first. Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If no DTCs are set**
2. Ignition ON.
3. Verify all tachometer segments illuminate and turn off as commanded when performing the Driver Information Center Segments test with the scan tool.

- **If tachometer segments do not illuminate**

Replace the P16 Instrument Cluster.

- **If tachometer segments illuminate properly**

4. Engine running.
5. Verify the tachometer value matches the scan tool Engine Speed parameter.

- **If the value does not match**

Replace the P16 Instrument Cluster.

- **If the tachometer value matches the value displayed on the scan tool**

6. Replace the K20 Engine Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Instrument Cluster or ECM replacement, programming and setup.

REPAIR INSTRUCTIONS

INFORMATION CENTER TELLTALE ASSEMBLY REPLACEMENT

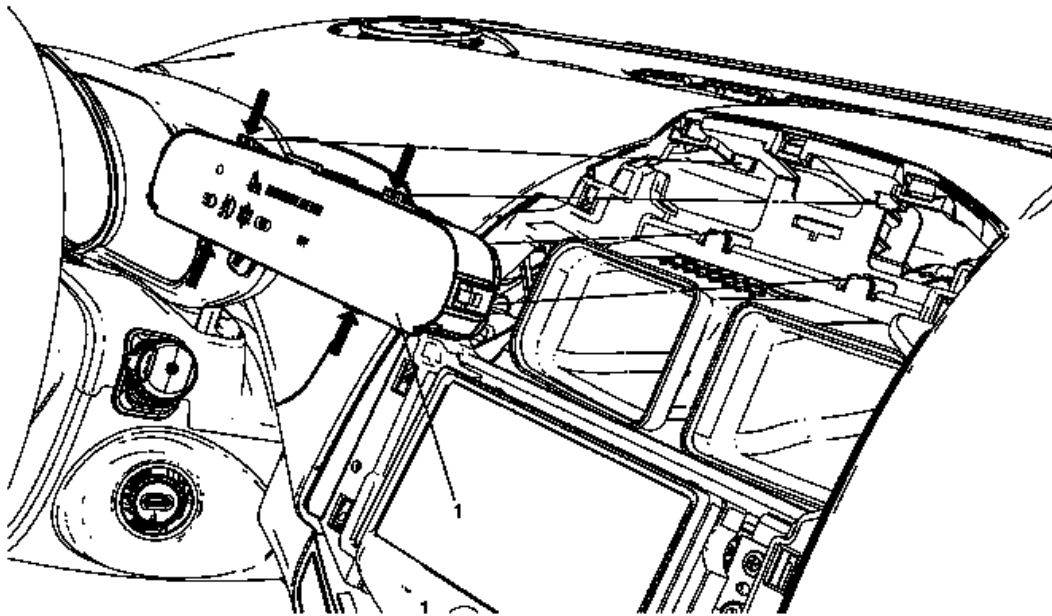


Fig. 5: Information Center Telltale Assembly
Courtesy of GENERAL MOTORS COMPANY

Information Center Telltale Assembly Replacement

Callout	Component Name
Preliminary Procedures 1. Disconnect the battery negative cable. 2. Remove I/P center molding. Refer to <u>Instrument Panel Center Molding Replacement</u> .	
1	Driver Information Center Telltale Assembly Procedure 1. Disconnect electrical components. 2. Carefully unclip the retainer.

INSTRUMENT CLUSTER REPLACEMENT

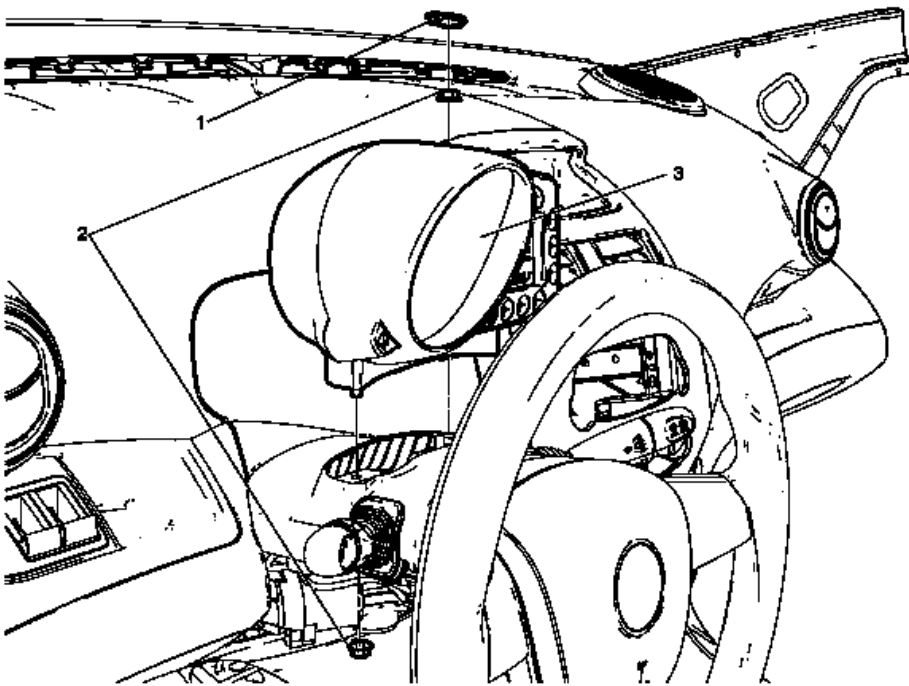


Fig. 6: Instrument Cluster

Courtesy of GENERAL MOTORS COMPANY

Instrument Cluster Replacement

Callout	Component Name
Preliminary Procedure Remove steering column lower trim cover. Refer to <u>Steering Column Lower Trim Cover Replacement</u> .	
1	Instrument Cluster Nut Cover
	Instrument Cluster Screw (Qty: 2)

2	CAUTION: Refer to <u>Fastener Caution</u> . Tighten 10 (89 lb in)
3	Instrument Cluster Assembly Procedure 1. Remove the cluster rear cover. 2. Disconnect electrical components. 3. After repairs, refer to <u>Control Module References</u> .

INSTRUMENT PANEL MULTIFUNCTION SWITCH REPLACEMENT

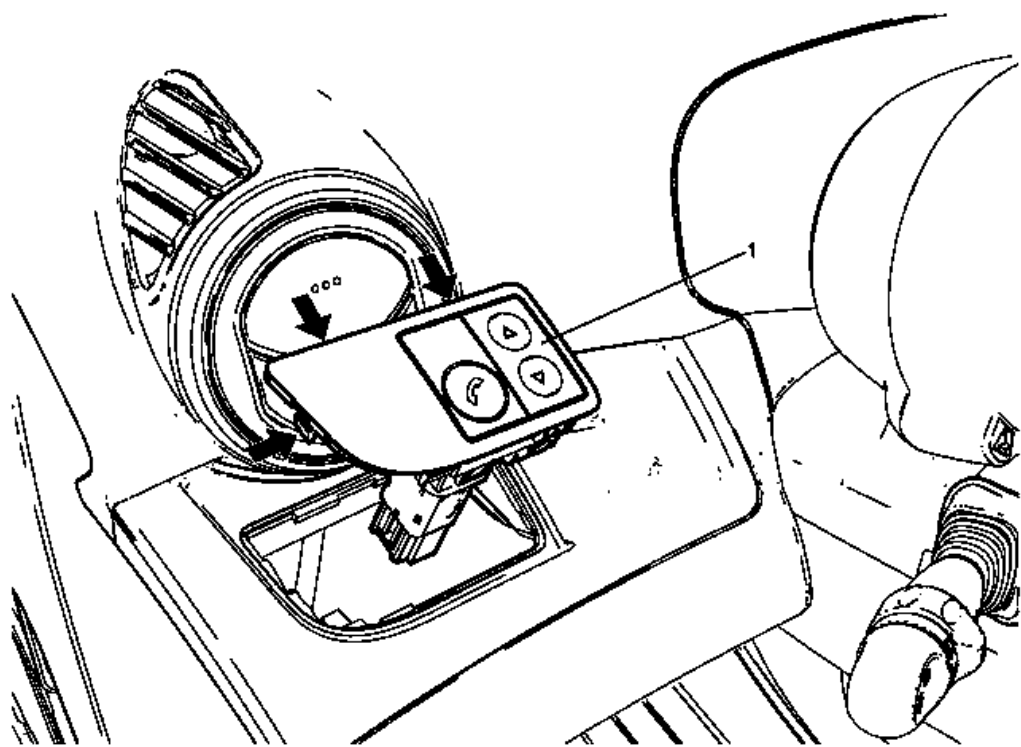


Fig. 7: Instrument Panel Multifunction Switch
Courtesy of GENERAL MOTORS COMPANY

Instrument Panel Multifunction Switch Replacement

Callout	Component Name
	Instrument Panel Multifunction Switch Assembly
	Procedure

1	1. Disconnect the tabs (the arrows in the illustration) carefully to prevent the damage for the switch and molding. 2. Disconnect the electrical connector.
---	---

DESCRIPTION AND OPERATION

AUDIBLE WARNINGS DESCRIPTION AND OPERATION

The audible warnings alert the driver of a system concern or a critical vehicle condition. The radio generates the audible warnings through the speakers. The radio receives audible warning requests via the serial data circuit. If the radio receives multiple audible warning requests, the warning with the highest priority sounds first. The radio is the chime producer. The following lists the audible warning sounds:

1. Single pulse gong
2. Multiple pulse gong
3. Single pulse beep
4. Multiple pulse beep
5. Click
6. Clack

Fasten Safety Belt Warning

The chime producer activates the fasten safety belt audible warning as requested by the body control module (BCM). The BCM sends a serial data message to the chime producer indicating the chime as a multiple gong. The fasten safety belt warning sounds and the fasten safety belt indicator illuminates when the following occurs:

- The ignition switch transitions to ON.
- The inflatable restraint sensing and diagnostic module (SDM) detects that the drivers seat belt is not buckled and the signal is low. The SDM sends a serial data message to the BCM indicating the seat belt status. The instrument cluster receives a serial data message from the BCM indicating the driver seat belt status.

If the seat belt is buckled when the ignition is turned ON, the chime does not sound. If the seat belt is buckled while the chime is sounding, the chime stops. If the seat belt is unbuckled after the initial transition to ON, the chime does not sound.

Lights On Warning

The chime producer activates the lights on warning as requested by the BCM. The BCM sends a serial data message to the chime producer indicating the chime as a multiple gong. The lights on warning sounds when the following occurs:

- The ignition is OFF.
- The BCM determines that the driver door is open and the signal circuit is low.

- The BCM determines that the headlamp switch is in the park or head position.

Brake Warning

The chime producer activates the brake audible warning as requested by multiple control modules. The BCM, electronic brake control module or the parking brake control module sends a serial data message to the chime producer indicating the chime as a multiple gong. The brake warning sounds and the BRAKE indicator illuminates when the following occurs:

- The ignition is ON.
- The vehicle speed is greater than 8 km/h (4.9 MPH). The instrument cluster receives a serial data message from the engine control module (ECM) indicating the vehicle speed.
- The BCM determines that the parking brake is engaged and the signal circuit is low.
- The brake fluid is low.

Key-In-Ignition Warning

The chime producer activates the key-in-ignition audible warning as requested by the BCM. The BCM sends a serial data message to the chime producer indicating the chime as a multiple gong. The key-in-ignition warning sounds when the following occurs:

- The ignition switch is OFF.
- The BCM determines that the driver door is open and the signal circuit is low.

Door Ajar Warning

The chime producer activates the door ajar audible warning as requested by the BCM. The BCM sends a serial data message to the chime producer indicating the chime frequency of a medium rate and continuous duration. The door ajar warning sounds and the appropriate door ajar indicator illuminates in the driver information center when the BCM determines that a door (driver door, passenger door, left rear door, right rear door) is open and the signal circuit is low. The instrument cluster also receives a serial data message from the BCM indicating the door ajar status.

Object Detection

The chime producer activates the object detection audible warning as requested by the object alarm module. When an object is within the measuring range of the sensor, the ultrasonic pulse is reflected and is received by the sending or a neighboring sensor. The sensor converts this signal into a voltage signal and sends this signal to the object alarm module. The object alarm module evaluates the received sensor signals. As soon as an object is within the measuring range, the object alarm module sends a message via CAN-Bus to the chime producer in order to give out the acoustic distance signal. The measuring range is between 30-120 cm (11.81-47.24 in). From a distance of 120 cm (47.24 in), the acoustic signal is active. The frequency of the beep sound increases with decreasing distance. From a distance less than 30 cm (11.81 in), the sound becomes continuous.

Additional Warnings

The following warnings have an associated instrument cluster indicator or driver information center message:

- Turn Signal Indicators-The chime producer activates the audible warning as requested by the BCM. The chime produces two different chimes, one when the turn signal turns off and another when the turn signal turns on.
- Vehicle Overspeed Message-The chime producer activates the audible warning as requested by the BCM. The BCM sends a serial data message to the chime producer.
- Fuel Level Low Message-The chime producer activates the audible warning as requested by the BCM. The BCM sends a serial data message to the chime producer.
- Oil Pressure Indicator-The chime producer activates the audible warning as requested by the BCM. The BCM sends a serial data message to the chime producer.
- Park Assist Fault Clean Rear Bumper Message-The chime producer activates the audible warning as requested by the BCM. The BCM sends a serial data message to the chime producer.
- Tire Pressure Low Indicator-The chime producer activates the audible warning as requested by the BCM. The BCM sends a serial data message to the chime producer.

Refer to **Indicator/Warning Message Description and Operation**.

DRIVER INFORMATION CENTER (DIC) DESCRIPTION AND OPERATION

In the lower middle of the instrument cluster, an additional display is installed. Its task is to give additional information, such as an odometer or error codes/warning messages. Refer to **Indicator/Warning Message Description and Operation**.

There are 4 switch functions for the driver information center:

- Menu
- Set/Clear
- Up
- Down

Menu

The Menu switch is used to navigate between the Vehicle Information Menu and the Trip/Fuel Information Menu. Cycle through the following vehicle parameters by successive pressing of the Menu switch.

Up and Down

The Up and the Down switches are used to navigate within the menus. Cycle through the following menu parameters by successive pressing of the Down switch.

Vehicle Information Menu

- Units Menu
- Speed Warning

Trip/Fuel Information Menu

- Trip A
- Fuel Range
- Average Fuel Economy
- Instantaneous Fuel Economy
- Average Vehicle Speed

Trip A

The trip odometer can be accessed through the driver information center switch Up/Down function.

Trip Display

Driver Information Center Trip Display	Range		
	Europe-SI	USA	GB
TRIP A	#####.km	#####.# miles	#####.# miles

Fuel Range

This message indicates the estimated distance that the vehicle can travel under the current fuel economy and fuel level conditions since the last battery connection to the instrument cluster. Fuel Range is calculated using the equation: Fuel Range = Range Distance/Range Fuel Used.

- Range Distance = The accumulated distance travelled since the last reset of this value.
- Fuel Used = The accumulated fuel delivered since the last reset of this value

The engine control module (ECM) sends the fuel range value to the instrument cluster. The instrument cluster receives a serial data message with fuel information. The fuel range value is retained during ignition OFF and can be changed between Europe-SI, USA and GB units by accessing the driver information center Units menu. The Fuel Range display cannot be reset. LOW is displayed when fuel range is below a predetermined value.

Average Fuel Economy

Average fuel economy is calculated using the equation: Average Fuel Economy = Distance/Fuel

- Distance = The accumulated distance travelled since the last reset of this value
- Fuel = The accumulated fuel consumption since the last reset of this value

The ECM sends the average fuel economy serial data message to the instrument cluster. The value of this mode is retained during ignition OFF and can be changed between English units and metric units by selecting from the driver information center options menu.

Instantaneous Fuel Economy

The ECM sends the instantaneous fuel economy serial data message to the instrument cluster. The value of this mode can be changed between English units and metric units by selecting from the driver information center options menu.

Average Vehicle Speed

Average speed is calculated using the equation: $\text{Average Speed} = \text{Average Speed Distance} / \text{Average Speed Time}$

- Distance = The accumulated distance travelled since the last reset of this value
- Ignition ON = The accumulated ignition on time since the last reset of this value

Outside Air Temperature

The outside air temperature can be accessed through the driver information center Trip/Fuel switch function. The driver information center shows the outside air temperature as a damped value. The time and rate of the temperature update is based on an algorithm in the instrument cluster. Factors such as last temperature reading, current temperature reading, length of time the vehicle was off, current vehicle speed and the distance driven effect when the displayed temperature is updated. To get the vehicle to display the most accurate temperature faster, drive the vehicle. Constant moving traffic will update the display to the correct temperature more quickly than stop and go traffic.

Units Menu

The unit mode is used to toggle between Europe-SI, USA and GB units and can be accessed through the driver information center Menu switch and the driver information center Set/Reset switch.

Compass

The vehicle may have a compass display on the Driver Information Center. The compass receives its heading and other information from the Global Positioning System (GPS) antenna. If applicable, the GPS antenna is located with the telematics communication interface control module.

Odometer

The instrument cluster displays the vehicle odometer in the driver information center. The ECM send a distance rolling count message on GMLAN to the body control module (BCM). The BCM uses this information to calculate the vehicle odometer. This odometer value is then sent to the instrument cluster on GMLAN. The instrument cluster does not calculate the odometer. The odometer displays miles or kilometers as selected in the Units menu.

The odometer value is stored in multiple modules. The instrument cluster is a secondary storage module for the odometer, while the BCM is the primary storage and accumulator.

In addition to storing the odometer value for the vehicle, the instrument cluster and the BCM store the VIN. Software checks are performed to ensure these modules and their stored odometer information, can not be move or transferred between different vehicles.

If the VINs do not match, the instrument cluster will go into an error mode and display "----" (dashes). If the VIN mismatch exists over a calibrated distance, the instrument cluster will "lock" the odometer display and only show dashes, even if the VIN mismatch is subsequently correct. The only way to clear or "unlock" the instrument cluster is to perform a BCM programming event using SPS.

Language

The driver information center is capable of displaying in different languages, corresponding to the radio language settings. The instrument cluster receives a serial data message with language information from the radio. This message is only sent one time, after a new language is selected. To set the language, see the owners manual.

INDICATOR/WARNING MESSAGE DESCRIPTION AND OPERATION

Indicator LIGHT ON

Refer to the owner's manual for the descriptions and explanations of all indicator lights.

For diagnosis and repair information related to an indicator light, refer to the System Diagnosis and the Description of Operation that the message relates to.

Message Displayed

Refer to the owner's manual for descriptions and explanations of all messages displayed.

For diagnosis and repair information related to a displayed message, refer to the System Diagnosis and the Description of Operation that the message relates to.

CHANGE TIMING BELT MESSAGE

The Instrument Cluster monitors the odometer mileage to determine when timing belt (if equipped) replacement may be necessary. After the vehicle has accumulated approximately 100, 000 miles (160, 000 kilometers), the Instrument Cluster may display the CHANGE TIMING BELT message. After the engine timing belt has been replaced, reset the CHANGE TIMING BELT message by locating and removing the fuses that supply power to the Instrument Cluster for two minutes.

Transmission Shift Lever Position Indicator

The Transmission Shift Lever Position Indicator (if equipped) is located on the center console and indicates the current transmission shift lever position. The Transmission Shift Lever Position Indicator receives power and ground and is controlled by the Body Control Module (BCM) via serial data. The Transmission Control Module determines transmission shift lever position based on signals from the Transmission Internal Mode Switch and sends the shift lever position information to the BCM via serial data.

INSTRUMENT CLUSTER DESCRIPTION AND OPERATION

Displays and Gauges Block Diagram

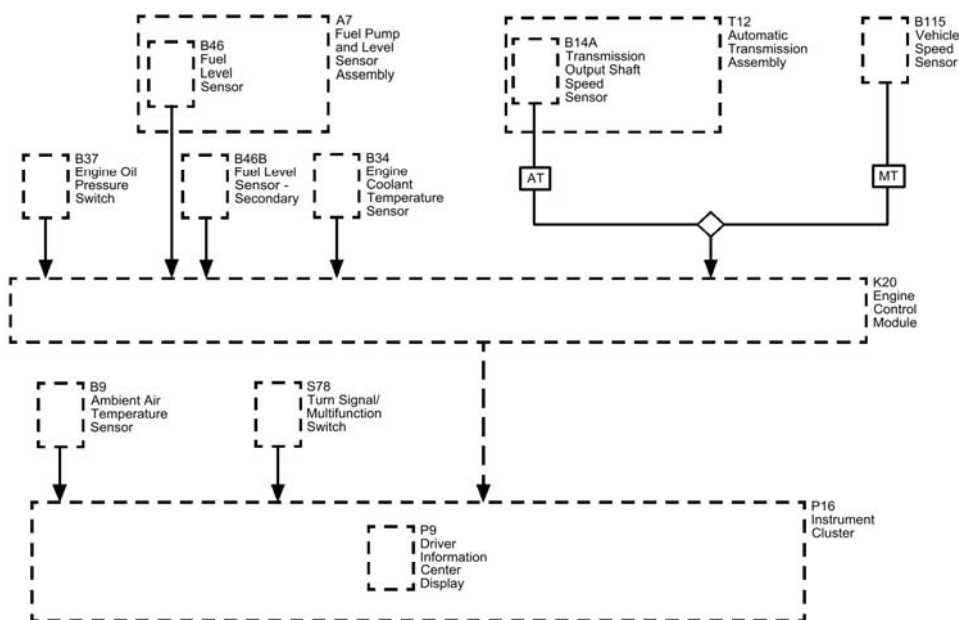


Fig. 8: Displays and Gauges Block Diagram
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
HW	Hard-Wired
HW	Hard-Wired
DA	Serial Data
HW	Hard-Wired
HW	Hard-Wired
HW	Hard-Wired
HW	Hard-Wired
HW	Hard-Wired
AT	Automatic Transmission
MT	Manual Transmission
P16	P16 Instrument Cluster
P9	P9 Driver Information Center Display
S78	S78 Turn Signal/Multifunction Switch
B9	B9 Ambient Air Temperature Sensor
B14A	B14A Transmission Output Shaft Speed Sensor
T12	T12 Automatic Transmission Assembly
B115	B115 Vehicle Speed Sensor
K20	K20 Engine Control Module

B46	B46 Fuel Level Sensor
A7	A7 Fuel Pump and Level Sensor Assembly
B37	B37 Engine Oil Pressure Switch
B46B	B46B Fuel Level Sensor - Secondary
B34	B34 Engine Coolant Temperature Sensor

Displays Test

Certain instrument cluster features are tested when the ignition is turned on in order to verify the features are working properly. The following occurs when the ignition is turned on:

- The ABS indicator illuminates briefly.
- The airbag indicator illuminates briefly.
- The battery indicator illuminates briefly.
- The brake indicator illuminates briefly.
- The door ajar indicator illuminates briefly.
- The fuel level low indicator illuminates briefly.
- The oil pressure low indicator illuminates briefly.
- The park assist service indicator illuminates briefly.
- The press clutch indicator illuminates briefly.
- The security indicator illuminates briefly.
- The service vehicle soon indicator illuminates briefly.
- The vehicle dynamic caution service indicator illuminates briefly.
- The vehicle dynamics caution off indicator illuminates briefly.

Indicators and Warning Messages

Refer to **Indicator/Warning Message Description and Operation**

Engine Coolant Temperature Gauge

The instrument cluster displays the engine coolant temperature as determined by the engine control module (ECM). The ECM sends the engine coolant temperature information via a High Speed CAN-Bus signal to the body control module (BCM). The BCM then sends the information via a Low Speed CAN-Bus signal to the instrument cluster to display the engine coolant temperature. The engine coolant temperature gauge defaults to 40°C (104°F) or below if:

- The ECM detects a malfunction in the engine coolant temperature sensor circuit.
- The BCM detects a loss of serial data communications with the ECM.
- The instrument cluster detects a loss of serial data communications with the BCM.

Fuel Level Gauge

The instrument cluster displays the fuel level based on the information from the ECM. The ECM converts the data from the fuel level sensors to a fuel level signal. The ECM sends the fuel level signal via a High Speed CAN-Bus signal to the BCM. The BCM then sends the information via a Low Speed CAN-Bus signal to the instrument cluster to display the fuel level. If the fuel level falls under 11% the instrument cluster switches on the low fuel level indicator. The fuel gauge defaults to empty if:

- The ECM detects a malfunction in the fuel level sensor circuit.
- The BCM detects a loss of serial data communications with the ECM.
- The instrument cluster detects a loss of serial data communications with the BCM.

Speedometer

The instrument cluster displays the vehicle speed based on the information from the ECM. The ECM sends the vehicle speed information via a High Speed CAN-Bus signal to the BCM. The BCM then sends the vehicle speed information via a Low Speed CAN-Bus signal to the instrument cluster in order to display the vehicle speed, either in kilometers or miles, based on the vehicle requirements. The speedometer defaults to 0 km/h (0 MPH) if:

- The BCM detects a loss of serial data communications with the ECM.
- The instrument cluster detects a loss of serial data communications with the BCM.

Tachometer

The instrument cluster displays the engine speed based on the information from the ECM. The ECM converts the data from the engine speed sensor to an engine revolution signal. The ECM sends the engine speed information via a High Speed CAN-Bus signal to the BCM. The BCM then sends the information via a Low Speed CAN-Bus signal to the instrument cluster to display the engine speed. The tachometer defaults to 0 RPM if:

- The ECM detects a malfunction in the engine speed sensor circuit.
- The BCM detects a loss of serial data communications with the ECM.
- The instrument cluster detects a loss of serial data communications with the BCM.

Driver Information Center Display

In the lower middle of the instrument cluster, an additional display is installed. Its task is to give additional information, such as an odometer or error codes. This part of the instrument cluster is available in 4 different variants, mostly depending on the assembled engine. For further information refer to **Driver Information Center (DIC) Description and Operation**.

ACCESSORIES & EQUIPMENT

Interior Trim and Paneling - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Assist Handle Bolt	5 N.m	44 lb in
Center Pillar Upper Trim Panel Screw	2 N.m	18 lb in
Front Side Door Pull Handle Screw	2 N.m	18 lb in
Front Side Door Trim Panel Applique Screw	2 N.m	18 lb in
Front Side Door Window Switch Bezel Screw	2 N.m	18 lb in
Liftgate Trim Panel Screw	2 N.m	18 lb in
Quarter Lower Rear Trim Panel Screw	2 N.m	18 lb in
Quarter Window Garnish Molding Screw	2 N.m	18 lb in
Rear Side Door Pull Handle Screw	2 N.m	18 lb in
Rear Side Door Sill Trim Plate Screw	2 N.m	18 lb in
Rear Side Door Window Switch Bezel Screw	2 N.m	18 lb in
Rear Wheelhouse Trim Finish Panel Screw	2 N.m	18 lb in
Sunshade Screw	2 N.m	18 lb in
Sunshade Support Screw	2 N.m	18 lb in

REPAIR INSTRUCTIONS

FRONT SIDE DOOR WINDOW SWITCH BEZEL REPLACEMENT

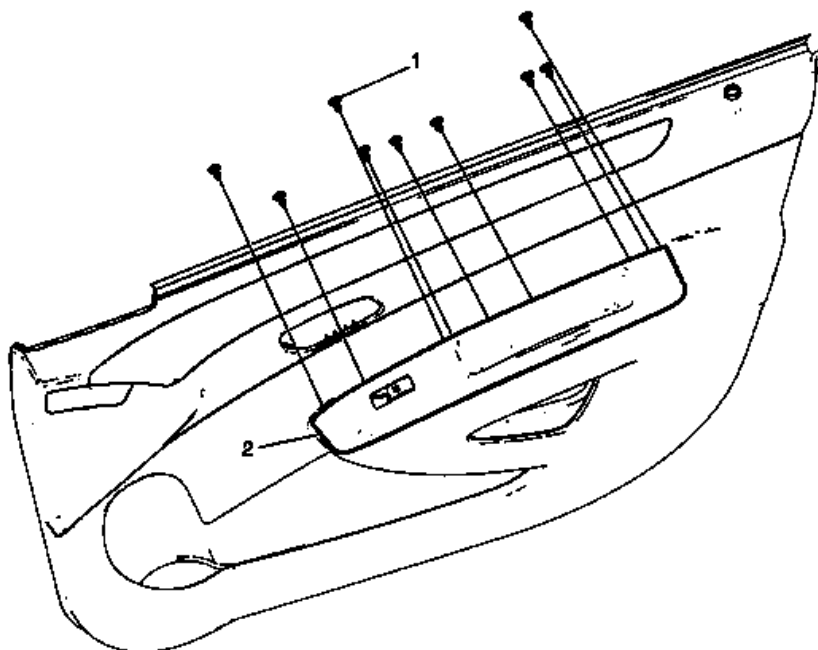


Fig. 1: Front Side Door Window Switch Bezel
 Courtesy of GENERAL MOTORS COMPANY

Front Side Door Window Switch Bezel Replacement

Callout	Component Name
Preliminary Procedure Remove the front side door trim. Refer to <u>Front Side Door Trim Panel Replacement</u> .	
1	Front Side Door Window Switch Bezel Screw (Qty: 9) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2 N.m (18 lb in)
2	Front Side Door Window Switch Bezel Assembly

REAR SIDE DOOR WINDOW SWITCH BEZEL REPLACEMENT

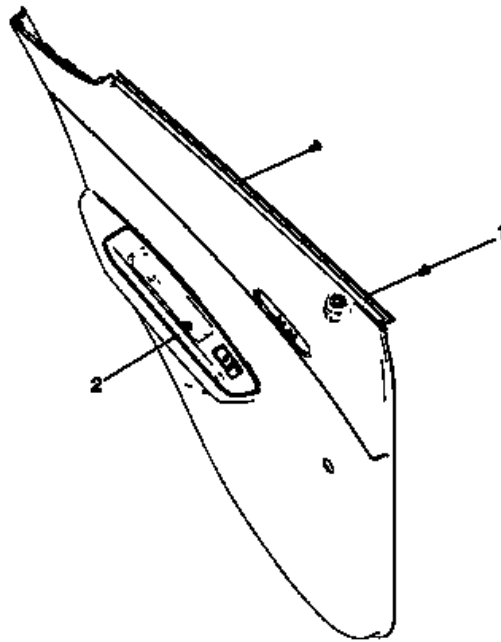


Fig. 2: Rear Side Door Window Switch Bezel
 Courtesy of GENERAL MOTORS COMPANY

Rear Side Door Window Switch Bezel Replacement

Callout	Component Name
Preliminary Procedure Remove the rear side door trim. Refer to <u>Rear Side Door Trim Panel Replacement</u> .	
1	Rear Side Door Window Switch Bezel Screw (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2 N.m (18 lb in)
2	Rear Side Door Window Switch Bezel Assembly

FRONT SIDE DOOR TRIM PANEL REPLACEMENT

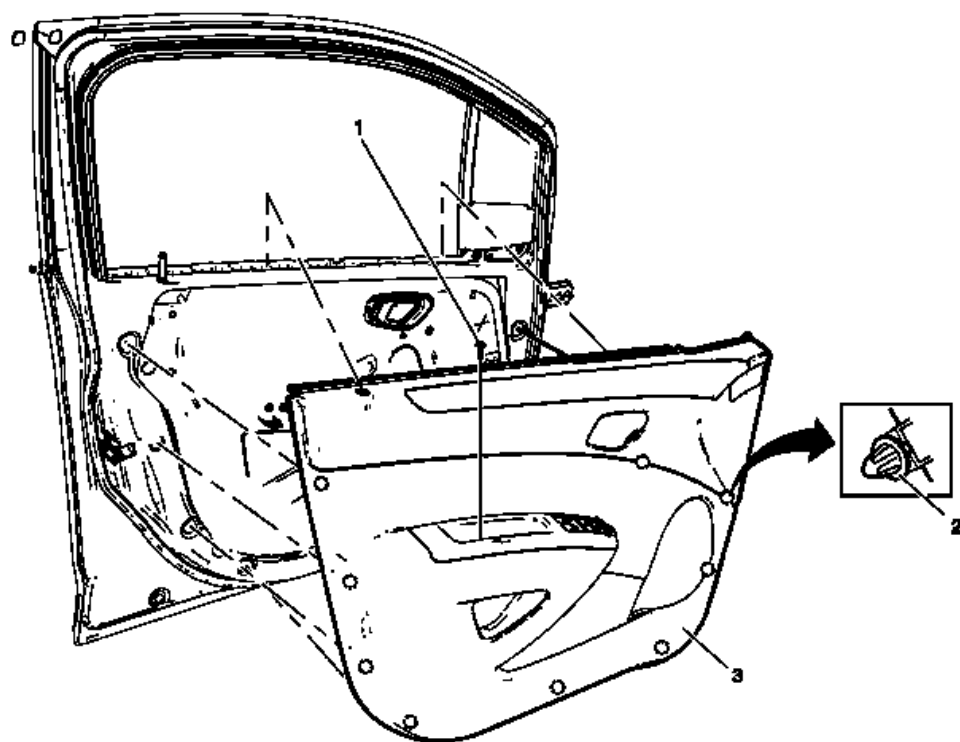


Fig. 3: Front Side Door Trim Panel
 Courtesy of GENERAL MOTORS COMPANY

Front Side Door Trim Panel Replacement

Callout	Component Name
Preliminary Procedure	
Remove the front side door upper trim panel. Refer to .	
1	Front Side Door Pull Handle Fastener CAUTION: Refer to Fastener Caution .
2	Front Side Door Trim Clip (Qty: 9)
3	Front Side Door Trim Assembly Procedure Disconnect the electrical connectors.

FRONT SIDE DOOR TRIM PANEL APPLIQUE REPLACEMENT

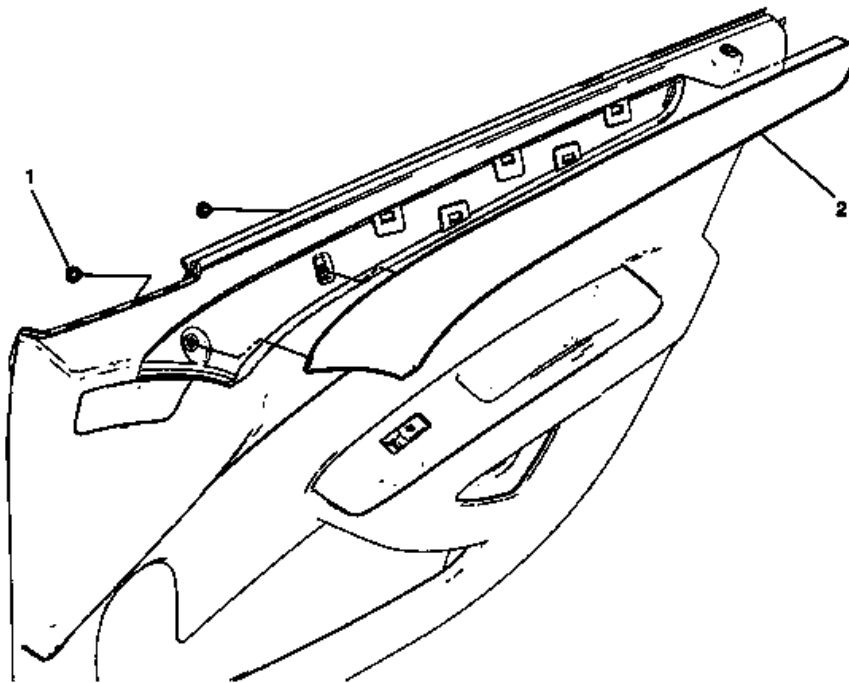


Fig. 4: Front Side Door Trim Panel Applique
 Courtesy of GENERAL MOTORS COMPANY

Front Side Door Trim Panel Applique Replacement

Preliminary Procedure	
Remove the front side door trim panel. Refer to Front Side Door Trim Panel Replacement .	
1	Front Side Door Trim Panel Applique Screw (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 2 N.m (18 lb in)
2	Front Side Door Trim Panel Applique Assembly

REAR SIDE DOOR TRIM PANEL REPLACEMENT

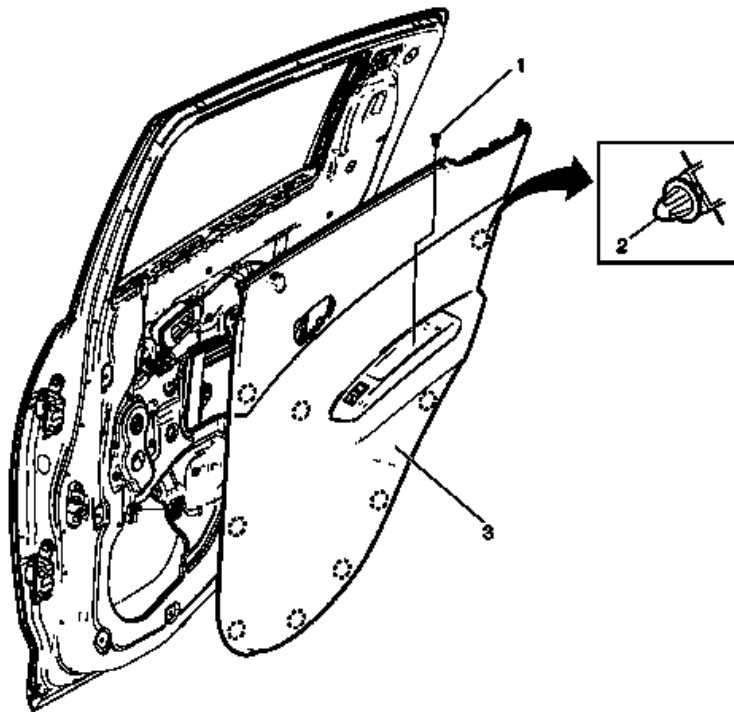


Fig. 5: Rear Side Door Trim Panel

Courtesy of GENERAL MOTORS COMPANY

Rear Side Door Trim Panel Replacement

Callout	Component Name
Preliminary Procedure Remove the rear side door upper rear trim panel. Refer to <u>Rear Side Door Upper Rear Trim Panel Replacement</u> .	
1	Rear Side Door Pull Handle Screw CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2 (18 lb in)
2	Rear Side Door Trim Clip (Qty: 9)
3	Rear Side Door Trim Assembly Procedure Disconnect the electrical connectors.

REAR SIDE DOOR UPPER REAR TRIM PANEL REPLACEMENT

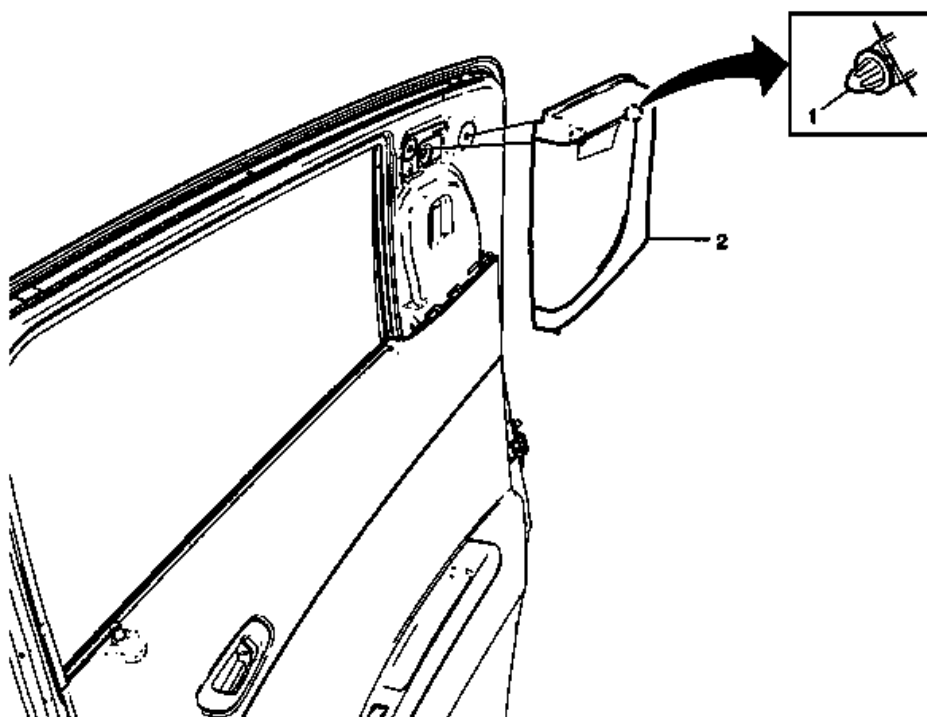


Fig. 6: Rear Side Door Upper Rear Trim Panel
 Courtesy of GENERAL MOTORS COMPANY

Rear Side Door Upper Rear Trim Panel Replacement

Callout	Component Name
1	Rear Side Door Upper Rear Trim Panel Clip (Qty: 2)
2	Rear Side Door Upper Rear Trim Panel Assembly
Procedure Pull the door upper rear trim panel away from the rear side door.	

REAR SEAT CUP HOLDER REPLACEMENT

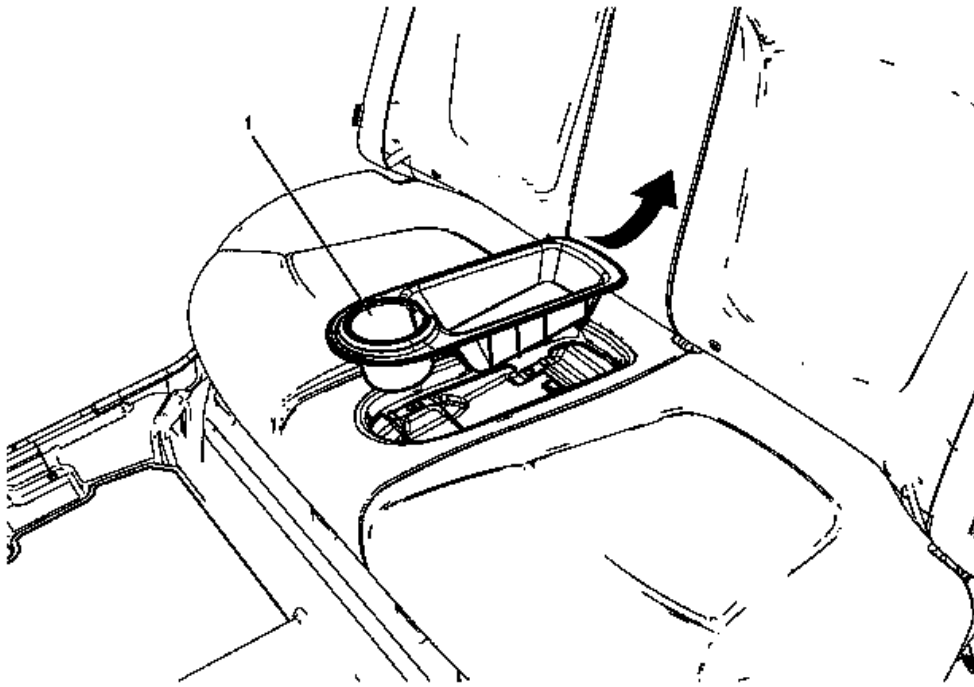


Fig. 7: Rear Seat Cup Holder
 Courtesy of GENERAL MOTORS COMPANY

Rear Seat Cup Holder Replacement

Callout	Component Name
1	Rear Seat Cup Holder Procedure 1. Using flat-bladed tool, pull the rear portion of the rear seat cup holder up. 2. Remove the cup holder following the arrow.

FRONT SIDE DOOR SILL TRIM PLATE REPLACEMENT

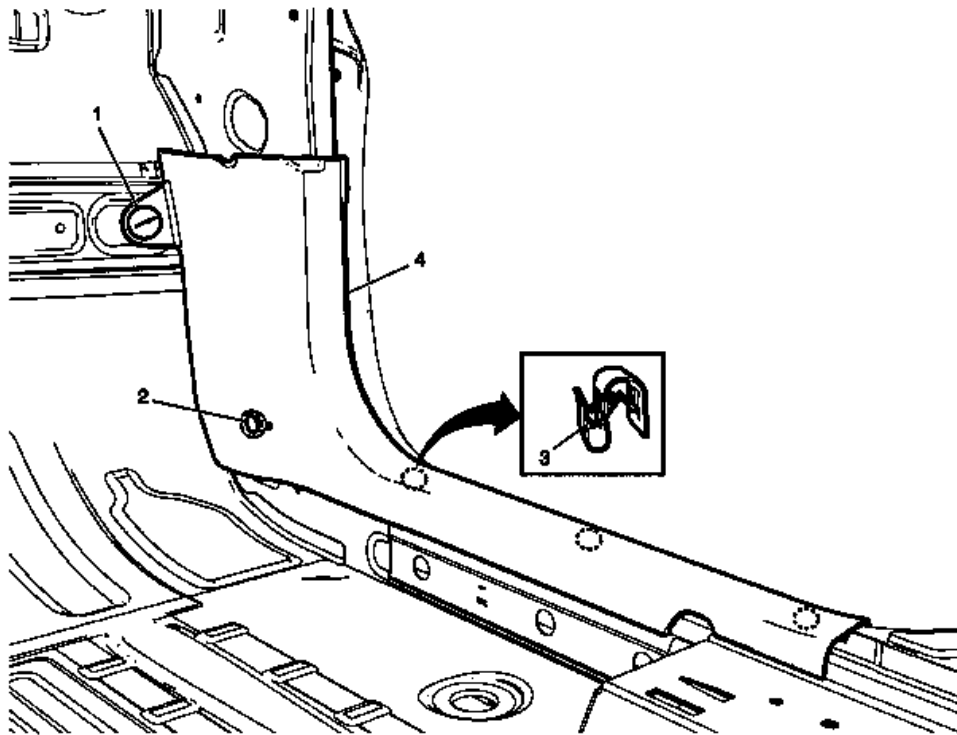


Fig. 8: Front Side Door Sill Trim Plate
 Courtesy of GENERAL MOTORS COMPANY

Front Side Door Sill Trim Plate Replacement

Callout	Component Name
1	Front Side Door Sill Trim Plate Retainer (Qty: 1)
2	Front Side Door Sill Trim Plate Push Pin Clip (Qty: 1)
3	Front Side Door Sill Trim Plate Clip (Qty: 3)
4	Front Side Door Sill Trim Plate

REAR SIDE DOOR SILL TRIM PLATE REPLACEMENT

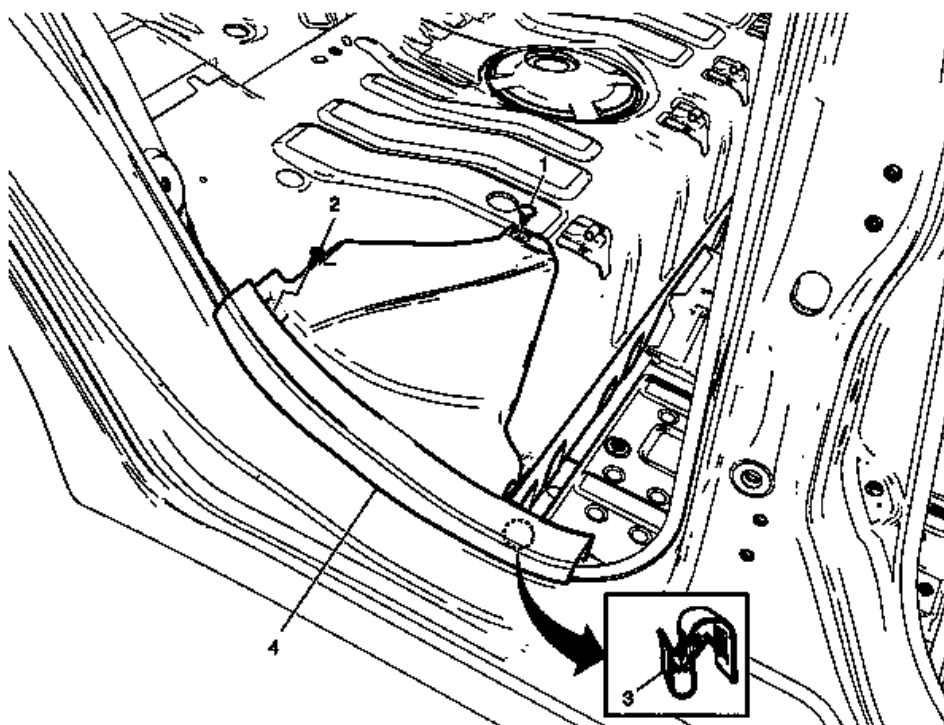


Fig. 9: Rear Side Door Sill Trim Plate Assembly
 Courtesy of GENERAL MOTORS COMPANY

Rear Side Door Sill Trim Plate Replacement

Callout	Component Name
Preliminary Procedure Remove the rear seat cushion. Refer to <u>Rear Seat Cushion Removal and Installation</u> .	
1	Rear Side Door Sill Trim Plate Push Clip (Qty: 1)
2	Rear Side Door Sill Trim Plate Screw (Qty: 1) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2 N.m (18 lb in)
3	Rear Side Door Sill Trim Plate Clip (Qty: 1)
4	Rear Side Door Sill Trim Plate Assembly

ASSIST HANDLE REPLACEMENT

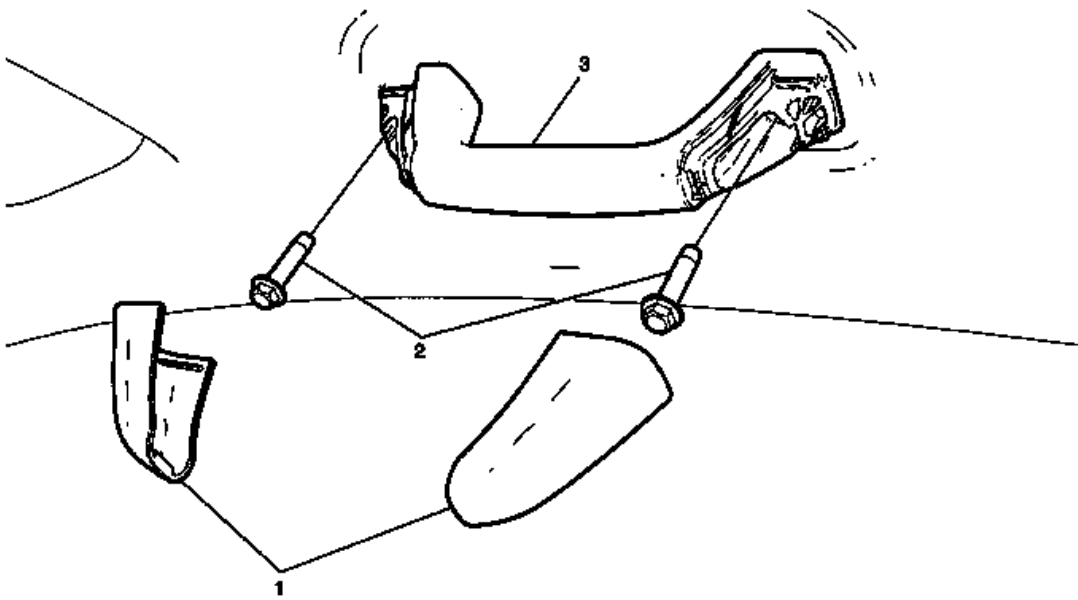


Fig. 10: Assist Handle Assembly
 Courtesy of GENERAL MOTORS COMPANY

Assist Handle Replacement

Callout	Component Name
1	Assist Handle Bolt Cover
2	Assist Handle Bolt (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 5 N.m (44 lb in)
3	Assist Handle Assembly

SUNSHADE REPLACEMENT

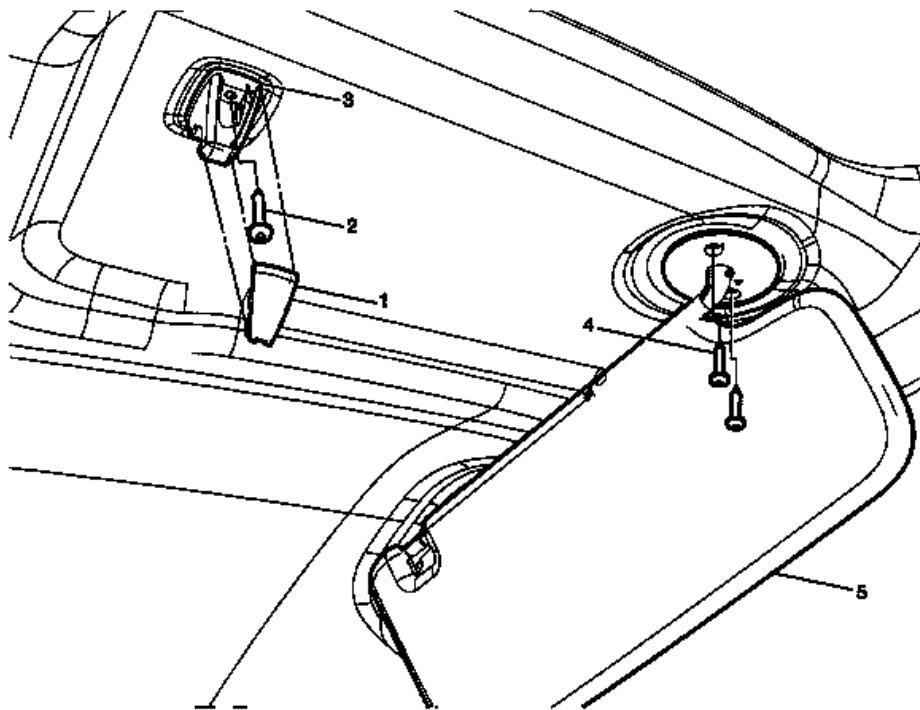


Fig. 11: Sunshade Assembly
 Courtesy of GENERAL MOTORS COMPANY

Sunshade Replacement

Callout	Component Name
1	Sunshade Support Screw Cover
2	Sunshade Support Screw (Qty: 1) CAUTION: Refer to <u>Fastener Caution</u> Tighten 2 N.m (18 lb in)
3	Sunshade Support
4	Sunshade Screw (Qty: 2) Tighten 2 N.m (18 lb in)
5	Sunshade Assembly

WINDSHIELD GARNISH MOLDING REPLACEMENT

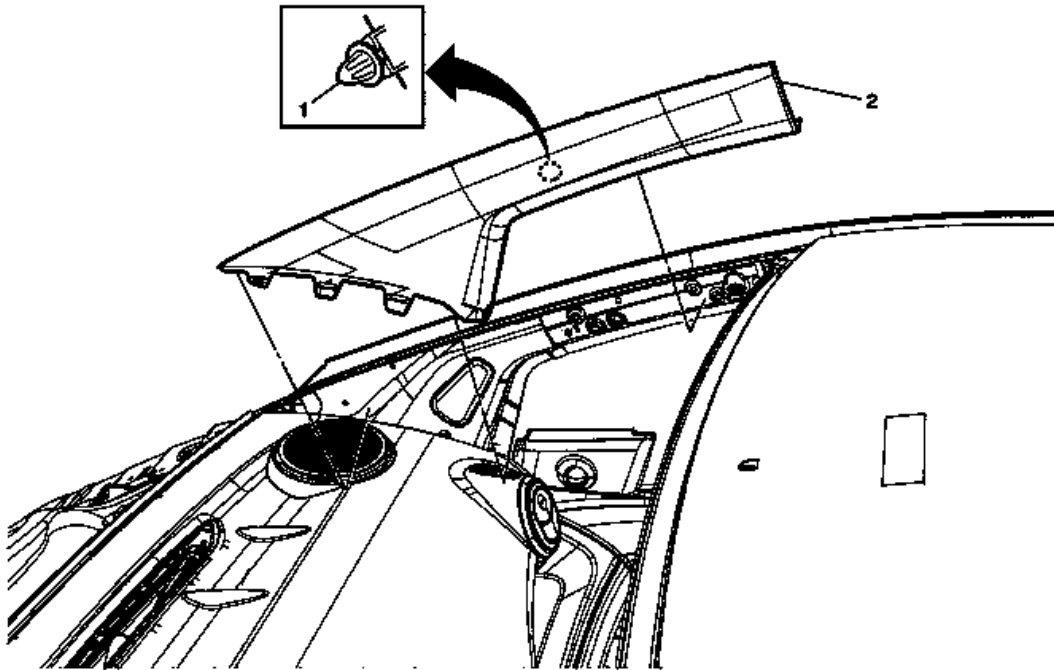


Fig. 12: Windshield Garnish Molding
 Courtesy of GENERAL MOTORS COMPANY

Windshield Garnish Molding Replacement

Callout	Component Name
Preliminary Procedure Disable the SIR system. Refer to <u>SIR Disabling and Enabling</u> .	
1	Windshield Garnish Molding Clip (Qty: 1) Procedure 1. Tabs must be installed prior to retainers. 2. Tabs to be fully seated in the instrument panel (I/P) trim panel retainer and valance panel. 3. Disconnect the electrical connectors. 4. Ensure the tether is reattached when installed.
2	Windshield Garnish Molding

CENTER PILLAR UPPER TRIM PANEL REPLACEMENT

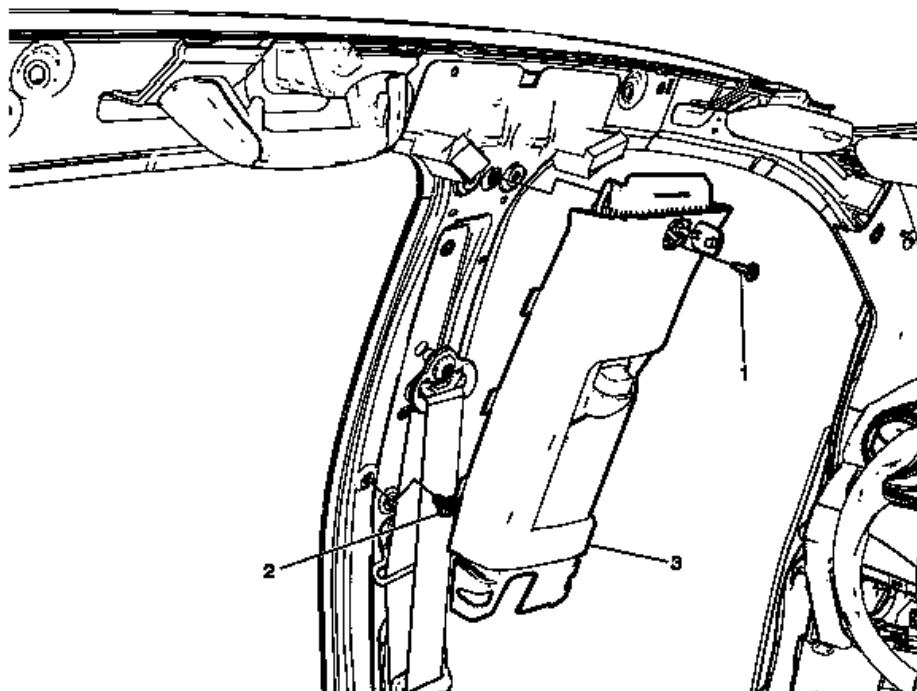


Fig. 13: Center Pillar Upper Trim Panel
 Courtesy of GENERAL MOTORS COMPANY

Center Pillar Upper Trim Panel Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the center pillar lower trim panel. Refer to <u>Center Pillar Lower Trim Panel Replacement</u>. 2. Remove the front seat belt lower anchor bolt. Refer to <u>Driver or Passenger Seat Retractor Side Belt Replacement</u>.	
1	Center Pillar Upper Trim Panel Screw (Qty: 1) CAUTION: Refer to <u>Fastener Caution</u>. Tighten 2 (18 lb in)
2	Center Pillar Upper Trim Panel Clip (Qty: 1)
3	Center Pillar Upper Trim Panel Assembly Procedure When replacing the center pillar upper trim panel, remove the seat belt through the panel.

CENTER PILLAR LOWER TRIM PANEL REPLACEMENT

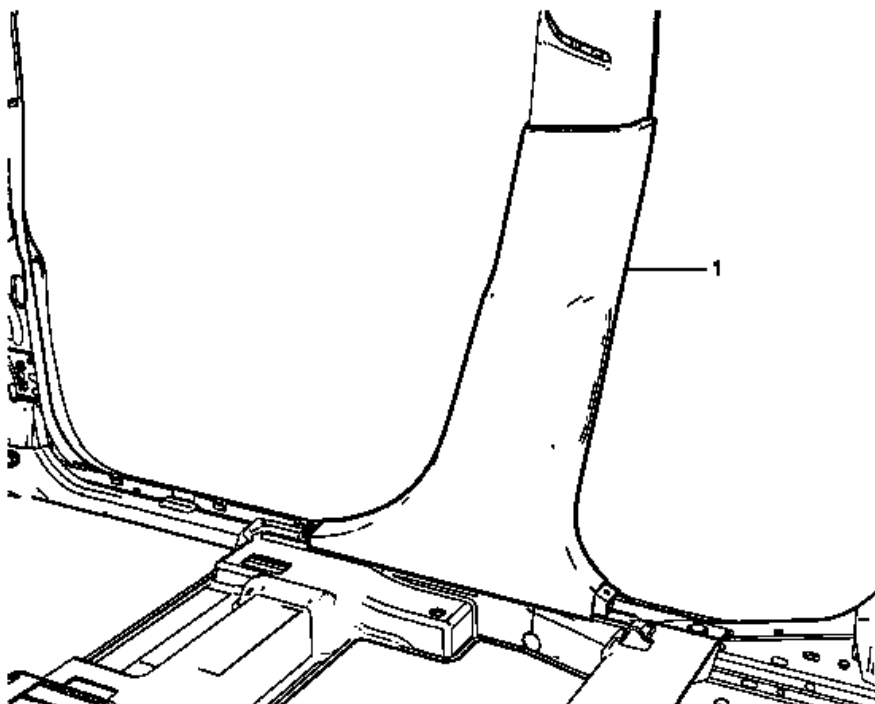


Fig. 14: Center Pillar Lower Trim Panel
Courtesy of GENERAL MOTORS COMPANY

Center Pillar Lower Trim Panel Replacement

Callout	Component Name
Preliminary Procedure	
1. Remove the front side door sill trim plate. Refer to <u>Front Side Door Sill Trim Plate Replacement.</u>	
2. Remove the rear side door sill trim plate. Refer to <u>Rear Side Door Sill Trim Plate Replacement.</u>	
1	Center Pillar Lower Trim Panel Assembly

QUARTER WINDOW GARNISH MOLDING REPLACEMENT

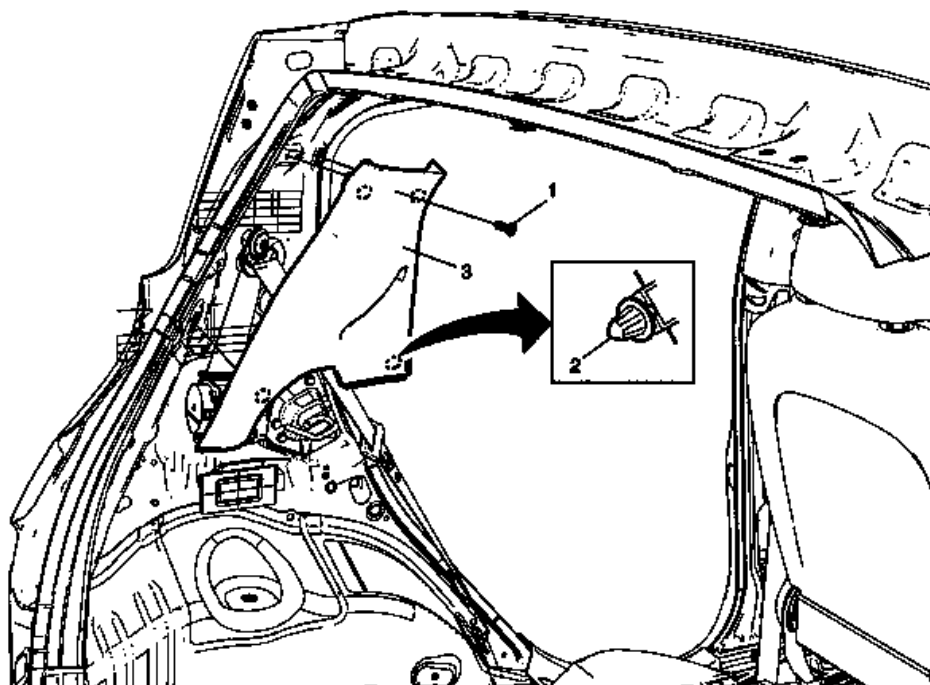


Fig. 15: Quarter Window Garnish Molding
 Courtesy of GENERAL MOTORS COMPANY

Quarter Window Garnish Molding Replacement

Callout	Component Name
Preliminary Procedure	
Remove the quarter lower rear trim panel. Refer to <u>Quarter Lower Rear Trim Panel Replacement</u> .	
1	Quarter Window Garnish Molding Screw (Qty: 1) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2 N.m (18 lb in)
2	Quarter Window Garnish Molding Clip (Qty: 4)
3	Quarter Window Garnish Molding Assembly

QUARTER LOWER REAR TRIM PANEL REPLACEMENT

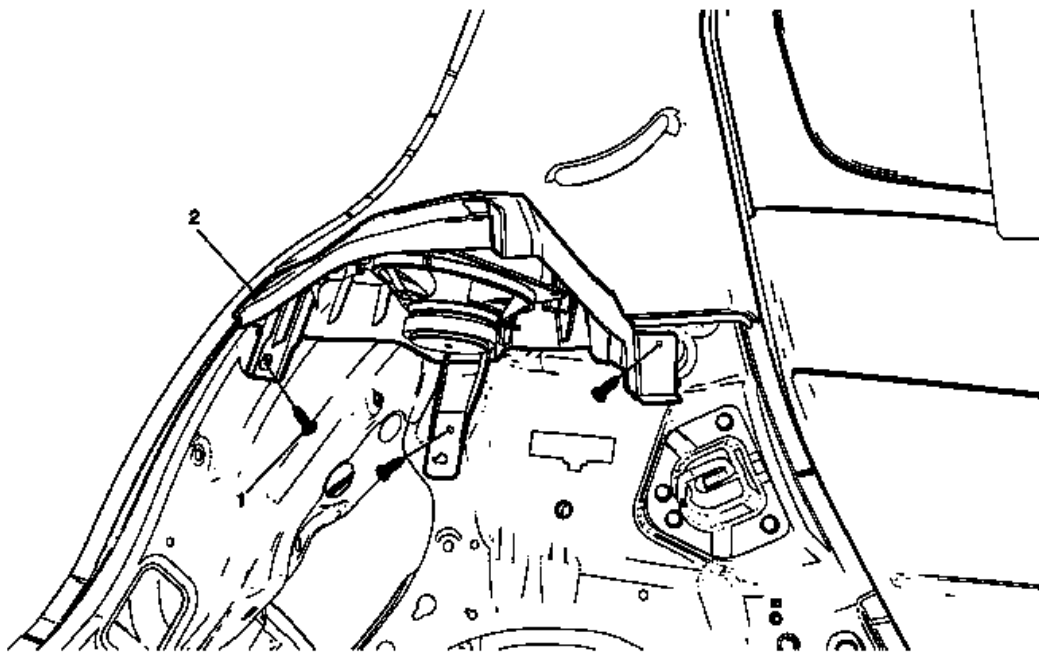


Fig. 16: Quarter Lower Rear Trim Panel
 Courtesy of GENERAL MOTORS COMPANY

Quarter Lower Rear Trim Panel Replacement

Callout	Component Name
Preliminary Procedure Remove the rear wheel house trim finish panel. Refer to <u>Rear Wheelhouse Trim Finish Panel Replacement</u> .	
1	Quarter Lower Rear Trim Panel Screw (Qty: 3) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2 N.m (18 lb in)
2	Quarter Lower Rear Trim Panel TIP: If necessary, disconnect the speaker electric wiring connector.

REAR WHEELHOUSE TRIM FINISH PANEL REPLACEMENT

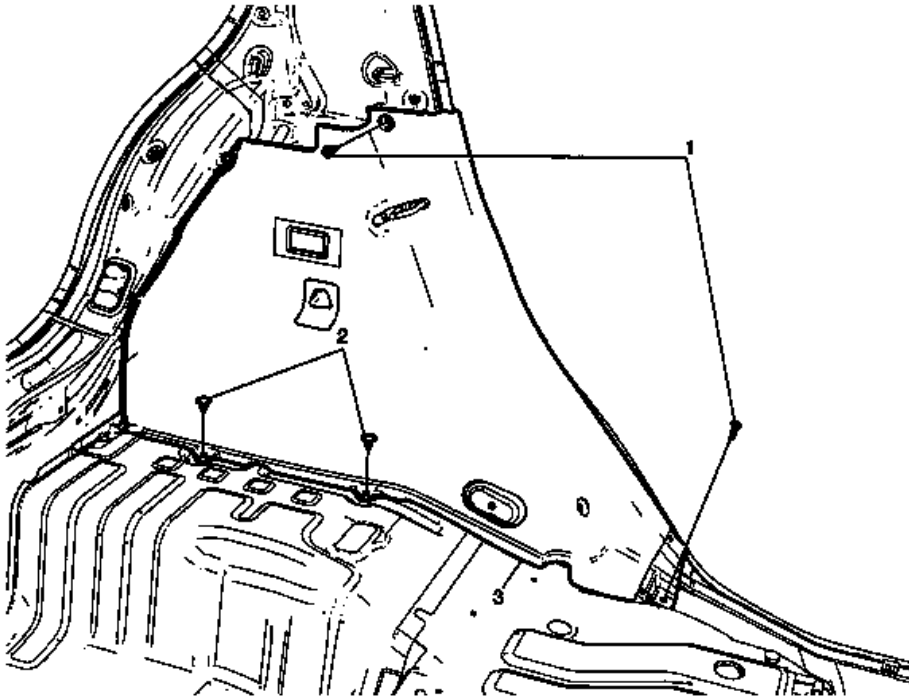


Fig. 17: Rear Wheelhouse Trim Finish Panel Assembly
 Courtesy of GENERAL MOTORS COMPANY

Rear Wheelhouse Trim Finish Panel Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the rear side door sill trim plate. Refer to <u>Rear Side Door Sill Trim Plate Replacement</u>. 2. Remove the rear seat back. Refer to <u>Rear Seat Back Cushion Removal and Installation</u>. 3. Remove the rear seat belt lower bolt. Refer to <u>Shoulder Belt Replacement - Rear</u>.	
1	Rear Wheel House Trim Finish Panel Screw (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2 N.m (18 lb in)
2	Rear Wheelhouse Trim Finish Panel Clip (Qty: 2)
3	Rear Wheelhouse Trim Finish Panel Assembly

REAR COMPARTMENT STOWAGE SHELF REPLACEMENT

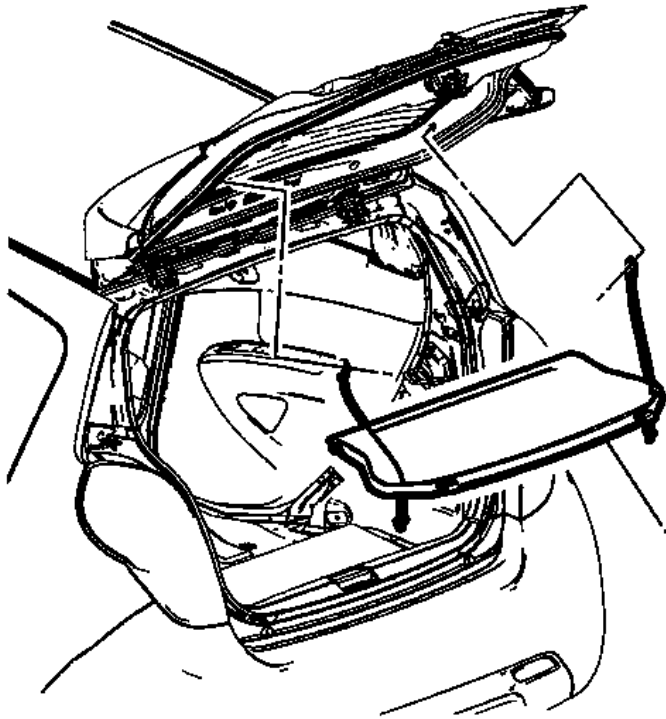


Fig. 18: Rear Compartment Stowage Shelf
Courtesy of GENERAL MOTORS COMPANY

Rear Compartment Stowage Shelf Replacement

Callout	Component Name
1	Rear Compartment Stowage Shelf Procedure Detach rear compartment stowage shelf from upper supports.

LIFTGATE TRIM PANEL REPLACEMENT

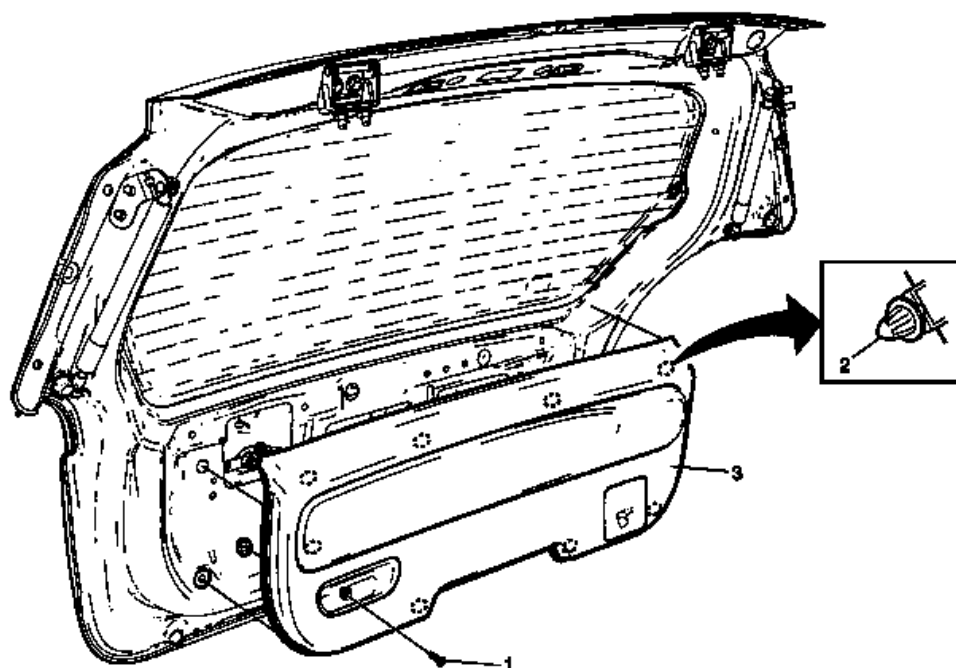


Fig. 19: Liftgate Trim Panel Assembly
 Courtesy of GENERAL MOTORS COMPANY

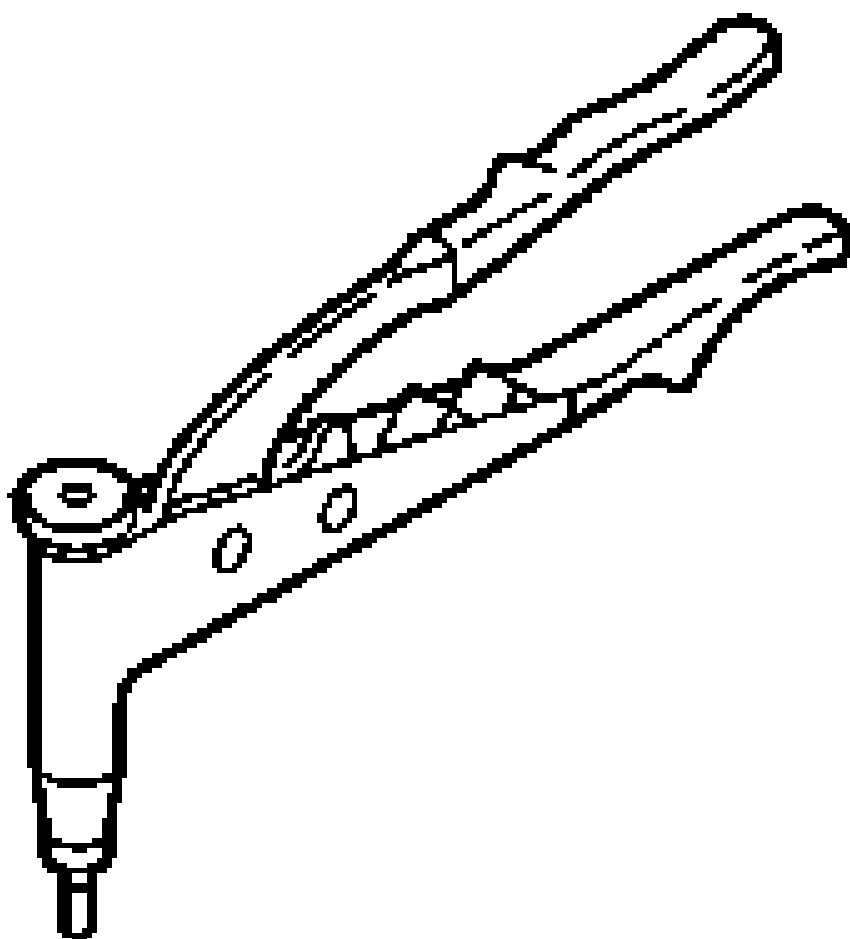
Liftgate Trim Panel Replacement

Callout	Component Name
1	Liftgate Trim Panel Screw (Qty: 1) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2 N.m (18 lb in)
2	Liftgate Trim Panel Clip (Qty: 8)
3	Liftgate Trim Panel Assembly (Qty: 9)

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description



BO-50048
KM-475-B
Trim
Remover

ACCESSORIES & EQUIPMENT

Remote Functions - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Remote Control Door Lock Receiver Nut	8	71 lb in

SCHEMATIC WIRING DIAGRAMS

REMOTE FUNCTION WIRING SCHEMATICS

Keyless Entry Wiring Schematics

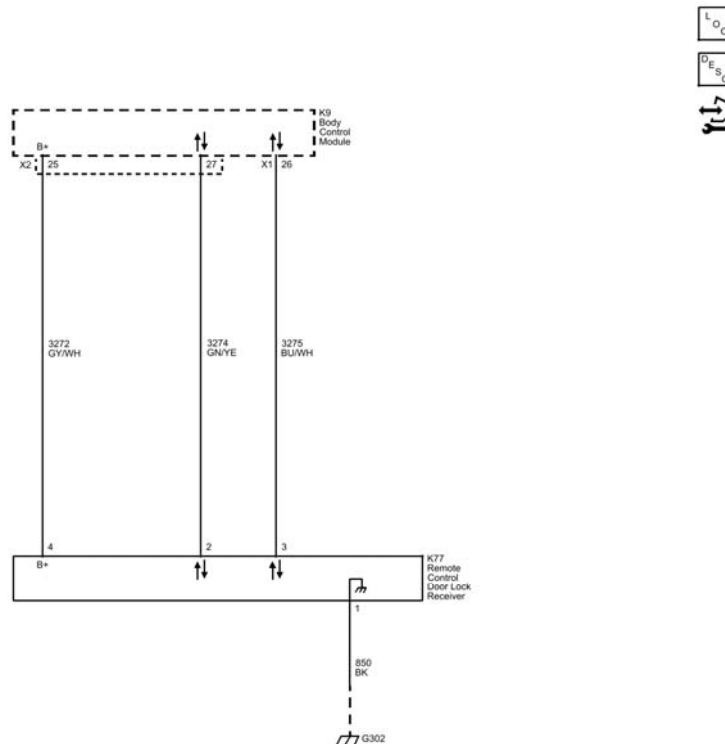


Fig. 1: Keyless Entry Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC B3101</u>	DTC B3101 Keyless Entry Data Link Circuit
<u>DTC B3105</u>	DTC B3105 Keyless Entry Transmitters
<u>DTC B3106</u>	DTC B3106 Keyless Entry Data Link
<u>DTC B3109-B3113</u>	DTC B3109 Keyless Entry Transmitter 1 Battery DTC B3110 Keyless Entry Transmitter 2 Battery DTC B3111 Keyless Entry Transmitter 3 Battery DTC B3112 Keyless Entry Transmitter 4 Battery DTC B3113 Keyless Entry Transmitter 5 Battery
<u>DTC B310D-B310F</u>	DTC B310D Keyless Entry Transmitter 6 Battery DTC B310E Keyless Entry Transmitter 7 Battery DTC B310F Keyless Entry Transmitter 8 Battery

DTC B3101: KEYLESS ENTRY DATA LINK

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B3101

Keyless Entry Data Link Circuit

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	B3101 00	B3101 00	-	-
Serial Data - Enable Line	B3101 00	B3101 00	B3101 00	B3101 00
Serial Data - Receive	B3101 00	B3101 00	B3101 00	B3101 00
Low Reference	-	B3101 00	-	-

Circuit/System Description

The body control module communicates with the remote control door lock receiver through the keyless entry serial data circuits. When any button on the keyless entry transmitter is pressed, the transmitter sends a signal to the remote control door lock receiver. The remote control door lock receiver sends a function request to the body control module, depending on which button is pressed on the transmitter. The body control module receives the message and performs the appropriate function.

Conditions for Running the DTC

The body control module monitors for this DTC at all times.

Conditions for Setting the DTC

No response is received from the remote control door lock receiver after the body control module requests information from or sends configuration commands to the remote control door lock receiver.

Action Taken When the DTC Sets

In the case of power loss, the remote control door lock receiver is disabled for 65 s. Otherwise no action is taken.

Conditions for Clearing the DTC

- A current DTC will clear when the fault is no longer present.
- A history DTC will clear after 40 consecutive ignition cycles without a fault present.

Reference Information

Schematic Reference

Remote Function Schematics

Component Connector End Views

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, scan tool disconnected, disconnect the harness connector at the K77 Remote Control Door Lock Receiver. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 30 ohms between the low reference circuit terminal 1 and ground.
 - **If 30 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If less than 30 ohms**
3. Ignition ON.
4. Test for greater than 11.5 V between the B+ circuit terminal 4 and ground.
 - **If 11.5 V or less**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If Infinite resistance.
 3. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If greater than 11.5 V**
5. Test for 1-6 V between the serial data circuit terminal 2 and ground.
 - **If less than 1 V**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the serial data circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the serial data circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If greater than 6 V**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the serial data circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.

- **If between 3-6 V**

6. Ignition OFF, disconnect the X1 and X2 harness connectors at the K9 Body Control Module, ignition ON.
7. Test for less than 1 V between the K9 Body Control Module serial data circuit terminal 26 X1 and ground.

- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

8. Ignition OFF.
9. Test for infinite resistance between the K9 Body Control Module serial data circuit terminal 26 X1 and ground.

- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

10. Test for less than 2 ohms between the K9 Body Control Module serial data circuit terminal 26 X1 and the K77 Remote Control Door Lock Receiver serial data circuit terminal 3.

- **If 2 ohms or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 ohms**

11. Replace the K77 Remote Control Door Lock Receiver.
12. Verify DTC B3101 does not set while operating the vehicle under the conditions for running the DTC.

- **If the DTC sets**

Replace the K9 Body Control Module

- **If the DTC does not set**

13. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for body control module or remote control door lock receiver replacement, programming, and setup.

DTC B3105: KEYLESS ENTRY TRANSMITTERS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B3105

Keyless Entry Transmitters

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

The body control module monitors the number of keyless entry transmitters programmed. Until at least one transmitter is programmed, the body control module determines a malfunction condition exists.

Conditions for Running the DTC

The body control module has been set up without transmitters being programmed.

Conditions for Setting the DTC

No keyless entry transmitter programmed to the body control module.

Action Taken When the DTC Sets

The keyless entry system is inoperative.

Conditions for Clearing the DTC

A current DTC is cleared when at least one transmitter has been programmed to the body control module.

Reference Information

Schematic Reference

Remote Function Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that the transmitter is a correct transmitter for the vehicle. This can be accomplished by comparing the part number printed on the transmitter to the appropriate part number in the parts catalog.
 - **If the transmitter is incorrect**

Replace the transmitter.
 - **If the transmitter is correct**
2. Program the transmitter. Refer to **Key with Integrated Transmitter Programming**.
3. Verify the transmitter has successfully completed the programming procedure.
 - **If the transmitter does not program successfully**

Replace the transmitter.
 - **If the transmitter programs successfully**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Key with Integrated Transmitter Programming

DTC B3106: KEYLESS ENTRY DATA LINK

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B3106

Keyless Entry Data Link

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

The body control module communicates with the remote control door lock receiver through the keyless entry serial data circuits. When any button on the keyless entry transmitter is pressed, the transmitter sends a signal to the remote control door lock receiver. The remote control door lock receiver sends a function request to the body control module, depending on which button is pressed on the transmitter. The body control module receives the message and performs the appropriate function.

Conditions for Running the DTC

A keyless transmitter button is pressed.

Conditions for Setting the DTC

The transmitter that is sending a signal to the remote control door lock receiver is different from those transmitters stored in the body control module.

Action Taken When the DTC Sets

No action is taken.

Conditions for Clearing the DTC

- A current DTC will clear when the fault is no longer present and the ignition switch is cycled.
- A history DTC will clear after 40 consecutive ignition cycles without a fault present.

Reference Information

Schematic Reference

Remote Function Schematics

Component Connector End Views

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. With a valid and learned transmitter, press and release a button on the transmitter.
2. Verify that DTC B3106 is not set.
 - **If DTC B3106 is set**

Replace the K77 Remote Control Door Lock Receiver.

- **If DTC B3106 is not set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for remote control door lock receiver replacement, programming, and setup.

DTC B3109-B3113: KEYLESS ENTRY TRANSMITTER 1-5 BATTERY

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B3109

Keyless Entry Transmitter 1 Battery

DTC B3110

Keyless Entry Transmitter 2 Battery

DTC B3111

Keyless Entry Transmitter 3 Battery

DTC B3112

Keyless Entry Transmitter 4 Battery

DTC B3113

Keyless Entry Transmitter 5 Battery

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

With each press of a keyless entry transmitter button, a message containing the current battery state of the transmitter is sent to the remote control door lock receiver, along with the commanded keyless entry function. The remote control door lock receiver sends this to the body control module to perform the requested function.

Conditions for Running the DTC

A keyless transmitter button is pressed.

Conditions for Setting the DTC

Three consecutive low battery signals are received from the same transmitter.

Action Taken When the DTC Sets

The keyless entry system is inoperative.

Conditions for Clearing the DTC

The DTC is cleared when a normal transmitter voltage signal is received from the transmitter that set the DTC.

Reference Information

Schematic Reference

Remote Function Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify none of the DTCs listed below are set:
 - DTC B3109
 - DTC B3110
 - DTC B3111
 - DTC B3112
 - DTC B3113
 - **If any of the DTCs are set**
1. Replace the battery in the appropriate keyless entry transmitter and operate the transmitter three consecutive times.
2. Verify the DTC does not set.
 - If the DTC sets, replace the keyless entry transmitter.
 - If the DTC does not set
3. All OK.
 - **If none of the DTCs are set**
2. All OK.

DTC B310D-B310F: KEYLESS ENTRY TRANSMITTER 6-8 BATTERY

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B310D

Keyless Entry Transmitter 6 Battery

DTC B310E

Keyless Entry Transmitter 7 Battery

DTC B310F

Keyless Entry Transmitter 8 Battery

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

With each press of a keyless entry transmitter button, a message containing the current battery state of the transmitter is sent to the remote control door lock receiver, along with the commanded keyless entry function. The remote control door lock receiver sends this to the body control module to perform the requested function.

Conditions for Running the DTC

A keyless transmitter button is pressed.

Conditions for Setting the DTC

Three consecutive low battery signals are received from the same transmitter.

Action Taken When the DTC Sets

The keyless entry system is inoperative.

Conditions for Clearing the DTC

The DTC is cleared when a normal transmitter voltage signal is received from the transmitter that set the DTC.

Reference Information

Schematic Reference

Remote Function Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify none of the DTCs listed below are set:
 - DTC B310D
 - DTC B310E
 - DTC B310F
 - **If any of the DTCs are set**
 1. Replace the battery in the appropriate keyless entry transmitter and operate the transmitter three consecutive times.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the keyless entry transmitter.
 - If the DTC does not set
 3. All OK.
 - **If none of the DTCs are set**
2. All OK.

SYMPTOMS - REMOTE FUNCTIONS

IMPORTANT: The following steps must be completed before using the symptom tables.

1. Perform **Diagnostic System Check - Vehicle** before using the Symptom Tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Keyless Entry System Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Keyless Entry System. Refer to **Checking Aftermarket Accessories**.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

Keyless Entry System Malfunction

KEYLESS ENTRY SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The keyless entry transmitter is part of the vehicle key. The keyless entry system will unlock the vehicle doors or open/unlock the rear compartment when a corresponding button on the keyless entry transmitter is pressed. This is accomplished by the keyless entry transmitter sending a radio frequency to the remote control door lock receiver, which then sends the signal to the body control module (BCM). The BCM interprets the signal and activates the requested function. A low transmitter battery or radio frequency (RF) interference from aftermarket devices such as 2-way radios, power inverters, cellular phone chargers, computers, etc. may cause a system malfunction. High RF traffic areas, such as gas stations which use pay-at-the-pump RF transponders, may also cause interference that could lead to a malfunction.

Diagnostic Aids

- Unwanted or inadvertent door lock/unlock activation may be requested by the OnStar® Remote Link app. It is possible that a customer may be unaware of account usage, result in an unwanted or phantom door lock/unlock. If normal system diagnosis does results in an inability to verify the customer's concern, contact Technical Assistance Center (TAC).
- If available, the EL 43241 Keyless Entry Tester may be used to diagnose a low transmitter battery or a malfunctioning transmitter. To test, place the transmitter on the test pad of the EL 43241 and press each transmitter button one at a time, holding each button for three seconds. If the green light on the tester does not illuminate and a tone does not sound, first replace the transmitter battery and retest. If the malfunction continues after replacing the transmitter battery, replace the transmitter.
- When using the EL 43241 Keyless Entry Tester, first inspect the keyless entry transmitter part number to determine that it is the correct model for the vehicle. An incorrect part number transmitter may pass the test, but it will not activate the keyless entry system.
- When the vehicle key is in the ignition, the keyless entry functions are disabled from all keyless entry transmitters.

Reference Information

Schematic Reference

Remote Function Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL 43241 Keyless Entry Tester

Circuit/System Verification

1. Verify that the vehicle key is correct for the vehicle. This can be accomplished by comparing the part number printed on the key to the appropriate part number in the parts catalog.
 - **If the vehicle key is incorrect**

Replace the vehicle key.
 - **If the vehicle key is correct**
2. Operate the transmitter while observing the scan tool Key Fob Function parameter for the appropriate transmitter.
3. Verify the scan tool Key Fob Function parameter corresponds with the function selected on the transmitter.
 - **If the Key Fob Function parameter does not correspond with the transmitter selection**

NOTE: Before replacing the transmitter, inspect the transmitter battery

contacts for any corrosion or damage. If no corrosion or damage is found, replace the transmitter battery and retest before replacing the transmitter.

1. Replace the vehicle key.
2. Operate the new transmitter while observing the scan tool Key Fob Function parameter for the transmitter.
3. Verify the scan tool Key Fob Function parameter correspond with the function selected on the transmitter.
 - If the Key Fob Function parameter does not correspond with the transmitter selection, replace the K9 Body Control Module
 - If the Key Fob Function parameter corresponds with the transmitter selection
4. All OK.
 - **If the Key Fob Function parameter corresponds with the transmitter selection**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Key with Integrated Transmitter Programming**
- **Control Module References** for body control module replacement, programming, and setup

REPAIR INSTRUCTIONS

REMOTE CONTROL DOOR LOCK RECEIVER REPLACEMENT

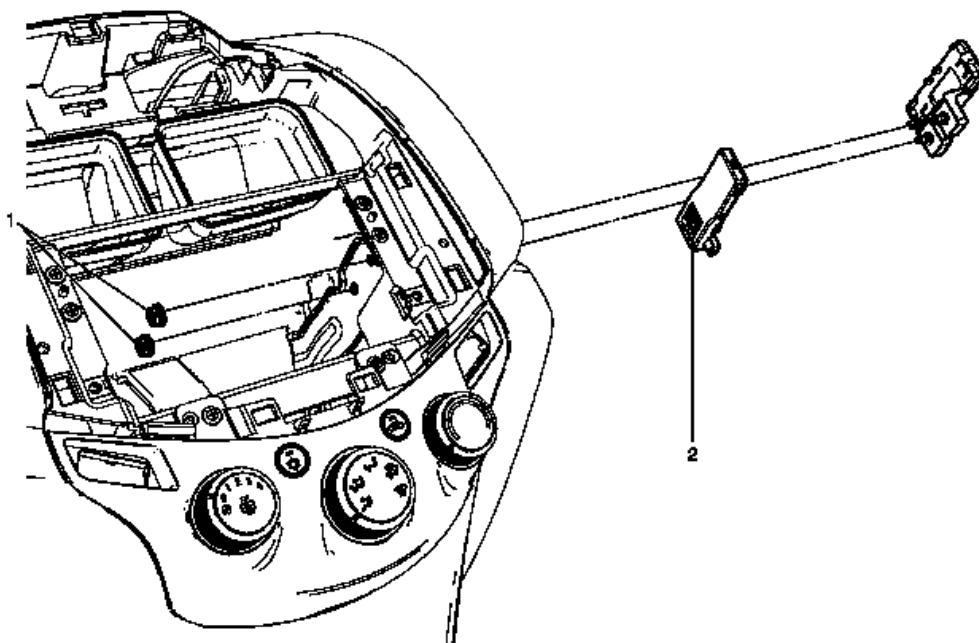


Fig. 2: Remote Control Door Lock Receiver
 Courtesy of GENERAL MOTORS COMPANY

Remote Control Door Lock Receiver Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the instrument panel compartment. Refer to <u>Instrument Panel Compartment Replacement</u> . 2. Remove the radio. Refer to <u>Radio Replacement</u> .	
1	Remote Control Door Lock Receiver Nut (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 8 (71 lb in)
2	Remote Control Door Lock Receiver Procedure 1. Disconnect the electrical connector. 2. Remove the remote control door lock receiver and bracket assembly. 3. Remove the remote control door lock receiver from the bracket.

DESCRIPTION AND OPERATION

KEYLESS ENTRY SYSTEM DESCRIPTION AND OPERATION

The keyless entry system is a vehicle entry device. The keyless entry system is used in conjunction with the door locks to unlock the vehicle. Keyless entry will lock/unlock the vehicle doors or open the rear compartment lid when a corresponding button on the keyless entry transmitter is pressed. This is accomplished by the transmitter sending a radio frequency to the remote control door lock receiver antenna that has a direct link to the body control module (BCM). The BCM interprets the signal and activates the requested function or request the appropriate control module to activate the function via a serial data message. A low transmitter battery or radio frequency interference from aftermarket devices, such as 2-way radios, power inverters, computers, etc., may cause a system malfunction. High radio frequency traffic areas, such as gas stations that use pay-at-the-pump radio frequency transponders, may also cause interference that could lead to a malfunction. Keyless entry allows you to operate the following features:

- Door lock/unlock
- Liftgate lock/unlock, if equipped
- Trunk release, if equipped
- Power liftgate, if equipped
- Panic alarm/vehicle locator
- Remote vehicle starting, if equipped

The keyless entry system has the following components:

- Keyless entry transmitters
- Body control module
- Remote control door lock receiver

Keyless Entry Transmitters

NOTE: When the vehicle key is in the ignition, keyless entry functions from all keyless entry transmitter are disabled.

The keyless entry transmitters are used to perform various entry functions while away from the immediate area of the vehicle. Keyless entry functions may work at up to 20 m (65 ft) away from the vehicle. Ambient conditions may affect the performance of the keyless entry transmitter and reduce the range at which keyless entry functions operate. Up to eight transmitters may be programmed to a single vehicle. The keyless entry transmitter is an integral part of the vehicle key.

OnStar® Remote Link (if equipped)

A vehicle operator may have the ability to perform some of the keyless entry functions using applications on personal devices such as a smart phone. Unwanted or inadvertent door lock/unlock activation may be requested by the OnStar® Remote Link application. It is possible that a customer may be unaware of account usage, resulting in an unwanted or phantom door lock/unlock. If normal system diagnosis results in an inability to

verify the customer's concern, contact Technical Assistance Center (TAC).

Body Control Module (BCM)

The BCM is a multifunction module that operates the keyless entry system. When a radio frequency message is received from a keyless entry transmitter, the BCM interprets this signal and performs the specific function, i.e. door lock, door unlock, or vehicle locate.

Remote Control Door Lock Receiver

The remote control door lock receiver acts as an antenna for the keyless entry system and communicates with the BCM through a dedicated serial data link. When a button is pressed on a keyless entry transmitter, the remote control door lock receiver receives this signal and sends the request to the BCM. The BCM interprets the signal and performs the specific function, i.e. door lock, door unlock, or vehicle locate.

Unlock Doors

Momentarily press the transmitter UNLOCK button in order to perform the following functions:

- Unlock only the driver door or all doors and liftgate (if equipped); this is customized through the driver information center.
- Illuminate the interior lamps for a determined length of time or until the ignition is turned ON.
- Flash the exterior lights; this is customized through the driver information center.
- Disarm the content theft deterrent system, if equipped.
- Deactivate the content theft deterrent system when in the alarm mode.

Lock All Doors

Press the transmitter LOCK button to perform the following functions:

- Lock all vehicle doors.
- Immediately turn OFF the interior lamps.
- Flash the exterior lights and/or sound the horn; this is customized through the driver information center.
- Arm the content theft deterrent system.

Trunk Release, if equipped

Press the trunk release button on the transmitter to open the trunk.

Power Liftgate, if equipped

Press and hold the power liftgate button to perform the following functions:

- Open or close the liftgate using the power liftgate function.
- Flash the tail lamps.
- Sound the interior power liftgate chime.

Vehicle Locator/Panic Alarm

A single press of the panic button performs the following functions. Some functions may be dependent on personalization settings:

- Pulse the horn three times.
- Flash the exterior lamps three times.

A press and hold of the panic button performs the following functions:

- Illuminate the interior lamps.
- Pulse the horn and flash the exterior lamps for 30 seconds or until the following conditions occur:
 - The panic button is pressed.
 - The ignition switch is turned to the RUN position with a valid key.

Remote Vehicle Start, if equipped

The remote vehicle start function allows engine starting while not in the vehicle. It also allows the vehicle HVAC system and other vehicle systems to enable, providing a comfortable vehicle upon entry. The remote vehicle start sequence begins by pressing and releasing the lock button and then pressing and holding the remote vehicle start buttons on the keyless entry transmitter. The turn signal lamps will illuminate to indicate the vehicle has received the remote start request. Each time a remote vehicle start is performed, the vehicle doors are locked, however they may then be unlocked/locked with the transmitter at any time. Only the first and second vehicle transmitters are able to control the remote vehicle start function. Any additional remote transmitters programmed to the vehicle will perform all other remote functions. Once activated, the engine is allowed to run for 10 minutes. The remote vehicle start time may be extended by an additional 10 minutes by again pressing and releasing the lock button and then pressing and holding the remote vehicle start buttons on the transmitter. This feature is called a remote vehicle start continue and allows a maximum of 20 minutes of engine running. If the remote vehicle start continue is performed at 7 minutes into the initial 10 minute time-out, a total of 17 minutes of engine running would occur. The remote vehicle start event may be suspended at any time by pressing only the remote vehicle start button on the transmitter or by entering the vehicle and turning ON the hazard lamps.

In between ignition cycles, only two remote vehicle start events may occur or be attempted. Once two events or attempts have been made, future remote vehicle start events will be suspended until the vehicle is started using the ignition.

Enable/Disable Remote Vehicle Start

Using the driver information center, remote vehicle start may be enabled or disabled as a part of vehicle personalization. Refer to the vehicle owners manual for more information.

Hood Ajar Switch

The hood switch provides status of the hood to the BCM for remote vehicle start purposes. The switch is integrated into the hood latch assembly.

Remote Vehicle Start Circuit Description

The BCM receives a signal from the keyless entry transmitter indicating a remote vehicle start request. A message is then sent to the BCM which determines if a crank request message will be sent to the ECM to allow engine starting. To determine if conditions are correct for a remote vehicle start event, the BCM will ensure the following conditions are met:

- A valid hood ajar switch closed signal is present.
- The doors are locked.
- The low fuel warning light is off.
- The hazard switch is OFF.
- The vehicle power mode is correct.
- No content theft deterrent alarm triggers are present.

When the BCM determines all conditions meet those required for a remote vehicle start event, a message is sent via serial data to the ECM. The ECM relies on the remote vehicle start message from the BCM to enable remote vehicle start when the crank request signal is received. If the ECM does not receive a valid remote vehicle start message, it will not attempt to start the engine. While the ECM is in remote vehicle start mode it will suspend engine operation if any of the following additional conditions occur:

- Vehicle speed is greater than 0
- Transmission is not in PARK
- Excessive engine coolant temperature
- Low oil pressure
- The malfunction indicator lamp (MIL) is commanded ON
- Engine crank time is greater than 30 seconds
- Excessive engine speed
- Accelerator pedal position too high
- Remote start timer equals 0
- Immobilizer system indicates tamper

Keyless Entry Personalization

Vehicle lock/unlock functions and remote vehicle start settings may be personalized. For functional descriptions and personalization instructions, refer to the vehicle owners manual.

ACCESSORIES & EQUIPMENT

Lighting - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Headlamp Screw	2.5 N.m	22 lb in
Rear License Plate Lamp Screw	2.0 N.m	18 lb in
Tail Lamp Screw	2.5 N.m	22 lb in

SCHEMATIC WIRING DIAGRAMS

HEADLIGHTS/DAYTIME RUNNING LIGHTS (DRL) WIRING SCHEMATICS

Headlamps Wiring Schematics

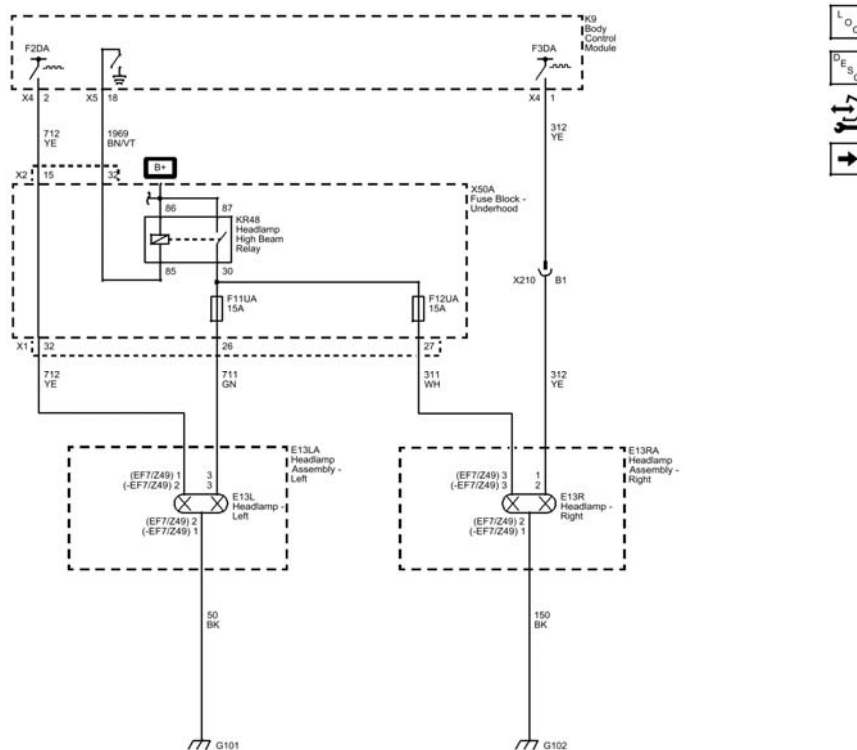


Fig. 1: Headlamps Wiring Schematic

Courtesy of GENERAL MOTORS COMPANY

Controls and Indicators Wiring Schematics

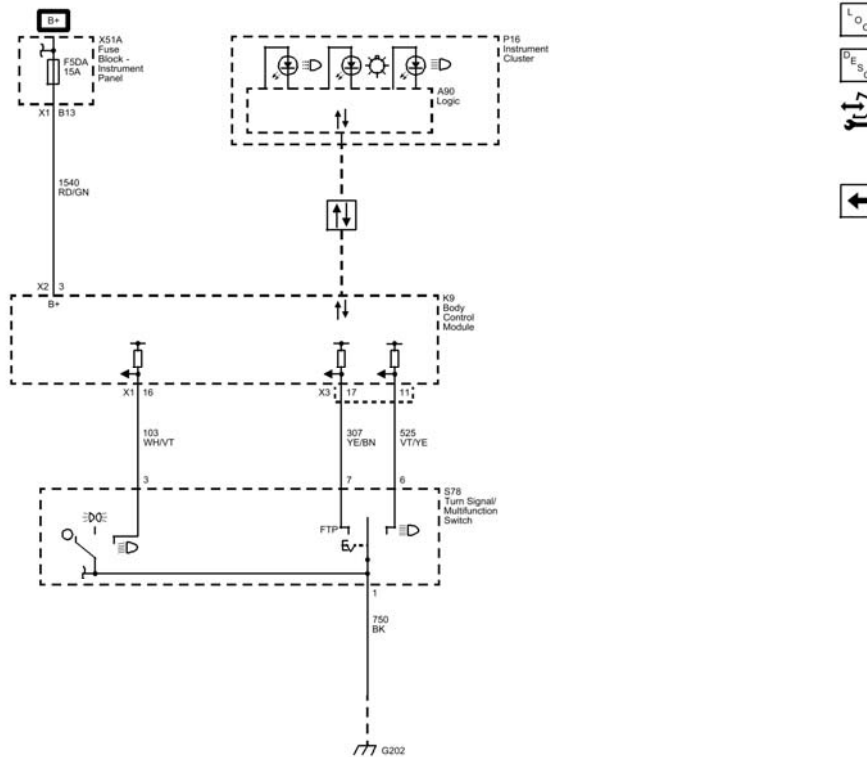


Fig. 2: Controls and Indicators Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

FOG LIGHTS WIRING SCHEMATICS

Fog Lamps Wiring Schematics

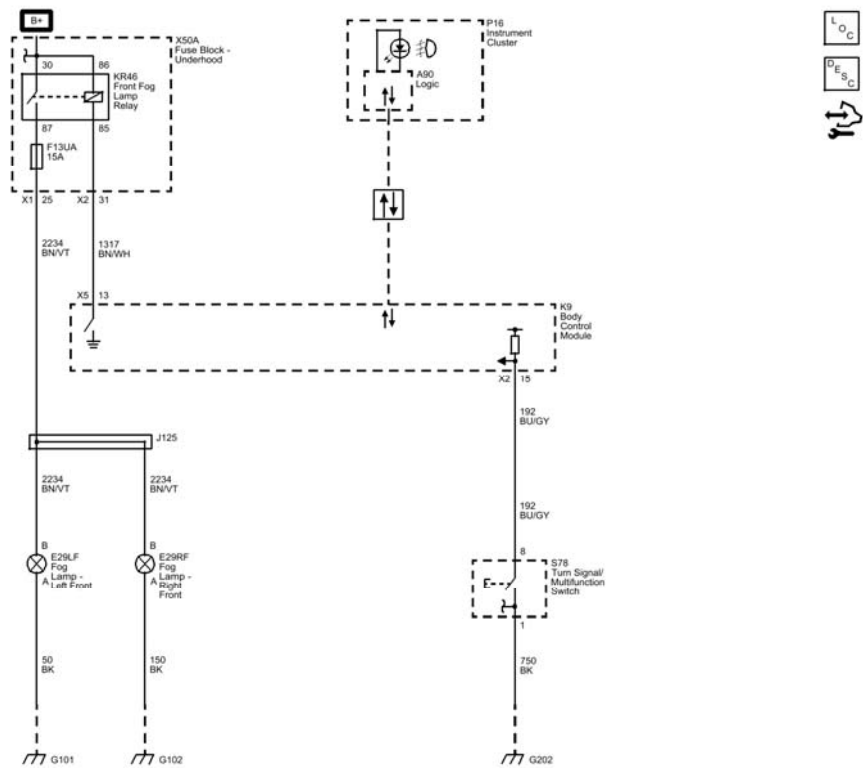


Fig. 3: Fog Lamps Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

EXTERIOR LIGHTS WIRING SCHEMATICS

Park, Turn, Hazard, Brake Lamp Controls and Indicators Wiring Schematics

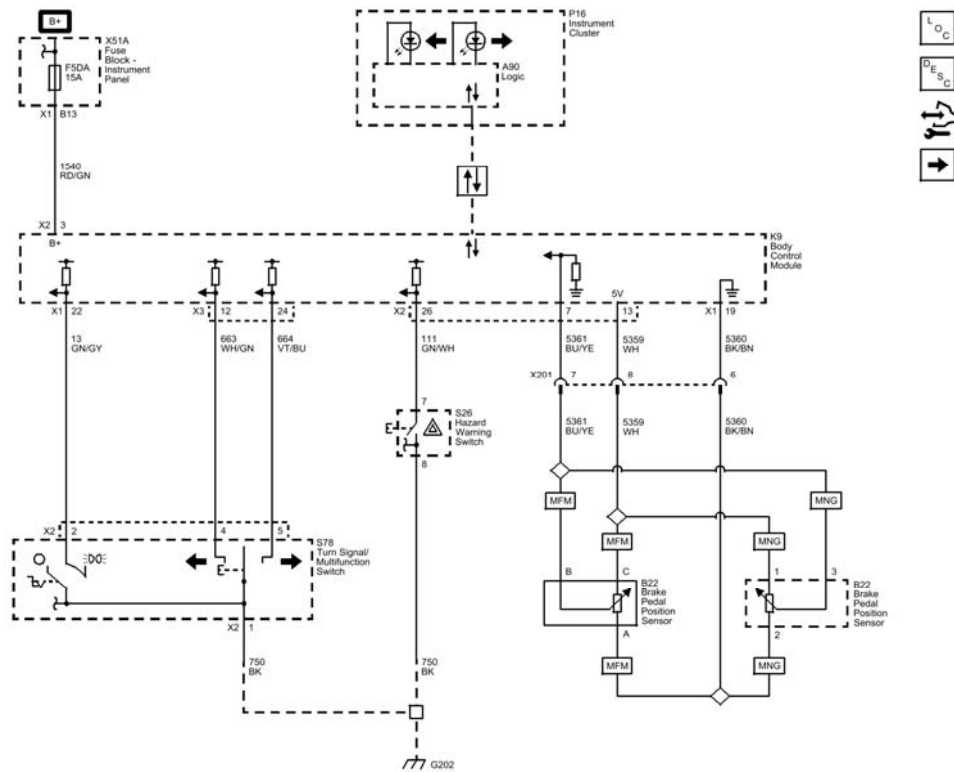


Fig. 4: Park, Turn, Hazard, Brake Lamp Controls and Indicators Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Park Lamps and Front Turn Signal Lamps Wiring Schematics

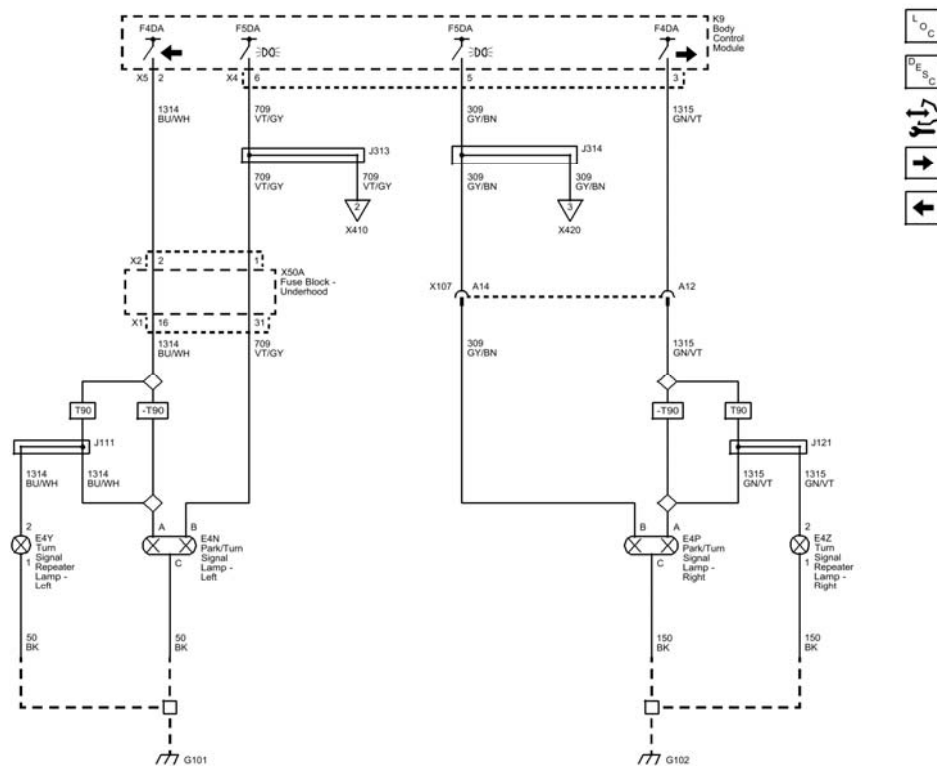


Fig. 5: Park Lamps and Front Turn Signal Lamps Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Tail, Stop, and Rear Turn Signal Lamps Wiring Schematics

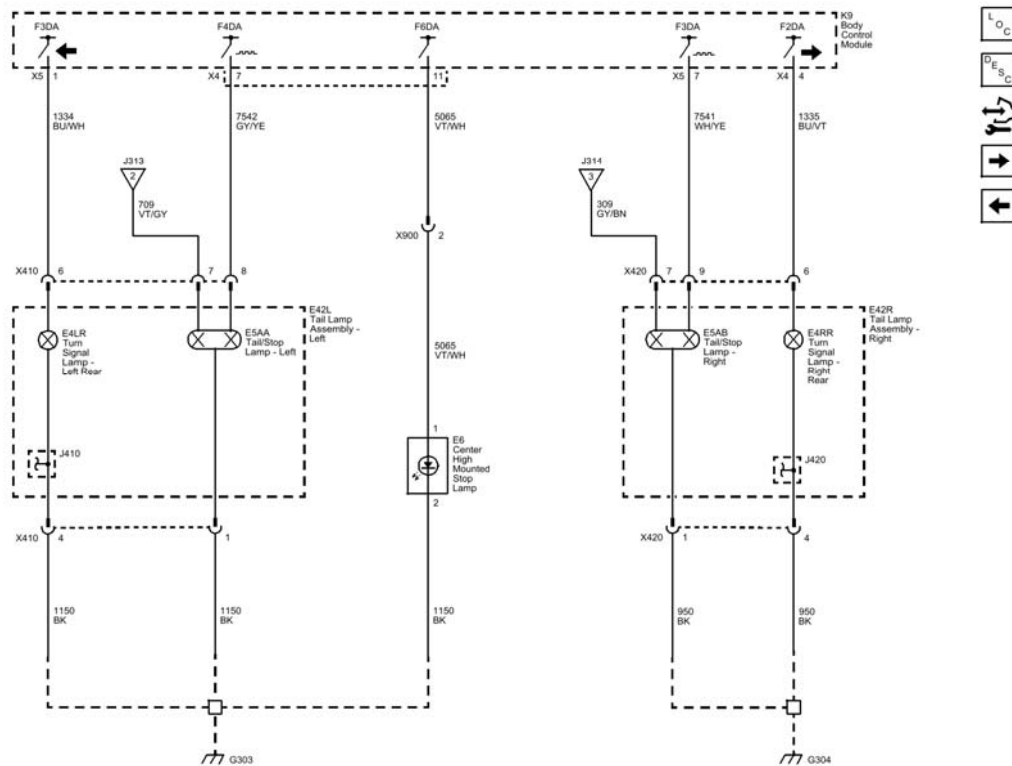


Fig. 6: Tail, Stop, and Rear Turn Signal Lamps Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

License and Backup Lamps Wiring Schematics

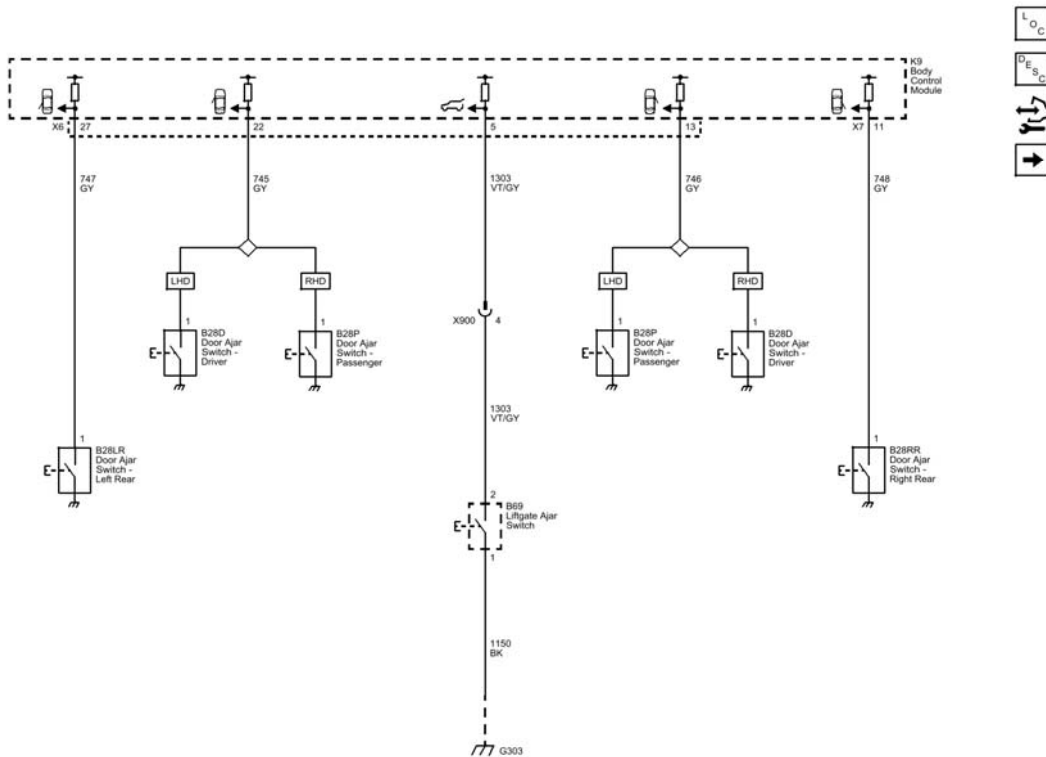


Fig. 8: Controls Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Dome Lamps Wiring Schematics

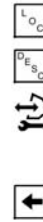
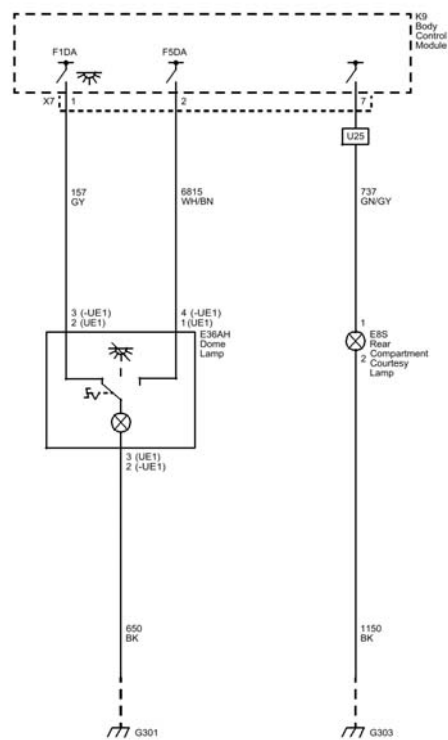
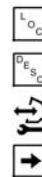


Fig. 9: Dome Lamps Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

INTERIOR LIGHTS DIMMING WIRING SCHEMATICS

Dimmer Switch and I/P Wiring Schematics



Doors, Seats and Center Console Wiring Schematics

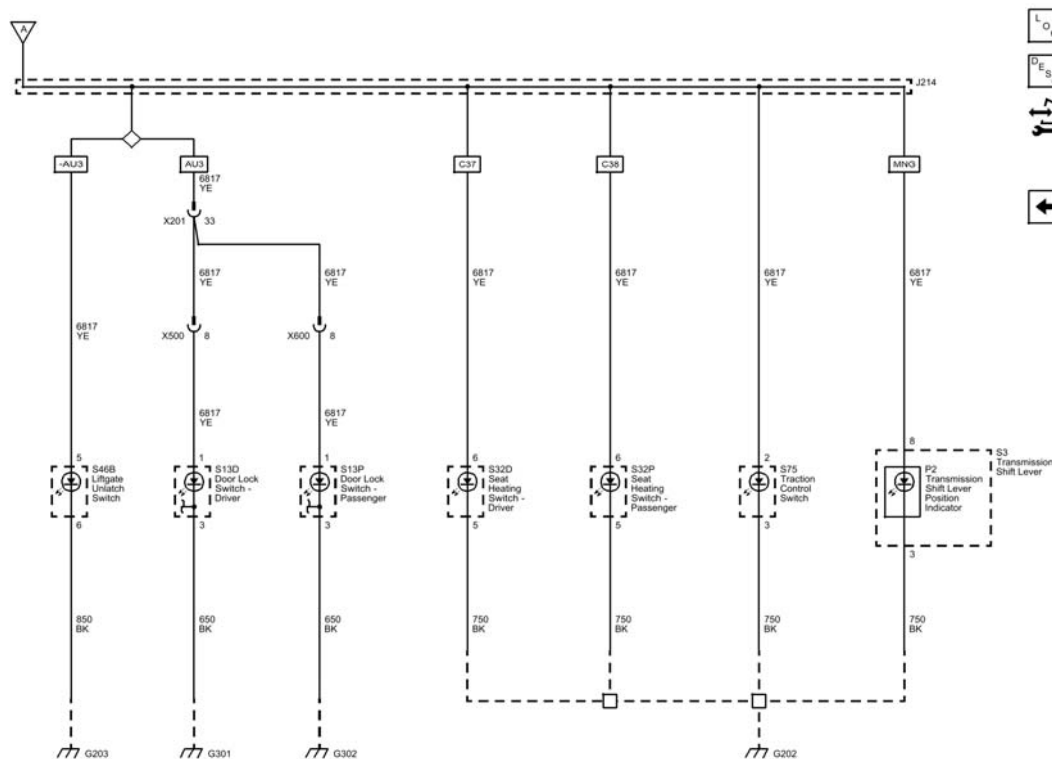


Fig. 11: Doors, Seats and Center Console Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC B1395</u>	DTC B1395 03 Control Module Voltage Reference Output 1 Circuit Low Voltage DTC B1395 07 Control Module Voltage Reference Output 1 Circuit High Voltage
<u>DTC B1480</u>	DTC B1480 02 Battery Rundown Protection Circuit Short to Ground
<u>DTC B2530</u>	DTC B2530 01 Front Fog Lamps Control Circuit Short to Battery DTC B2530 02 Front Fog Lamps Control Circuit Short to Ground DTC B2530 04 Front Fog Lamps Control Circuit Open
	DTC B2545 01 Backup Lamps Circuit Short to Battery

<u>DTC B2545</u>	DTC B2545 02 Backup Lamps Circuit Short to Ground DTC B2545 04 Backup Lamps Circuit Open
<u>DTC B2570</u>	DTC B2570 02 Trunk Lamp Control Circuit Short to Ground
<u>DTC B2575 or B2699</u>	DTC B2575 01 Headlamps Control Circuit Short to Battery DTC B2575 02 Headlamps Control Circuit Short to Ground DTC B2575 04 Headlamps Control Circuit Open DTC B2699 01 Right Headlamp Control Circuit Short to Battery DTC B2699 02 Right Headlamp Control Circuit Short to Ground DTC B2699 04 Right Headlamp Control Circuit Open
<u>DTC B257A</u>	DTC B257A 00 Headlamp Switch Input Signals Correlation Malfunction
<u>DTC B2580</u>	DTC B2580 01 Headlamp High Beam Control Circuit Short to Battery DTC B2580 02 Headlamp High Beam Control Circuit Short to Ground DTC B2580 04 Headlamp High Beam Control Circuit Open
<u>DTC B2585 or B3867</u>	DTC B2585 01 Left Park Lamps Control Circuit Short to Battery DTC B2585 02 Left Park Lamps Control Circuit Short to Ground DTC B2585 04 Left Park Lamps Control Circuit Open DTC B3867 01 Right Park Lamps Control Circuit Short to Battery DTC B3867 02 Right Park Lamps Control Circuit Short to Ground DTC B3867 04 Right Park Lamps Control Circuit Open
<u>DTC B2610</u>	DTC B2610 01 Passenger Compartment Dimming 1 Circuit Short to Battery DTC B2610 02 Passenger Compartment Dimming 1 Circuit Short to Ground DTC B2610 04 Passenger Compartment Dimming 1 Circuit Open
<u>DTC B2615</u>	DTC B2615 02 Passenger Compartment Dimming 2 Circuit Short to Ground
<u>DTC B2625</u>	DTC B2625 01 Display Dimming Pulse Width Modulation Output Circuit Short to Battery DTC B2625 02 Display Dimming Pulse Width Modulation Output Circuit Short to Ground

	DTC B2625 04 Display Dimming Pulse Width Modulation Output Circuit Open
<u>DTC B2652</u>	DTC B2652 02 Passenger Compartment Dimming 3 Circuit Short to Ground
<u>DTC B3596</u>	DTC B3596 00 Hazard Lamps Request Circuit Malfunction
<u>DTC B3600</u>	DTC B3600 03 Passenger Compartment Dimming Request Signal Circuit Low Voltage DTC B3600 07 Passenger Compartment Dimming Request Signal Circuit High Voltage
<u>DTC B3650</u>	DTC B3650 08 High Beam Request Signal Circuit Performance - Signal Invalid
<u>DTC B3806</u>	DTC B3806 00 High Beam and Headlamp Flash Select Circuit Malfunction
<u>DTC B3881 or B3882</u>	DTC B3881 01 Tail Lamp Circuit Short to Battery DTC B3881 02 Tail Lamp Circuit Short to Ground DTC B3881 04 Tail Lamp Circuit Open DTC B3882 01 Right Tail Lamp Circuit Short to Battery DTC B3882 02 Right Tail Lamp Circuit Short to Ground DTC B3882 04 Right Tail Lamp Circuit Open
<u>DTC B3883</u>	DTC B3883 01 License Plate Lamp Circuit Short to Battery DTC B3883 02 License Plate Lamp Circuit Short to Ground DTC B3883 04 License Plate Lamp Circuit Open
<u>DTC B3884</u>	DTC B3884 02 Center High Mounted Brake Lamp Circuit Short to Ground
<u>DTC B3948 or B3949</u>	DTC B3948 01 Left Front Turn Signal Circuit Short to Battery DTC B3948 02 Left Front Turn Signal Circuit Short to Ground DTC B3948 04 Left Front Turn Signal Circuit Open DTC B3949 01 Right Front Turn Signal Circuit Short to Battery DTC B3949 02 Right Front Turn Signal Circuit Short to Ground DTC B3949 04 Right Front Turn Signal Circuit Open
<u>DTC B3950 or B3951</u>	DTC B3950 01 Left Rear Turn Signal Circuit Short to Battery DTC B3950 02 Left Rear Turn Signal Circuit Short to Ground DTC B3950 04 Left Rear Turn Signal Circuit Open DTC B3951 01 Right Rear Turn Signal Circuit Short to Battery

	DTC B3951 02 Right Rear Turn Signal Circuit Short to Ground DTC B3951 04 Right Rear Turn Signal Circuit Open
<u>DTC C0277 or C0890</u>	DTC C0277 06 Brake Pedal Position Sensor Circuit Low Voltage/Open DTC C0277 07 Brake Pedal Position Sensor Circuit High Voltage DTC C0277 09 Brake Pedal Position Sensor Circuit Too Fast Transitions DTC C0277 4B Brake Pedal Position Sensor Circuit Calibration Not Learned DTC C0890 03 Control Module Voltage Reference Output 3 Circuit Low Voltage DTC C0890 07 Control Module Voltage Reference Output 3 Circuit High Voltage
<u>DTC C0297</u>	DTC C0297 02 Brake Applied Output Circuit Short to Ground

DTC B1395: CONTROL MODULE VOLTAGE REFERENCE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B1395 03

Control Module Voltage Reference Output 1 Circuit Low Voltage

DTC B1395 07

Control Module Voltage Reference Output 1 Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F1DA (BCM 1) Fuse B+	B101E 43, B1395 03, B1517 07, C0890 03, U0121 00,	B101E 43, B1395 03, B1517 07, C0890 03, U0121 00,	-	-
Instrument Panel Dimmer	B1395 03,	B3600 03	B1395 07	-

Switch B+ Reference	B3600 03,			
Instrument Panel Dimmer Switch Signal	B1395 03, B3600 03,	B3600 03	B3600 07	-
Instrument Panel Dimmer Switch Low Reference	1	1	1	-
1. Interior Backlighting Malfunction				

Circuit/System Description

The instrument panel dimmer switch is used to increase and decrease the brightness of the interior backlighting components. The instrument panel dimmer switch provides a voltage signal to the body control module (BCM) that will increase as the brightness of the lights are increased and decrease as the brightness of the lights are decreased. The BCM provides B+, low reference, and signal circuits to the instrument panel dimmer switch. When the instrument panel dimmer switch is placed in the desired position, the dimmed voltage setting is applied from the instrument panel dimmer switch through the instrument panel dimmer switch signal circuit to the BCM. The BCM interprets the signal and applies a pulse width modulated (PWM) voltage through the LED dimming 1 and dimming 2 control circuits illuminating the interior backlighting to the requested level of brightness.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Park Lamps ON.

Conditions for Setting the DTC

DTC B1395 03

- The BCM detects a short to ground in the instrument panel dimmer switch B+ reference circuit.
- The BCM detects a short to ground in the instrument panel dimmer switch signal circuit.
- The BCM detects a short to ground or an open/high resistance in the F1DA (BCM 1) fuse B+ circuit.

DTC B1395 07

The BCM detects a short to voltage in the instrument panel dimmer switch B+ reference circuit.

Actions Taken When the DTC Sets

The BCM will not dim any interior backlighting. All interior backlighting will default to maximum brightness.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

- **Interior Lights Dimming Schematics**
- **Body Control System Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the S36 Instrument Panel Dimmer Switch, ignition ON.
2. Verify a test lamp illuminates between the low reference circuit terminal 2 and B+.
 - **If the test lamp does not illuminate**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the low reference circuit terminal 2 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If the test lamp illuminates**
3. Test for B+ between the B+ reference circuit terminal 1 and ground.
 - **If less than B+**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the B+ reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance
- 3. Test for less than 2 ohms in the B+ reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
- **If B+**
- 4. Verify a test lamp does not illuminate between the B+ reference circuit terminal 1 and ground.
 - **If the test lamp illuminates**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the B+ reference circuit terminal 2 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp does not illuminate**
- 5. Park lamps ON, verify a test lamp does not illuminate between the signal circuit terminal 3 and ground.
 - **If the test lamp illuminates**
 1. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit terminal 3 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp does not illuminate**
- 6. Ignition ON, park lamps OFF, test for between 57.4 K ohms and 58 K ohms between the signal circuit terminal 3 and ground.
 - **If not between 57.4 K ohms and 58 K ohms**
 1. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If between 57.4 K ohms and 58 K ohms**
- 7. Test or replace the S36 Instrument Panel Dimmer Switch.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Instrument Panel Multifunction Switch Replacement**
- **Control Module References** for BCM replacement, programming, and setup

DTC B1480: BATTERY RUNDOWN PROTECTION CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B1480 02

Battery Rundown Protection Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Dome Lamps Control	B2615 02	2	2	-
Reading Lamps Control	B1480 02	1	1	-
Dome Lamp Ground	-	1, 2	-	-
1. Courtesy Lamps Malfunction 2. Dome Lamps Malfunction				

Circuit/System Description

The body control module (BCM) supplies battery voltage to the reading lamps via the courtesy lamp control circuit. The front reading lamps controlled by an individual switch that is activated by the operator when additional cabin lighting is required. In the event that the reading lamp were to remain illuminated for more than 10 min with the ignition switch in the OFF position the BCM will deactivate the reading lamp control circuit to prevent total battery discharge.

Conditions for Running the DTC

Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

The BCM detects a short to ground in the reading lamp control circuit.

Actions Taken When the DTC Sets

The BCM will disable the circuit and the reading lamp will be inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.

- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

- **Interior Lights Schematics**
- **Body Control System Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, exterior lamps OFF, disconnect the harness connectors at the E36AH Dome Lamp.
2. Connect a test lamp between the appropriate control circuit terminal listed below and ground.
 - E36AH Dome Lamp - terminal 1 (with UE1)
 - E36AH Dome Lamp - terminal 4 (without UE1)
3. Verify the test lamp turns ON and OFF when commanding the Inadvertent Load ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X7 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, replace the K9 Body Control Module.
- **If the test lamp is always ON**
 1. Ignition OFF, disconnect the X7 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 body control module.
- **If the test lamp turns ON and OFF**
- 4. Test or replace the E36AH Dome Lamp.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Center Courtesy Lamp Replacement**
- **Control Module References** for BCM replacement, programming, and setup

DTC B2530: FRONT FOG LAMPS CONTROL CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B2530 01

Front Fog Lamps Control Circuit Short to Battery

DTC B2530 02

Front Fog Lamps Control Circuit Short to Ground

DTC B2530 04

Front Fog Lamps Control Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F13UA (FRT FOG) Fuse B+	1	1	-	-
Front Fog Lamp Switch Signal	1	1	1	-

Front Fog Lamp Relay Control	B2530 02, B2530 04	B2530 02, B2530 04	B2530 01	-
Front Fog Lamp Control	1	1	1	-
Front Fog Lamp Ground - Left	-	1	-	-
Front Fog Lamp Ground - Right	-	1	-	-
Turn Signal/Multifunction Switch Ground	-	1	-	-
1. Front Fog Lamps Malfunction				

Circuit/System Description

The front fog lamp relay is supplied with battery voltage at all times. The front fog lamp switch signal circuit is grounded momentarily by pressing the front fog lamp switch. The body control module (BCM) energizes the front fog lamp relay by applying ground to the front fog lamp relay control circuit. When the front fog lamp relay is energized, the relay switch contacts close and battery voltage is applied through the front fog lamps fuse to the front fog lamp control circuit which illuminates the front fog lamps.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Front fog lamps ON.

Conditions for Setting the DTC

DTC B2530 01

The BCM detects a short to voltage in the front fog lamp relay control circuit for 5 seconds or greater.

DTC B2530 02

The BCM detects a short to ground in the front fog lamp relay control circuit.

DTC B2530 04

The BCM detects an open in the front fog lamp relay control circuit.

Actions Taken When the DTC Sets

DTC B2530 01 and B2530 04

The front fog lamps will not operate when the park lamps are ON and the front fog lamp switch is active.

DTC B2530 02

The front fog lamps always ON.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Fog Lights Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the KR46 front fog lamp relay, ignition ON.
2. Verify a test lamp illuminates between the B+ circuit terminal 30 and ground.
 - **If the test lamp does not illuminate**

Replace the X50A fuse block - underhood.

- **If the test lamp illuminates**

3. Verify a test lamp illuminates between the B+ circuit terminal 86 and ground.
 - **If the test lamp does not illuminate**

Replace the X50A fuse block - underhood.

- **If the test lamp illuminates**

4. Ignition OFF, connect a test lamp between the control circuit terminal 85 and B+, ignition ON.
5. Verify the test lamp turns ON and OFF when commanding the Front Fog Lamps ON and OFF with a scan

tool.

- **If the test lamp is always OFF**

1. Ignition OFF, disconnect the X5 harness connector at the K9 body control module, ignition ON.
2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Ignition OFF.
4. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.

- **If the test lamp is always ON**

1. Ignition OFF, disconnect the X5 harness connector at the K9 body control module.
2. Test for infinite resistance between the control circuit terminal and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 body control module.

- **If the test lamp turns ON and OFF**

6. Test or replace the KR46 front fog lamp relay.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Relay Replacement (Within an Electrical Center)** , **Relay Replacement (Attached to Wire Harness)**
- **Fuse Block Replacement**
- **Control Module References** for BCM replacement, programming, and setup

DTC B2545: BACKUP LAMPS CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B2545 01

Backup Lamps Circuit Short to Battery

DTC B2545 02

Backup Lamps Circuit Short to Ground

DTC B2545 04

Backup Lamps Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F6DA (BCM 6) Fuse B+	B2545 01, B2545 04, B2615 02	B2545 01, B2545 04, B2615 02	-	-
Backup Lamp Switch Signal (Manual Transmission)	P0812	P0812	1	-
Backup Lamps Control	B2545 02	B2545 01, B2545 04	B2545 01	-
Backup Lamp Switch Ground (Manual Transmission)	-	P0812	-	-
Backup Lamp Ground - Left	-	1	-	-
Backup Lamp Ground - Right	-	1	-	-
1. Backup Lamps Malfunction				

Circuit/System Description

Automatic Transmission

With the engine running and the transmission in the reverse position, the transmission control module (TCM) sends a serial data message to the body control module (BCM). The message indicates that the gear selector is in the reverse position. The BCM applies battery voltage to the backup lamps control circuit illuminating the backup lamps. Once the driver moves the gear selector out of the reverse position, a message is sent by the TCM via serial data requesting the BCM to remove battery voltage from the backup lamps control circuit. The engine must be running for the backup lamps to operate.

Manual Transmission

The engine control module (ECM) provides a signal circuit to the backup lamp switch which is permanently grounded. With the engine running and the transmission in the reverse position, the backup lamp switch signal circuit is pulled low and the ECM responds by sending a serial data message to the body control module (BCM). The message indicates that the gear selector is in the reverse position. The BCM applies battery voltage to the backup lamps control circuit illuminating the backup lamps. Once the driver moves the gear selector out of the reverse position, a message is sent by the ECM via serial data requesting the BCM to remove battery voltage from the backup lamps control circuit. The engine must be running for the backup lamps to operate.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.

- Engine RUNNING.
- Transmission placed in REVERSE gear.

Conditions for Setting the DTC

DTC B2545 01 and DTC B2545 04

- The BCM detects an open/high resistance in the backup lamps control circuit.
- The BCM detects a short to ground or an open/high resistance in the F6DA (BCM 6) fuse B+ circuit.

DTC B2545 02

The BCM detects a short to ground in the backup lamps control circuit.

Actions Taken When the DTC Sets

DTC B2545 02 and B2545 04

The backup lamps will not operate.

DTC B2545 01

The backup lamps are always ON.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Diagnostic Aids

When testing at the backup lamp bulb socket, make sure all measurements and test lamp connections are in the correct terminal location and do not come in contact with each other during testing.

Reference Information

Schematic Reference

Exterior Lights Schematics

Body Control System Schematics

Connector End View Reference

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Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the X5 harness connector at the K9 body control module, ignition ON.
2. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 body control module.
 - **If the test lamp illuminates**
3. Ignition OFF, connect the X5 harness connector at the K9 body control module.
4. Ignition OFF, exterior lamps OFF, remove the appropriate E5 backup lamp bulb at the appropriate E42 tail lamp assembly. It may take up to 2 minutes for all vehicle systems to power down.
5. Test for less than 5 ohms between the ground circuit at the socket terminal and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
6. Connect a test lamp between the control circuit at the socket terminal and ground, ignition ON.
7. Verify the test lamp turns ON and OFF when commanding the Backup Lamps ON and OFF with a scan tool.

- **If the test lamp is always OFF**

1. Ignition OFF, disconnect the X7 harness connector at the K9 body control module.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.

- **If the test lamp is always ON**

1. Ignition OFF, disconnect the X7 harness connector at the K9 body control module, ignition ON.
2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 body control module.

- **If the test lamp turns ON and OFF**

8. Test or replace the appropriate E5 backup lamp.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Tail Lamp Bulb Replacement**
- **Control Module References** for BCM replacement, programming, and setup

DTC B2570: TRUNK LAMP CONTROL CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B2570 02

Trunk Lamp Control Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Rear Compartment Courtesy Lamp Control	B2570 02	1	1	-

Rear Compartment Courtesy Lamp Ground	-	1	-	-
1. Rear Compartment Lamp Malfunction				

Circuit/System Description

The body control module (BCM) applies battery voltage to the rear compartment courtesy lamp through the rear compartment lamp control circuit. When the BCM receives a rear compartment lid open input from the rear compartment lid latch, the BCM applies battery voltage to the rear compartment lamp control circuit illuminating the rear compartment courtesy lamp. In the event that the rear compartment lamp were to remain illuminated for more than 10 minutes with the ignition switch in the OFF position and no doors opened, the BCM will deactivate the rear compartment lamp control circuit to prevent total battery discharge.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Rear compartment OPEN.

Conditions for Setting the DTC

The BCM detects a short to ground on the rear compartment courtesy lamp control circuit.

Actions Taken When the DTC Sets

The rear compartment lamp is inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Interior Lights Schematics

Connector End View Reference

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Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, exterior lamps OFF, disconnect the harness connector at the E8S rear compartment courtesy lamp. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 ohms between the ground circuit terminal 2 and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
3. Connect a test lamp between the control circuit terminal 1 and ground, ignition ON.
4. Verify the test lamp turns ON and OFF when commanding the Cargo Lamp ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X7 harness connector at the K9 body control module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the X7 harness connector at the K9 body control module, ignition ON.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 body control module.
 - **If the test lamp turns ON and OFF**
5. Test or replace the E8S rear compartment courtesy lamp.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Rear Compartment Courtesy Lamp Replacement**
- **Control Module References** for BCM replacement, programming, and setup

DTC B2575 OR B2699: HEADLAMPS CONTROL CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B2575 01

Headlamps Control Circuit Short to Battery

DTC B2575 02

Headlamps Control Circuit Short to Ground

DTC B2575 04

Headlamps Control Circuit Open

DTC B2699 01

Right Headlamp Control Circuit Short to Battery

DTC B2699 02

Right Headlamp Control Circuit Short to Ground

DTC B2699 04

Right Headlamp Control Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F3DA (BCM 3) Fuse B+	B2699 01, B2699 04	B2699 01, B2699 04	-	-
F4DA (BCM 4) Fuse B+	B2575 01,	B2575 01, B2575	-	-

	B2575 04	04		
Low Beam Headlamp Control - Left	B2575 02	B2575 01, B2575 04	B2575 04	-
Low Beam Headlamp Control - Right	B2699 02	B2699 01, B2699 04	B2699 04	-
Headlamp Ground - Left	-	1	-	-
Headlamp Ground - Right	-	1	-	-
1. Headlamps Malfunction				

Circuit/System Description

With the headlamp switch in the ON position, the headlamp switch headlamp ON signal circuit is grounded through the headlamp switch. The body control module (BCM) responds by applying battery positive voltage to the left and right low beam headlamp control circuits illuminating the low beam headlamps.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Low beam headlamps ON.

Conditions for Setting the DTC

DTC B2575 01 and B2575 04

- The BCM detects a short to voltage or an open/high resistance in the left low beam headlamp control circuit.
- The BCM detects a short to ground or an open/high resistance in the F4DA (BCM 4) fuse B+ circuit.

DTC B2575 02

The BCM detects a short to ground in the left low beam headlamp control circuit.

DTC B2699 01 and B2699 04

- The BCM detects a short to voltage or an open/high resistance in the right low beam headlamp control circuit.
- The BCM detects a short to ground or an open/high resistance in the F3DA (BCM 3) fuse B+ circuit.

DTC B2699 02

The BCM detects a short to ground in the right low beam headlamp control circuit.

Actions Taken When the DTC Sets

- When DTC B2575 sets, the left low beam headlamp will be inoperative.
- When DTC B2699 sets, the right low beam headlamp will be inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

- **Headlights/Daytime Running Lights (DRL) Schematics**
- **Body Control System Schematics**

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

DTC B2575

1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module, ignition ON.
2. Verify a test lamp illuminates between the B+ circuit terminal 2 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.

2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If the test lamp illuminates**
3. Ignition OFF, connect the X1 harness connector at the K9 Body Control Module.
4. Ignition OFF, exterior lamps OFF, disconnect the harness connector at the E13L Headlamp - Left.
5. Test for less than 5 ohms between the appropriate ground circuit terminal listed below and ground.
 - E13L Headlamp - Left terminal 1 (with T90)
 - E13L Headlamp - Left terminal 2 (without T90)
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
6. Connect a test lamp between the appropriate control circuit terminal listed below and ground, ignition ON.
 - E13L Headlamp - Left terminal 2 (with T90)
 - E13L Headlamp - Left terminal 1 (without T90)
7. Verify the test lamp turns ON and OFF when commanding the Left Low Beam/Daytime Running Lamp ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X4 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the X4 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
8. Test or replace the E13L Headlamp - Left.

DTC B2699

1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module, ignition ON.
2. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If the test lamp illuminates**
3. Ignition OFF, connect the X1 harness connector at the K9 Body Control Module.
4. Ignition OFF, exterior lamps OFF, disconnect the harness connector at the E13R Headlamp - Right.
5. Test for less than 5 ohms between the appropriate ground circuit terminal listed below and ground.
 - E13R Headlamp - Right terminal 1 (with T90)
 - E13R Headlamp - Right terminal 2 (without T90)
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
6. Connect a test lamp between the appropriate control circuit terminal listed below and ground, ignition ON.
 - E13R Headlamp - Right terminal 2 (with T90)
 - E13R Headlamp - Right terminal 1 (without T90)
7. Verify the test lamp turns ON and OFF when commanding the Right Low Beam/Daytime Running Lamp ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X4 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.

- **If the test lamp is always ON**

1. Ignition OFF, disconnect the X4 harness connector at the K9 Body Control Module, ignition ON.
2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.

- **If the test lamp turns ON and OFF**

8. Test or replace the E13R Headlamp - Right.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Headlamp Bulb Replacement**
- **Control Module References** for BCM replacement, programming, and setup

DTC B257A: HEADLAMP SWITCH INPUT SIGNALS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B257A 00

Headlamp Switch Input Signals Correlation Malfunction

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Headlamp Switch Park Lamps ON Signal	2	B257A 00	2	-
Headlamp Switch Headlamps ON Signal	B257A 00	1	1	-
Turn Signal/Multifunction Switch Ground	-	1	-	-
1. Headlamps Malfunction 2. Park, License, and/or Tail Lamps Malfunction				

Circuit/System Description

For headlamp operation, the body control module (BCM) monitors two signal circuits from the headlamp switch. With the headlamp switch in the PARK LAMPS position, the headlamp switch park lamps ON signal circuit is grounded, indicating that the park lamps have been requested. When the headlamp switch is in the HEADLAMP position, both the headlamp switch park lamps ON signal circuit and the headlamp switch headlamps ON signal circuit are grounded. The BCM responds by commanding the park lamps and headlamps ON.

Conditions for Running the DTC

Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

- The BCM detects an open/high resistance in the headlamp switch park lamps ON signal circuit.
- The BCM detects a short to ground in the headlamp switch headlamps ON signal circuit.

Actions Taken When the DTC Sets

- When DTC B257A 00 is present on the headlamp switch headlamps ON signal circuit, the low beam headlamps are always ON. The BCM disregards all headlamp switch inputs.
- When DTC B257A 00 is present on the headlamp switch park lamps ON signal circuit, the park lamps and low beam headlamps are inoperative in the PARK and HEAD positions.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Headlights/Daytime Running Lights (DRL) Schematics

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**

- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, all doors closed, all accessories OFF, disconnect the harness connector at the S78 turn signal/multifunction switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 15 ohms between the ground circuit terminal 1 and ground.
 - **If 15 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 15 ohms**
3. Ignition ON.
4. Verify the scan tool Park Lamps Switch parameter is Inactive.
 - **If not Inactive**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 body control module.
 2. Test for infinite resistance between the signal circuit terminal 2 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 body control module.
 - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 1.
6. Verify the scan tool Park Lamps Switch parameter is Active.
 - **If not Active**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 body control module, ignition ON.
 2. Test for less than 1 V between the signal circuit terminal 2 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.
 - **If Active**
7. Verify the scan tool Headlamps On Switch parameter is Inactive.
 - **If not Inactive**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 body control module.

2. Test for infinite resistance between the signal circuit terminal 3 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 body control module.
 - **If Inactive**
8. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the ground circuit terminal 1.
9. Verify the scan tool Headlamps On Switch parameter is Active.
 - **If not Active**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 body control module, ignition ON.
 2. Test for less than 1 V between the signal circuit terminal 3 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.
 - **If Active**
10. Test or replace the S78 turn signal/multifunction switch.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Turn Signal Switch Replacement**
- **Control Module References** for BCM replacement, programming, and setup

DTC B2580: HEADLAMP HIGH BEAM CONTROL CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B2580 01

Headlamp High Beam Control Circuit Short to Battery

DTC B2580 02

Headlamp High Beam Control Circuit Short to Ground

DTC B2580 04

Headlamp High Beam Control Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F3DA (BCM 3) Fuse B+	B2699 01, B2699 04	B2699 01, B2699 04	-	-
F4DA (BCM 4) Fuse B+	B2575 01, B2575 04	B2575 01, B2575 04	-	-
Headlamp High Beam Relay Control	B2580 02	B2580 04	B2580 01	-
High Beam Headlamp Control - Left	1	1	1	-
High Beam Headlamp Control - Right	1	1	1	-
Headlamp Ground - Left	-	B2575 01, B2575 04	-	-
Headlamp Ground - Right	-	B2699 01, B2699 04	-	-
1. Headlamps Malfunction				

Circuit/System Description

The high beam and flash to pass functions are contained within the turn signal/multifunction switch. The BCM provides the turn signal/multifunction switch with two signal circuits, the high beam signal circuit and the flash to pass signal circuit. When the low beam headlamps are ON and the turn signal/multifunction switch is placed in the high beam position, ground is applied to the BCM through the high beam signal circuit. The BCM responds to the high beam request by applying ground to the high beam relay control circuit which energizes the high beam relay. With the high beam relay energized, the switch contacts close allowing battery voltage to flow through the high beam fuses to the high beam control circuits illuminating the high beam headlamps.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- High beam headlamps ON.

Conditions for Setting the DTC

DTC B2580 01

The BCM detects a short to voltage in the headlamp high beam relay control circuit.

DTC B2580 02

The BCM detects a short to ground in the headlamp high beam relay control circuit.

DTC B2580 04

The BCM detects an open in the headlamp high beam relay control circuit.

Actions Taken When the DTC Sets

The high beam headlamps and flash to pass will not operate.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Headlights/Daytime Running Lights (DRL) Schematics

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, remove the KR48 headlamp high beam relay.
2. Connect a test lamp between the control circuit terminal 86 and B+, ignition ON.
3. Verify the test lamp turns ON and OFF when commanding the High Beams ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X5 harness connector at the K9 body control module, ignition ON.

2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Ignition OFF.
4. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.
 - **If the test lamp is always ON**
1. Ignition OFF, disconnect the X5 harness connector at the K9 body control module.
2. Test for infinite resistance between the control circuit terminal and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 body control module.
 - **If the test lamp turns ON and OFF**
4. Test or replace the KR48 headlamp high beam relay.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Relay Replacement (Within an Electrical Center)** , **Relay Replacement (Attached to Wire Harness)**
- **Control Module References** for BCM replacement, programming, and setup

DTC B2585 OR B3867: PARK LAMPS CONTROL CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B2585 01

Left Park Lamps Control Circuit Short to Battery

DTC B2585 02

Left Park Lamps Control Circuit Short to Ground

DTC B2585 04

Left Park Lamps Control Circuit Open

DTC B3867 01

Right Park Lamps Control Circuit Short to Battery

DTC B3867 02

Right Park Lamps Control Circuit Short to Ground

DTC B3867 04

Right Park Lamps Control Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F5DA (BCM 5) Fuse B+	B3867 01, B3867 04, B3881 01, B3881 04, B3949 01, B3949 04, B3950 01, B3950 04	B3867 01, B3867 04, B3881 01, B3881 04, B3949 01, B3949 04, B3950 01, B3950 04	-	-
Headlamp Switch Park Lamps ON Signal	2	B257A 00	2	-
Front Park and Rear Tail Lamp Control - Left	B2585 02	B2585 01, B2585 04	B2585 01, B2585 04	-
Front Park and Rear Tail Lamp Control - Right	B3867 02	B3867 01, B3867 04	B3867 01, B3867 04	-
Turn Signal/Multifunction Switch Ground	-	2	-	-
Park Lamp Ground - Left Front	-	1	-	-
Park Lamp Ground - Right Front	-	1	-	-
Rear Tail/Stop Lamps Ground - Left	-	1	-	-
Rear Tail/Stop Lamps Ground - Right	-	1	-	-
1. Park, License, and/or Tail Lamps Malfunction 2. Park Lamp Switch Malfunction				

Circuit/System Description

When the headlamp switch is placed in the HEAD or PARK position, ground is applied to the park lamp switch ON signal circuit to the body control module (BCM). The BCM responds by applying voltage to the park lamps, tail lamps, and license lamps control circuits illuminating the park, tail, and license lamps.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Park lamps ON.

Conditions for Setting the DTC

DTC B2585 01 and B2585 04

The BCM detects a short to voltage or an open/high resistance in the left park lamps control circuit.

DTC B2585 02

The BCM detects a short to ground in the left park lamps control circuit.

DTC B3867 01 and B3867 04

- The BCM detects a short to voltage or an open/high resistance in the right park lamps control circuit.
- The BCM detects a short to ground or an open/high resistance in the F5DA (BCM 5) fuse B+ circuit.

DTC B3867 02

The BCM detects a short to ground in the right park lamps control circuit.

Actions Taken When the DTC Sets

DTC B2585 01

The left park lamps are always ON.

DTC B2585 02 and B2585 04

The left park lamps are always OFF.

DTC B3867 01

The right park lamps are always ON.

DTC B3867 02 and B3867 04

The right park lamps are always OFF.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Diagnostic Aids

When testing at the park lamp bulb sockets, make sure all measurements and test lamp connections are in the correct terminal location and do not come in contact with each other during testing.

Reference Information

Schematic Reference

- **Exterior Lights Schematics**
- **Body Control System Schematics**

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

DTC B2585

1. Ignition OFF, exterior lamps OFF, disconnect the harness connector at the appropriate left front park lamp or left rear tail lamp. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 ohms between the appropriate ground circuit terminal listed below and ground.
 - E4N park/turn signal lamp - left socket terminal
 - E5AA tail lamp - left rear socket terminal
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**

3. Connect a test lamp between the appropriate control circuit terminal listed below and ground, ignition ON.
 - E4N park/turn signal lamp - left socket terminal
 - E5AA tail lamp - left rear socket terminal
4. Verify the test lamp turns ON and OFF when commanding the Left Park Lamps ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X4 harness connector at the K9 body control module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the X4 harness connector at the K9 body control module, ignition ON.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 body control module.
 - **If the test lamp turns ON and OFF**
5. Test or replace the appropriate left park/tail lamp.

DTC B3867

1. Ignition OFF, disconnect the X2 harness connector at the K9 body control module, ignition ON.
2. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 body control module.
 - **If the test lamp illuminates**
3. Ignition OFF, connect the X2 harness connector at the K9 body control module.
4. Ignition OFF, exterior lamps OFF, disconnect the harness connector at the appropriate right front park

lamp or right rear side marker lamp. It may take up to 2 minutes for all vehicle systems to power down.

5. Test for less than 5 ohms between the appropriate ground circuit terminal listed below and ground.
 - E4P park/turn signal lamp - right socket terminal
 - E5AB tail lamp - right rear socket terminal
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
6. Connect a test lamp between the appropriate control circuit terminal listed below and ground, ignition ON.
 - E4P park/turn signal lamp - right socket terminal
 - E5AB tail lamp - right rear socket terminal
7. Verify the test lamp turns ON and OFF when commanding the Right Park Lamps ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X4 harness connector at the K9 body control module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the X4 harness connector at the K9 body control module, ignition ON.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 body control module.
 - **If the test lamp turns ON and OFF**
8. Test or replace the appropriate right park/tail lamp.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Tail Lamp Replacement**
- **Parking and Turn Signal Lamp Bulb Replacement**
- **Control Module References** for BCM replacement, programming, and setup

DTC B2610: PASSENGER COMPARTMENT DIMMING 1

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B2610 01

Passenger Compartment Dimming 1 Circuit Short to Battery

DTC B2610 02

Passenger Compartment Dimming 1 Circuit Short to Ground

DTC B2610 04

Passenger Compartment Dimming 1 Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
LED Backlight Dimming Control Terminal 8 X2	B2610 02	B2610 04, 1	B2610 01, 1	-
1. Interior Backlighting Malfunction				

Circuit/System Description

The instrument panel dimmer switch is used to increase and decrease the brightness of the interior backlighting components. The instrument panel dimmer switch provides a voltage signal to the body control module (BCM) that will increase as the brightness of the lights are increased and decrease as the brightness of the lights are decreased. The BCM provides a low reference signal and a B+ voltage reference to the instrument panel dimmer switch. When the instrument panel dimmer switch is placed in the desired position, the dimmed voltage setting is applied from the instrument panel dimmer switch through the instrument panel dimmer switch signal circuit to the BCM. The BCM interprets the signal and applies a pulse width modulated (PWM) voltage through the LED dimming 1 and dimming 2 control circuits illuminating the interior backlighting to the requested level of brightness.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Park lamps ON.

Conditions for Setting the DTC

DTC B2610 01

The BCM detects a short to battery in the LED backlight dimming control circuit terminal 8 X2.

DTC B2610 02

The BCM detects a short to ground in the LED backlight dimming control circuit terminal 8 X2.

DTC B2610 04

The BCM detects an open/high resistance in the LED backlight dimming control circuit terminal 8 X2.

Actions Taken When the DTC Sets

The BCM will disable the LED backlight dimming control circuits.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Interior Lights Dimming Schematics

Connector End View Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

NOTE: Each component with backlighting may need to be disconnected to isolate a short to voltage or short to ground. Use the schematics to identify the following:

- Backlighting components the vehicle is equipped with
- Each component's control and ground circuit terminals
- Component locations on the backlighting control circuit

1. Ignition OFF, all doors closed, all accessories OFF, disconnect the harness connector at the component with inoperative backlighting. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 15 ohms between the appropriate ground circuit terminal listed below and ground.
 - S13D Door Lock Switch - Driver terminal 3
 - S13P Door Lock Switch - Passenger terminal 3
 - S36 Instrument Panel Dimmer Switch - terminal 5
 - S46B Liftgate Unlatch Switch - terminal 6
 - S32D Seat Heating Switch - Driver terminal 5
 - S32P Seat Heating Switch - Passenger terminal 5
 - S70L Steering Wheel Controls Switch - Left terminal 2
 - S70R Steering Wheel Controls Switch - Right terminal 2
 - S75 Traction Control Switch - terminal 3
 - S3 Transmission Shift Lever - terminal 3
 - **If 15 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 15 ohms**
3. Connect a test lamp between the appropriate control circuit terminal listed below and ground.
 - K33 HVAC control module - terminal 6 X1
 - S13D Door Lock Switch - Driver terminal 1
 - S13P Door Lock Switch - Passenger terminal 1
 - S36 Instrument Panel Dimmer Switch - terminal 4
 - S46B Liftgate Unlatch Switch - terminal 5
 - S32D Seat Heating Switch - Driver terminal 6
 - S32P Seat Heating Switch - Passenger terminal 6
 - S70L Steering Wheel Controls Switch - Left terminal 1
 - S70R Steering Wheel Controls Switch - Right terminal 1

- S75 Traction Control Switch - terminal 2
 - S3 Transmission Shift Lever - terminal 8
4. Verify the test lamp turns ON and OFF when commanding the LED Backlight Dimming ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
 5. Test or replace the component with inoperative backlighting.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Hazard Warning Switch Replacement**
- **Transmission Control Replacement**
- **Steering Wheel Control Switch Assembly Replacement**
- **Control Module References** for BCM or HVAC control module replacement, programming, and setup

DTC B2615: PASSENGER COMPARTMENT DIMMING

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B2615 02

Passenger Compartment Dimming 2 Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F6DA (BCM 6) Fuse B+	B2545 01, B2545 04, B2615 02	B2545 01, B2545 04, B2615 02	-	-
Dome Lamp Control	B2615 02	2	2	-
Reading Lamp Control	B1480 02	1	1	-
Dome Lamp Ground	-	1, 2	-	-
1. Courtesy Lamps Malfunction 2. Dome Lamps Malfunction				

Circuit/System Description

The body control module (BCM) applies battery voltage to the dome/reading lamps through the dome/reading lamp control circuit. When any door is opened, the jam switch contacts close and the BCM receives a door-ajar input. If the BCM receives a door lock or unlock input or a rear hatch open input, the BCM will activate the dome/reading lamp control circuit, providing battery voltage to dome/reading lamps. In the event that any of these courtesy lamps were to remain illuminated for more than 10 min with the ignition switch in the OFF position, the BCM will deactivate the courtesy lamp control circuit to prevent total battery discharge.

Conditions for Running the DTC

Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

- The BCM detects a short to ground in the dome lamp control circuit.
- The BCM detects a short to ground or an open/high resistance in the F6DA (BCM 6) fuse B+ circuit.

Actions Taken When the DTC Sets

The BCM will disable the dome lamps control circuit.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

- Interior Lights Schematics
- Body Control System Schematics

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the X5 harness connector at the K9 body control module, ignition ON.
2. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 body control module.
 - **If the test lamp illuminates**
3. Ignition OFF, connect the X5 harness connector at the K9 body control module.
4. Ignition OFF, all doors closed, all accessories OFF, disconnect the harness connector at the E36AH dome lamp. It may take up to 2 minutes for all vehicle systems to power down.
5. Test for less than 10 ohms between the appropriate ground circuit terminal listed below and ground.
 - E36AH dome lamp - terminal 3 with UE1
 - E36AH dome lamp - terminal 2 without UE1
 - **If 10 ohms or greater**
 1. Ignition OFF.

2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
6. Connect a test lamp between the appropriate control circuit terminal listed below and ground.
 - E36AH dome lamp - terminal 2 with UE1
 - E36AH dome lamp - terminal 3 without UE1
7. Verify the test lamp turns ON and OFF when commanding the Courtesy Lamps ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X7 harness connector at the K9 body control module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the X7 harness connector at the K9 body control module, ignition ON.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 body control module.
 - **If the test lamp turns ON and OFF**
8. Test or replace the E36AH dome lamp.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for BCM replacement, programming, and setup

DTC B2625: DISPLAY DIMMING PULSE WIDTH MODULATION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B2625 01

Display Dimming Pulse Width Modulation Output Circuit Short to Battery

DTC B2625 02

Display Dimming Pulse Width Modulation Output Circuit Short to Ground

DTC B2625 04

Display Dimming Pulse Width Modulation Output Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
LED Backlight Dimming Control Terminal 5 X1	B2625 02	B2625 04	B2625 01	-

Circuit/System Description

The instrument panel dimmer switch is used to increase and decrease the brightness of the interior backlighting components. The instrument panel dimmer switch provides a voltage signal to the body control module (BCM) that will increase as the brightness of the lights are increased and decrease as the brightness of the lights are decreased. The BCM provides a low reference signal and a B+ voltage reference to the instrument panel dimmer switch. When the instrument panel dimmer switch is placed in the desired position, the dimmed voltage setting is applied from the instrument panel dimmer switch through the instrument panel dimmer switch signal circuit to the BCM. The BCM interprets the signal and applies a pulse width modulated (PWM) voltage through the LED dimming 1 and dimming 2 control circuits illuminating the interior backlighting to the requested level of brightness.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Ignition ON.

Conditions for Setting the DTC

The BCM detects a short to ground in the LED backlight dimming control circuit terminal 5 X1.

Actions Taken When the DTC Sets

The LED backlight dimming control circuit driver is shut down.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.

- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Interior Lights Dimming Schematics

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the X1 harness connector at the K33 HVAC control module.
2. Connect a test lamp between the control circuit terminal 10 and ground.
3. Verify the test lamp turns ON and OFF while turning the ignition switch ON and OFF.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 body control module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 body control module, ignition ON.
 2. Test for less than 1 V between the control circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 body control module.
 - **If the test lamp turns ON and OFF**
4. Test or replace the K33 HVAC control module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for BCM or HVAC control module replacement, programming, and setup

DTC B2652: PASSENGER COMPARTMENT DIMMING 3

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B2652 02

Passenger Compartment Dimming 3 Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Hazard Warning Switch LED Backlight Dimming Control	B2652 02	1	1	-
Hazard Warning Switch Ground	-	1	-	-
1. Interior Backlighting Malfunction				

Circuit/System Description

The instrument panel dimmer switch is used to increase and decrease the brightness of the interior backlighting components. The instrument panel dimmer switch provides a voltage signal to the body control module (BCM) that will increase as the brightness of the lights are increased and decrease as the brightness of the lights are decreased. The BCM provides a low reference signal and a B+ voltage reference to the instrument panel dimmer switch. When the instrument panel dimmer switch is placed in the desired position, the dimmed voltage setting is applied from the instrument panel dimmer switch through the instrument panel dimmer switch signal circuit to the BCM. The BCM interprets the signal and applies a pulse width modulated (PWM) voltage through the LED dimming 1 and dimming 2 control circuits illuminating the interior backlighting to the requested level of brightness.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Park lamps ON.

Conditions for Setting the DTC

The BCM detects a short to ground in the hazard warning switch backlight dimming control circuit.

Actions Taken When the DTC Sets

The BCM will disable the hazard warning switch backlight dimming control circuit.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Interior Lights Dimming Schematics

Connector End View Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S26 Hazard Warning Switch. It may take up to 2 minutes for all vehicle systems to

power down.

2. Test for less than 5 ohms between the ground circuit terminal 3 and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
3. Connect a test lamp between the control circuit terminal 2 and ground, ignition ON.
4. Verify the test lamp turns ON and OFF when commanding the Hazard Lamps Switch Backlight ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
5. Test or replace the S26 Hazard Warning Switch.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Hazard Warning Switch Replacement**
- **Control Module References** for BCM replacement, programming, and setup

DTC B3596: HAZARD LAMPS REQUEST

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B3596 00

Hazard Lamps Request Circuit Malfunction

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Hazard Warning Switch Signal	1	1	1	B3596 00
Hazard Warning Switch LED Backlighting Control	B2652 02	2	2	-
Hazard Warning Switch Ground	-	1	-	-
1. Hazard Lamps Malfunction 2. Hazard Warning Switch Backlighting Malfunction				

Circuit/System Description

The hazard flashers may be activated in any power mode. The hazard warning switch signal circuit is momentarily grounded when the hazard warning switch is pressed. The body control module (BCM) responds to the hazard warning switch signal input by supplying battery voltage to all four turn signal lamps in an ON and OFF duty cycle. When the hazard warning switch is activated, the BCM sends a serial data message to the instrument cluster requesting both turn signal indicators to be cycled ON and OFF.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Hazard lamps ON.

Conditions for Setting the DTC

The hazard warning switch input is Active for longer than 60 seconds.

Actions Taken When the DTC Sets

The hazard warning lamps are inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S26 hazard warning switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 ohms between the ground circuit terminal 8 and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
3. Ignition ON.
4. Verify the scan tool Hazard Lamps Switch parameter is Inactive.
 - **If not Inactive**
 1. Ignition OFF, disconnect the X2 harness connector at the K9 body control module.
 2. Test for infinite resistance between the signal circuit terminal 7 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 body control module.
 - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 7 and ground.

6. Verify the scan tool Hazard Lamps Switch parameter is Active.
 - **If not Active**
 1. Ignition OFF, disconnect the X2 harness connector at the K9 body control module, ignition ON.
 2. Test for less than 1 V between the signal circuit terminal 7 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.
 - **If Active**
7. Test or replace the S26 hazard warning switch.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Hazard Warning Switch Replacement**
- **Control Module References** for BCM replacement, programming, and setup

DTC B3600: PASSENGER COMPARTMENT DIMMING REQUEST SIGNAL

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B3600 03

Passenger Compartment Dimming Request Signal Circuit Low Voltage

DTC B3600 07

Passenger Compartment Dimming Request Signal Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F1DA (BCM 1) Fuse B+	B101E 43, B1395 03, B1517 07,	B101E 43, B1395 03, B1517 07,	-	-

	C0890 03, U0121 00,	C0890 03, U0121 00,		
Instrument Panel Dimmer Switch B+ Reference	B1395 03, B3600 03,	B3600 03	B1395 07	-
Instrument Panel Dimmer Switch Signal	B1395 03, B3600 03,	B3600 03	B3600 07	-
Instrument Panel Dimmer Switch Low Reference	1	1	1	-
1. Interior Backlighting Malfunction				

Circuit/System Description

The instrument panel dimmer switch is used to increase and decrease the brightness of the interior backlighting components. The instrument panel dimmer switch provides a voltage signal to the body control module (BCM) that will increase as the brightness of the lights are increased and decrease as the brightness of the lights are decreased. The BCM provides a low reference signal and a B+ voltage reference to the instrument panel dimmer switch. When the instrument panel dimmer switch is placed in the desired position, the dimmed voltage setting is applied from the instrument panel dimmer switch through the instrument panel dimmer switch signal circuit to the BCM. The BCM interprets the signal and applies a pulse width modulated (PWM) voltage through the LED dimming 1 and dimming 2 control circuits illuminating the interior backlighting to the requested level of brightness.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Park Lamps ON.

Conditions for Setting the DTC

DTC B3600 03

- The BCM detects a short to ground or an open/high resistance in the instrument panel dimmer switch B+ reference circuit.
- The BCM detects a short to ground or an open/high resistance in the instrument panel dimmer switch signal circuit.

DTC B3600 07

The BCM detects a short to voltage in the instrument panel dimmer switch signal circuit.

Actions Taken When the DTC Sets

The BCM will not dim any interior backlighting. All interior backlighting will default to maximum brightness.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.

- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

- **Interior Lights Dimming Schematics**
- **Body Control System Schematics**

Connector End View Reference

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Interior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the S36 Instrument Panel Dimmer Switch, ignition ON.
2. Verify a test lamp illuminates between the low reference circuit terminal 2 and B+.
 - **If the test lamp does not illuminate**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the low reference circuit terminal 2 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If the test lamp illuminates**
 - 3. Test for B+ between the B+ reference circuit terminal 1 and ground.
 - **If less than B+**

1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module.
2. Test for infinite resistance between the B+ reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 ohms in the B+ reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If B+**
4. Verify a test lamp does not illuminate between the B+ reference circuit terminal 1 and ground.
 - **If the test lamp illuminates**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the B+ reference circuit terminal 2 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp does not illuminate**
5. Park lamps ON, verify a test lamp does not illuminate between the signal circuit terminal 3 and ground.
 - **If the test lamp illuminates**
 1. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit terminal 3 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp does not illuminate**
6. Ignition ON, park lamps OFF, test for between 57.4 K ohms and 58 K ohms between the signal circuit terminal 3 and ground.
 - **If not between 57.4 K ohms and 58 K ohms**
 1. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If between 57.4 K ohms and 58 K ohms**
7. Test or replace the S36 Instrument Panel Dimmer Switch.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Instrument Panel Multifunction Switch Replacement**
- **Control Module References** for BCM replacement, programming, and setup

DTC B3650: HIGH BEAM REQUEST SIGNAL

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B3650 08

High Beam Request Signal Circuit Performance - Signal Invalid

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Headlamp Switch Headlamps ON Signal	B257A 00	1	1	-
Headlamp Switch Park Lamps ON Signal	2	B257A 00	2	-
Turn Signal/Multifunction Switch Flash To Pass Signal	B3806 00	1	1	-
Turn Signal/Multifunction Switch High Beam Signal	B3650 08	1	1	-
Turn Signal/Multifunction Switch Ground	-	1	-	-
1. Headlamps Malfunction 2. Park, License, and/or Tail Lamps Malfunction				

Circuit/System Description

When the low beam headlamps are on and the turn signal/multifunction switch is placed in the high beam position, ground is applied to the body control module (BCM) through the high beam signal circuit. The BCM responds to the high beam request by applying ground to the high beam relay control circuit which energizes the high beam relay. With the high beam relay energized, the switch contacts close allowing battery voltage to flow through the high beam fuses to the high beam control circuits illuminating the high beam headlamps.

Conditions for Running the DTC

Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

The BCM detects a short to ground in the turn signal/multifunction switch high beam signal circuit.

Actions Taken When the DTC Sets

The high beam headlamps will not operate.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Headlights/Daytime Running Lights (DRL) Schematics

Connector End View Reference

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Exterior Lighting Systems Description and Operation

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- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S78 turn signal/multifunction switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 15 ohms between the ground circuit terminal 1 and ground.
 - **If 15 ohms or greater**
 1. Ignition OFF.

2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 15 ohms**
3. Ignition ON.
4. Verify the scan tool High Beam Select Switch parameter is Inactive.
 - **If not Inactive**
 1. Ignition OFF, disconnect the X3 harness connector at the K9 body control module.
 2. Test for infinite resistance between the signal circuit terminal 6 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 body control module.
 - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 6 and the ground circuit terminal 1.
6. Verify the scan tool High Beam Select Switch parameter is Active.
 - **If not Active**
 1. Ignition OFF, disconnect the X3 harness connector at the K9 body control module, ignition ON.
 2. Test for less than 1 V between the signal circuit terminal 6 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.
 - **If Active**
7. Test or replace the S78 turn signal/multifunction switch.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Turn Signal Switch Replacement**
- **Control Module References** for BCM replacement, programming, and setup

DTC B3806: HIGH BEAM AND HEADLAMP FLASH SELECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B3806 00

High Beam and Headlamp Flash Select Circuit Malfunction

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Headlamp Switch Headlamps ON Signal	B257A 00	1	1	-
Headlamp Switch Park Lamps ON Signal	2	B257A 00	2	-
Turn Signal/Multifunction Switch Flash To Pass Signal	B3806 00	1	1	-
Turn Signal/Multifunction Switch High Beam Signal	B3650 08	1	1	-
Turn Signal/Multifunction Switch Ground	-	1	-	-
1. Headlamps Malfunction 2. Park, License, and/or Tail Lamps Malfunction				

Circuit/System Description

When the turn signal/multifunction switch is momentarily placed in the flash to pass position, ground is applied to the body control module (BCM) through the flash to pass signal circuit. The BCM responds to the flash to pass request by applying ground to the high beam relay control circuit which energizes the high beam relay. With the high beam relay energized, the switch contacts close allowing battery voltage to flow through the high beam fuses to the high beam control circuits illuminating the high beam headlamps. The high beam headlamps will only illuminate for as long as the flash to pass switch is activated.

Conditions for Running the DTC

Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

The BCM detects a short to ground in the turn signal/multifunction switch flash to pass signal circuit.

Actions Taken When the DTC Sets

The high beam lamps and the high beam indicator on the instrument cluster are always ON.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Headlights/Daytime Running Lights (DRL) Schematics

Connector End View Reference

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Electrical Information Reference

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- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S78 turn signal/multifunction switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 15 ohms between the ground circuit terminal 1 and ground.
 - **If 15 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 15 ohms**
3. Ignition ON.
4. Verify the scan tool Headlamps Flash Switch parameter is Inactive.
 - **If not Inactive**
 1. Ignition OFF, disconnect the X3 harness connector at the K9 body control module.
 2. Test for infinite resistance between the signal circuit terminal 7 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance, replace the K9 body control module.
- **If Inactive**
- 5. Install a 3 A fused jumper wire between the signal circuit terminal 7 and the ground circuit terminal 1.
- 6. Verify the scan tool Headlamps Flash Switch parameter is Active.
 - **If not Active**
 - 1. Ignition OFF, disconnect the X3 harness connector at the K9 body control module, ignition ON.
 - 2. Test for less than 1 V between the signal circuit terminal 7 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 - 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.
 - **If Active**
- 7. Test or replace the S78 turn signal/multifunction switch.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Turn Signal Switch Replacement**
- **Control Module References** for BCM replacement, programming, and setup

DTC B3881 OR B3882: TAIL LAMP CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B3881 01

Tail Lamp Circuit Short to Battery

DTC B3881 02

Tail Lamp Circuit Short to Ground

DTC B3881 04

Tail Lamp Circuit Open

DTC B3882 01

Right Tail Lamp Circuit Short to Battery

DTC B3882 02

Right Tail Lamp Circuit Short to Ground

DTC B3882 04

Right Tail Lamp Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F5DA (BCM 5) Fuse B+	B3867 01, B3867 04, B3881 01, B3881 04, B3949 01, B3949 04, B3950 01, B3950 04	B3867 01, B3867 04, B3881 01, B3881 04, B3949 01, B3949 04, B3950 01, B3950 04	-	-
Brake Pedal Position Sensor 5 V Reference	C0277 06, C0890 03, C0161 71	C0277 06, C0161 71	C0890 07, C0161 71	-
Brake Pedal Position Sensor Signal	C0277 06, C0161 71	C0277 06, C0161 71	C0277 07, C0161 71	C0277 09
Center High Mounted Stop Lamp Control	B3884 02	2	2	-
Stop Lamp Control - Left	B3881 02	B3881 01, B3881 04	B3881 01	-
Stop Lamp Control - Right	B3882 02	B3882 01, B3882 04	B3882 01	-
Brake Pedal Position Sensor Low Reference	-	C0277 07, C0161 71	1	-
Center High Mounted Stop Lamp Ground	-	2	-	-
Rear Tail/Stop Lamp Ground - Left	-	1	-	-
Rear Tail/Stop Lamp Ground - Right	-	1	-	-
1. Stop Lamps Malfunction 2. Center High Mounted Stop Lamp Malfunction				

Circuit/System Description

The brake pedal position (BPP) sensor is used to sense the action of the driver application of the brake pedal. The BPP sensor provides an analog voltage signal that will increase as the brake pedal is applied. The body control module (BCM) provides a low reference signal and a 5-volt reference voltage to the BPP sensor. When the variable signal reaches a voltage threshold indicating the brakes have been applied, the BCM will apply battery voltage to the left and right stop lamp control circuits as well as the center high mounted stop lamp (CHMSL) control circuit illuminating the left and right stop lamps and the CHMSL.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Brakes APPLIED.

Conditions for Setting the DTC

DTC B3881 01 and B3881 04

- The BCM detects a short to voltage or an open/high resistance in the left stop lamp control circuit.
- The BCM detects a short to ground or an open/high resistance in the F5DA (BCM 5) fuse B+ circuit.

DTC B3881 02

The BCM detects a short to ground in the left stop lamp control circuit.

DTC B3882 01

The BCM detects a short to voltage in the right stop lamp control circuit.

DTC B3882 02

The BCM detects a short to ground in the right stop lamp control circuit.

DTC B3882 04

The BCM detects an open/high resistance in the right stop lamp control circuit.

Actions Taken When the DTC Sets

The appropriate stop lamp will not operate.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Diagnostic Aids

When testing at the stop lamp bulb socket, make sure all measurements and test lamp connections are in the correct terminal location and do not come in contact with each other during testing.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

DTC B3881

1. Ignition OFF, disconnect the X2 harness connector at the K9 body control module, ignition ON.
2. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 body control module.

- **If the test lamp illuminates**
- 3. Ignition OFF, connect the X2 harness connector at the K9 body control module.
- 4. Ignition OFF, exterior lamps OFF, remove the E5AA tail/stop lamp bulb - left. It may take up to 2 minutes for all vehicle systems to power down.
- 5. Test for less than 5 ohms between the ground circuit at the socket terminal and ground.
 - **If 5 ohms or greater**
 - 1. Ignition OFF.
 - 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
- 6. Connect a test lamp between the control circuit at the socket terminal and ground, ignition ON.
- 7. Verify the test lamp turns ON and OFF when commanding the Left Brake Lamp ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 - 1. Ignition OFF, disconnect the X4 harness connector at the K9 body control module.
 - 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 - 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.
 - **If the test lamp is always ON**
 - 1. Ignition OFF, disconnect the X4 harness connector at the K9 body control module, ignition ON.
 - 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 body control module.
 - **If the test lamp turns ON and OFF**
- 8. Test or replace the E5AA tail/stop lamp - left.

DTC B3882

- 1. Ignition OFF, exterior lamps OFF, remove the E5AB tail/stop lamp bulb - right. It may take up to 2 minutes for all vehicle systems to power down.
- 2. Test for less than 5 ohms between the ground circuit at the socket terminal and ground.
 - **If 5 ohms or greater**
 - 1. Ignition OFF.
 - 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, repair the open/high resistance in the ground connection.
- **If less than 5 ohms**
- 3. Connect a test lamp between the control circuit at the socket terminal and ground, ignition ON.
- 4. Verify the test lamp turns ON and OFF when commanding the Right Brake Lamp ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X5 harness connector at the K9 body control module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the X5 harness connector at the K9 body control module, ignition ON.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 body control module.
 - **If the test lamp turns ON and OFF**
- 5. Test or replace the E5AB tail/stop lamp - right.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Tail Lamp Replacement**
- **Control Module References** for BCM replacement, programming, and setup

DTC B3883: LICENSE PLATE LAMP CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B3883 01

License Plate Lamp Circuit Short to Battery

DTC B3883 02

License Plate Lamp Circuit Short to Ground

DTC B3883 04

License Plate Lamp Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
License Plate Lamp Control	B3883 02	B3883 01, B3883 04	B3883 01, B3883 04	-
License Plate Lamp Ground	-	B3883 01, B3883 04	-	-

Circuit/System Description

When the headlamp switch is placed in the HEAD or PARK position, ground is applied to the park lamp switch ON signal circuit to the body control module (BCM). The BCM responds by applying voltage to the park lamps, tail lamps, and license lamps control circuits illuminating the park, tail, and license lamps.

Conditions for Running the DTC

Battery voltage must be between 9-16 V.

DTC B3883 01

Headlamp switch in OFF position.

DTC B3883 02 or B3883 04

Headlamp switch in PARK or ON positions.

Conditions for Setting the DTC

DTC B3883 01

- The BCM detects a short to voltage in the license lamp control circuit.
- The BCM detects an open/high resistance in the license lamp ground circuit.

DTC B3883 02

The BCM detects a short to ground in the license lamp control circuit.

DTC B3883 04

- The BCM detects an open/high resistance in the license lamp control circuit.
- The BCM detects an open/high resistance in the license lamp ground circuit.

Actions Taken When the DTC Sets

DTC B3883 01

License lamp always ON.

DTC B3883 02 or B3883 04

License lamp inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, exterior lamps OFF, remove the E7 license plate lamp bulb. It may take up to 2 minutes for

all vehicle systems to power down.

2. Test for less than 5 ohms between the ground circuit terminal 1 and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
3. Connect a test lamp between the control circuit terminal 2 and ground, ignition ON.
4. Verify the test lamp turns ON and OFF when commanding the License Plate Lamps ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X4 harness connector at the K9 body control module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the X4 harness connector at the K9 body control module, ignition ON.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 body control module.
 - **If the test lamp turns ON and OFF**
5. Test or replace the E7 license plate lamp bulb.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Rear License Plate Lamp Replacement**
- **Control Module References** for BCM replacement, programming, and setup

DTC B3884: CENTER HIGH MOUNTED BRAKE LAMP

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B3884 02

Center High Mounted Brake Lamp Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Center High Mounted Stop Lamp Control	B3884 02	1	1	-
Center High Mounted Stop Lamp Ground	-	1	-	-
1. Stop Lamps Malfunction				

Circuit/System Description

The brake pedal position sensor is used to sense the action of the driver application of the brake pedal. The brake pedal position sensor provides an analog voltage signal that will increase as the brake pedal is applied. The body control module (BCM) provides a low reference signal and a 5 V reference voltage to the brake pedal position sensor. When the variable signal reaches a voltage threshold indicating the brakes have been applied, the BCM will apply battery voltage to the right and left stop lamp control circuits, engine control module (ECM), and center high mounted stop lamp control circuit.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Brakes APPLIED.

Conditions for Setting the DTC

The BCM detects a short to ground in the center high mounted stop lamp control circuit.

Actions Taken When the DTC Sets

The BCM will not illuminate the center high mounted stop lamp.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

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Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, exterior lamps OFF, disconnect the harness connector at the E6 center high mounted stop lamp. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 ohms between the ground circuit terminal 2 and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
3. Connect a test lamp between the control circuit terminal 1 and ground, ignition ON.
4. Verify the test lamp turns ON and OFF when commanding the Center Brake Lamp ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X4 harness connector at the K9 body control module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, replace the K9 body control module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the X4 harness connector at the K9 body control module, ignition ON.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 body control module.
 - **If the test lamp turns ON and OFF**
5. Test or replace the E6 center high mounted stop lamp.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **High Mount Stop Lamp Replacement**
- **Control Module References** for BCM replacement, programming, and setup

DTC B3948 OR B3949: FRONT TURN SIGNAL CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B3948 01

Left Front Turn Signal Circuit Short to Battery

DTC B3948 02

Left Front Turn Signal Circuit Short to Ground

DTC B3948 04

Left Front Turn Signal Circuit Open

DTC B3949 01

Right Front Turn Signal Circuit Short to Battery

DTC B3949 02

Right Front Turn Signal Circuit Short to Ground

DTC B3949 04

Right Front Turn Signal Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F5DA (BCM 5) Fuse B+	B3867 01, B3867 04, B3881 01, B3881 04, B3949 01, B3949 04, B3950 01, B3950 04	B3867 01, B3867 04, B3881 01, B3881 04, B3949 01, B3949 04, B3950 01, B3950 04	-	-
F7DA (BCM 7) Fuse B+	B3948 01, B3948 04, B3951 01, B3951 04	B3948 01, B3948 04, B3951 01, B3951 04	-	-
Turn Signal Switch Signal - Left	1	1	1	-
Turn Signal Switch Signal - Right	1	1	1	-
Turn Signal Control - Left Front	B3948 02	B3948 01, B3948 04	B3948 01, B3948 04	-
Turn Signal Control - Left Rear	B3950 02	B3950 01, B3950 04	B3950 01, B3950 04	-
Turn Signal Control - Right Front	B3949 02	B3949 01, B3949 04	B3949 01, B3949 04	-
Turn Signal Control - Right Rear	B3951 02	B3951 01, B3951 04	B3951 01, B3951 04	-
Turn Signal Lamp Ground - Left Front	-	B3948 01, B3948 04	-	-
Turn Signal Lamp Ground - Right Front	-	B3949 01, B3949 04	-	-
Turn Signal Lamp Ground - Left Rear	-	B3950 01, B3950 04	-	-
Turn Signal Lamp Ground - Right Rear	-	B3951 01, B3951 04	-	-
Turn Signal Repeater Lamp Ground - Left - with T90	-	B3948 01, B3948 04	-	-
Turn Signal Repeater Lamp Ground - Right - with T90	-	B3949 01, B3949 04	-	-
Turn Signal/Multifunction Switch Ground	-	1	-	-
1. Turn Signal Lamps and/or Indicators Malfunction				

Circuit/System Description

Ground is applied at all times to the turn signal/multifunction switch. The turn signal lamps may only be activated with the ignition switch in the ON or START positions. When the turn signal/multifunction switch is placed in either the turn left or turn right position, ground is applied to the body control module (BCM) through either the right turn or left turn signal switch signal circuit. The BCM responds to the turn signal switch input by applying a pulsating voltage to the front and rear turn signal lamps through their respective control circuits. When a turn signal request is received by the BCM, a serial data message is sent to the instrument cluster requesting the respective turn signal indicator be pulsed ON and OFF.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Ignition ON.

Conditions for Setting the DTC

DTC B3948 01 and B3948 04

- The BCM detects an open/high resistance in the left front turn signal control circuit.
- The BCM detects an open/high resistance in the left front turn signal ground circuit.
- The BCM detects a short to ground or an open/high resistance in the F7DA (BCM 7) fuse B+ circuit.

DTC B3948 02

The BCM detects a short to ground in the left front turn signal control circuit.

DTC B3949 01 and B3949 04

- The BCM detects an open/high resistance in the right front turn signal control circuit.
- The BCM detects an open/high resistance in the right front turn signal ground circuit.
- The BCM detects a short to ground or an open/high resistance in the F5DA (BCM 5) fuse B+ circuit.

DTC B3949 02

The BCM detects a short to ground in the right front turn signal control circuit.

Actions Taken When the DTC Sets

DTC B3948

- The left front turn signal is inoperative.
- The left turn signal indicator on the instrument cluster flashes rapidly.

DTC B3949

- The right front turn signal is inoperative.
- The right turn signal indicator on the instrument cluster flashes rapidly.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Diagnostic Aids

When testing at the turn signal lamp bulb socket, make sure all measurements and test lamp connections are in the correct terminal location and do not come in contact with each other during testing.

Reference Information

Schematic Reference

- **Exterior Lights Schematics**
- **Body Control System Schematics**

Connector End View Reference

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- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

DTC B3948

1. Ignition OFF, disconnect the X5 harness connector at the K9 body control module, ignition ON.
2. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Ignition OFF.
2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Ignition OFF.
2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 body control module.

- **If the test lamp illuminates**

3. Ignition OFF, connect the X5 harness connector at the K9 body control module.
4. Ignition OFF, exterior lamps OFF, remove the appropriate E4 turn signal lamp bulb - left front. It may take up to 2 minutes for all vehicle systems to power down.
5. Test for less than 5 ohms between the appropriate ground circuit terminal listed below and ground.
 - E4N park/turn signal lamp - left socket terminal C
 - E4Y turn signal repeater lamp - left socket terminal 1
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
6. Connect a test lamp between the appropriate control circuit terminal listed below and ground, ignition ON.
 - E4N park/turn signal lamp - left socket terminal A
 - E4Y turn signal repeater lamp - left socket terminal 2
7. Verify the test lamp turns ON and OFF when commanding the Left Front Turn Signal Lamp ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X5 harness connector at the K9 body control module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.
 - **If the test lamp is always ON**

1. Ignition OFF, disconnect the X5 harness connector at the K9 body control module, ignition ON.
2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 body control module.
 - **If the test lamp turns ON and OFF**
8. Test or replace the appropriate E4 turn signal lamp bulb - left front.

DTC B3949

1. Ignition OFF, disconnect the X2 harness connector at the K9 body control module, ignition ON.
2. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 body control module.
 - **If the test lamp illuminates**
3. Ignition OFF, connect the X2 harness connector at the K9 body control module.
4. Ignition OFF, exterior lamps OFF, remove the E4P turn signal lamp bulb - right front. It may take up to 2 minutes for all vehicle systems to power down.
5. Test for less than 5 ohms between the appropriate ground circuit terminal listed below and ground.
 - E4P park/turn signal lamp - right socket terminal C
 - E4Z turn signal repeater lamp - right socket terminal 1
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
6. Connect a test lamp between the appropriate control circuit terminal listed below and ground, ignition ON.
 - E4P park/turn signal lamp - right socket terminal A
 - E4Z turn signal repeater lamp - right socket terminal 2
7. Verify the test lamp turns ON and OFF when commanding the Right Front Turn Signal Lamp ON and

OFF with a scan tool.

- **If the test lamp is always OFF**

1. Ignition OFF, disconnect the X4 harness connector at the K9 body control module.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.

- **If the test lamp is always ON**

1. Ignition OFF, disconnect the X4 harness connector at the K9 body control module, ignition ON.
2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 body control module.

- **If the test lamp turns ON and OFF**

8. Test or replace the appropriate E4 turn signal lamp bulb - right front.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Parking and Turn Signal Lamp Bulb Replacement**
- **Control Module References** for BCM replacement, programming, and setup

DTC B3950 OR B3951: REAR TURN SIGNAL CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B3950 01

Left Rear Turn Signal Circuit Short to Battery

DTC B3950 02

Left Rear Turn Signal Circuit Short to Ground

DTC B3950 04

Left Rear Turn Signal Circuit Open

DTC B3951 01

Right Rear Turn Signal Circuit Short to Battery

DTC B3951 02

Right Rear Turn Signal Circuit Short to Ground

DTC B3951 04

Right Rear Turn Signal Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F5DA (BCM 5) Fuse B+	B3867 01, B3867 04, B3881 01, B3881 04, B3949 01, B3949 04, B3950 01, B3950 04	B3867 01, B3867 04, B3881 01, B3881 04, B3949 01, B3949 04, B3950 01, B3950 04	-	-
F7DA (BCM 7) Fuse B+	B3948 01, B3948 04, B3951 01, B3951 04	B3948 01, B3948 04, B3951 01, B3951 04	-	-
Turn Signal Switch Signal - Left	1	1	1	-
Turn Signal Switch Signal - Right	1	1	1	-
Turn Signal Control - Left Front	B3948 02	B3948 01, B3948 04	B3948 01, B3948 04	-
Turn Signal Control - Left Rear	B3950 02	B3950 01, B3950 04	B3950 01, B3950 04	-
Turn Signal Control - Right Front	B3949 02	B3949 01, B3949 04	B3949 01, B3949 04	-
Turn Signal Control - Right Rear	B3951 02	B3951 01, B3951 04	B3951 01, B3951 04	-
Turn Signal Lamp Ground - Left Front	-	B3948 01, B3948 04	-	-
Turn Signal Lamp Ground - Right Front	-	B3949 01, B3949 04	-	-
Turn Signal Lamp Ground - Left Rear	-	B3950 01, B3950 04	-	-

Turn Signal Lamp Ground - Right Rear	-	B3951 01, B3951 04	-	-
Turn Signal Repeater Lamp Ground - Left - with T90	-	B3948 01, B3948 04	-	-
Turn Signal Repeater Lamp Ground - Right - with T90	-	B3949 01, B3949 04	-	-
Turn Signal/Multifunction Switch Ground	-	1	-	-
1. Turn Signal Lamps and/or Indicators Malfunction				

Circuit/System Description

Ground is applied at all times to the turn signal/multifunction switch. The turn signal lamps may only be activated with the ignition switch in the ON or START positions. When the turn signal/multifunction switch is placed in either the turn right or turn left position, ground is applied to the body control module (BCM) through either the right turn or left turn signal switch signal circuit. The BCM responds to the turn signal switch input by applying a pulsating voltage to the front and rear turn signal lamps through their respective control circuits. When a turn signal request is received by the BCM, a serial data message is sent to the instrument cluster requesting the respective turn signal indicator be pulsed ON and OFF.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Ignition ON.

Conditions for Setting the DTC

DTC B3950 01 and B3950 04

- The BCM detects an open/high resistance in the left rear turn signal control circuit.
- The BCM detects an open/high resistance in the left rear turn signal ground circuit.
- The BCM detects a short to ground or an open/high resistance in the F5DA (BCM 5) fuse B+ circuit.

DTC B3950 02

The BCM detects a short to ground in the left rear turn signal control circuit.

DTC B3951 01 and B3951 04

- The BCM detects an open/high resistance in the right rear turn signal control circuit.
- The BCM detects an open/high resistance in the right rear turn signal ground circuit.
- The BCM detects a short to ground or an open/high resistance in the F7DA (BCM 7) fuse B+ circuit.

DTC B3951 02

The BCM detects a short to ground in the right rear turn signal control circuit.

Actions Taken When the DTC Sets

DTC B3950

- The left rear turn signal is inoperative.
- The left turn signal indicator on the instrument cluster flashes rapidly.

DTC B3951

- The right rear turn signal is inoperative.
- The right turn signal indicator on the instrument cluster flashes rapidly.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Diagnostic Aids

When testing at the turn signal lamp bulb socket, make sure all measurements and test lamp connections are in the correct terminal location and do not come in contact with each other during testing.

Reference Information

Schematic Reference

- **Exterior Lights Schematics**
- **Body Control System Schematics**

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

DTC B3950

1. Ignition OFF, disconnect the X2 harness connector at the K9 body control module, ignition ON.
2. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 body control module.
 - **If the test lamp illuminates**
 - 3. Ignition OFF, connect the X2 harness connector at the K9 body control module.
 - 4. Ignition OFF, exterior lamps OFF, remove the E4LR turn signal lamp bulb - left rear. It may take up to 2 minutes for all vehicle systems to power down.
 - 5. Test for less than 5 ohms between the ground circuit at the socket terminal and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
 - 6. Connect a test lamp between the control circuit at the socket terminal and ground, ignition ON.
 - 7. Verify the test lamp turns ON and OFF when commanding the Left Rear Turn Signal Lamp ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X5 harness connector at the K9 body control module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, replace the K9 body control module.
- **If the test lamp is always ON**
- 1. Ignition OFF, disconnect the X5 harness connector at the K9 body control module, ignition ON.
- 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 body control module.
- **If the test lamp turns ON and OFF**
- 8. Test or replace the E4LR turn signal lamp bulb - left rear.

DTC B3951

1. Ignition OFF, disconnect the X5 harness connector at the K9 body control module, ignition ON.
2. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 - 1. Ignition OFF.
 - 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 - 1. Ignition OFF.
 - 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 body control module.
 - **If the test lamp illuminates**
3. Ignition OFF, connect the X5 harness connector at the K9 body control module.
4. Ignition OFF, exterior lamps OFF, remove the E4RR turn signal lamp bulb - right rear. It may take up to 2 minutes for all vehicle systems to power down.
5. Test for less than 5 ohms between the ground circuit at the socket terminal and ground.
 - **If 5 ohms or greater**
 - 1. Ignition OFF.
 - 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
6. Connect a test lamp between the control circuit at the socket terminal and ground, ignition ON.
7. Verify the test lamp turns ON and OFF when commanding the Right Rear Turn Signal Lamp ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 - 1. Ignition OFF, disconnect the X4 harness connector at the K9 body control module.

2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance

3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.
 - **If the test lamp is always ON**

1. Ignition OFF, disconnect the X4 harness connector at the K9 body control module, ignition ON.

2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 body control module.

- **If the test lamp turns ON and OFF**

8. Test or replace the E4RR turn signal lamp bulb - right rear.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Tail Lamp Bulb Replacement**
- **Control Module References** for BCM replacement, programming, and setup

DTC C0277 OR C0890: BRAKE PEDAL POSITION SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC C0277 06

Brake Pedal Position Sensor Circuit Low Voltage/Open

DTC C0277 07

Brake Pedal Position Sensor Circuit High Voltage

DTC C0277 09

Brake Pedal Position Sensor Circuit Too Fast Transitions

DTC C0277 4B

Brake Pedal Position Sensor Circuit Calibration Not Learned

DTC C0890 03

Control Module Voltage Reference Output 3 Circuit Low Voltage

DTC C0890 07

Control Module Voltage Reference Output 3 Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Brake Pedal Position Sensor 5 V Reference	C0277 06, C0890 03, C0161 71	C0277 06, C0161 71	C0890 07, C0161 71	-
Brake Pedal Position Sensor Signal	C0277 06, C0161 71	C0277 06, C0161 71	C0277 07, C0161 71	C0277 09
Center High Mounted Stop Lamp Control	B3884 02	2	2	-
Stop Lamp Control - Left	B3881 02	B3881 04	B3881 01	-
Stop Lamp Control - Right	B3882 02	B3882 04	B3882 01	-
Brake Pedal Position Sensor Low Reference	-	C0277 07, C0161 71	1	-
Center High Mounted Stop Lamp Ground	-	2	-	-
Rear Tail/Stop Lamp Ground - Left	-	1	-	-
Rear Tail/Stop Lamp Ground - Right	-	1	-	-
1. Stop Lamps Malfunction 2. Center High Mounted Stop Lamp Malfunction				

Circuit/System Description

The brake pedal position (BPP) sensor is used to sense the action of the driver application of the brake pedal. The BPP sensor provides an analog voltage signal that will increase as the brake pedal is applied. The body control module (BCM) provides a low reference signal and a 5-volt reference voltage to the BPP sensor. When the variable signal reaches a voltage threshold indicating the brakes have been applied, the BCM will apply battery voltage to the left and right stop lamp control circuits as well as the center high mounted stop lamp (CHMSL) control circuit illuminating the left and right stop lamps and the CHMSL.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Brakes APPLIED.

Conditions for Setting the DTC

DTC C0277 06

- The BCM detects a short to ground or an open/high resistance in the BPP sensor 5 V reference circuit.
- The BCM detects a short to ground or an open/high resistance in the BPP sensor signal circuit.

DTC C0277 07

- The BCM detects a short to voltage in the BPP sensor 5 V reference circuit.
- The BCM detects a short to voltage in the BPP sensor signal circuit.

DTC C0277 09

The BCM detects the BPP sensor signal is changing faster than possible under normal operating conditions.

DTC C0277 4B

The DTC will set when the BPP sensor home position is not learned.

DTC C0890 03

The BCM detects a short to ground in the BPP sensor 5 V reference circuit.

DTC C0890 07

- The BCM detects a short to voltage in the BPP sensor 5 V reference circuit.
- The BCM detects a short to voltage in the BPP sensor low reference circuit.

Actions Taken When the DTC Sets

- The Traction Control indicator is commanded ON.
- For DTC C0277 4B, the stop lamps may not activate at the expected brake pedal positions.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- For DTC C0277 07 the ignition must be cycled before the code can be cleared.
- For DTC C0277 4B a successful brake pedal position sensor calibration has been performed.
- A history DTC will clear once 50 malfunction-free ignition cycles have occurred.
- A DTC will not clear the current status until the next ignition cycle.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

DTC C0277 06, C0277 07, C0890 03, and C0890 07

1. Ignition OFF, disconnect the harness connector at the B22 Brake Pedal Position Sensor, ignition ON.
2. Verify a test lamp illuminates between the appropriate low reference circuit terminal listed below and B+.
 - Terminal A - with MX2
 - Terminal B - with MNG
 - **If the test lamp does not illuminate**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If the test lamp illuminates**
3. Ignition ON.
4. Test for 4.8-5.2 V between the appropriate 5 V reference circuit terminal listed below and ground.
 - Terminal C - with MX2
 - Terminal A - with MNG

- **If less than 4.8 V**
 1. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the 5 V reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
- **If greater than 5.2 V**
 1. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
- **If between 4.8-5.2 V**
- 5. Verify the scan tool Brake Pedal Applied parameter is Inactive.
 - **If not Inactive**
 1. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the appropriate signal circuit terminal listed below and ground.
 - Terminal B - with MX2
 - Terminal C - with MNG
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If Inactive**
- 6. Install a 3 A fused jumper wire between the appropriate 5 V reference and signal circuit terminals listed below.
 - 5 V reference terminal C and signal terminal B - with MX2
 - 5 V reference terminal A and signal terminal C - with MNG
- 7. Verify the scan tool Brake Pedal Applied parameter is Active.
 - **If not Active**
 1. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If Active**
- 8. Test or replace the B22 Brake Pedal Position Sensor.

DTC C0277 4B

1. Verify DTC C0277 4B is not set.
 - **If DTC C0277 4B is set**
 1. Ignition ON
 2. Perform the BPP sensor recalibration procedure for the K9 Body Control Module. Refer to **Brake Pedal Position Sensor Calibration**.
 3. Verify the DTC does not reset while operating the vehicle under the conditions for running the DTC.
 - If the DTC resets, replace the B22 Brake Pedal Position Sensor.
 - If the DTC does not reset
 4. All OK.
 - **If DTC C0277 4B is not set**
2. All OK.

DTC C0277 09

1. Verify DTC C0277 09 is not set.
 - **If DTC C0277 09 is set**
 1. Replace the B22 Brake Pedal Position Sensor.
 2. Perform the BPP sensor recalibration procedure for the K9 Body Control Module. Refer to **Brake Pedal Position Sensor Calibration**.
 3. Verify the DTC does not reset while operating the vehicle under the conditions for running the DTC.
 - If the DTC resets, replace the K9 Body Control Module.
 - If the DTC does not reset
 4. All OK.
 - **If DTC C0277 09 is not set**
2. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Brake Pedal Position Sensor Replacement**
- **Brake Pedal Position Sensor Calibration**
- **Control Module References** for BCM replacement, programming, and setup

DTC C0297: BRAKE APPLIED OUTPUT CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC C0297 02

Brake Applied Output Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Brake Applied Signal	C0297 02	C0297 02	1	-
1. Cruise Control Malfunction				

Circuit/System Description

The brake pedal position sensor is used to sense the action of the driver application of the brake pedal. The brake pedal position sensor provides an analog voltage signal that will increase as the brake pedal is applied. The body control module (BCM) provides a low reference signal and a 5 V reference voltage to the brake pedal position sensor. When the variable signal reaches a voltage threshold indicating the brakes have been applied, the BCM will apply battery voltage to the right and left stop lamp control circuits, engine control module (ECM), and center high mounted stop lamp control circuit.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Brakes APPLIED.

Conditions for Setting the DTC

The BCM detects a short to ground or an open/high resistance on the brake applied signal circuit.

Actions Taken When the DTC Sets

The cruise control system is disabled.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 50 consecutive malfunction-free ignition cycles have occurred.

Diagnostic Aids

Verify that the brake pedal position sensor is properly calibrated.

Reference Information

Schematic Reference

Cruise Control Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the X1 harness connector at the K20 engine control module.
2. Connect a test lamp between the signal circuit terminal 25 and ground, ignition ON.
3. Verify the test lamp turns ON and OFF while pressing and releasing the brake pedal.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X5 harness connector at the K9 body control module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the X5 harness connector at the K9 body control module, ignition ON.
 2. Test for less than 1 V between the signal circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 body control module.
 - **If the test lamp turns ON and OFF**
4. Replace the K20 engine control module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Brake Pedal Position Sensor Calibration**
- **Control Module References** for BCM or ECM replacement, programming, and setup

SYMPTOMS - LIGHTING

NOTE: **The following steps must be completed before using a symptom table.**

- Perform the **Diagnostic System Check - Vehicle** before using a symptom table in order to verify that all of the following conditions are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data link.
- Review the system description and operation in order to familiarize yourself with the system functions. Refer to the following:
 - **Exterior Lighting Systems Description and Operation**
 - **Interior Lighting Systems Description and Operation**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the lighting system. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Thoroughly inspect the wiring and connectors. An incomplete inspection of the wiring and connectors may result in misdiagnosis causing part replacement with the reappearance of the malfunction. If an intermittent malfunction exists, refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Backup Lamps Malfunction (Automatic Transmission), Backup Lamps Malfunction (Manual Transmission)**

- Courtesy Lamps Malfunction
- Dome Lamps Malfunction
- Front Fog Lamps Malfunction
- Hazard Lamps Malfunction
- Headlamps Malfunction
- Interior Backlighting Malfunction
- Park, License, and/or Tail Lamps Malfunction
- Rear Compartment Lamp Malfunction
- Stop Lamps Malfunction
- Turn Signal Lamps and/or Indicators Malfunction

BACKUP LAMPS MALFUNCTION (AUTOMATIC TRANSMISSION)

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F6DA (BCM 6) Fuse B+	B2545 01, B2545 04, B2615 02	B2545 01, B2545 04, B2615 02	-	-
Backup Lamps Control	B2545 02	B2545 01, B2545 04	B2545 01	-
Backup Lamp Ground - Left	-	1	-	-
Backup Lamp Ground - Right	-	1	-	-
1. Backup Lamps Malfunction				

Circuit/System Description

With the engine running and the transmission in the reverse position, the transmission control module (TCM) sends a serial data message to the body control module (BCM). The message indicates that the gear selector is in the reverse position. The BCM applies battery voltage to the backup lamps control circuit illuminating the backup lamps. Once the driver moves the gear selector out of the reverse position, a message is sent by the TCM via serial data requesting the BCM to remove battery voltage from the backup lamps control circuit. The engine must be running for the backup lamps to operate.

Diagnostic Aids

When testing at the backup lamp bulb socket, make sure all measurements and test lamp connections are in the

correct terminal location and do not come in contact with each other during testing.

Reference Information

Schematic Reference

Exterior Lights Schematics

Body Control System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the X5 harness connector at the K9 body control module, ignition ON.
2. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 body control module.
 - **If the test lamp illuminates**

3. Ignition OFF, connect the X5 harness connector at the K9 body control module.
4. Ignition OFF, exterior lamps OFF, remove the appropriate E5 backup lamp bulb at the appropriate E42 tail lamp assembly. It may take up to 2 minutes for all vehicle systems to power down.
5. Test for less than 5 ohms between the ground circuit at the socket terminal and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
6. Connect a test lamp between the control circuit at the socket terminal and ground, ignition ON.
7. Verify the test lamp turns ON and OFF when commanding the Backup Lamps ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X7 harness connector at the K9 body control module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the X7 harness connector at the K9 body control module, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 body control module.
 - **If the test lamp turns ON and OFF**
8. Test or replace the appropriate E5 backup lamp.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Tail Lamp Bulb Replacement**
- **Control Module References** for BCM replacement, programming, and setup

BACKUP LAMPS MALFUNCTION (MANUAL TRANSMISSION)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F6DA (BCM 6) Fuse B+	B2545 01, B2545 04, B2615 02	B2545 01, B2545 04, B2615 02	-	-
Backup Lamp Switch Signal (Manual Transmission)	P0812	P0812	1	-
Backup Lamps Control	B2545 02	B2545 01, B2545 04	B2545 01	-
Backup Lamp Switch Ground (Manual Transmission)	-	P0812	-	-
Backup Lamp Ground - Left	-	1	-	-
Backup Lamp Ground - Right	-	1	-	-
1. Backup Lamps Malfunction				

Circuit/System Description

The engine control module (ECM) provides a signal circuit to the backup lamp switch which is permanently grounded. With the engine running and the transmission in the reverse position, the backup lamp switch signal circuit is pulled low and the ECM responds by sending a serial data message to the body control module (BCM). The message indicates that the gear selector is in the reverse position. The BCM applies battery voltage to the backup lamps control circuit illuminating the backup lamps. Once the driver moves the gear selector out of the reverse position, a message is sent by the ECM via serial data requesting the BCM to remove battery voltage from the backup lamps control circuit. The engine must be running for the backup lamps to operate.

Diagnostic Aids

When testing at the backup lamp bulb socket, make sure all measurements and test lamp connections are in the correct terminal location and do not come in contact with each other during testing.

Reference Information

Schematic Reference

Exterior Lights Schematics

Body Control System Schematics

Connector End View Reference

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Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Engine ON.
2. Verify the scan tool Reverse Position Switch parameter changes between ON and OFF while shifting the vehicle between the neutral and reverse gears.
 - **If the parameter does not change**

Refer to Backup Lamp Switch Malfunction.
 - **If the parameter changes**
3. Verify the backup lamps turn ON and OFF when commanding the Backup Lamps ON and OFF with a scan tool.
 - **If the backup lamps do not turn ON and OFF**

Refer to Backup Lamps Malfunction.
 - **If the backup lamps turn ON and OFF**
4. All OK.

Circuit/System Testing

Backup Lamp Switch Malfunction

1. Ignition OFF, exterior lamps OFF, all doors closed, disconnect the harness connector at the B16 backup lamp switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 ohms between the ground circuit terminal 2 and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
- **If less than 5 ohms**
- 3. Ignition ON.
- 4. Verify the scan tool Reverse Position Switch parameter is Off.
 - **If not Off**
 1. Ignition OFF, disconnect the X1 harness connector at the K20 engine control module.
 2. Test for infinite resistance between the signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 engine control module.
 - **If Off**
- 5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the ground circuit terminal 2.
- 6. Verify the scan tool Reverse Position Switch parameter is On.
 - **If not On**
 1. Ignition OFF, disconnect the X1 harness connector at the K20 engine control module.
 2. Test for less than 1 V between the signal circuit terminal 1 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 engine control module.
 - **If On**
- 7. Test or replace the B16 backup lamp switch.

Backup Lamps Malfunction

1. Ignition OFF, disconnect the X5 harness connector at the K9 body control module, ignition ON.
2. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 body control module.

- **If the test lamp illuminates**
- 3. Ignition OFF, connect the X5 harness connector at the K9 body control module.
- 4. Ignition OFF, exterior lamps OFF, remove the appropriate E5 backup lamp bulb at the appropriate E42 tail lamp assembly. It may take up to 2 minutes for all vehicle systems to power down.
- 5. Test for less than 5 ohms between the ground circuit at the socket terminal and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
- 6. Connect a test lamp between the control circuit at the socket terminal and ground, ignition ON.
- 7. Verify the test lamp turns ON and OFF when commanding the Backup Lamps ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X7 harness connector at the K9 body control module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the X7 harness connector at the K9 body control module, ignition ON.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 body control module.
 - **If the test lamp turns ON and OFF**
- 8. Test or replace the appropriate E5 backup lamp.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Tail Lamp Bulb Replacement**
- **Backup Lamp Switch Replacement (MX2, MFM)**
- **Control Module References** for BCM or ECM replacement, programming, and setup

COURTESY LAMPS MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F6DA (BCM 6) Fuse B+	B2545 01, B2545 04, B2615 02	B2545 01, B2545 04, B2615 02	-	-
Dome Lamp Control	B2615 02	2	2	-
Reading Lamp Control	B1480 02	1	1	-
Dome Lamp Ground	-	1, 2	-	-
1. Courtesy Lamps Malfunction 2. Dome Lamps Malfunction				

Circuit/System Description

The body control module (BCM) supplies battery voltage to the reading lamp via the courtesy lamp control circuit. The reading lamp is controlled by an individual switch that is activated by the operator when additional cabin lighting is required. In the event that the courtesy reading lamp were to remain illuminated for more than 10 min with the ignition switch in the OFF position the BCM will deactivate the courtesy lamp control circuit to prevent total battery discharge.

Reference Information

Schematic Reference

- **Interior Lights Schematics**
- **Body Control System Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, all doors closed, all accessories OFF, disconnect the harness connector at the E36AH Dome Lamp. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 ohms between the appropriate ground circuit terminal listed below and ground.
 - E36AH Dome Lamp - terminal 3 (with UE1)
 - E36AH Dome Lamp - terminal 2 (without UE1)
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Connect a test lamp between the appropriate control circuit terminal listed below and ground.
 - E36AH Dome Lamp - terminal 1 (with UE1)
 - E36AH Dome Lamp - terminal 4 (without UE1)
4. Verify the test lamp turns ON and OFF when commanding the Inadvertent Load ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X7 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the X7 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
5. Test or replace the E36AH Dome Lamp.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Center Courtesy Lamp Replacement**
- **Control Module References** for BCM replacement, programming, and setup

DOMELAMPS MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F6DA (BCM 6) Fuse B+	B2545 01, B2545 04, B2615 02	B2545 01, B2545 04, B2615 02	-	-
Dome Lamp Control	B2615 02	2	2	-
Reading Lamp Control	B1480 02	1	1	-
Dome Lamp Ground	-	1, 2	-	-
1. Courtesy Lamps Malfunction 2. Dome Lamps Malfunction				

Circuit/System Description

When any door is opened, the door ajar switch contacts close and the body control module (BCM) receives a door-open input. The BCM illuminates the dome lamp when any door is opened or a door lock/unlock request is activated with the key fob. After all doors have been closed, the dome lamp will remain illuminated approximately 3 seconds after the last door closes. In the event that the dome lamp were to remain illuminated for more than 10 min with the ignition switch in the OFF position the BCM will deactivate the dome lamp control circuit to prevent total battery discharge.

Reference Information

Schematic Reference

- **Interior Lights Schematics**
- **Body Control System Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Door Ajar Sw. parameter changes between Active and Inactive while opening and closing each vehicle door.
 - **If the parameter does not change**

Refer to **Door Ajar Indicator Malfunction** .

- **If the parameter changes**
3. Verify the dome lamps turn ON and OFF while commanding the Courtesy Lamps ON and OFF with a scan tool.
 - **If the dome lamps do not turn ON and OFF**

Refer to Circuit/System Testing.

- **If the dome lamps turn ON and OFF**
4. All OK.

Circuit/System Testing

1. Ignition OFF, all doors closed, all accessories OFF, disconnect the harness connector at the E36AH Dome Lamp. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 ohms between the appropriate ground circuit terminal listed below and ground.
 - E36AH Dome Lamp - terminal 3 (with UE1)
 - E36AH Dome Lamp - terminal 2 (without UE1)
 - **If 10 ohms or greater**

1. Ignition OFF.
2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Connect a test lamp between the appropriate control circuit terminal listed below and ground.
 - E36AH Dome Lamp - terminal 2 (with UE1)
 - E36AH Dome Lamp - terminal 3 (without UE1)
4. Verify the test lamp turns ON and OFF when commanding the Courtesy Lamps ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X7 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the X7 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
 - 5. Test or replace the E36AH Dome Lamp.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Center Courtesy Lamp Replacement**
- **Control Module References** for BCM replacement, programming, and setup

FRONT FOG LAMPS MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F13UA (FRT FOG) Fuse B+	1	1	-	-
Front Fog Lamp Switch Signal	1	1	1	-
Front Fog Lamp Relay Control	B2530 02, B2530 04	B2530 02, B2530 04	B2530 01	-
Front Fog Lamp Control	1	1	1	-
Front Fog Lamp Ground - Left	-	1	-	-
Front Fog Lamp Ground - Right	-	1	-	-
Turn Signal/Multifunction Switch Ground	-	1	-	-
1. Front Fog Lamps Malfunction				

Circuit/System Description

The front fog lamp relay is supplied with battery voltage at all times. The front fog lamp switch signal circuit is grounded momentarily by pressing the front fog lamp switch. The body control module (BCM) energizes the front fog lamp relay by applying ground to the front fog lamp relay control circuit. When the front fog lamp relay is energized, the relay switch contacts close and battery voltage is applied through the front fog lamps fuse to the front fog lamp control circuit which illuminates the front fog lamps.

Reference Information

Schematic Reference

Fog Lights Schematics

Connector End View Reference

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Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON, headlamps ON.
2. Verify the scan tool Front Fog Lamps Switch parameter changes between Active and Inactive while commanding the front fog lamps ON and OFF with the front fog lamp switch.
 - **If the parameter does not change**

Refer to Front Fog Lamp Switch Malfunction.
 - **If the parameter changes**
3. Verify the front fog lamps turn ON and OFF when commanding the Front Fog Lamps ON and OFF with a scan tool.
 - **If the front fog lamps do not turn ON and OFF**

Refer to Front Fog Lamps Malfunction.
 - **If the front fog lamps turn ON and OFF**
4. Verify the front fog lamp indicator on the instrument cluster turns ON and OFF while commanding the front fog lamps ON and OFF with the front fog lamp switch.
 - **If the front fog lamp indicator does not turn ON and OFF**

Refer to Front Fog Lamp Indicator Malfunction.
 - **If the front fog lamp indicator turns ON and OFF**
5. All OK.

Circuit/System Testing

Front Fog Lamp Switch Malfunction

1. Ignition OFF, all doors closed, all accessories OFF, disconnect the harness connector at the S78 turn signal/multifunction switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 15 ohms between the ground circuit terminal 1 and ground.
 - **If 15 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 15 ohms**
3. Ignition ON.
4. Verify the scan tool Front Fog Lamps Switch parameter is Inactive.

- **If not Inactive**

1. Ignition OFF, disconnect the X7 harness connector at the K9 body control module.
2. Test for infinite resistance between the signal circuit terminal 8 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 body control module.

- **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 8 and the ground circuit terminal 1.
6. Verify the scan tool Front Fog Lamps Switch parameter is Active.

- **If not Active**

1. Ignition OFF, disconnect the X7 harness connector at the K9 body control module, ignition ON.
2. Test for less than 1 V between the signal circuit terminal 2 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.

- **If Active**

7. Test or replace the S78 turn signal/multifunction switch.

Front Fog Lamps Malfunction

1. Ignition OFF, disconnect the KR46 front fog lamp relay, ignition ON.
2. Verify a test lamp illuminates between the B+ circuit terminal 30 and ground.

- **If the test lamp does not illuminate**

Replace the X50A fuse block - underhood.

- **If the test lamp illuminates**

3. Verify a test lamp illuminates between the B+ circuit terminal 86 and ground.

- **If the test lamp does not illuminate**

Replace the X50A fuse block - underhood.

- **If the test lamp illuminates**

4. Ignition OFF, connect a test lamp between the control circuit terminal 85 and B+, ignition ON.
5. Verify the test lamp turns ON and OFF when commanding the Front Fog Lamps ON and OFF with a scan tool.

- **If the test lamp is always OFF**

1. Ignition OFF, disconnect the X5 harness connector at the K9 body control module, ignition ON.
2. Test for less than 1 V between the control circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
- 3. Ignition OFF.
- 4. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.
 - **If the test lamp is always ON**
- 1. Ignition OFF, disconnect the X5 harness connector at the K9 body control module.
- 2. Test for infinite resistance between the control circuit terminal and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 body control module.
 - **If the test lamp turns ON and OFF**
- 6. Ignition OFF, connect the KR46 front fog lamp relay.
- 7. Ignition OFF, exterior lamps OFF, disconnect the harness connector at the appropriate E29 fog lamp.
- 8. Test for less than 5 ohms between the ground circuit terminal A and ground.
 - **If 5 ohms or greater**
- 1. Ignition OFF.
- 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
- 9. Connect a test lamp between the control circuit terminal B and ground, ignition ON.
- 10. Verify the test lamp turns ON and OFF when commanding the Front Fog Lamps ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
- 1. Ignition OFF, disconnect the X1 harness connector at the X50A fuse block - underhood.
- 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
- 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the KR46 front fog lamp relay.
 - **If the test lamp is always ON**
- 1. Ignition OFF, disconnect the X1 harness connector at the X50A fuse block - underhood, ignition ON.
- 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the KR46 front fog lamp relay.

- If the test lamp turns ON and OFF

11. Test or replace the appropriate E29 fog lamp.

Front Fog Lamp Indicator Malfunction

1. Ignition ON.
2. Verify the front fog lamp indicator turns ON and OFF when commanding the Instrument Cluster All Indicators Test ON and OFF with a scan tool.

- If the front fog lamp indicator is always OFF or remains ON

Replace the P16 instrument cluster.

- If the front fog lamp indicator turns ON and OFF

3. Replace the K9 body control module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Front Fog Lamp Replacement (Projection)**
- **Front Fog Lamp Bulb Replacement (Projection)**
- **Relay Replacement (Within an Electrical Center) , Relay Replacement (Attached to Wire Harness)**
- **Fuse Block Replacement**
- **Control Module References** for BCM or Instrument Cluster replacement, programming, and setup

HAZARD LAMPS MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Hazard Warning Switch Signal	1	1	1	B3596 00
Hazard Warning Switch LED Backlighting Control	B2652 02	2	2	-
Hazard Warning Switch Ground	-	1	-	-
1. Hazard Lamps Malfunction 2. Hazard Warning Switch Backlighting Malfunction				

Circuit/System Description

The hazard flashers may be activated in any power mode. The hazard warning switch signal circuit is momentarily grounded when the hazard warning switch is pressed. The body control module (BCM) responds to the hazard warning switch signal input by supplying battery voltage to all four turn signal lamps in an ON and OFF duty cycle. When the hazard warning switch is activated, the BCM sends a serial data message to the instrument cluster requesting both turn signal indicators to be cycled ON and OFF.

The instrument panel dimmer switch controls are located on the headlamp switch assembly and are used to increase and decrease the brightness of the interior backlighting components. When the instrument panel dimmer switch is placed in a desired brightness position, the body control module (BCM) receives a signal from the instrument dimmer switch and responds by applying a pulse width modulated (PWM) voltage to the hazard switch LED backlighting control circuit illuminating the LED to the desired level of brightness.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

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Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Hazard Lamps Switch parameter changes between Active and Inactive while commanding the hazard lamps ON and OFF with the hazard warning switch.
 - **If the parameter does not change**

Refer to Hazard Warning Switch Malfunction.

- **If the parameter changes**

3. Verify all left and right turn signal lamps turn ON and OFF while commanding the hazard lamps ON and OFF with the hazard warning switch.

- **If all turn signal lamps do not turn ON and OFF**

Refer to **Turn Signal Lamps and/or Indicators Malfunction**

- **If all turn signal lamps turn ON and OFF**

4. Verify the hazard warning switch backlighting turns ON and OFF while commanding the Hazard Lamps Switch Backlight ON and OFF with a scan tool.

- **If the hazard warning switch backlighting does not turn ON and OFF**

Refer to Hazard Warning Switch Backlighting Malfunction.

- **If the hazard warning switch backlighting turns ON and OFF**

5. All OK.

Circuit/System Testing

Hazard Warning Switch Malfunction

1. Ignition OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S26 hazard warning switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 ohms between the ground circuit terminal 8 and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
3. Ignition ON.
4. Verify the scan tool Hazard Lamps Switch parameter is Inactive.
 - **If not Inactive**
 1. Ignition OFF, disconnect the X2 harness connector at the K9 body control module.
 2. Test for infinite resistance between the signal circuit terminal 7 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 body control module.
 - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 7 and ground.

6. Verify the scan tool Hazard Lamps Switch parameter is Active.
 - **If not Active**
 1. Ignition OFF, disconnect the X2 harness connector at the K9 body control module, ignition ON.
 2. Test for less than 1 V between the signal circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.
 - **If Active**
7. Test or replace the S26 hazard warning switch.

Hazard Warning Switch Backlighting Malfunction

1. Ignition OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S26 hazard warning switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 ohms between the ground circuit terminal 3 and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
3. Connect a test lamp between the control circuit terminal 2 and ground, ignition ON.
4. Verify the test lamp turns ON and OFF when commanding the Hazard Lamps Switch Backlight ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 body control module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 body control module, ignition ON.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.

- If less than 1 V, replace the K9 body control module.
 - **If the test lamp turns ON and OFF**
5. Test or replace the S26 hazard warning switch.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Hazard Warning Switch Replacement**
- **Control Module References** for BCM replacement, programming, and setup

HEADLAMPS MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F3DA (BCM 3) Fuse B+	B2699 01, B2699 04	B2699 01, B2699 04	-	-
F4DA (BCM 4) Fuse B+	B2575 01, B2575 04	B2575 01, B2575 04	-	-
Headlamp High Beam Relay Control	B2580 02	B2580 04	B2580 01	-
Low Beam Headlamp Control - Left	B2575 02	B2575 01, B2575 04	B2575 04	-
Low Beam Headlamp Control - Right	B2699 02	B2699 01, B2699 04	B2699 04	-
High Beam Headlamp Control - Left	2	2	2	-
High Beam Headlamp Control - Right	2	2	2	-
Headlamp Switch Headlamps ON Signal	B257A 00	3	3	-
Turn Signal/Multifunction Switch Flash To Pass Signal	B3806 00	4	4	-
Turn Signal/Multifunction Switch High Beam Signal	B3650 08	4	4	-
Headlamp Ground - Left	-	B2575 04	-	-
Headlamp Ground - Right	-	B2699 04	-	-
Headlamp Switch Ground	-	1, 3	-	-

Turn Signal/Multifunction Switch Ground	-	4	-	-
1. Headlamps Malfunction - Low Beam 2. Headlamps Malfunction - High Beam 3. Headlamp Switch Malfunction 4. Turn Signal/Multifunction Switch Malfunction				

Circuit/System Description

The body control module (BCM) monitors two signal circuits from the headlamp switch. With the headlamp switch in the PARK position, the headlamp switch park lamps ON signal circuit is grounded, indicating that the park lamps have been requested. When the headlamp switch is placed in the HEADLAMP position, both the headlamp switch park lamps ON signal circuit and the headlamp switch headlamps ON signal circuit are grounded. The BCM responds to the inputs by illuminating the park lamps and headlamps. When the low beam headlamps are requested, the BCM applies B+ to both low beam headlamp control circuits illuminating the low beam headlamps.

The high beam and flash to pass functions are contained within the turn signal/multifunction switch. The BCM provides the turn signal/multifunction switch with two signal circuits, the high beam signal circuit and the flash to pass signal circuit. When the low beam headlamps are ON and the turn signal/multifunction switch is placed in the high beam position, ground is applied to the BCM through the high beam signal circuit. The BCM responds to the high beam request by applying ground to the high beam relay control circuit which energizes the high beam relay. With the high beam relay energized, the switch contacts close allowing battery voltage to flow through the high beam fuses to the high beam control circuits illuminating the high beam headlamps.

When the turn signal/multifunction switch is momentarily placed in the flash to pass position, ground is applied to the BCM through the flash to pass signal circuit. The BCM responds by applying ground to the high beam relay control circuit which energizes the high beam relay illuminating the high beams for a brief moment or until the flash to pass switch is released.

Reference Information

Schematic Reference

- **Headlights/Daytime Running Lights (DRL) Schematics**
- **Body Control System Schematics**

Connector End View Reference

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- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Headlamps On Switch parameter changes between Active and Inactive while commanding the headlamp ON and OFF with the headlamp switch.
 - **If the parameter does not change**

Refer to Headlamp Switch Malfunction.
 - **If the parameter changes**
3. Verify the scan tool Headlamps Flash Switch parameter changes between Active and Inactive while commanding the flash to pass ON and OFF with the turn signal/multifunction switch.
 - **If the parameter does not change**

Refer to Turn Signal/Multifunction Switch Malfunction.
 - **If the parameter changes**
4. Verify the scan tool High Beam Select Switch parameter changes between Active and Inactive while commanding the high beams ON and OFF with the turn signal/multifunction switch.
 - **If the parameter does not change**

Refer to Turn Signal/Multifunction Switch Malfunction.
 - **If the parameter changes**
5. Verify the left low beam turns ON and OFF when commanding the Left Low Beam/Daytime Running Lamp ON and OFF with a scan tool.
 - **If the left low beam does not turn ON and OFF**

Refer to Headlamps Malfunction - Low Beam.
 - **If the left low beam turns ON and OFF**
6. Verify the right low beam turns ON and OFF when commanding the Right Low Beam/Daytime Running Lamp ON and OFF with a scan tool.
 - **If the right low beam does not turn ON and OFF**

Refer to Headlamps Malfunction - Low Beam.

- **If the right low beam turns ON and OFF**

7. Verify the high beams turn ON and OFF when commanding the High Beams ON and OFF with a scan tool.

- **If the high beams do not turn ON and OFF**

Refer to Headlamps Malfunction - High Beam.

- **If the high beams turn ON and OFF**

8. Verify the high beam indicator on the instrument cluster turns ON and OFF while commanding the All Indicators Test ON and OFF with a scan tool.

- **If the high beam indicator does not turn ON and OFF**

Refer to High Beam Indicator Malfunction.

- **If the high beam indicator turns ON and OFF**

9. All OK.

Circuit/System Testing

Headlamp Switch Malfunction

1. Ignition OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S78 Turn Signal/Multifunction Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 15 ohms between the ground circuit terminal 1 and ground.
 - **If 15 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 15 ohms**
3. Ignition ON.
4. Verify the scan tool Park Lamps Switch parameter is Inactive.
 - **If not Inactive**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal 2 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 1.

6. Verify the scan tool Park Lamps Switch parameter is Active.
 - **If not Active**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit terminal 2 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If Active**
7. Verify the scan tool Headlamps On Switch parameter is Inactive.
 - **If not Inactive**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal 3 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If Inactive**
8. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the ground circuit terminal 1.
9. Verify the scan tool Headlamps On Switch parameter is Active.
 - **If not Active**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit terminal 3 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If Active**
10. Test or replace the S78 Turn Signal/Multifunction Switch.

Turn Signal/Multifunction Switch Malfunction

1. Ignition OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S78 Turn Signal/Multifunction Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 15 ohms between the ground circuit terminal 1 and ground.
 - **If 15 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
- **If less than 15 ohms**
- 3. Ignition ON.
- 4. Verify the scan tool High Beam Select Switch parameter is Inactive.
 - **If not Inactive**
 1. Ignition OFF, disconnect the X3 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal 6 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If Inactive**
- 5. Install a 3 A fused jumper wire between the signal circuit terminal 6 and the ground circuit terminal 1.
- 6. Verify the scan tool High Beam Select Switch parameter is Active.
 - **If not Active**
 1. Ignition OFF, disconnect the X3 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit terminal 6 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If Active**
- 7. Verify the scan tool Headlamps Flash Switch parameter is Inactive.
 - **If not Inactive**
 1. Ignition OFF, disconnect the X3 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal 7 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If Inactive**
- 8. Install a 3 A fused jumper wire between the signal circuit terminal 7 and the ground circuit terminal 1.
- 9. Verify the scan tool Headlamps Flash Switch parameter is Active.
 - **If not Active**
 1. Ignition OFF, disconnect the X3 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit terminal 7 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, replace the K9 Body Control Module.
 - **If Active**
10. Test or replace the S78 Turn Signal/Multifunction Switch.

Headlamps Malfunction - Low Beam

1. Ignition OFF, exterior lamps OFF, disconnect the harness connector at the appropriate E13 Headlamp. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 ohms between the appropriate ground circuit terminal listed below and ground.
 - Terminal 1 - with T90
 - Terminal 2 - without T90
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
3. Connect a test lamp between the appropriate control circuit terminal listed below and ground, ignition ON.
 - Terminal 1 - without T90
 - Terminal 2 - with T90
4. Verify the test lamp turns ON and OFF when commanding the appropriate Low Beam/Daytime Running Lamp ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X4 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the X4 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
5. Test or replace the appropriate E4 Headlamp - Low Beam.

Headlamps Malfunction - High Beam

1. Ignition OFF, remove the KR48 Headlamp High Beam Relay, ignition ON.
2. Verify a test lamp illuminates between the B+ circuit terminal 85 and ground.
 - **If the test lamp does not illuminate**

Replace the X50A Fuse Block - Underhood.
 - **If the test lamp illuminates**
3. Verify a test lamp illuminates between the B+ circuit terminal 30 and ground.
 - **If the test lamp does not illuminate**

Replace the X50A Fuse Block - Underhood.
 - **If the test lamp illuminates**
4. Ignition OFF, connect a test lamp between the control circuit terminal 86 and B+, ignition ON.
5. Verify the test lamp turns ON and OFF when commanding the High Beams ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X5 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Ignition OFF.
 4. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the X5 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit terminal and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
 - 6. Ignition OFF, exterior lamps OFF, connect the KR48 Headlamp High Beam Relay.
 - 7. Disconnect the harness connector at the appropriate E13 Headlamp. It may take up to 2 minutes for all vehicle systems to power down.
 - 8. Test for less than 5 ohms between the appropriate ground circuit terminal listed below and ground.
 - Terminal 1 - with T90
 - Terminal 2 - without T90
 - **If 5 ohms or greater**

1. Ignition OFF.
2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
9. Connect a test lamp between the control circuit terminal 3 and ground, ignition ON.
10. Verify the test lamp turns ON and OFF when commanding the High Beams ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X1 harness connector at the X50A Fuse Block - Underhood.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the KR48 Headlamp High Beam Relay.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the X1 harness connector at the X50A Fuse Block - Underhood, ignition ON.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the KR48 Headlamp High Beam Relay.
 - **If the test lamp turns ON and OFF**
 - 11. Test or replace the appropriate E4 Headlamp - High Beam.

High Beam Indicator Malfunction

1. Ignition ON.
2. Verify the high beam indicator turns ON and OFF when commanding the Instrument Cluster All Indicators Test ON and OFF with a scan tool.
 - **If the high beam indicator is always OFF or remains ON**

Replace the P16 Instrument Cluster.
 - **If the high beam indicator turns ON and OFF**
3. Replace the K9 Body Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Headlamp Bulb Replacement**
- **Relay Replacement (Within an Electrical Center)** , **Relay Replacement (Attached to Wire Harness)**
- **Turn Signal Switch Replacement**
- **Control Module References** for BCM or Instrument Cluster replacement, programming, and setup

INTERIOR BACKLIGHTING MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F1DA (BCM 1) Fuse B+	B101E 43, B1395 03, B1517 07, C0890 03, U0121 00,	B101E 43, B1395 03, B1517 07, C0890 03, U0121 00,	-	-
Instrument Panel Dimmer Switch B+	B1395 03, B3600 03	B3600 03	B1395 07	-
Instrument Panel Dimmer Switch Signal	B1395 03, B3600 03	B3600 03	B3600 07	-
Hazard Warning Switch LED Backlight Dimming Control	B2652 02	1	1	-
LED Backlight Dimming Control Terminal 8 X2	B2610 02	B2610 04	B2610 01	-
LED Backlight Dimming Control Terminal 5 X1	B2625 02	B2625 04	B2625 01	-
Instrument Panel Dimmer Switch Low Reference	2	2	2	-
Door Lock Switch - Driver Ground	-	1	-	-
Door Lock Switch - Passenger Ground	-	1	-	-
Hazard Warning Switch - Ground	-	3	-	-
Instrument Panel Dimmer Switch Ground	-	1	-	-
Seat Heating Switch - Driver Ground	-	1	-	-
Seat Heating Switch - Passenger	-	1	-	-

Ground				
Steering Wheel Control Switch - Left Ground	-	1	-	-
Steering Wheel Control Switch - Right Ground	-	1	-	-
Liftgate Unlatch Switch Ground	-	1	-	-
Traction Control Switch Ground	-	1	-	-
Transmission Shift Lever Position Indicator Ground	-	1	-	-
1. Interior Backlighting Malfunction 2. Dimmer Switch Malfunction 3. Hazard Warning Switch Backlighting Malfunction				

Circuit/System Description

The instrument panel dimmer switch is used to increase and decrease the brightness of the interior backlighting components. The instrument panel dimmer switch provides a voltage signal to the body control module (BCM) that will increase as the brightness of the lights are increased and decrease as the brightness of the lights are decreased. The BCM provides a low reference, signal, and B+ voltage circuits to the instrument panel dimmer switch. When the instrument panel dimmer switch is placed in the desired position, the dimmed voltage setting is applied from the instrument panel dimmer switch through the instrument panel dimmer switch signal circuit to the BCM. The BCM interprets the signal and applies a pulse width modulated (PWM) voltage through the light emitting diode (LED) dimming control circuits illuminating the interior backlighting to the requested level of brightness.

Reference Information

Schematic Reference

Interior Lights Dimming Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool LED Backlight Dimming Command parameter changes between a high percentage to a low percentage while operating the dimmer switch from high to low.

- **If the parameter does not change**

Refer to Dimmer Switch Malfunction.

- **If the parameter changes**

3. Verify the backlighting components turn ON and OFF while commanding the LED Backlight Dimming ON and OFF with a scan tool.

- **If the backlighting components do not turn ON and OFF**

Refer to Interior Backlighting Malfunction.

- **If the backlighting components turn ON and OFF**

4. Verify the hazard warning switch backlighting turns ON and OFF while commanding the Hazard Lamps Switch Backlight ON and OFF with a scan tool.

- **If the hazard warning switch backlighting does not turn ON and OFF**

Refer to Hazard Warning Switch Backlighting Malfunction.

- **If the hazard warning switch backlighting turns ON and OFF**

5. Verify the amber HVAC recirculation indicator illuminates when turning the recirculation function ON/OFF.

- **If the amber HVAC recirculation indicator does not illuminate**

Refer to HVAC Recirculation Indicator Malfunction.

- **If the amber HVAC recirculation indicator illuminates**

6. All OK.

Circuit/System Testing

Dimmer Switch Malfunction

1. Ignition OFF, disconnect the harness connector at the S36 Instrument Panel Dimmer Switch, ignition ON.
2. Verify a test lamp illuminates between the low reference circuit terminal 2 and B+.

- **If the test lamp does not illuminate**

1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module, ignition ON.
2. Test for less than 1 V between the low reference circuit terminal 2 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If the test lamp illuminates**
3. Test for B+ between the B+ reference circuit terminal 1 and ground.
 - **If less than B+**
 - 1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module.
 - 2. Test for infinite resistance between the B+ reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 - 3. Test for less than 2 ohms in the B+ reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If B+**
4. Verify a test lamp does not illuminate between the B+ reference circuit terminal 1 and ground.
 - **If the test lamp illuminates**
 - 1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module, ignition ON.
 - 2. Test for less than 1 V between the B+ reference circuit terminal 2 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp does not illuminate**
5. Park lamps ON, verify a test lamp does not illuminate between the signal circuit terminal 3 and ground.
 - **If the test lamp illuminates**
 - 1. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module, ignition ON.
 - 2. Test for less than 1 V between the signal circuit terminal 3 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp does not illuminate**
6. Ignition ON, park lamps OFF, test for between 57.4 K ohms and 58 K ohms between the signal circuit terminal 3 and ground.
 - **If not between 57.4 K ohms and 58 K ohms**
 - 1. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module.
 - 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance
- 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
- **If between 57.4 K ohms and 58 K ohms**
- 7. Test or replace the S36 Instrument Panel Dimmer Switch.

Interior Backlighting Malfunction

NOTE: Each component with backlighting may need to be disconnected to isolate a short to voltage or short to ground. Use the schematics to identify the following:

- Backlighting components the vehicle is equipped with
- Each component's control and ground circuit terminals
- Component locations on the backlighting control circuit

1. Ignition OFF, all doors closed, all accessories OFF, disconnect the harness connector at the component with inoperative backlighting. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 15 ohms between the appropriate ground circuit terminal listed below and ground.
 - S13D Door Lock Switch - Driver terminal 3
 - S13P Door Lock Switch - Passenger terminal 3
 - S36 Instrument Panel Dimmer Switch - terminal 5
 - S46B Liftgate Unlatch Switch - terminal 6
 - S32D Seat Heating Switch - Driver terminal 5
 - S32P Seat Heating Switch - Passenger terminal 5
 - S70L Steering Wheel Controls Switch - Left terminal 2
 - S70R Steering Wheel Controls Switch - Right terminal 2
 - S75 Traction Control Switch - terminal 3
 - S3 Transmission Shift Lever - terminal 3
 - **If 15 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 15 ohms**
3. Connect a test lamp between the appropriate control circuit terminal listed below and ground.
 - K33 HVAC control module - terminal 6 X1
 - S13D Door Lock Switch - Driver terminal 1

- S13P Door Lock Switch - Passenger terminal 1
 - S36 Instrument Panel Dimmer Switch - terminal 4
 - S46B Liftgate Unlatch Switch - terminal 5
 - S32D Seat Heating Switch - Driver terminal 6
 - S32P Seat Heating Switch - Passenger terminal 6
 - S70L Steering Wheel Controls Switch - Left terminal 1
 - S70R Steering Wheel Controls Switch - Right terminal 1
 - S75 Traction Control Switch - terminal 2
 - S3 Transmission Shift Lever - terminal 8
4. Verify the test lamp turns ON and OFF when commanding the LED Backlight Dimming ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
 5. Test or replace the component with inoperative backlighting.

Hazard Warning Switch Backlighting Malfunction

1. Ignition OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S26 Hazard Warning Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 ohms between the ground circuit terminal 3 and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**

3. Connect a test lamp between the control circuit terminal 2 and ground, ignition ON.
4. Verify the test lamp turns ON and OFF when commanding the Hazard Lamps Switch Backlight ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
5. Test or replace the S26 Hazard Warning Switch.

HVAC Recirculation Indicator Malfunction

1. Ignition OFF, disconnect the X1 harness connector at the K33 HVAC Control Module.
2. Connect a test lamp between the control circuit terminal 10 and ground.
3. Verify the test lamp turns ON and OFF while turning the ignition switch ON and OFF.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
4. Test or replace the K33 HVAC Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Hazard Warning Switch Replacement**
- **Transmission Control Replacement**
- **Steering Wheel Control Switch Assembly Replacement**
- **Control Module References** for BCM or HVAC control module replacement, programming, and setup

PARK, LICENSE, AND/OR TAIL LAMPS MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F5DA (BCM 5) Fuse B+	B3867 01, B3867 04, B3881 01, B3881 04, B3949 01, B3949 04, B3950 01, B3950 04	B3867 01, B3867 04, B3881 01, B3881 04, B3949 01, B3949 04, B3950 01, B3950 04	-	-
Headlamp Switch Park Lamps ON Signal	2	B257A 00	2	-
License Plate Lamp Control	B3883 02	B3883 01, B3883 04	B3883 01, B3883 04	-
Front Park and Rear Tail Lamp Control - Left	B2585 02	B2585 01, B2585 04	B2585 01, B2585 04	-
Front Park and Rear Tail Lamp Control - Right	B3867 02	B3867 01, B3867 04	B3867 01, B3867 04	-
License Plate Lamp Ground	-	1	-	-
Park Lamp Ground - Left Front	-	1	-	-
Park Lamp Ground - Right Front	-	1	-	-
Rear Tail/Stop Lamps Ground - Left	-	1	-	-
Rear Tail/Stop Lamps Ground - Right	-	1	-	-
Turn Signal/Multifunction Switch Ground	-	2	-	-

- | |
|---|
| <ol style="list-style-type: none">1. Park, License, and/or Tail Lamps Malfunction2. Park Lamp Switch Malfunction |
|---|

Circuit/System Description

When the headlamp switch is placed in the HEAD or PARK position, ground is applied to the park lamp switch ON signal circuit to the body control module (BCM). The BCM responds by applying voltage to the park lamps, tail lamps, and license lamps control circuits illuminating the park, tail, and license lamps.

Diagnostic Aids

When testing at the park lamp bulb sockets, make sure all measurements and test lamp connections are in the correct terminal location and do not come in contact with each other during testing.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Park Lamp Switch parameter changes between Active and Inactive while commanding the park lamps ON and OFF with the headlamp switch.
 - **If the parameter does not change**

Refer to Park Lamp Switch Malfunction.

- **If the parameter changes**

3. Verify the left park lamps turn ON and OFF when commanding the Left Park Lamps ON and OFF with a scan tool.

- **If the left park lamps do not turn ON and OFF**

Refer to Park Lamps Malfunction.

- **If the left park lamps turn ON and OFF**

4. Verify the right park lamps turn ON and OFF when commanding the Right Park Lamps ON and OFF with a scan tool.

- **If the right park lamps do not turn ON and OFF**

Refer to Park Lamps Malfunction.

- **If the right park lamps turn ON and OFF**

5. Verify the license plate lamp turns ON and OFF when commanding the License Plate Lamps ON and OFF with a scan tool.

- **If the license plate lamp does not turn ON and OFF**

Refer to License Plate Lamp Malfunction.

- **If the license plate lamp turns ON and OFF**

6. All OK.

Circuit/System Testing

Park Lamp Switch Malfunction

1. Ignition OFF, all doors closed, all accessories OFF, disconnect the harness connector at the S78 turn signal/multifunction switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 15 ohms between the ground circuit terminal 1 and ground.
 - **If 15 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 15 ohms**
3. Ignition ON.
4. Verify the scan tool Park Lamps Switch parameter is Inactive.
 - **If not Inactive**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 body control module.

2. Test for infinite resistance between the signal circuit terminal 2 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 body control module.
 - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 1.
6. Verify the scan tool Park Lamps Switch parameter is Active.
 - **If not Active**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 body control module, ignition ON.
 2. Test for less than 1 V between the signal circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.
 - **If Active**
7. Test or replace the S78 turn signal/multifunction switch.

Park Lamps Malfunction

1. Ignition OFF, exterior lamps OFF, disconnect the harness connector at the appropriate park lamp. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 ohms between the appropriate ground circuit terminal listed below and ground.
 - E4N park/turn signal lamp - left socket terminal C
 - E4P park/turn signal lamp - right socket terminal C
 - E5AA tail/stop lamp - left rear socket terminal
 - E5AB tail/stop lamp - right rear socket terminal
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
3. Connect a test lamp between the appropriate control circuit terminal listed below and ground, ignition ON.
 - E4N park/turn signal lamp - left socket terminal B
 - E4P park/turn signal lamp - right socket terminal B
 - E5AA tail/stop lamp - left rear socket terminal
 - E5AB tail/stop lamp - right rear socket terminal
4. Verify the test lamp turns ON and OFF when commanding the appropriate Park Lamps ON and OFF with

a scan tool.

- **If the test lamp is always OFF**

1. Ignition OFF, disconnect the X4 harness connector at the K9 body control module.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.

- **If the test lamp is always ON**

1. Ignition OFF, disconnect the X4 harness connector at the K9 body control module, ignition ON.
2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 body control module.

- **If the test lamp turns ON and OFF**

5. Test or replace the appropriate park lamp.

License Plate Lamp Malfunction

1. Ignition OFF, exterior lamps OFF, remove the E7 license plate lamp bulb. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 ohms between each ground circuit terminal 1 and ground.

- **If 5 ohms or greater**

1. Ignition OFF.
2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.

- **If less than 5 ohms**

3. Connect a test lamp between the control circuit terminal 2 and ground, ignition ON.
4. Verify the test lamp turns ON and OFF when commanding the License Plate Lamps ON and OFF with a scan tool.

- **If the test lamp is always OFF**

1. Ignition OFF, disconnect the X4 harness connector at the K9 body control module.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.

- **If the test lamp is always ON**
 1. Ignition OFF, disconnect the X4 harness connector at the K9 body control module, ignition ON.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 body control module.
 - **If the test lamp turns ON and OFF**
- 5. Test or replace the E7 license plate lamp bulb.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Rear License Plate Lamp Replacement**
- **Parking and Turn Signal Lamp Bulb Replacement**
- **Turn Signal Switch Replacement**
- **Control Module References** for BCM replacement, programming, and setup

REAR COMPARTMENT LAMP MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Rear Compartment Courtesy Lamp Control	B2570 02	1	1	-
Rear Compartment Courtesy Lamp Ground	-	1	-	-
1. Rear Compartment Lamp Malfunction				

Circuit/System Description

The body control module (BCM) applies battery voltage to the rear compartment courtesy lamp through the rear compartment lamp control circuit. When the BCM receives a rear compartment lid open input from the rear compartment lid latch, the BCM applies battery voltage to the rear compartment lamp control circuit illuminating the rear compartment courtesy lamp. In the event that the rear compartment lamp were to remain illuminated for more than 10 minutes with the ignition switch in the OFF position and no doors opened, the BCM will deactivate the rear compartment lamp control circuit to prevent total battery discharge.

Reference Information

Schematic Reference

Interior Lights Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, exterior lamps OFF, disconnect the harness connector at the E8S rear compartment courtesy lamp. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 ohms between the ground circuit terminal 2 and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
3. Connect a test lamp between the control circuit terminal 1 and ground, ignition ON.
4. Verify the test lamp turns ON and OFF when commanding the Cargo Lamp ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X7 harness connector at the K9 body control module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance
- 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.
 - **If the test lamp is always ON**
 - 1. Ignition OFF, disconnect the X7 harness connector at the K9 body control module, ignition ON.
 - 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 body control module.
 - **If the test lamp turns ON and OFF**
- 5. Test or replace the E8S rear compartment courtesy lamp.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Rear Compartment Courtesy Lamp Replacement**
- **Control Module References** for BCM replacement, programming, and setup

STOP LAMPS MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Brake Pedal Position Sensor 5 V Reference	C0277 06, C0890 03, C0161 71	C0277 06, C0161 71	C0890 07, C0161 71	-
Brake Pedal Position Sensor Signal	C0277 06, C0161 71	C0277 06, C0161 71	C0277 07, C0161 71	C0277 09
Center High Mounted Stop Lamp Control	B3884 02	2	2	-
Stop Lamp Control - Left	B3881 02	B3881 04	B3881 01	-
Stop Lamp Control - Right	B3882 02	B3882 04	B3882 01	-
Brake Pedal Position Sensor Low Reference	-	C0277 07, C0161 71	1	-
Center High Mounted Stop				

Lamp Ground	-	2	-	-
Rear Tail/Stop Lamp Ground - Left	-	1	-	-
Rear Tail/Stop Lamp Ground - Right	-	1	-	-
1. Stop Lamps Malfunction 2. Center High Mounted Stop Lamp Malfunction				

Circuit/System Description

The brake pedal position (BPP) sensor is used to sense the action of the driver application of the brake pedal. The BPP sensor provides an analog voltage signal that will increase as the brake pedal is applied. The body control module (BCM) provides a low reference signal and a 5-volt reference voltage to the BPP sensor. When the variable signal reaches a voltage threshold indicating the brakes have been applied, the BCM will apply battery voltage to the left and right stop lamp control circuits as well as the center high mounted stop lamp (CHMSL) control circuit illuminating the left and right stop lamps and the CHMSL.

Diagnostic Aids

When testing at the stop lamp bulb socket, make sure all measurements and test lamp connections are in the correct terminal location and do not come in contact with each other during testing.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Brake Lamps Command parameter changes between Active and Inactive while pressing and releasing the brake pedal.
 - **If the parameter does not change**

Refer to Brake Pedal Position Sensor Malfunction.
 - **If the parameter changes**
3. Verify the left brake lamp turns ON and OFF when commanding the Left Brake Lamp ON and OFF with a scan tool.
 - **If the left brake lamp does not turn ON and OFF**

Refer to Stop Lamps Malfunction.
 - **If the left brake lamp turns ON and OFF**
4. Verify the right brake lamp turns ON and OFF when commanding the Right Brake Lamp ON and OFF with a scan tool.
 - **If the right brake lamp does not turn ON and OFF**

Refer to Stop Lamps Malfunction.
 - **If the right brake lamp turns ON and OFF**
5. Verify the center high mounted stop lamp turns ON and OFF when commanding the Center Brake Lamp ON and OFF with a scan tool.
 - **If the center high mounted stop does not turn ON and OFF**

Refer to Center High Mount Stop Lamp Malfunction.
 - **If the center high mounted stop turns ON and OFF**
6. All OK.

Circuit/System Testing

Brake Pedal Position Sensor Malfunction

1. Ignition OFF, disconnect the harness connector at the B22 Brake Pedal Position Sensor, ignition ON.
2. Test for less than 1 V between the appropriate low reference circuit terminal listed below and ground.
 - Terminal A - with MX2
 - Terminal B - without MNG
 - **If 1 V or greater**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the low reference circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K9 Body Control Module.
- **If less than 1 V**
- 3. Test or replace the B22 Brake Pedal Position Sensor.

Stop Lamps Malfunction

1. Ignition OFF, exterior lamps OFF, remove the appropriate E5A Tail/Stop Lamp bulb. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 ohms between the ground circuit at the socket terminal and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
3. Connect a test lamp between the control circuit at the socket terminal and ground, ignition ON.
4. Verify the test lamp turns ON and OFF when commanding the appropriate Brake Lamp ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module.
 - X4 left stop lamp
 - X5 right stop lamp
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module, ignition ON.
 - X4 left stop lamp
 - X5 right stop lamp
 1. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**

5. Test or replace the appropriate E5A Tail/Stop Lamp.

Center High Mount Stop Lamp Malfunction

1. Ignition OFF, exterior lamps OFF, disconnect the harness connector at the E6 Center High Mounted Stop Lamp. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 ohms between the ground circuit terminal 2 and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
3. Connect a test lamp between the control circuit terminal 1 and ground, ignition ON.
4. Verify the test lamp turns ON and OFF when commanding the Center Brake Lamp ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X4 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the X4 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
5. Test or replace the E6 Center High Mounted Stop Lamp.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **High Mount Stop Lamp Replacement**
- **Tail Lamp Bulb Replacement**
- **Brake Pedal Position Sensor Replacement**
- **Brake Pedal Position Sensor Calibration**

- **Control Module References** for BCM replacement, programming, and setup

TURN SIGNAL LAMPS AND/OR INDICATORS MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F5DA (BCM 5) Fuse B+	B3867 01, B3867 04, B3881 01, B3881 04, B3949 01, B3949 04, B3950 01, B3950 04	B3867 01, B3867 04, B3881 01, B3881 04, B3949 01, B3949 04, B3950 01, B3950 04	-	-
F7DA (BCM 7) Fuse B+	B3948 01, B3948 04, B3951 01, B3951 04	B3948 01, B3948 04, B3951 01, B3951 04	-	-
Turn Signal Switch Signal - Left	1	1	1	-
Turn Signal Switch Signal - Right	1	1	1	-
Turn Signal Control - Left Front	B3948 02	B3948 01, B3948 04	B3948 01, B3948 04	-
Turn Signal Control - Left Rear	B3950 02	B3950 01, B3950 04	B3950 01, B3950 04	-
Turn Signal Control - Right Front	B3949 02	B3949 01, B3949 04	B3949 01, B3949 04	-
Turn Signal Control - Right Rear	B3951 02	B3951 01, B3951 04	B3951 01, B3951 04	-
Turn Signal Lamp Ground - Left Front	-	B3948 01, B3948 04	-	-
Turn Signal Lamp Ground - Right Front	-	B3949 01, B3949 04	-	-
Turn Signal Lamp Ground - Left Rear	-	B3950 01, B3950 04	-	-
Turn Signal Lamp Ground - Right Rear	-	B3951 01, B3951 04	-	-
Turn Signal Repeater Lamp Ground		B3948 01,		

- Left - with T90	-	B3948 04	-	-
Turn Signal Repeater Lamp Ground - Right - with T90	-	B3949 01, B3949 04	-	-
Turn Signal/Multifunction Switch Ground	-	1	-	-
1. Turn Signal/Multifunction Switch Malfunction				

Circuit/System Description

Ground is applied at all times to the turn signal/multifunction switch. The turn signal lamps may only be activated with the ignition switch in the ON or START positions. When the turn signal/multifunction switch is placed in either the turn left or turn right position, ground is applied to the body control module (BCM) through either the right turn or left turn signal switch signal circuit. The BCM responds to the turn signal switch input by applying a pulsating voltage to the front and rear turn signal lamps through their respective control circuits. When a turn signal request is received by the BCM, a serial data message is sent to the instrument cluster requesting the respective turn signal indicator be pulsed ON and OFF.

Diagnostic Aids

When testing at the turn signal lamp bulb socket, make sure all measurements and test lamp connections are in the correct terminal location and do not come in contact with each other during testing.

Reference Information

Schematic Reference

- Exterior Lights Schematics
- Body Control System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Right Turn Signal Switch and Left Turn Signal Switch parameters change between Active and Inactive while cycling the turn signal switch between the right and left positions.

- **If the parameters do not change**

Refer to Turn Signal/Multifunction Switch Malfunction.

- **If the parameters change**

3. Verify the left front turn signal lamps turn ON and OFF while commanding the Left Front Turn Signal Lamp ON and OFF with a scan tool.

- **If the left front turn signal lamps do not turn ON and OFF**

Refer to Turn Signal Lamps Malfunction.

- **If the left front turn signal lamps turn ON and OFF**

4. Verify the right front turn signal lamps turn ON and OFF while commanding the Right Front Turn Signal Lamp ON and OFF with a scan tool.

- **If the right front turn signal lamps do not turn ON and OFF**

Refer to Turn Signal Lamps Malfunction.

- **If the right front turn signal lamps turn ON and OFF**

5. Verify the left rear turn signal lamps turn ON and OFF while commanding the Left Rear Turn Signal Lamp ON and OFF with a scan tool.

- **If the left rear turn signal lamps do not turn ON and OFF**

Refer to Turn Signal Lamps Malfunction.

- **If the left rear turn signal lamps turn ON and OFF**

6. Verify the right rear turn signal lamps turn ON and OFF while commanding the Right Rear Turn Signal Lamp ON and OFF with a scan tool.

- **If the right rear turn signal lamps do not turn ON and OFF**

Refer to Turn Signal Lamps Malfunction.

- **If the right rear turn signal lamps turn ON and OFF**

7. Verify the left and right turn signal indicators turn ON and OFF while commanding the All Indicators Test ON and OFF with a scan tool.

- **If the left or right turn signal indicators do not turn ON and OFF**

Refer to Turn Signal Indicators Malfunction.

- **If the left and right turn signal indicators turn ON and OFF**

8. All OK.

Circuit/System Testing

Turn Signal/Multifunction Switch Malfunction

1. Ignition OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S78 Turn Signal/Multifunction Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 15 ohms between the ground circuit terminal 1 and ground.
 - **If 15 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 15 ohms**
3. Ignition ON.
4. Verify the scan tool Left Turn Signal Switch parameter is Inactive.
 - **If not Inactive**
 1. Ignition OFF, disconnect the X3 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal 4 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 4 and the ground circuit terminal 1.
6. Verify the scan tool Left Turn Signal Switch parameter is Active.
 - **If not Active**
 1. Ignition OFF, disconnect the X3 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit terminal 4 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If Active**
7. Verify the scan tool Right Turn Signal Switch parameter is Inactive.
 - **If not Inactive**

1. Ignition OFF, disconnect the X3 harness connector at the K9 Body Control Module.
2. Test for infinite resistance between the signal circuit terminal 5 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
- **If Inactive**
8. Install a 3 A fused jumper wire between the signal circuit terminal 5 and the ground circuit terminal 1.
9. Verify the scan tool Right Turn Signal Switch parameter is Active.
 - **If not Active**
 - 1. Ignition OFF, disconnect the X3 harness connector at the K9 Body Control Module, ignition ON.
 - 2. Test for less than 1 V between the signal circuit terminal 5 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 - 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If Active**
10. Test or replace the S78 Turn Signal/Multifunction Switch.

Turn Signal Lamps Malfunction

1. Ignition OFF, exterior lamps OFF, remove the appropriate E4 Turn Signal Lamp bulb. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 ohms between the appropriate ground circuit at the socket terminal and ground.
 - **If 5 ohms or greater**
 - 1. Ignition OFF.
 - 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
3. Connect a test lamp between the appropriate control circuit at the socket terminal and ground.
4. Verify the test lamp turns ON and OFF when commanding the appropriate Turn Signal Lamp ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 - 1. Ignition OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module.
 - X5 left turn signals
 - X4 right turn signals
 - 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance
- 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If the test lamp is always ON**
- 1. Ignition OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module, ignition ON.
 - X5 left turn signals
 - X4 right turn signals
- 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
- 5. Test or replace the appropriate E4 Turn Signal Lamp bulb.

Turn Signal Indicators Malfunction

1. Ignition ON.
2. Verify the left and right turn signal indicators turn ON and OFF while commanding the All Indicators Test ON and OFF with a scan tool.
 - **If the left or right turn signal indicators are always OFF or remain ON**

Replace the P16 Instrument Cluster.

- **If the left and right turn signal indicators turn ON and OFF**
- 3. Replace the K9 Body Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Parking and Turn Signal Lamp Bulb Replacement**
- **Tail Lamp Bulb Replacement**
- **Turn Signal Switch Replacement**
- **Control Module References** for BCM replacement, programming, and setup

REPAIR INSTRUCTIONS

BRAKE PEDAL POSITION SENSOR CALIBRATION

NOTE: Brake system does not use a brake switch, stoplight switch or brakelight switch. System uses a Brake Pedal Position Sensor to control these functions.

Calibration Criteria

NOTE: Do not apply the brake pedal during the brake pedal position sensor calibration procedure. Any movement of the brake pedal during this procedure will cause the calibration procedure to fail. If this occurs, the brake pedal position sensor calibration must be repeated.

Brake pedal position sensor calibration must be performed after the brake pedal position sensor, body control module (BCM), or engine control module (ECM) have been serviced. The calibration procedure will set the brake pedal position sensor home value. This value is used by the BCM and ECM to determine the action of the driver applying the brake system and to provide this information to the vehicle subsystems via serial data.

Calibration Procedure

1. Apply the parking brake.
2. Ignition ON, engine OFF, place the transmission in the PARK position for automatic transmission or NEUTRAL position for manual transmission.
3. Install a scan tool.
4. Clear all DTCs before proceeding.
5. Navigate to the Configuration/Reset Functions menu of the BCM.
6. Select the Brake Pedal Position Sensor Learn procedure and follow the directions displayed on the screen.
7. Navigate to the Configuration/Reset Functions menu of the ECM.
8. Select the Learn Functions menu.
9. Select the Brake Pedal Position Sensor Learn procedure and follow the directions displayed on the screen.

BRAKE PEDAL POSITION SENSOR REPLACEMENT

NOTE: Brake system does not use a brake switch, stoplight switch or brakelight switch. System uses a Brake Pedal Position Sensor to control these functions.

Removal Procedure

1. Remove the instrument panel lower reinforcement bracket. Refer to **Instrument Panel Lower Reinforcement Bracket Replacement**.

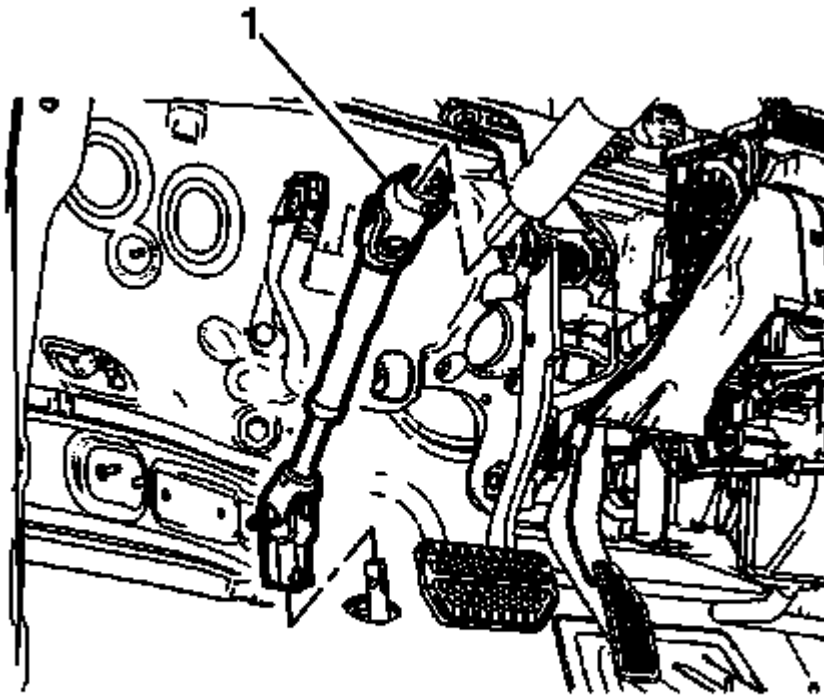


Fig. 12: Intermediate Steering Shaft
Courtesy of GENERAL MOTORS COMPANY

2. Remove the intermediate steering shaft (1). Refer to **Intermediate Steering Shaft Replacement** .
3. Disconnect the brake pedal position sensor electrical connector.

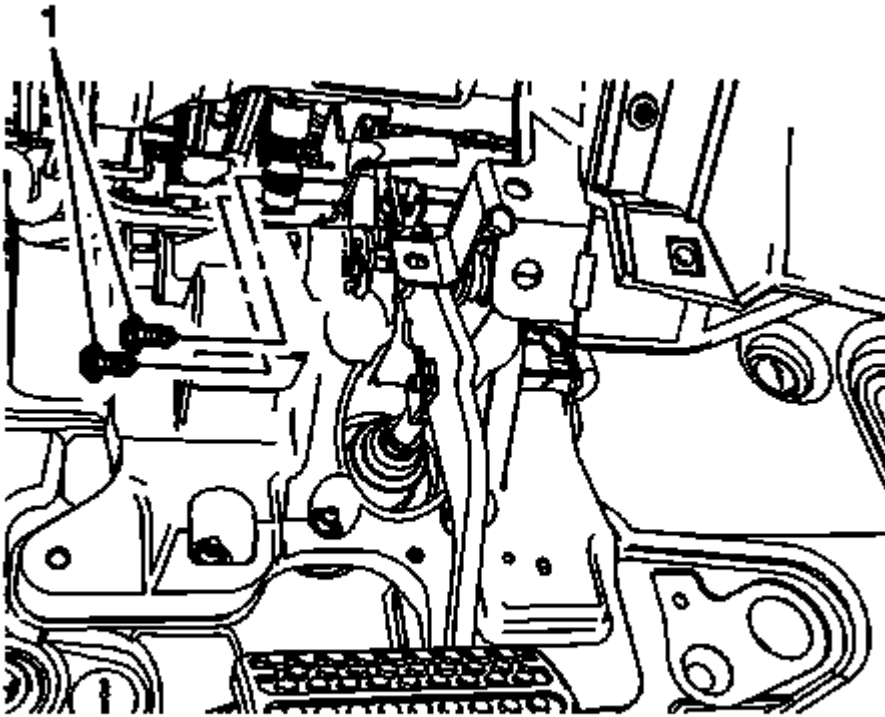


Fig. 13: Brake Pedal Position Sensor Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove the brake pedal position sensor bracket bolts (1).
5. Remove the brake pedal position sensor and bracket assembly.

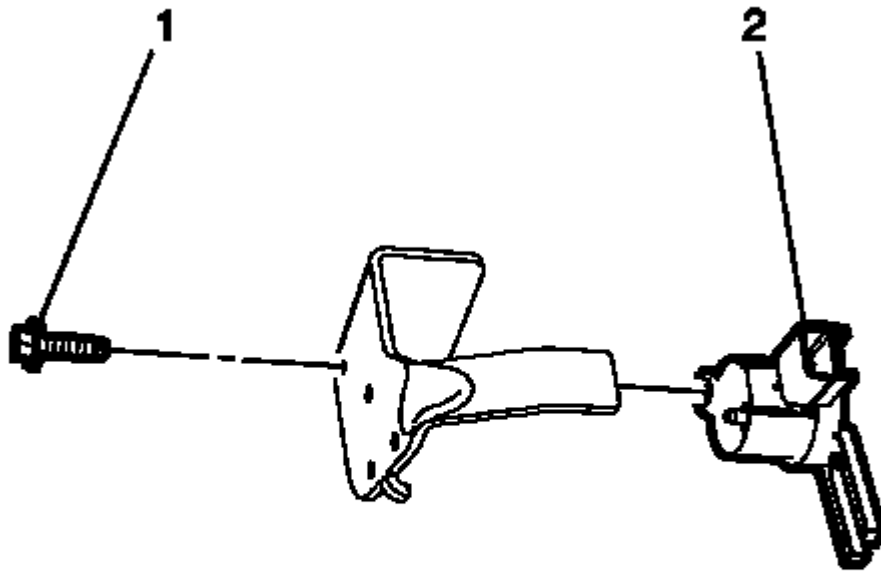


Fig. 14: Brake Pedal Position Sensor Bolt
Courtesy of GENERAL MOTORS COMPANY

6. Remove the brake pedal position sensor bolt (1).
7. Remove the brake pedal position sensor (2) from the bracket.

Installation Procedure

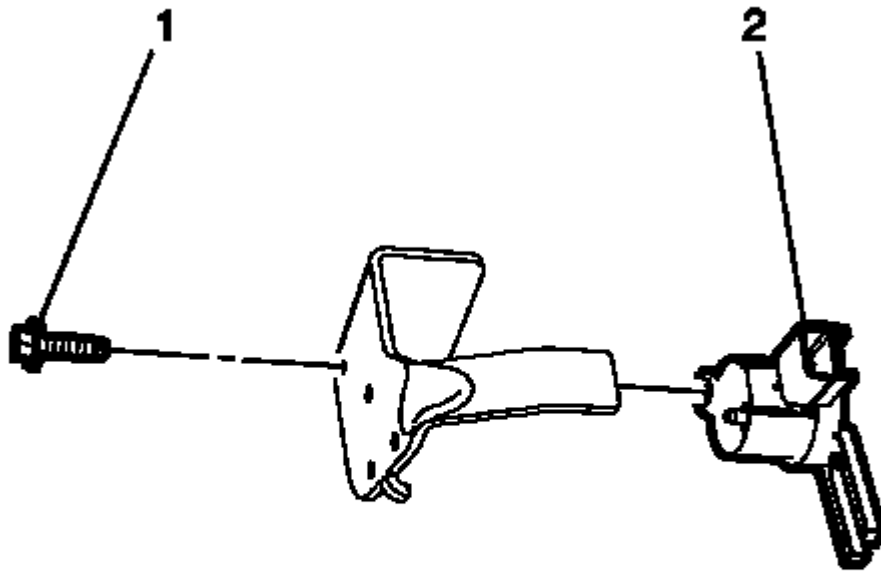


Fig. 15: Brake Pedal Position Sensor Bolt
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Align the brake pedal position sensor pin to the brake pedal bracket.**

1. Install the brake pedal position sensor bolt (1) through the bracket and to the brake pedal position sensor (2)..

CAUTION: Refer to Fastener Caution .

2. Tighten the brake pedal position sensor bolt to 3 (27 lb in)

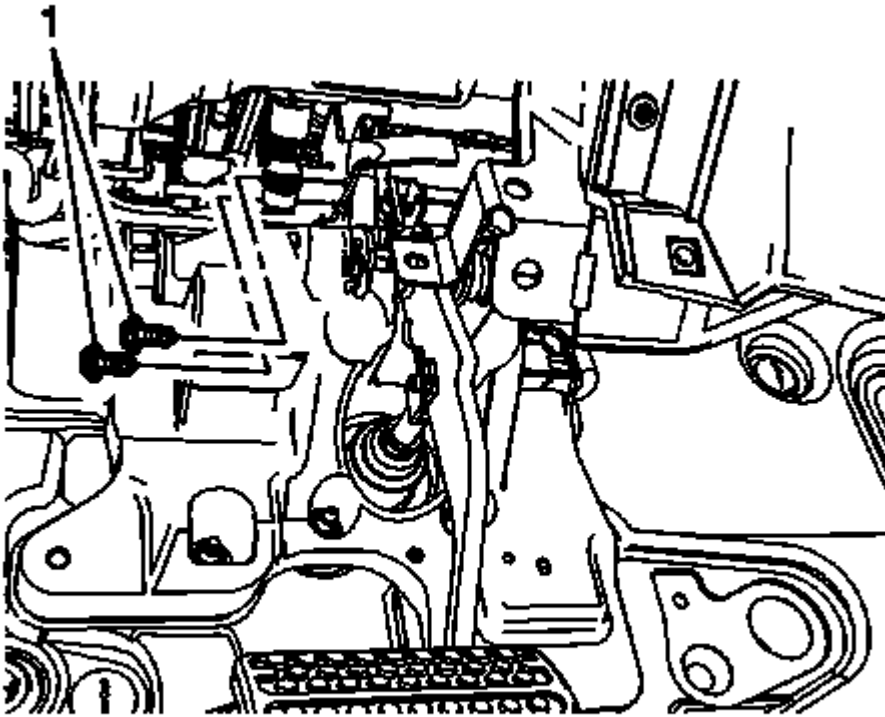


Fig. 16: Brake Pedal Position Sensor Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Install the brake pedal position sensor and bracket assembly to the brake and accelerator pedal assembly.
4. Install the brake pedal position sensor bracket bolts (1) and tighten to 3 (27 lb in).
5. Connect the brake pedal position sensor electrical connector.

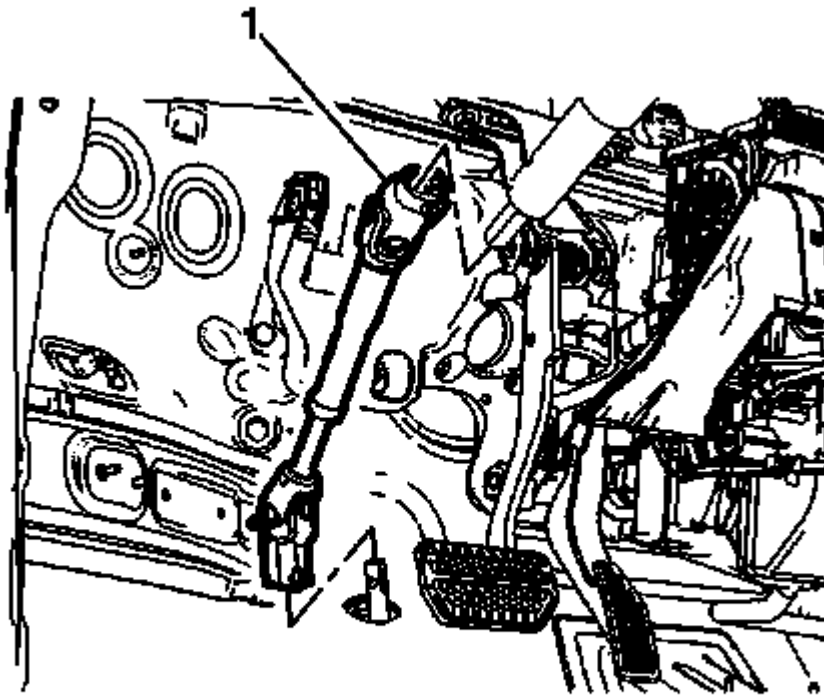


Fig. 17: Intermediate Steering Shaft
Courtesy of GENERAL MOTORS COMPANY

6. Install the intermediate steering shaft (1). Refer to **Intermediate Steering Shaft Replacement** .
7. Install the instrument panel lower reinforcement bracket. Refer to **Instrument Panel Lower Reinforcement Bracket Replacement** .
8. Calibrate the brake pedal position sensor. Refer to **Brake Pedal Position Sensor Calibration**.

HAZARD WARNING SWITCH REPLACEMENT

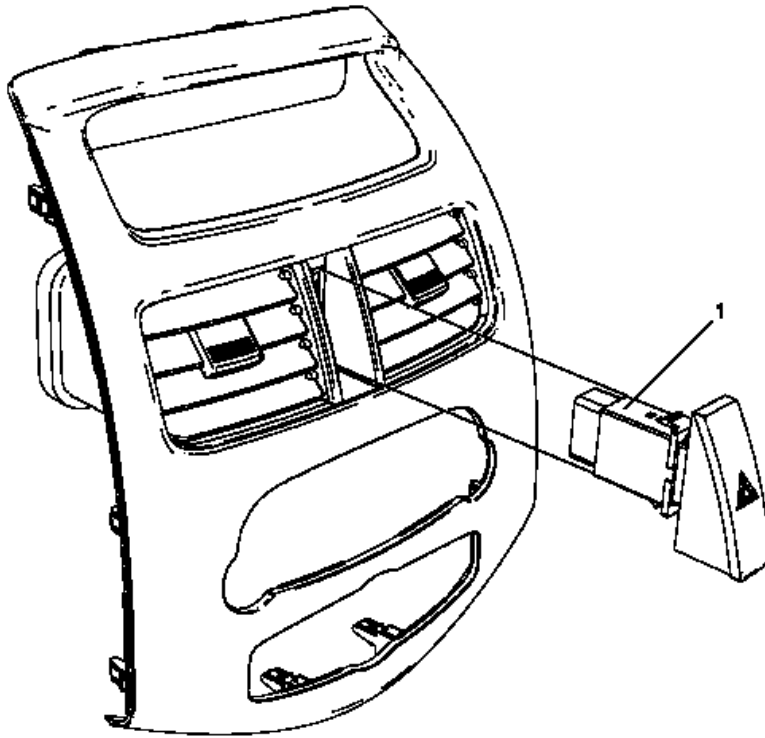


Fig. 18: Hazard Warning Switch
 Courtesy of GENERAL MOTORS COMPANY

Hazard Warning Switch Replacement

Callout	Component Name
Preliminary Procedure	
Remove the instrument panel center molding. Refer to <u>Instrument Panel Center Molding Replacement</u>	
1	Hazard Warning Switch
	Procedure 1. Disconnect the electrical connector. 2. Squeeze tabs on switch to unsnap from housing bracket.

CENTER COURTESY LAMP REPLACEMENT

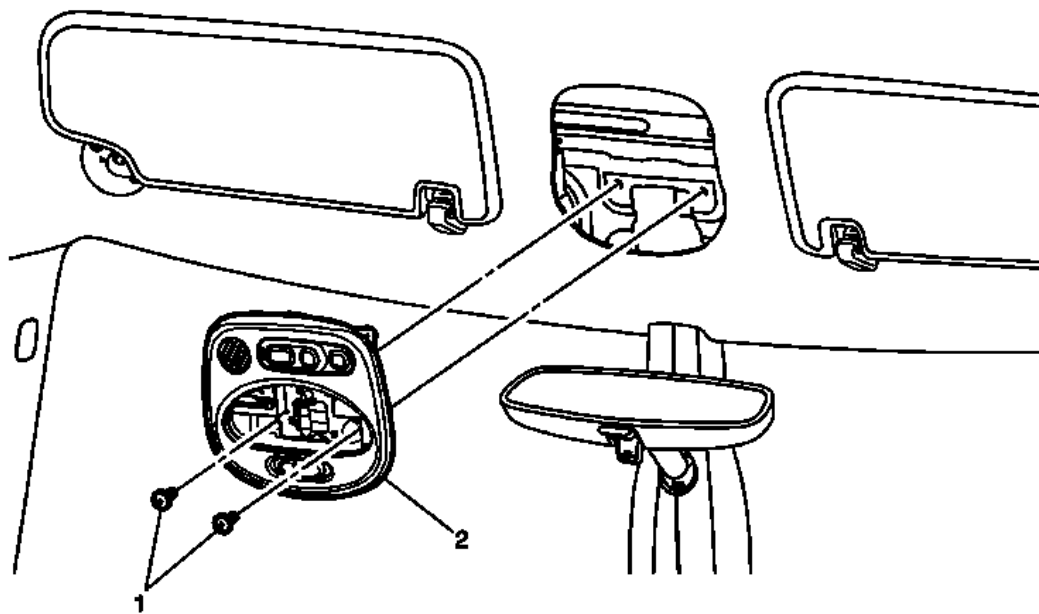


Fig. 19: Center Courtesy Lamp
 Courtesy of GENERAL MOTORS COMPANY

Center Courtesy Lamp Replacement

Callout	Component Name
Preliminary Procedure Remove the center courtesy lamp lens. Refer to .	
1	Center Courtesy Lamp Fasteners (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> .
2	Center Courtesy Lamp Procedure Disconnect the electrical connections.

HEADLAMP REPLACEMENT

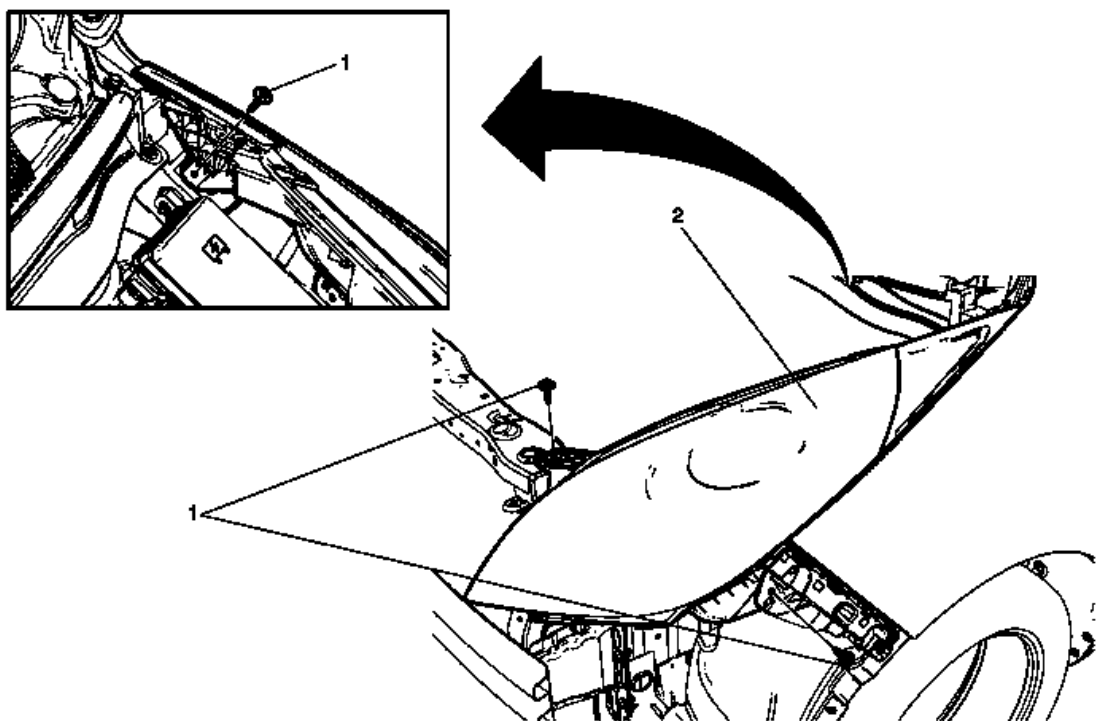


Fig. 20: Headlamp
 Courtesy of GENERAL MOTORS COMPANY

Headlamp Replacement

Callout	Component Name
Preliminary Procedure Remove the front bumper fascia. Refer to Front Bumper Fascia Replacement .	
1	Headlamp Screw (Qty: 3) CAUTION: Refer to Fastener Caution . Tighten 2.5 N.m (22 lb in)
2	Headlamp Assembly Procedure 1. Pull the headlamp assembly forward far enough to access the electrical connection. 2. Disconnect the headlamp electrical connector from the forward lamp harness connector. 3. Remove the headlamp assembly. 4. Aim the headlamps after installation. Refer to Headlamp Aiming.

HEADLAMP BULB REPLACEMENT

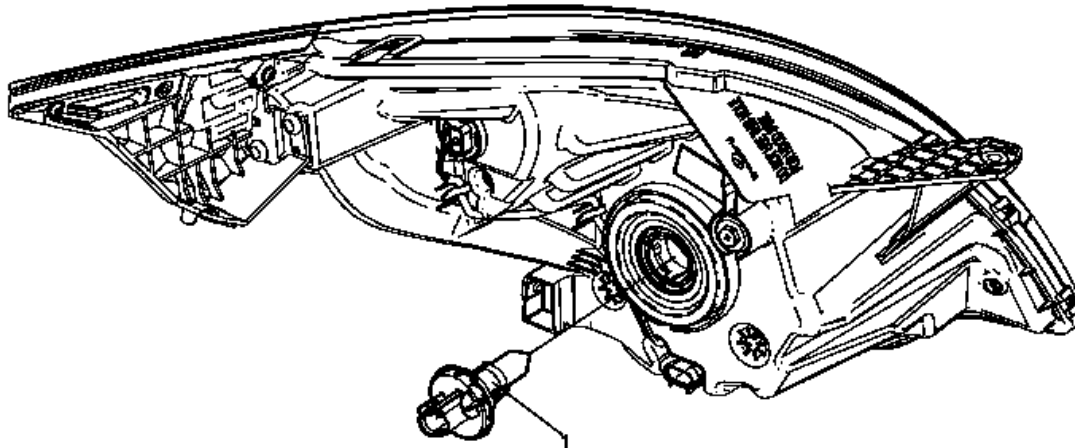


Fig. 21: Headlamp Bulb

Courtesy of GENERAL MOTORS COMPANY

Headlamp Bulb Replacement

Callout	Component Name
1	Headlamp Bulb WARNING: Refer to <u>Halogen Bulb Warning</u> . Procedure 1. Disconnect electrical connector. 2. Rotate the headlamp bulb counterclockwise to remove from the headlamp.

HEADLAMP BRACKET REPLACEMENT

Removal Procedure

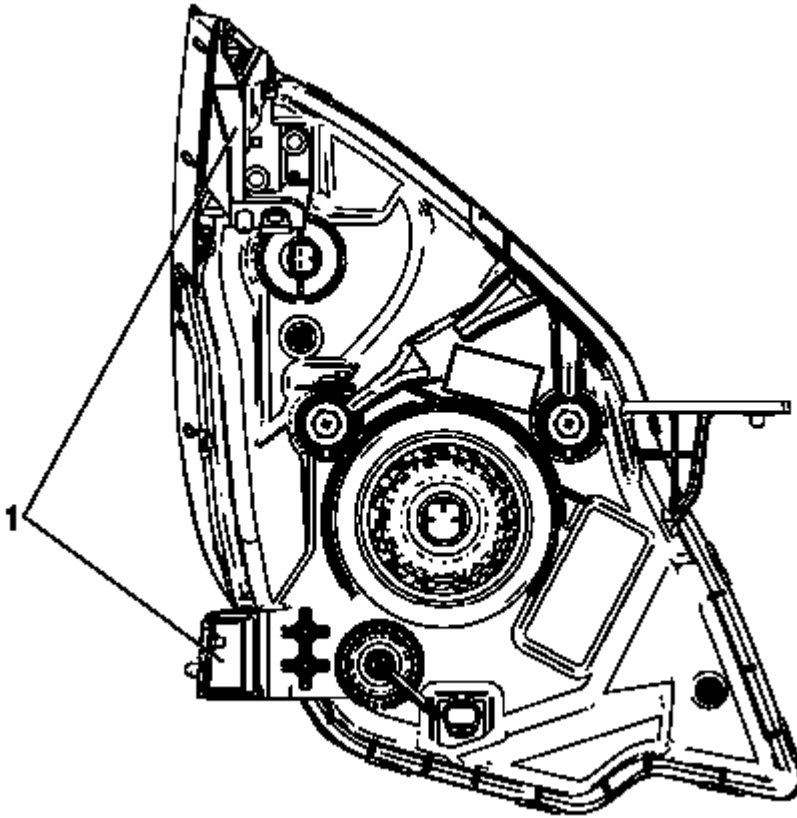


Fig. 22: Headlamp Bracket

Courtesy of GENERAL MOTORS COMPANY

1. Remove the headlamp. Refer to **Headlamp Replacement**.
2. There are 2 replacement brackets (1) on each headlamp.

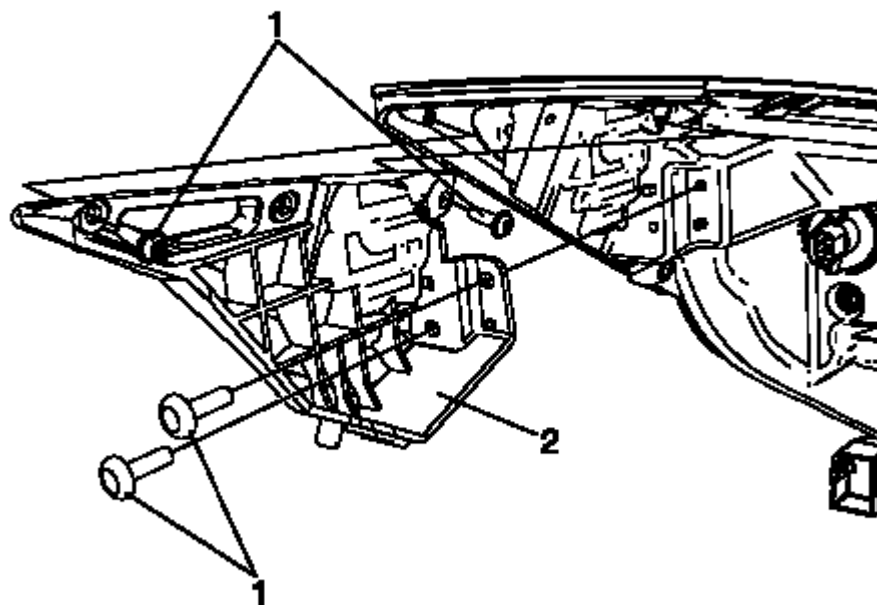


Fig. 23: Screws And Bracket

Courtesy of GENERAL MOTORS COMPANY

3. For bracket, 1 remove the screws (1) and bracket 1 (2).

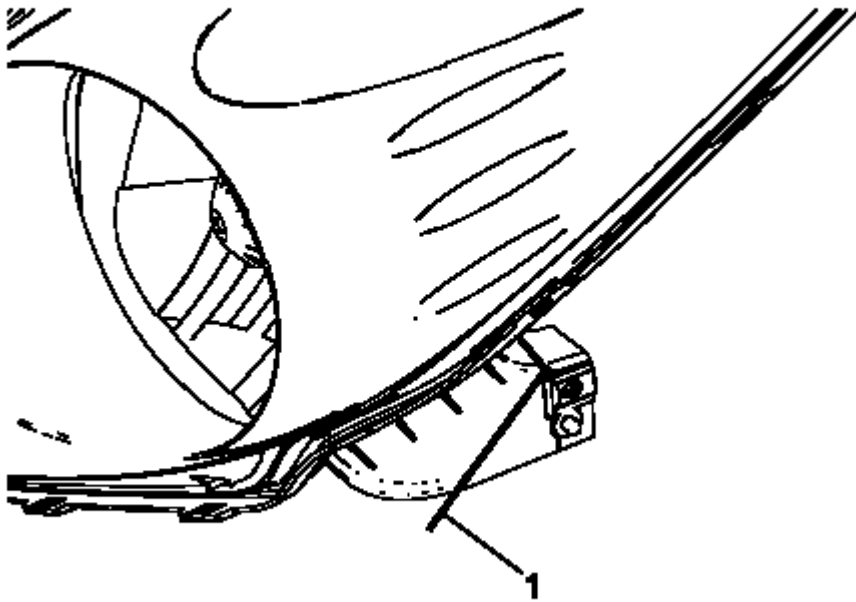


Fig. 24: Marked Line

Courtesy of GENERAL MOTORS COMPANY

4. For bracket 2, cut the bracket along the marked line (1).

Installation Procedure

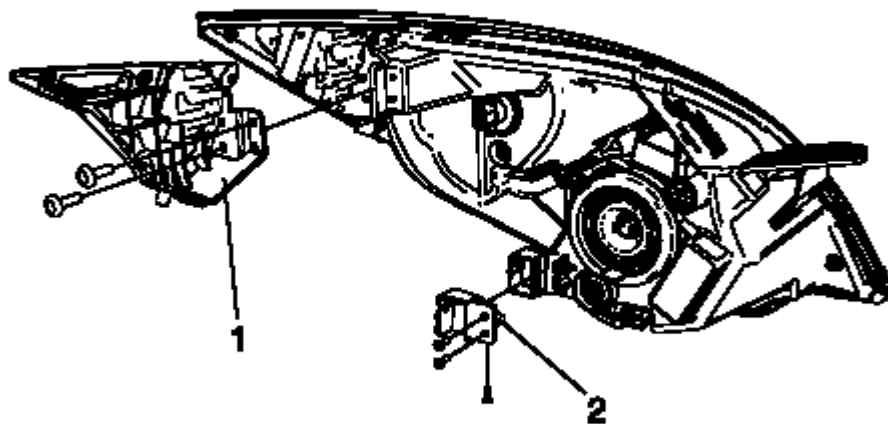


Fig. 25: Bracket

Courtesy of GENERAL MOTORS COMPANY

1. For bracket 1, install the bracket (1) with the specified attachments.
2. For bracket 2, install the bracket (2) with the specified attachments.
3. Install the headlamp. Refer to **Headlamp Replacement**.

HEADLAMP AIMING

Visual Aiming Preparation Procedure

NOTE: Some state and local laws specify requirements for headlamp aim. Comply with all of these laws when performing any headlamp aiming operations.

Headlamp aim should be checked:

- When a new headlamp capsule is installed.
- If service or repairs to the front end area have, or may have, disturbed the headlamps or their mounting.

The aiming screen should meet the following criteria:

- The area will consist of a level surface large enough to allow for a vehicle and an additional 7.62 m (25

ft) measured from face of lamps to the front of the aiming screen.

- The screen will be 1.52 m (5 ft) high x 3.66 m (12 ft) wide with a matte white surface well shaded from extraneous light, and properly adjusted to the floor on which the vehicle stands. Provisions should be made to align the aiming screen parallel with the vehicle.
- The screen shall be provided with a fixed vertical centerline, two laterally adjustable vertical tapes, and one vertically adjustable horizontal tape.
- If a regular commercial aiming screen is not available, the screen may consist of a vertical wall having a clear uninterrupted area approximately 1.83 m (6 ft) high and 3.66 m (12 ft) wide. The surface should be finished with a washable non-gloss white paint.

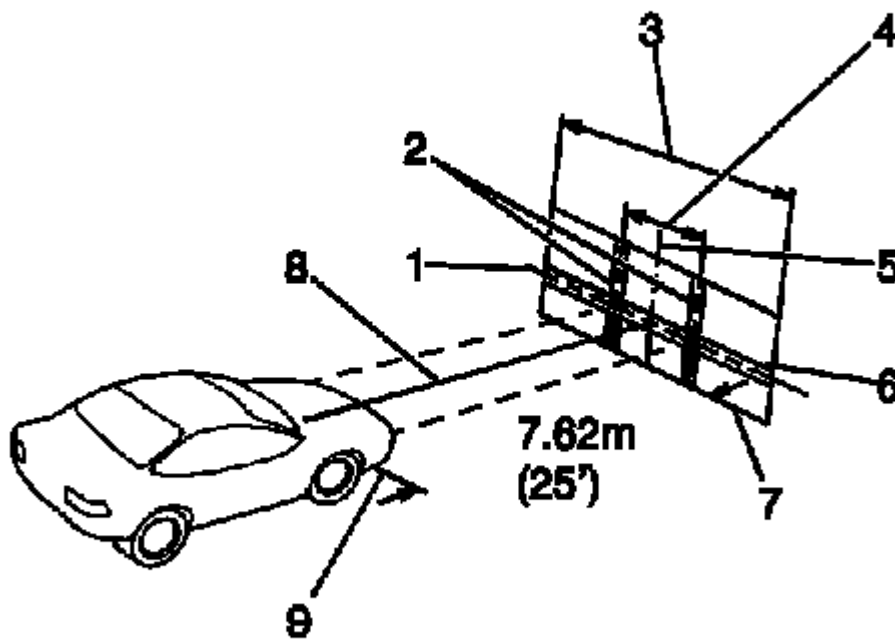


Fig. 26: Headlamp Aiming/Adjusting
Courtesy of GENERAL MOTORS COMPANY

- After the aiming screen has been set up in a permanent location, paint a reference line on the floor directly under the lens of the lamps to indicate the proper location of the headlamps when they are being aimed:
 - Distance between headlamps (1)
 - Center line of screen (2)
 - Adjustable vertical pointer (3)

- Adjustable horizontal tape (4)
- Diagram of light screen (5)
- Vertical center line ahead of right headlamp pointer position (6)
- 7.62 m (25 ft) (7)
- Car axis (8)
- Adjustable vertical pointer
- Horizontal center line of lamps
- Vertical center line ahead of left headlamp

Prior to aiming the headlamps, the following steps must be taken:

1. Remove any snow, ice or mud from the vehicle.
2. The vehicle must have a full tank of gas.
3. Stop all other work on the vehicle.
4. If any service has been performed on the vehicle, make sure that all of the components are back in their original place.
5. The vehicle must be on a level surface.

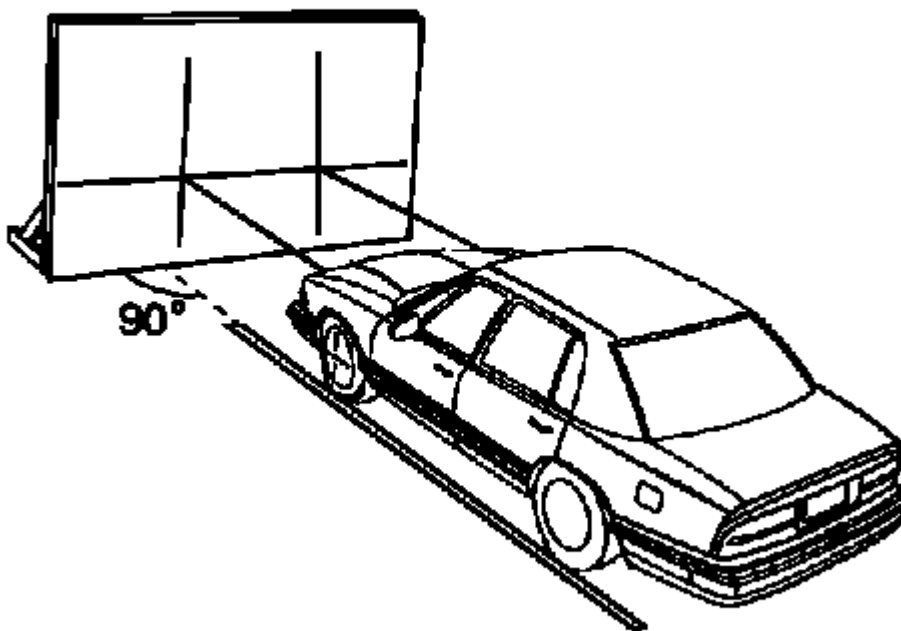


Fig. 27: View Of Headlamp Aiming Screen & Vehicle Alignment
Courtesy of GENERAL MOTORS COMPANY

6. The vehicle left tires must be aligned with the reference line extending from the screen with the headlamps aligned with the reference line.
7. Do not load any cargo in the vehicle.
8. The vehicle must contain approximately 75 kg (165 lb) on the driver seat.
9. Inflate the tires to the proper pressure.
10. Simulate the vehicle loads if the intended use of the vehicle is for hauling heavy loads or towing a trailer.
11. Rock the vehicle in order to stabilize the suspension.
12. Turn on the headlamps to low beam and observe the left and the top edges of the high intensity zone on the screen. The edges of the high intensity zone should fall within the specifications.

Headlamp Aiming Procedure

1. Open the hood.

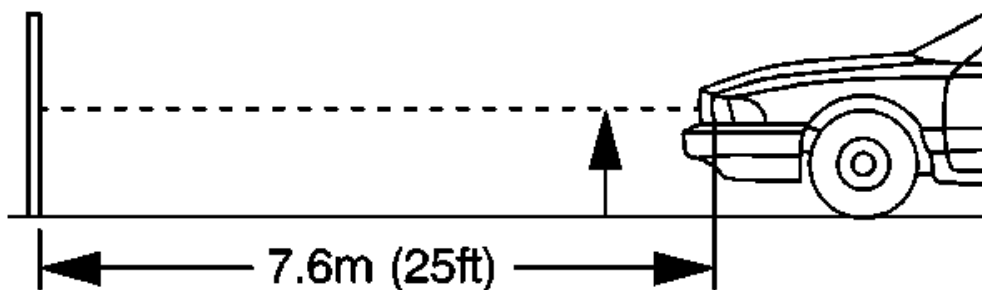


Fig. 28: Measuring Distance Between Headlamps Face & Aiming Screen
Courtesy of GENERAL MOTORS COMPANY

2. Measure from the floor to the center of the headlamp bulb. Some headlamps have an aim dot marked on the headlamp lens.
3. At the screen, measure from the floor and place the horizontal tape at the measured distance.
4. Measure from the reference line on the floor to the left headlamp bulb centerline.
5. At the screen, measure from the reference line and place the vertical tape at the measured distance.
6. Measure from the reference line on the floor to the right headlamp bulb centerline.
7. At the screen, measure from the reference line and place the vertical tape at the measured distance.

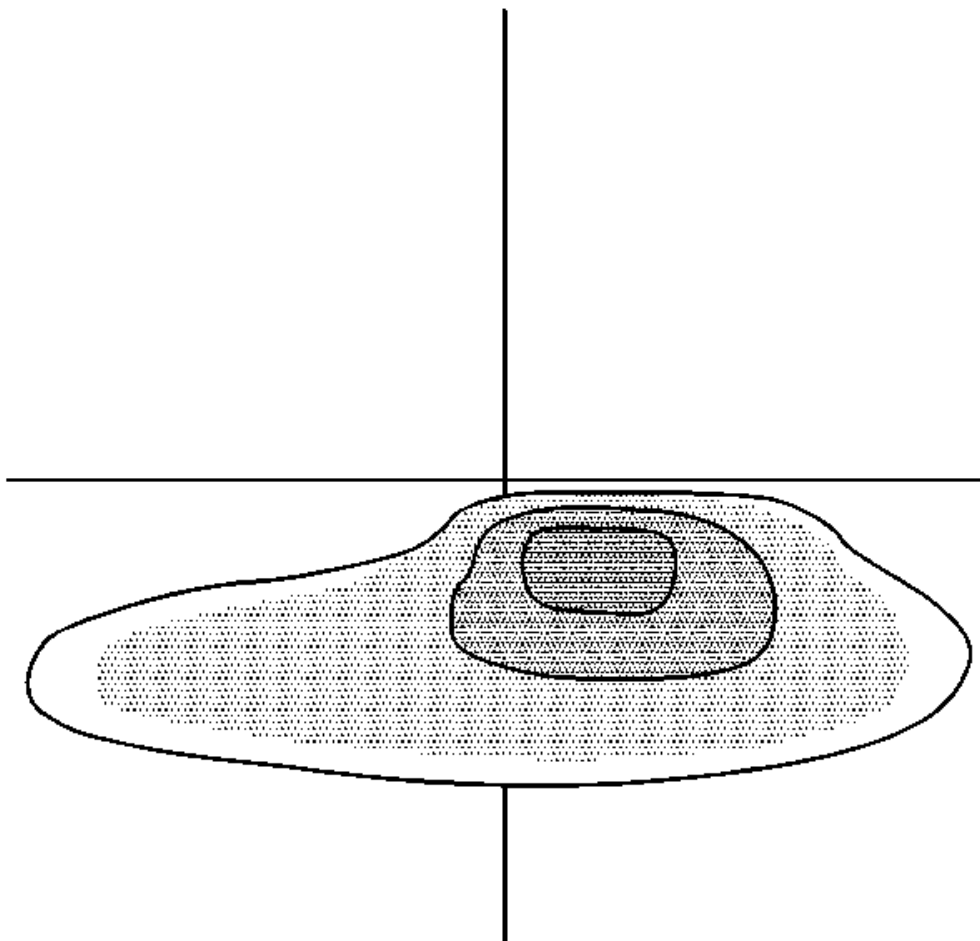


Fig. 29: Identifying Right Side Low Beam Proper Screen Positioning
Courtesy of GENERAL MOTORS COMPANY

NOTE: DO NOT cover the headlamp. This may cause excessive heat build up.

8. Turn ON the low beam headlamps. Block the light from projecting onto the screen from the passenger side headlamp.

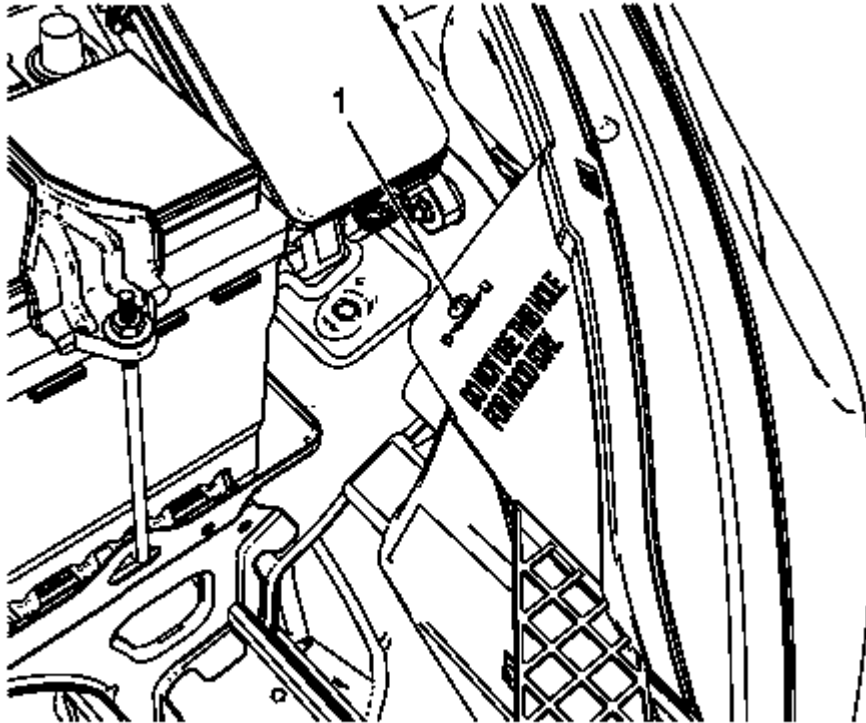


Fig. 30: Vertical Aim Screw

Courtesy of GENERAL MOTORS COMPANY

9. Adjust the vertical aim screw (1) of the headlamps to the specifications required by the state and the local authorities, or as shown in step number 8.
10. Repeat the aiming procedure for the passenger side headlamp while blocking the light from projecting onto the screen from the driver side headlamp.
11. Turn the headlamps OFF.
12. Close the hood.

FRONT FOG LAMP REPLACEMENT (PROJECTION)

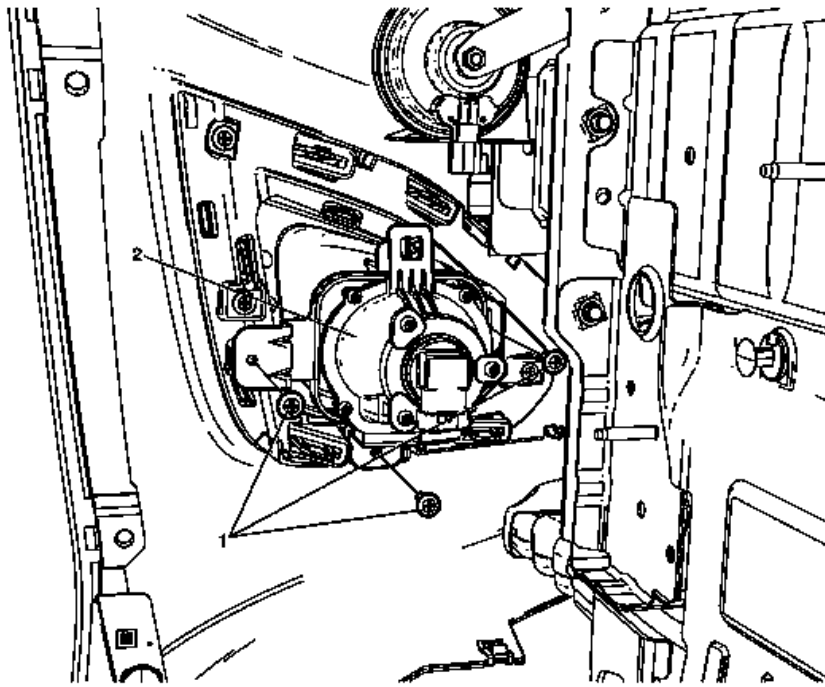


Fig. 31: Front Fog Lamp Assembly
 Courtesy of GENERAL MOTORS COMPANY

Front Fog Lamp Replacement (Projection)

Callout	Component Name
Preliminary Procedures	
1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Remove the front wheelhouse liner. Refer to <u>Front Wheelhouse Liner Replacement</u> . 3. Disconnect fog lamp bulb socket electrical connector.	
1	Front Fog Lamp Screw (Qty: 3)
2	Front Fog Lamp Assembly
	Procedure 1. Remove the lamp assembly from the fog lamp bracket. 2. Aim the fog lamp after installation. Refer to <u>Fog Lamp Aiming</u> .

FRONT FOG LAMP BULB REPLACEMENT (PROJECTION)

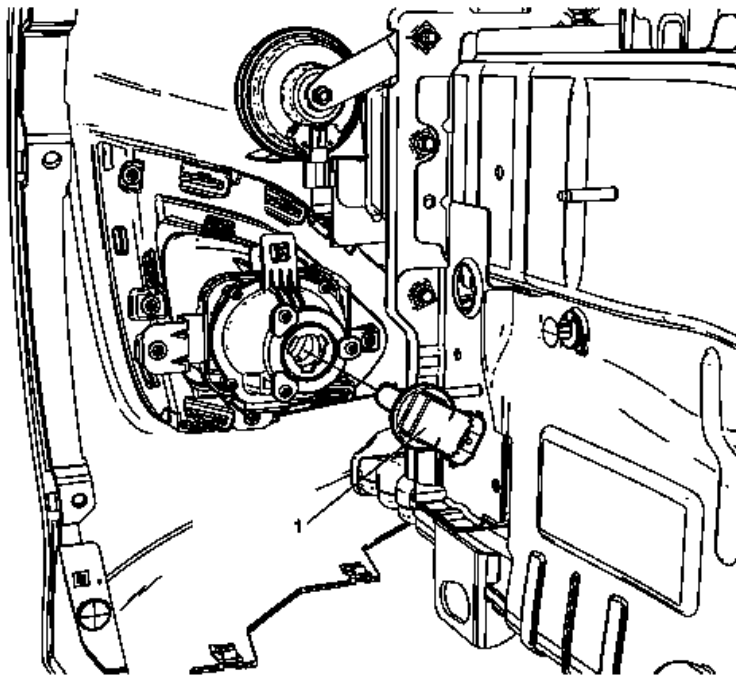


Fig. 32: Front Fog Lamp Bulb
 Courtesy of GENERAL MOTORS COMPANY

Front Fog Lamp Bulb Replacement (Projection)

Callout	Component Name
Preliminary Procedures 1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Remove the front wheelhouse liner. Refer to <u>Front Wheelhouse Liner Replacement</u> . 3. Disconnect fog lamp bulb socket electrical connector.	
1	Front Fog Lamp Projector Bulb WARNING: Refer to <u>Halogen Bulb Warning</u> . Procedure Rotate the bulb socket counterclockwise to remove from the lamp housing.

FRONT FOG LAMP COVER REPLACEMENT

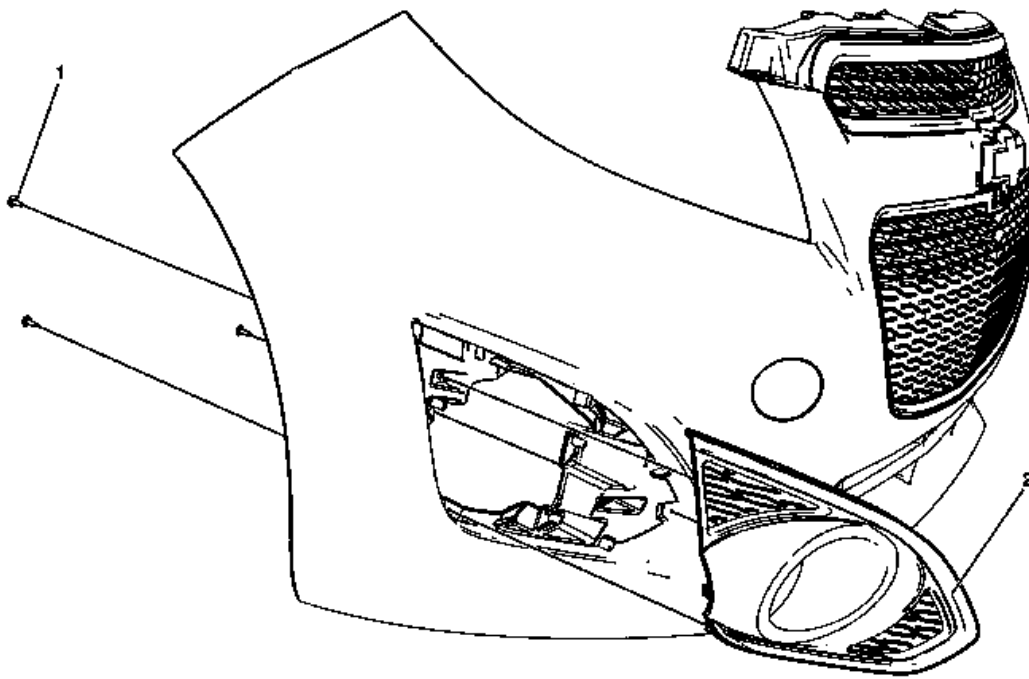


Fig. 33: Front Fog Lamp Cover
 Courtesy of GENERAL MOTORS COMPANY

Front Fog Lamp Cover Replacement

Callout	Component Name
1	Front Fog Lamp Cover Screw CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2 (18 lb in)
2	Front Fog Lamp Cover Procedure 1. Lift the vehicle. 2. Remove the tire and wheel. Refer to <u>Tire and Wheel Removal and Installation</u> . 3. Remove the front wheelhouse liner. Refer to <u>Front Wheelhouse Liner Replacement</u> . 4. Release the cover taps. 5. Remove the front fog lamp cover.

FOG LAMP AIMING

Preparation Procedure

NOTE: Horizontal aim is not adjustable on this vehicle. Vertical aim is done by an adjusting nut located on the rear of the fog lamp. Prior to aiming the fog lamps, perform the following steps:

1. Completely assemble all of the components on the vehicle.
2. Place the vehicle on a level surface.
3. Stop all unnecessary operations or work that could affect the ride height of the vehicle.
4. Close the doors and verify that the luggage compartment is empty.
5. Stabilize the suspension by rocking the vehicle sideways.
6. Ensure that the fuel level is full.
7. Ensure that the tires are inflated to the proper pressure.
8. Ensure that the driver or a similar weight, approximately 75 kg (165 lb), is in the vehicle driver seat.

Aiming Procedure

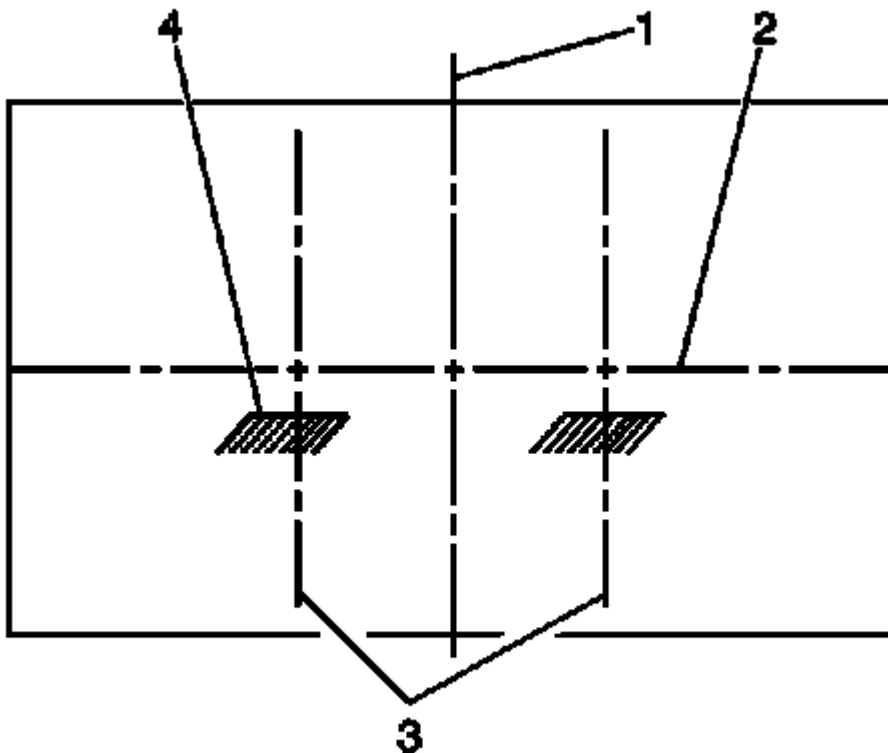


Fig. 34: Locating Alignment Points On Target Screen
Courtesy of GENERAL MOTORS COMPANY

1. Park the vehicle 7.6 m (25 ft) away from the target screen.
2. Measure from the center of the fog lamp to the ground line. Using this measurement, mark the horizontal centerline (2) of the fog lamp on the target screen directly in front of the vehicle.
3. Turn ON the fog lamps. The top of the fog lamp beam image (4) on the target screen should be 102 mm (4 in) below the center of the fog lamp lens height.

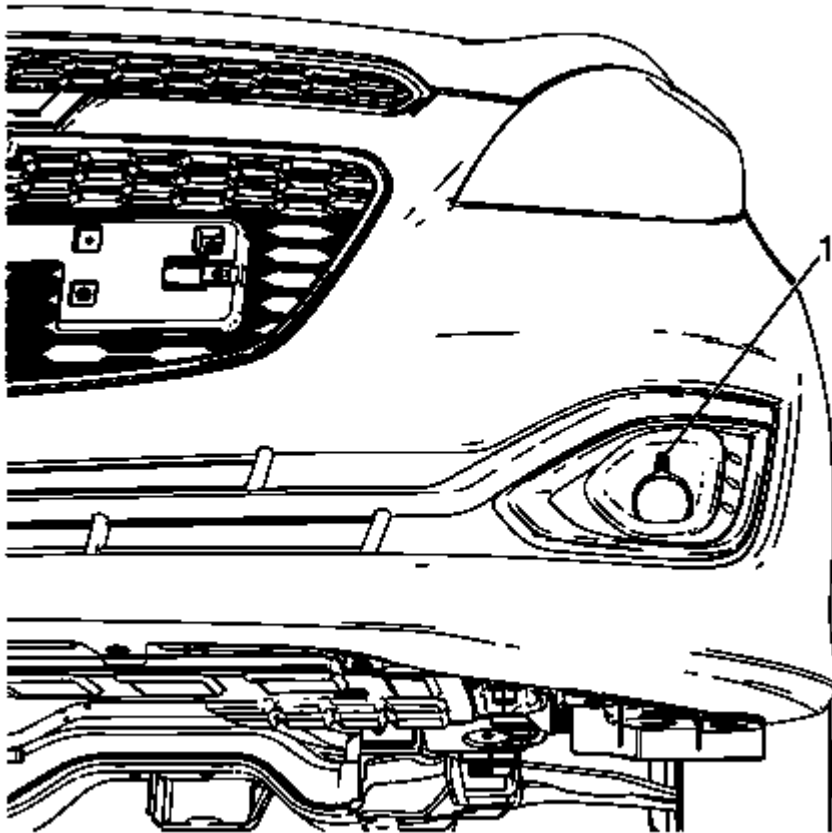


Fig. 35: Fog Lamp Screw

Courtesy of GENERAL MOTORS COMPANY

4. Adjust the fog lamp as required using the adjusting screw (1) above the projector lens on the outside of the front bumper fascia.
5. Turn OFF the fog lamps.

PARKING AND TURN SIGNAL LAMP BULB REPLACEMENT

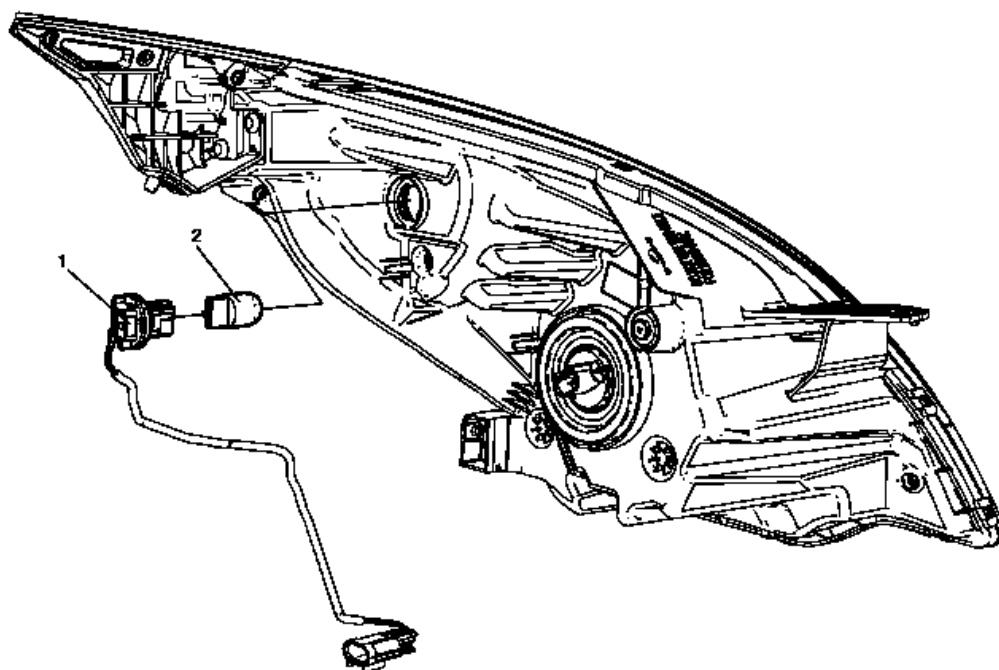


Fig. 36: Parking and Turn Signal Lamp Bulb
 Courtesy of GENERAL MOTORS COMPANY

Parking and Turn Signal Lamp Bulb Replacement

Callout	Component Name
1	Park/Turn Signal Bulb Socket WARNING: Refer to <u>Halogen Bulb Warning</u> . NOTE: Rotate counterclockwise and remove the socket from the headlamp assembly.
2	Park/Turn Signal Bulb Procedure Pull the bulb straight from the lamp harness socket.

HIGH MOUNT STOP LAMP REPLACEMENT

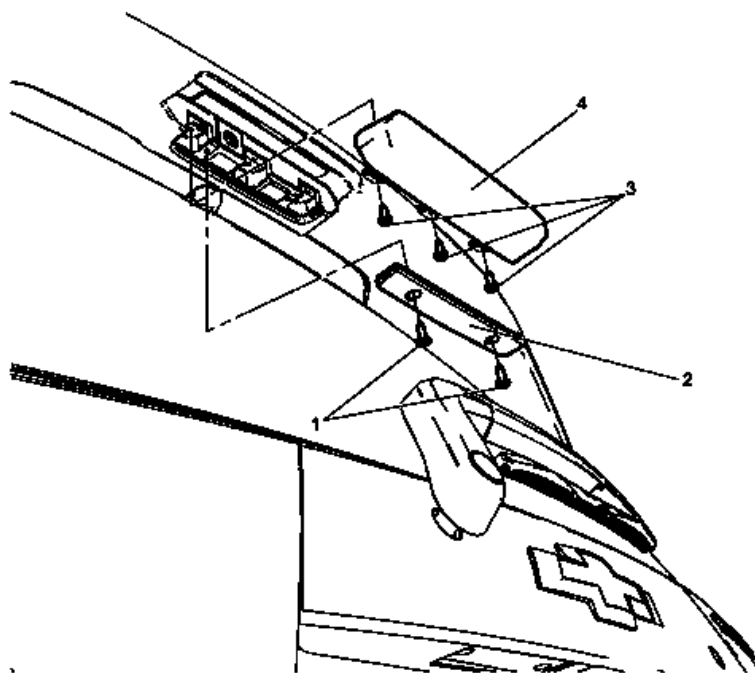


Fig. 37: High Mount Stop Lamp
 Courtesy of GENERAL MOTORS COMPANY

High Mount Stop Lamp Replacement

Callout	Component Name
1	High Mount Stop Lamp Cover Screw (Qty: 2)
2	High Mount Stop Lamp Cover
3	High Mount Stop Lamp Screw (Qty: 3)
4	High Mount Stop Lamp Assembly
Procedure Disconnect the electrical connector at the high mount stop lamp.	

REAR LICENSE PLATE LAMP REPLACEMENT

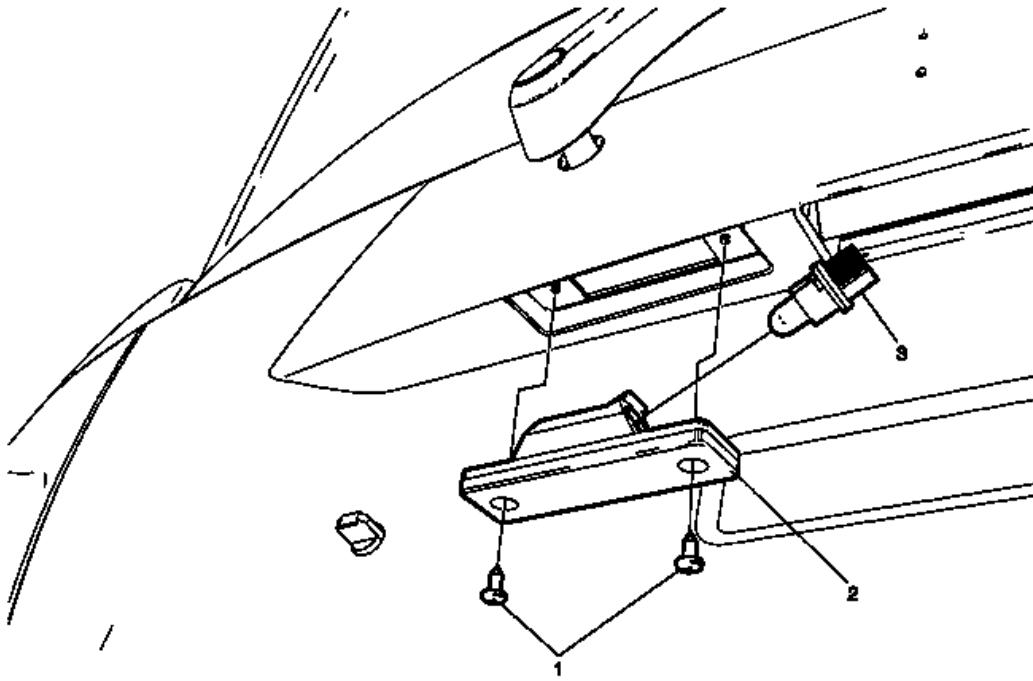


Fig. 38: Rear License Plate Lamp
 Courtesy of GENERAL MOTORS COMPANY

Rear License Plate Lamp Replacement

Callout	Component Name
1	Rear License Plate Lamp Screw (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2.0 N.m (18 lb in)
2	Rear License Plate Lamp
3	Rear License Plate Lamp Socket

TAIL LAMP REPLACEMENT

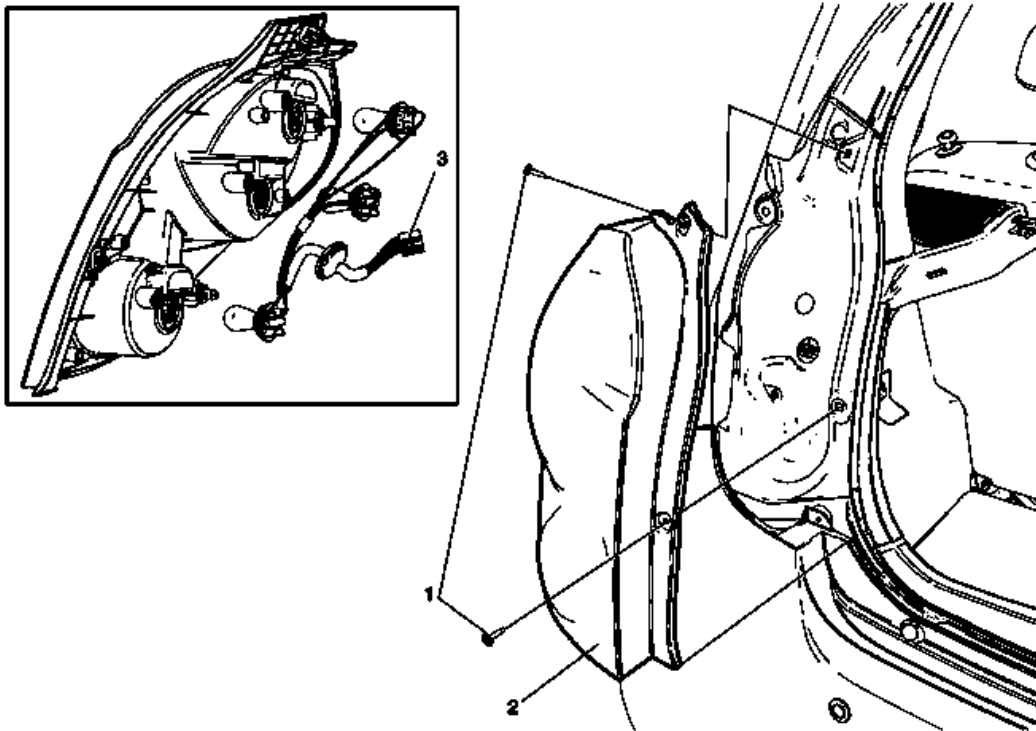


Fig. 39: Tail Lamp

Courtesy of GENERAL MOTORS COMPANY

Tail Lamp Replacement

Callout	Component Name
1	Tail Lamp Screw (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2.5 N.m (22 lb in)
2	Tail Lamp Assembly Procedure 1. Using a blunt tool, tap gently on the tail lamp studs before attempting to remove the tail lamp assembly from the lamp pocket. 2. Pull the tail lamp assembly rearward. 3. Disconnect the tail lamp bulbs assembly electrical connector.
	Tail Lamp Wiring Harness and Bulb Assembly WARNING:

3

Refer to Halogen Bulb Warning .

TIP: Rotate the bulbs counterclockwise and remove from the tail lamp housing.

TAIL LAMP BULB REPLACEMENT

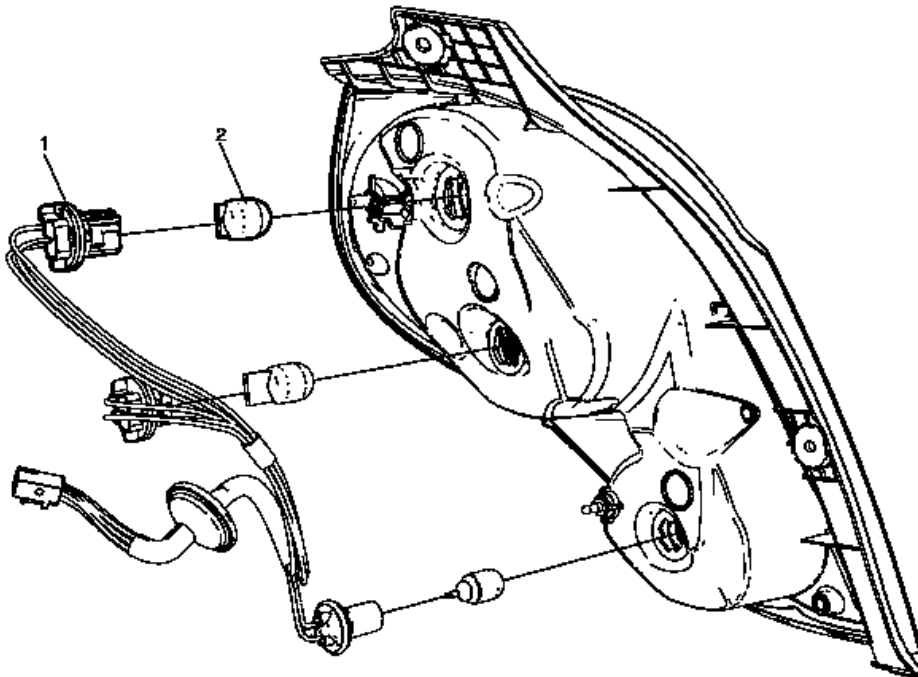


Fig. 40: Tail Lamp Bulb

Courtesy of GENERAL MOTORS COMPANY

Tail Lamp Bulb Replacement

Callout	Component Name
Preliminary Procedure Remove the tail lamp assembly. Refer to <u>Tail Lamp Replacement</u> .	
1	Tail Lamp Bulb Harness Socket WARNING: Refer to <u>Halogen Bulb Warning</u> . NOTE: Rotate the bulb socket from the tail lamp housing.
2	Tail Lamp Bulb Procedure Pull the bulb straight from the lamp harness socket.

REAR COMPARTMENT COURTESY LAMP REPLACEMENT

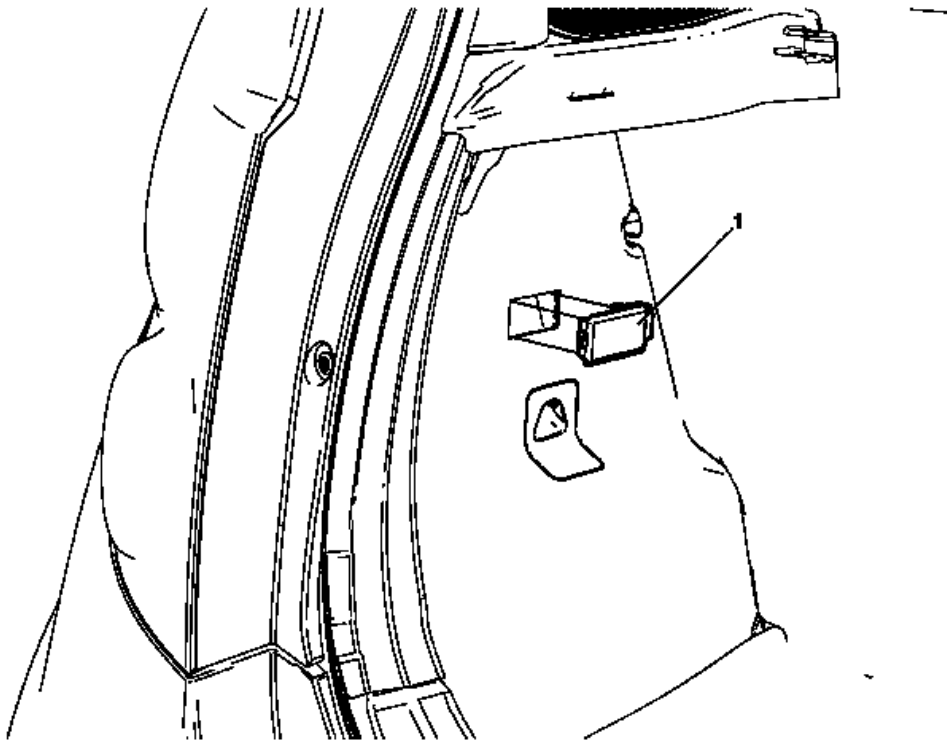


Fig. 41: Rear Compartment Courtesy Lamp
Courtesy of GENERAL MOTORS COMPANY

Rear Compartment Courtesy Lamp Replacement

Callout	Component Name
1	Rear Compartment Courtesy Lamp WARNING: Refer to <u>Halogen Bulb Warning</u> .

DESCRIPTION AND OPERATION

EXTERIOR LIGHTING SYSTEMS DESCRIPTION AND OPERATION

Exterior Lamps

The exterior lighting system consist of the following lamps if equipped:

- Backup lamps
- Front fog lamps
- Hazard warning lamps
- Headlamps

- Park, tail and license lamps
- Repeater lamps
- Stop lamps
- Turn signal lamps

Low Beam Headlamps

The body control module (BCM) monitors two signal circuits from the headlamp switch. With the headlamp switch in the PARK position, the headlamp switch park lamps ON signal circuit is grounded, indicating that the park lamps have been requested. When the headlamp switch is placed in the HEADLAMP position, both the headlamp switch park lamps ON signal circuit and the headlamp switch headlamps ON signal circuit are grounded. The BCM responds to the inputs by illuminating the park lamps and headlamps. When the low beam headlamps are requested, the BCM applies B+ to both low beam headlamp control circuits illuminating the low beam headlamps.

The BCM will also command the low beam headlamps ON during daylight conditions when the following conditions are met:

- Headlamp switch in the AUTO position
- Windshield wipers ON
- Vehicle in any gear but PARK - automatic transmission
- Vehicle in motion - manual transmission

When the BCM commands the low beam headlamps ON, the operator will notice the interior backlighting for the instrument cluster and the various other switches dim to the level of brightness selected by the instrument panel dimmer switch.

High Beam Headlamps

When the low beam headlamps are ON and the turn signal/multifunction switch is placed in the high beam position, ground is applied to the BCM through the high beam signal circuit. The BCM responds to the high beam request by applying ground to the high beam relay control circuit which energizes the high beam relay. With the high beam relay energized, the switch contacts close allowing battery voltage to flow through the left and right high beam fuses to the high beam control circuits illuminating the left and right high beam headlamps.

Daytime Running Lamps (DRL)

The daytime running lamps (DRL) will illuminate the right and left low beam headlamps continuously. The DRLs will operate when the following conditions are met:

- The ignition is in the RUN or CRANK position
- The shift lever is out of the PARK position for vehicles equipped with automatic transmissions or the parking brake is released for vehicles with manual transmissions
- The low and high beam headlamps are OFF

With the headlamp switch is in the off position the BCM will command the low beam headlamps ON. The low

beam headlamps are the designated DRL's. Any function or condition that turns on the headlamps will cancel DRL operation.

Flash to Pass (FTP)

When the turn signal/multifunction switch is momentarily placed in the flash to pass (FTP) position, ground is applied from to the turn signal/multifunction switch. The turn signal/multifunction switch applies ground to the body control module (BCM) through the FTP switch signal circuit. The BCM then applies ground to the high beam relay control circuit. This energizes the high beam relay, closing the switch side contacts of the high beam relay, applying battery voltage to the left and right high beam fuses. Battery voltage is applied from the high beam fuses through the high beam control circuit to the high beam headlamp assemblies. This causes the high beam headlamps to illuminate at full brightness momentarily.

Front Fog Lamps

The front fog lamp relay is supplied with battery voltage at all times. The front fog lamp switch signal circuit is grounded momentarily by pressing the front fog lamp switch. The body control module (BCM) energizes the front fog lamp relay by applying ground to the front fog lamp relay control circuit. When the front fog lamp relay is energized, the relay switch contacts close and battery voltage is applied through the front fog lamp fuse to the front fog lamp control circuit which illuminates the front fog lamps.

Hazard Warning Lamps

The hazard warning lamps may be activated in any power mode. The hazard warning switch signal circuit is momentarily grounded when the hazard warning switch is pressed. The body control module (BCM) responds to the hazard warning switch signal input by supplying battery voltage to all four turn signal lamps in an ON and OFF duty cycle. When the hazard warning switch is activated, the BCM sends a serial data message to the instrument cluster requesting both turn signal indicators to be cycled ON and OFF.

The instrument panel dimmer switch controls are used to increase and decrease the brightness of the interior backlighting components. When the instrument panel dimmer switch is placed in a desired brightness position, the body control module (BCM) receives a signal from the instrument panel dimmer switch and responds by applying a pulse width modulated (PWM) voltage to the hazard switch LED backlighting control circuit illuminating the LED to the desired level of brightness.

Park, Tail, and License Lamps

When the headlamp switch is placed in the HEAD or PARK position, ground is applied to the park lamp switch ON signal circuit to the body control module (BCM). The BCM responds by applying voltage to the park lamps, tail lamps, and license lamps control circuits illuminating the park, tail, and license lamps.

Stop Lamps

NOTE: Brake system does not use a brake switch, stoplight switch or brakelight switch. System uses a Brake Pedal Position Sensor to control these functions.

The brake pedal position (BPP) sensor is used to sense the action of the driver application of the brake pedal. The BPP sensor provides an analog voltage signal that will increase as the brake pedal is applied. The body

control module (BCM) provides a low reference signal and a 5-volt reference voltage to the BPP sensor. When the variable signal reaches a voltage threshold indicating the brakes have been applied, the BCM will apply battery voltage to the left and right stop lamp control circuits as well as the center high mounted stop lamp (CHMSL) control circuit illuminating the left and right stop lamps and the CHMSL.

Turn Signal Lamps

Ground is applied at all times to the turn signal/multifunction switch. The turn signal lamps may only be activated with the ignition switch in the ON or START positions. When the turn signal/multifunction switch is placed in either the TURN RIGHT or TURN LEFT position, ground is applied to the body control module (BCM) through either the right turn or left turn signal switch signal circuit. The BCM responds to the turn signal switch input by applying a pulsating voltage to the front and rear turn signal lamps through their respective control circuits. When a turn signal request is received by the BCM, a serial data message is sent to the instrument cluster requesting the respective turn signal indicator be pulsed ON and OFF.

Backup Lamps

Automatic Transmission

With the engine ON and the transmission in the reverse position, the transmission control module (TCM) sends a serial data message to the body control module (BCM). The message indicates that the gear selector is in the reverse position. The BCM applies battery voltage to the backup lamps control circuit illuminating the backup lamps. Once the driver moves the gear selector out of the reverse position, a message is sent by the TCM via serial data requesting the BCM to remove battery voltage from the backup lamps control circuit. The engine must be ON for the backup lamps to operate.

Manual Transmission

The engine control module (ECM) provides a signal circuit to the backup lamp switch which is permanently grounded. With the engine ON and the transmission in the reverse position, the backup lamp switch signal circuit is pulled low and the ECM responds by sending a serial data message to the body control module (BCM). The message indicates that the gear selector is in the reverse position. The BCM applies battery voltage to the backup lamps control circuit illuminating the backup lamps. Once the driver moves the gear selector out of the reverse position, a message is sent by the ECM via serial data requesting the BCM to remove battery voltage from the backup lamps control circuit. The engine must be ON for the backup lamps to operate.

Battery Run Down Protection/Inadvertent Power

To provide battery run down protection, the exterior lamps will be deactivated automatically under certain conditions. The BCM monitors the state of the headlamp switch. If the park or headlamp switch is ON when the ignition switch is placed in either the CRANK or RUN position and then placed in the OFF position, the BCM initiates a 10 min timer. At the end of the 10 min, the BCM will turn off the control power output to the park lamp controls as well as the headlamp relay coils, deactivating the exterior lamps. This feature will be cancelled if any power mode other than OFF becomes active. The BCM will disable battery run down protection if any of the following conditions exist. The park or headlamp switch is placed in the ON to OFF position, and back to the ON position during battery run down protection. The BCM determined that the park or headlamp switch was not active when the ignition was turned OFF.

INTERIOR LIGHTING SYSTEMS DESCRIPTION AND OPERATION

Interior Lamps

The interior lighting consist of two groups. This first group includes lamps that may not be dimmed.

- Dome lamp/reading lamps
- Rear compartment courtesy lamp

Dome Lamp

When any door is opened, the associated door jamb switch closes providing a door open input to the body control module (BCM). The BCM responds by applying battery positive voltage to the dome lamp control circuit illuminating the dome lamp. The dome lamp will turn OFF immediately if the ignition switch is turned to the ON position or approximately 20 seconds after all doors are closed. The dome lamp will normally turn OFF using the theater dimming feature when controlled by the BCM. If the operator inadvertently leaves any interior lamp ON, the BCM will turn all interior lamps OFF after 10 minutes has passed since any switch activation has been detected by the BCM.

Keyless Entry Interior Illumination

When the operator uses the keyless entry transmitter in order to unlock the doors, the BCM receives a door-unlock signal. The BCM must receive inputs from various systems that indicate that the ignition switch is OFF, the courtesy lamp switch is OFF, and all doors are closed before the BCM will activate the interior lamps. The courtesy lamps will remain ON for 20 seconds after the door is closed. The BCM will turn off the courtesy lamps OFF through the theater dimming feature. If the door locks are activated to the LOCK position, or if the ignition switch is turned to either the RUN or CRANK position, the courtesy lamps will turn OFF immediately.

Rear Compartment Courtesy Lamp

The BCM provides battery positive voltage to the rear compartment courtesy lamp. When the rear compartment is opened, the rear compartment latch opens providing a rear compartment open input to the BCM. The BCM responds by applying battery positive voltage to the rear compartment lamp control circuit illuminating the rear compartment lamp.

Reading Lamp

The inadvertent power supply voltage circuit from the BCM provides battery positive voltage the reading lamp. When the reading lamp switch is activated, the switch contacts close providing a path to ground and the reading lamp illuminates. If the operator inadvertently leaves a reading lamp ON, the BCM will turn all interior lamps OFF after 10 minutes has passed since any switch activation has been detected by the BCM.

Battery Rundown Protection/Inadvertent Power

The BCM inadvertent power supply voltage circuit provides battery positive voltage to all of the interior lamps. In the event that any of these lamps were to remain illuminated for a period of more than 10 minutes with the ignition switch in the OFF position, the BCM will deactivate the inadvertent power supply voltage circuit to prevent total battery discharge.

Interior Lamps Dimming

The second group includes lamps which may be dimmed.

- Door lock switch - driver
- Door lock switch - passenger
- Hazard warning switch
- Headlamp switch
- HVAC control head assembly
- Instrument cluster
- Liftgate unlatch switch
- Radio
- Seat heating switch - driver
- Seat heating switch - passenger
- Steering wheel controls switch - left
- Steering wheel controls switch - right
- Transmission shift lever position indicator
- Vehicle stability control switch

When the headlamp switch is placed in the PARK or HEAD position, the park lamp switch signal circuit provides an input to the body control module (BCM). The BCM responds by applying voltage to the park lamps as well as the dimming control circuits illuminating all components with interior backlighting. All LED and incandescent backlighting turns ON at the dimming level indicated by the instrument panel dimmer switch. The instrument panel dimmer switch is a potentiometer type switch used to accomplish dimming controls. The instrument panel dimmer switch contains a battery positive voltage reference circuit, a signal circuit, and a low reference circuit from the BCM. When the instrument panel dimmer switch is held in the decrease brightness position, the BCM receives a low voltage signal via the instrument panel dimmer switch signal circuit. The BCM responds by decreasing the brightness of all interior backlighting by decreasing the voltage supplied to the backlighting components via the dimming control circuits. When the instrument panel dimmer switch is held in the increase brightness position, the BCM receives a high voltage signal via the instrument panel dimmer switch signal circuit. The BCM responds by increasing the brightness of all interior backlighting by increasing the voltage supplied to the backlighting components via the dimming control circuits.

ACCESSORIES & EQUIPMENT

Luggage Rack and Roof Trim - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Luggage Carrier Side Rail Mounting Nut	9 N.m	80 lb in

REPAIR INSTRUCTIONS

LUGGAGE CARRIER REPLACEMENT

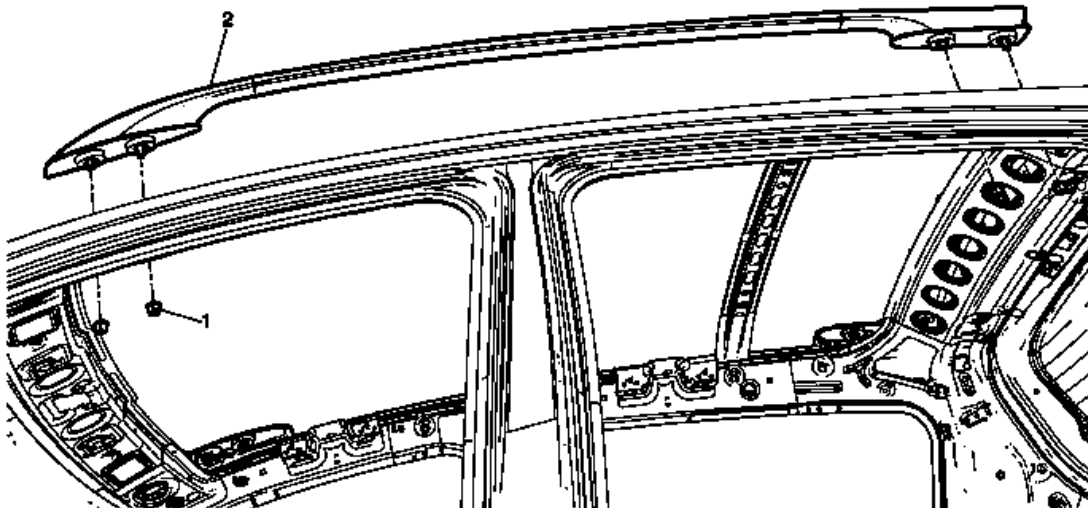


Fig. 1: Luggage Carrier

Courtesy of GENERAL MOTORS COMPANY

Luggage Carrier Replacement

Callout	Component Name
Preliminary Procedure	
Remove the headlining trim panel. Refer to Headlining Trim Panel Replacement .	

1	Luggage Carrier Side Rail Mounting Nut (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 9 N.m (80 lb in)
2	Luggage Carrier Side Rail

ENGINE

Maintenance and Lubrication - Spark

SPECIFICATIONS

APPROXIMATE FLUID CAPACITIES

The following approximate capacities are given in English and metric conversions. All capacities are approximate. When adding, be sure to fill to the approximate level as recommended in this manual. Recheck fluid level after filling.

Approximate Fluid Capacities

Application	Specification	
	Metric	English
Automatic Transaxle Fluid		
• 1.2 L DOHC B12D LL0 Engine	4.7 L	5.0 qt
Brake Fluid	0.5 L	0.58 qt
Engine Coolant		
• 1.2 L DOHC B12D LL0 Engine	4.74 L	5.0 qt
Engine Oil (With Filter)		
• 1.2 L DOHC B12D LL0 Engine	3.8 L	4.0 qt
Engine Oil (Without Filter)		
• 1.2 L DOHC B12D LL0 Engine	3.50 L	3.70 qt
Manual Transaxle Lubricant		
• 1.2 L DOHC B12D LL0 Engine	2.1 L	2.2 qt

FLUID AND LUBRICANT RECOMMENDATIONS

The Recommended Fluids and Lubricants information will be found in the Owner's Manual. Refer to the Maintenance Schedule subsection of the Owner's Manual.

You may be able to use the Search information function using the words Fluids or Lubricants.

Most transmission, transfer case, front and rear axle lubricant recommendations will be found in those service categories (subsections).

MAINTENANCE ITEMS

The Normal Maintenance Replacement Parts information will only be found in the Owner's Manual. Refer to the Maintenance Schedule subsection of the Owner's Manual.

You may be able to use the search information function using the words Replacement Parts.

MAINTENANCE

MAINTENANCE SCHEDULE

The Maintenance Schedule information will only be found in the Owner's Manual.

Refer to the Maintenance Schedule subsection of the Owner's Manual, or you may be able to use the search information function using the words Scheduled Maintenance.

REMINDER INDICATOR RESET PROCEDURES

GM - Buick / Cadillac / Chevrolet / GMC / Olds / Pontiac - 1980-14

CHANGE TRANS FLUID MESSAGE

NOTE: To determine the appropriate reset procedure, refer to CHANGE TRANS FLUID MESSAGE RESET INDEX. Only the vehicles listed in this index have a CHANGE TRANS FLUID MESSAGE reset.

CHANGE TRANS FLUID MESSAGE RESET INDEX

Model & Year	Reset Procedure
Aurora	
1995-99	<u>Change Trans Fluid Message Reset - Procedure 4</u>
Concours	
1994-98	<u>Change Trans Fluid Message Reset - Procedure 1</u>
1999	<u>Change Trans Fluid Message Reset - Procedure 2</u>
CTS	
2003	<u>Change Trans Fluid Message Reset - Procedure 3</u>
2004	<u>Change Trans Fluid Message Reset - Procedure 2</u>
DeVille	
1992-97	<u>Change Trans Fluid Message Reset - Procedure 1</u>
1998-04	<u>Change Trans Fluid Message Reset - Procedure 2</u>
Eldorado	
1992-98	<u>Change Trans Fluid Message Reset - Procedure 1</u>
1999-00	<u>Change Trans Fluid Message Reset - Procedure 2</u>
2001-02	<u>Change Trans Fluid Message Reset - Procedure 1</u>
Seville	
1992-97	<u>Change Trans Fluid Message Reset - Procedure 1</u>
1998-04	<u>Change Trans Fluid Message Reset - Procedure 2</u>
SRX	
2004	<u>Change Trans Fluid Message Reset - Procedure 2</u>

CHANGE TRANS FLUID MESSAGE RESET - PROCEDURE 1

This message will appear on the Driver Information Center (DIC) when transaxle fluid change is due. Change fluid in both the oil pan and side cover.

1. To reset display, turn ignition ON with engine OFF.
2. On the climate control panel, press and hold OFF and REAR DEFOG buttons until TRANS FLUID RESET message appears in DIC (about 5-20 seconds).

CHANGE TRANS FLUID MESSAGE RESET - PROCEDURE 2

The CHANGE TRANS FLUID message will appear on the Driver Information Center (DIC) when transaxle fluid change is due. Percentage of transaxle fluid life remaining may be checked at any time by pressing INFO button several times until TRANS FLUID LIFE message appears.

1. To reset display, turn ignition key ON with engine OFF.
2. Press the INFO button until TRANS FLUID LIFE message appears.
3. Press and hold INFO RESET button until display shows 100 percent TRANS FLUID LIFE. Transaxle fluid life index is now reset.

CHANGE TRANS FLUID MESSAGE RESET - PROCEDURE 3

Resetting With Base Audio System

Press CLR button located to the right of the DIC display to acknowledge the CHANGE TRANS FLUID message. This will clear the message from the display and reset it. To reset transmission fluid life indicator, press up or down arrow on INFO button located to the right of the DIC display to access the DIC menu. Once percentage TRANS FLUID LIFE menu item is highlighted, press and hold CLR button. Percentage will return to 100, and transmission fluid life indicator will be reset. Repeat if percentage does not return to 100.

Resetting With Navigation System

Press multifunction button located to the right of the DIC display, next to the OK prompt to acknowledge the CHANGE TRANS FLUID message. This will clear the message form the display and reset it. To reset transmission fluid life indicator, turn system on by pressing PWR/VOL knob once. PWR/VOL knob is located to the lower left of the DIC display. Press INFO button located to the left of the DIC display to access the VEHICLE INFO menu. Turn TUNE/SEL knob located to the lower right of the DIC display until TRANS FLUID LIFE is highlighted. Press knob once to select it. Once percentage TRANS FLUID LIFE is displayed, press multifunction button next to the RESET prompt in the upper right corner of the display. Percentage will return to 100, and transmission fluid life indicator will be reset. Repeat if percentage does not return to 100.

CHANGE TRANS FLUID MESSAGE RESET - PROCEDURE 4

1. The Driver Information Center (DIC) displays estimated percentage of the remaining useful life of transaxle fluid. When remaining fluid life is 0 percent, the display will show CHANGE TRNS FLUID NOW. After changing transaxle fluid, reset oil life display.
2. To reset the display, turn ignition on with engine off. Press ENG button to select the TRNS FLUID LIFE percentage display. Then, press and hold in RESET for at least 5 seconds.
3. The word RESET will appear. Then, TRNS FLUID 100 will be displayed.

CHECK ENGINE LIGHT

NOTE: To determine the appropriate reset procedure, refer to CHECK ENGINE LIGHT RESET INDEX. Only vehicles listed in this index have a check engine light reset.

CHECK ENGINE LIGHT RESET INDEX

Model & Year	Reset Procedure
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Geo Tracker

1989-94

Check Engine Light Reset - Procedure 1

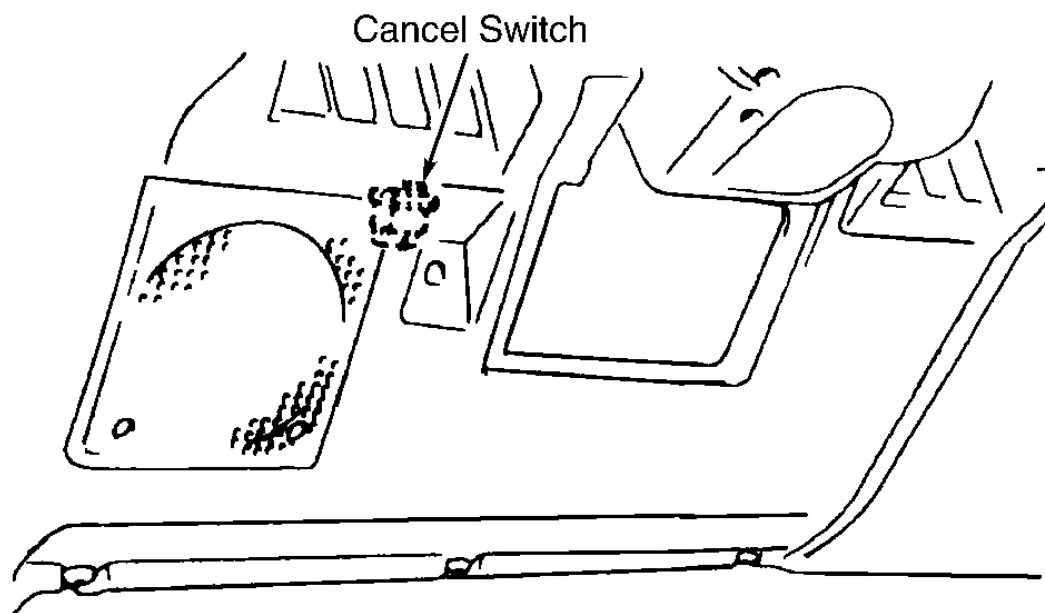
CHECK ENGINE LIGHT RESET - PROCEDURE 1

Federal Emissions

1. CHECK ENGINE light functions as a service reminder indicator and emission system service. CHECK ENGINE light will come on each 50,000 miles (PCV and EGR), each 80,000 miles (oxygen sensor) and each 100,000 miles (charcoal canister) to indicate needed emission system service.
2. After servicing and/or replacing components, reset CHECK ENGINE light by sliding cancel switch to its opposite position. See **CHECK ENGINE LIGHT RESET SWITCH LOCATION (GEO TRACKER)** for switch location.

CHECK ENGINE LIGHT RESET SWITCH LOCATION (GEO TRACKER)

Application	Location
1989-91	Behind Access Panel, Directly Below Steering Column
1992-94	(1) Behind Instrument Panel, Next To Left Speaker
(1) See <u>Fig. 1</u> .	



G50F12299

Fig. 1: Check Engine Light Reset Switch Location (1992-94 Geo Tracker - Federal Emissions)
Courtesy of GENERAL MOTORS CORP.

California Emissions

CHECK ENGINE light indicates when it is necessary to have emission system serviced, regardless of mileage. CHECK ENGINE light comes on briefly when starting as a bulb check. If light does not come on or stays on constantly, repair as necessary.

FUEL FILTER LIFE

NOTE: To determine the appropriate reset procedure, refer to Fuel Filter Life Reset Index. Only vehicles listed in this index have a fuel filter life reset.

FUEL FILTER LIFE RESET INDEX

Application	Reset Procedure
Some Models	<u>Fuel Filter Life Reset - Procedure 1</u>

NOTE: ALWAYS reset the FUEL FILTER LIFE system (if equipped) after a fuel filter change.

"FUEL FILTER LIFE" message will appear when a reset is performed either by using the steering wheel controls or performing manual reset procedure.

FUEL FILTER LIFE RESET - PROCEDURE 1

1. On vehicles with steering wheel controls, press and hold the select button for 5 seconds while the FUEL FILTER LIFE message is displayed. This message will appear on the Driver Information Center (DIC) for 10 seconds.
2. On vehicles without steering wheel controls, go to next step.
3. Without pressing the pedals, turn the ignition key to the ON position, engine off. Wait 5 seconds.
4. Completely depress the brake and accelerator pedals simultaneously and hold for 10 seconds. The system is now reset. Turn ignition key OFF.
5. On all vehicles, the next time engine is started, the message will no longer be displayed.

OIL CHANGE REMINDER

NOTE: Most 1981-88 General Motors vehicles do not use a Service Reminder Indicator (SRI).

NOTE: To determine the appropriate reset procedure, refer to Oil Change Reminders Reset Index. Only vehicles listed in this index have an oil change reminder reset.

OIL CHANGE REMINDERS RESET INDEX

Model & Year	Reset Procedure
Alero	

1999-03	<u>Oil Change Reminder Reset - Procedure 1</u>
2004	<u>Oil Change Reminder Reset - Procedure 3</u>
Acadia	
2007-10	<u>Oil Change Reminder Reset - Procedure 16</u>
2011-15	<u>Oil Change Reminder Reset - Procedure 6</u>
Allante	
1989-93	<u>Oil Change Reminder Reset - Procedure 23</u>
ATS	
2013-14	<u>Oil Change Reminder Reset - Procedure 33</u>
Aurora	
1995-99	<u>Oil Change Reminder Reset - Procedure 27</u>
2001-03	<u>Oil Change Reminder Reset - Procedure 6</u>
Avalanche	
2002-06	<u>Oil Change Reminder Reset - Procedure 3</u>
2007-13	<u>Oil Change Reminder Reset - Procedure 6</u>
Aveo	
2009-11	<u>Oil Change Reminder Reset - Procedure 3</u>
Aztek	
2001-05	<u>Oil Change Reminder Reset - Procedure 3</u>
Bravada	
2002-04	<u>Oil Change Reminder Reset - Procedure 11</u>
Bonneville	
2003-05	<u>Oil Change Reminder Reset - Procedure 6</u>
Brougham	
1992	<u>Oil Change Reminder Reset - Procedure 3</u>
Camaro	
1998-02	<u>Oil Change Reminder Reset - Procedure 1</u>
2010-14	<u>Oil Change Reminder Reset - Procedure 18</u>
Canyon	
2004-12	<u>Oil Change Reminder Reset - Procedure 10</u>
Caprice	
1994	<u>Oil Change Reminder Reset - Procedure 2</u>
1995-96	<u>Oil Change Reminder Reset - Procedure 3</u>
2011-14	<u>Oil Change Reminder Reset - Procedure 18</u>
Captive Sport	
2012-15	<u>Oil Change Reminder Reset - Procedure 6</u>
Classic	
2005	<u>Oil Change Reminder Reset - Procedure 4</u>
Cobalt & G5 Pursuit (Canadian)	
2005-09	<u>Oil Change Reminder Reset - Procedure 4</u>
Colorado	
2004-12	

	<u>Oil Change Reminder Reset - Procedure 10</u>
Concours	
1994-96	<u>Oil Change Reminder Reset - Procedure 19</u>
1997-99	<u>Oil Change Reminder Reset - Procedure 6</u>
Corvette	
1990-96	<u>Oil Change Reminder Reset - Procedure 5</u>
1997-13	<u>Oil Change Reminder Reset - Procedure 6</u>
2014	<u>Oil Change Reminder Reset - Procedure 33</u>
Cruze	
2011-14	<u>Oil Change Reminder Reset - Procedure 18</u>
CTS	
2003-04	<u>Oil Change Reminder Reset - Procedure 20</u>
2005-08	<u>Oil Change Reminder Reset - Procedure 22</u>
2009	<u>Oil Change Reminder Reset - Procedure 6</u>
2010-11	<u>Oil Change Reminder Reset - Procedure 3</u> or <u>Oil Change Reminder Reset - Procedure 19</u>
2012-14	<u>Oil Change Reminder Reset - Procedure 6</u>
Cutlass Calais, Cutlass Supreme, Cutlass Ciera, Cutlass Cruiser & Touring Sedan	
1990-91	<u>Oil Change Reminder Reset - Procedure 28</u>
DeVille	
1991-93	<u>Oil Change Reminder Reset - Procedure 25</u>
1994-99	<u>Oil Change Reminder Reset - Procedure 19</u>
2000-05	<u>Oil Change Reminder Reset - Procedure 16</u>
DTS	
2006-11	<u>Oil Change Reminder Reset - Procedure 6</u>
Eighty Eight & Ninety Eight	
1990-91	<u>Oil Change Reminder Reset - Procedure 28</u>
1992-94	<u>Oil Change Reminder Reset - Procedure 29</u>
1995-97	<u>Oil Change Reminder Reset - Procedure 30</u>
Eldorado	
1989-91	<u>Oil Change Reminder Reset - Procedure 24</u>
1992-93	<u>Oil Change Reminder Reset - Procedure 26</u>
1994-97	<u>Oil Change Reminder Reset - Procedure 19</u>
1997-02	<u>Oil Change Reminder Reset - Procedure 6</u>
ELR	
2014	<u>Oil Change Reminder Reset - Procedure 33</u>
Enclave	
2008-15	<u>Oil Change Reminder Reset - Procedure 16</u>
Encore	
2013-14	<u>Oil Change Reminder Reset - Procedure 18</u>
Envoy/ XL	

2002-06	<u>Oil Change Reminder Reset - Procedure 6</u>
2007-09	<u>Oil Change Reminder Reset - Procedure 4</u>
Equinox	
2005-09	<u>Oil Change Reminder Reset - Procedure 3</u>
2011-14	<u>Oil Change Reminder Reset - Procedure 6</u>
Escalade Series	
2002-06	<u>Oil Change Reminder Reset - Procedure 3</u>
2007-14	<u>Oil Change Reminder Reset - Procedure 6</u>
2015	<u>Oil Change Reminder Reset - Procedure 33</u>
Express/ Cutaway/ RV	
2003-14	<u>Oil Change Reminder Reset - Procedure 3</u>
Firebird	
1998-02	<u>Oil Change Reminder Reset - Procedure 6</u>
Fleetwood	
1991-92	<u>Oil Change Reminder Reset - Procedure 25</u>
1993-96	<u>Oil Change Reminder Reset - Procedure 3</u>
Grand Am	
1999-02	<u>Oil Change Reminder Reset - Procedure 2</u>
2003-05	<u>Oil Change Reminder Reset - Procedure 3</u>
Grand Prix	
1998-03	<u>Oil Change Reminder Reset - Procedure 3</u>
2004-08	<u>Oil Change Reminder Reset - Procedure 6</u>
GTO	
2004-06	<u>Oil Change Reminder Reset - Procedure 3</u>
G5	
2007-09	<u>Oil Change Reminder Reset - Procedure 4</u>
G6	
2005-10	<u>Oil Change Reminder Reset - Procedure 32</u>
G8	
2008-09	<u>Oil Change Reminder Reset - Procedure 9</u>
HHR	
2006-11	<u>Oil Change Reminder Reset - Procedure 4</u>
Impala	
2000-06	<u>Oil Change Reminder Reset - Procedure 8</u>
2007-13	<u>Oil Change Reminder Reset - Procedure 6</u>
2014-15	<u>Oil Change Reminder Reset - Procedure 33</u>
Impala Limited	
2014	<u>Oil Change Reminder Reset - Procedure 6</u>
Intrigue	
1998-02	<u>Oil Change Reminder Reset - Procedure 3</u>
LaCrosse & Allure	
2005-14	

	<u>Oil Change Reminder Reset - Procedure 18</u>
LeSabre	
1994-99	<u>Oil Change Reminder Reset - Procedure 12</u>
2000-05	<u>Oil Change Reminder Reset - Procedure 14</u>
Lucerne	
2006-10	<u>Oil Change Reminder Reset - Procedure 6</u>
2011	<u>Oil Change Reminder Reset - Procedure 18</u>
Lumina	
1997-01	<u>Oil Change Reminder Reset - Procedure 6</u>
Malibu	
2004-07	<u>Oil Change Reminder Reset - Procedure 13</u>
2008-12	<u>Oil Change Reminder Reset - Procedure 4</u>
2013-15	<u>Oil Change Reminder Reset - Procedure 18</u>
Montana	
2000-05	<u>Oil Change Reminder Reset - Procedure 3</u>
2006	<u>Oil Change Reminder Reset - Procedure 6</u>
Monte Carlo	
1997-99	<u>Oil Change Reminder Reset - Procedure 6</u>
2000-06	<u>Oil Change Reminder Reset - Procedure 8</u>
2007	<u>Oil Change Reminder Reset - Procedure 6</u>
Park Avenue	
1991-94	<u>Oil Change Reminder Reset - Procedure 15</u>
1995-96	<u>Oil Change Reminder Reset - Procedure 12</u>
1997-05	<u>Oil Change Reminder Reset - Procedure 14</u>
Pickup/Cab & Chassis (C/K)	
1996-00	<u>Oil Change Reminder Reset - Procedure 3</u>
Rainier	
2004-07	<u>Oil Change Reminder Reset - Procedure 17</u>
Regal	
1997-04	<u>Oil Change Reminder Reset - Procedure 6</u>
2011-14	<u>Oil Change Reminder Reset - Procedure 18</u>
Rendezvous	
2002-07	<u>Oil Change Reminder Reset - Procedure 17</u>
Roadmaster	
1994	<u>Oil Change Reminder Reset - Procedure 15</u> or <u>Oil Change Reminder Reset - Procedure 2</u>
1995-96	<u>Oil Change Reminder Reset - Procedure 3</u>
Savana/ Cutaway/ RV	
2003-14	<u>Oil Change Reminder Reset - Procedure 3</u>
Seville	
1989-91	<u>Oil Change Reminder Reset - Procedure 24</u>

1992-93	<u>Oil Change Reminder Reset - Procedure 26</u>
1994-97	<u>Oil Change Reminder Reset - Procedure 19</u>
1998-04	<u>Oil Change Reminder Reset - Procedure 16</u>
Sierra 1500/ 2500/ 3500	
1999-06	<u>Oil Change Reminder Reset - Procedure 3</u>
2007-15	<u>Oil Change Reminder Reset - Procedure 6</u>
Silhouette	
2000-01	<u>Oil Change Reminder Reset - Procedure 3</u>
2002-04	<u>Oil Change Reminder Reset - Procedure 6</u>
Silverado 1500/ 2500/ 3500	
2001-06	<u>Oil Change Reminder Reset - Procedure 3</u>
2007-15	<u>Oil Change Reminder Reset - Procedure 6</u>
Solstice	
2006-10	<u>Oil Change Reminder Reset - Procedure 4</u>
Sonic	
2012-14	<u>Oil Change Reminder Reset - Procedure 18</u>
Spark	
2013-14	<u>Oil Change Reminder Reset - Procedure 18</u>
SRX	
2004	<u>Oil Change Reminder Reset - Procedure 20</u>
2005-06	<u>Oil Change Reminder Reset - Procedure 22</u>
2007-09	<u>Oil Change Reminder Reset - Procedure 6</u>
2010-12	<u>Oil Change Reminder Reset - Procedure 18</u>
2013-15	<u>Oil Change Reminder Reset - Procedure 33</u>
SS	
2014	<u>Oil Change Reminder Reset - Procedure 18</u>
SSR	
2004	<u>Oil Change Reminder Reset - Procedure 3</u>
2005-06	<u>Oil Change Reminder Reset - Procedure 6</u>
STS	
2005-11	<u>Oil Change Reminder Reset - Procedure 7</u>
Suburban	
2000-06	<u>Oil Change Reminder Reset - Procedure 3</u>
2007-15	<u>Oil Change Reminder Reset - Procedure 6</u>
Tahoe	
2000-06	<u>Oil Change Reminder Reset - Procedure 3</u>
2007-15	<u>Oil Change Reminder Reset - Procedure 6</u>
Terrain	
2011-14	<u>Oil Change Reminder Reset - Procedure 6</u>
Tornado	
1989-92	<u>Oil Change Reminder Reset - Procedure 31</u>
Torrent	

2006-09	<u>Oil Change Reminder Reset - Procedure 3</u>
Trailblazer	
2002-09	<u>Oil Change Reminder Reset - Procedure 11</u>
Traverse	
2009-14	<u>Oil Change Reminder Reset - Procedure 6</u>
Uplander, Montana SV6 (Canadian)	
2005-08	<u>Oil Change Reminder Reset - Procedure 6</u>
Venture	
2000-04	<u>Oil Change Reminder Reset - Procedure 3</u>
2005	<u>Oil Change Reminder Reset - Procedure 6</u>
Verano	
2012-14	<u>Oil Change Reminder Reset - Procedure 18</u>
Volt	
2011-14	<u>Oil Change Reminder Reset - Procedure 21</u>
XLR	
2004	<u>Oil Change Reminder Reset - Procedure 6</u>
2005-09	<u>Oil Change Reminder Reset - Procedure 19</u>
XTS	
2013-14	<u>Oil Change Reminder Reset - Procedure 33</u>
Yukon/ XL	
2000-06	<u>Oil Change Reminder Reset - Procedure 3</u>
2007-13	<u>Oil Change Reminder Reset - Procedure 6</u>

OIL CHANGE REMINDER RESET - PROCEDURE 1

1. The CHANGE OIL (or CHANGE ENGINE OIL) message is displayed when its time to change engine oil, usually between 3000 and 7500 miles since last oil change.
2. To reset the oil life monitor, turn the ignition switch to RUN position, with engine off. Press the TRIP/OIL RESET button on the instrument panel for 12 seconds. The OIL CHANGE light will start to flash to confirm that system is reset (on some models a chime will also sound). Reset is complete when OIL CHANGE light goes out.

OIL CHANGE REMINDER RESET - PROCEDURE 2

Engine oil life monitor calculates engine oil temperature and RPM. It indicates when the engine oil is nearly worn out. A CHANGE OIL light on the instrument cluster is illuminated when it is time to change the engine oil. To reset CHANGE OIL light:

1. Remove IP fuse block cover (cover can be seen when driver's door is open).
2. Turn ignition ON, engine OFF.
3. Press OIL RESET button and hold for 5 seconds.
4. If Oil Life light does not reset, repeat procedure with ignition OFF.

OIL CHANGE REMINDER RESET - PROCEDURE 3

Engine oil life monitor calculates engine oil temperature and RPM. It indicates when the engine oil is nearly worn out. A CHANGE OIL light on the instrument cluster is illuminated when it is time to change the engine oil.

1. To reset oil life monitor and turn off CHANGE OIL light, turn ignition switch to ON position with engine off.
2. Depress accelerator pedal to wide open throttle 3 times within 5 seconds. This throttle signal will inform the PCM to reset the oil life monitor and turn off the light. If light does not turn off, turn ignition off and repeat procedure.

OIL CHANGE REMINDER RESET - PROCEDURE 4

When the system has calculated that oil life has been diminished, it will indicate that an oil change is necessary. A CHANGE ENGINE OIL SOON message will come on. Change the engine oil as soon as possible within the next 600 miles (1,000 km). It is possible that, if driving under the best conditions, the oil life system may not indicate that an oil change is necessary for over a year. However, the engine oil and filter must be changed at least once a year and at this time the system must be reset.

Reset Procedure

1. Turn the ignition key to RUN with the engine OFF.
2. Press the INFO and RESET buttons on the Driver Information Center (DIC) at the same time to enter the personalization menu.
3. Press the INFO button to scroll through the available personalization menu modes until the DIC display shows OIL-LIFE RESET.
4. Press the INFO and RESET buttons at the same time for one second and release.
5. Press and hold the reset button until the DIC display shows ACKNOWLEDGED. This will tell you the system has been reset.
6. Turn the key to LOCK/OFF.

Alternate Method (Some Models)

1. Turn the ignition key to RUN with the engine off.
2. Fully press the release the accelerator pedal 3 times within 5 seconds. Several beeps sound. This confirms the oil life system has been reset.
3. If the CHANGE/OIL message comes back on when you start the engine, the engine oil life system has not been reset. Repeat the procedure.

OIL CHANGE REMINDER RESET - PROCEDURE 5

Engine oil life monitor calculates engine oil temperature and RPM. It indicates when the oil is nearly worn out. A CHANGE OIL light on left side of instrument cluster is illuminated when it is time to change oil. To reset oil life monitor:

1. Turn ignition on.
2. Depress ENG MET button on trip monitor and release.
3. Within 5 seconds, depress and release ENG MET button again.
4. Within 5 seconds, depress and hold the ENG MET or GAUGES button again. The CHANGE OIL light should flash.
5. Depress and hold the RANGE or GAUGES button until the CHANGE OIL light stops flashing and goes out. When the light goes out, the engine oil life monitor is reset. This should take about 10 seconds.

NOTE: If the light does not reset, turn ignition off and repeat the procedure.

OIL CHANGE REMINDER RESET - PROCEDURE 6

The Driver Information Center (DIC) will display a CHANGE OIL message when an oil change is due. The instrument cluster may also have a CHANGE OIL light. To reset the oil life monitor:

Reset Procedure

1. Turn ignition switch to RUN position, with engine off.
2. Press the TRIP (on some models SELECT or SET/RESET) button, located on the DIC, until the OIL LIFE display appears. Message will display percentage of oil life remaining.

NOTE: On models without DIC buttons, use the TRIP/ODOMETER reset stem.

3. Press and hold SET/RESET button (on some models, the check-symbol button) on DIC for at least 5 seconds. The message will change to indicate that the Oil Life has been reset. On some models, 3 chimes will also sound.
4. Turn ignition off.
5. Turn the key to OFF. If the light or message comes back on when you start your vehicle, the oil life system has not reset. Repeat the procedure.

NOTE: On some models, if oil life system does not reset, try turning ignition OFF after displaying oil life message. Then press and hold reset button.

Alternate Method (Some Models)

1. Turn the ignition key to RUN with the engine off.
2. Fully press the release the accelerator pedal 3 times within 5 seconds. Several beeps sound. This confirms the oil life system has been reset.
3. If the CHANGE/OIL message comes back on when you start the engine, the engine oil life system has not been reset. Repeat the procedure.

OIL CHANGE REMINDER RESET - PROCEDURE 7

When the system has calculated that oil life has been diminished, it indicates that an oil change is necessary. A

CHANGE ENGINE OIL SOON message in the DIC comes on. Reset the system whenever the engine oil is changed so that the system can calculate the next engine oil change. To reset the system:

1. Press the up or down arrow to scroll the DIC to show OIL LIFE.
2. Once the XXX% ENGINE OIL LIFE menu item is highlighted, press and hold the RESET button until the percentage shows 100%

OIL CHANGE REMINDER RESET - PROCEDURE 8

The CHANGE ENGINE OIL message is displayed when its time to change engine oil, usually between 3000 and 7500 miles since last oil change. The oil change interval is not based on mileage, but on engine revolutions and engine operating temperature.

1. There are 2 ways to reset the engine oil life monitor. To reset the engine oil life monitor using the accelerator pedal, go to step 4. To reset the engine oil life monitor using the radio, turn the radio off. Turn ignition to ACC or ON, with the engine off. Press and hold the DISP (on some models, TUNE DISP) button (or knob) on the radio for at least 5 seconds until SETTINGS is displayed.
2. Press the SEEK (on some models, SEEK PTYPE or SEEK PSCAN) up or down arrow to scroll through the main menu. Scroll until OIL LIFE appears on the display. Press the PREV or NEXT button to enter the sub-menu. RESET will be displayed.
3. Press the DISP/TUNE DISP button to reset. A chime will sound to verify the new setting and DONE will be displayed for one second. Once the message indicator has been reset, scroll through the menu until EXIT appears on the display. Press the DISP/TUNE DISP button to exit the program. A chime will sound to verify the exit.
4. To reset the engine oil life monitor using the accelerator pedal, turn ignition on with engine off. Fully depress and release the accelerator pedal slowly 3 times within 5 seconds. If CHANGE ENGINE OIL light flashes, oil life monitor is reset. If the CHANGE ENGINE OIL light comes back on and stays on, oil life monitor has not reset. Repeat reset procedure.

OIL CHANGE REMINDER RESET - PROCEDURE 9

When the system has calculated that oil life has been diminished, it will indicate that an oil change is necessary. A CHANGE message will come on. Change the engine oil as soon as possible within the next 600 miles (1000 km). It is possible that, if driving under the best conditions, the oil life may not indicate that an oil change is necessary for over a year. However, the engine oil and filter must be changed at least once a year and at this time the system must be reset.

To reset the Engine Oil Life System, do the following:

1. Press and hold the TRIP button on the steering wheel while turning on the ignition. Do not start the engine.
2. The instrument panel cluster will prompt to clear the service code.
3. Release the button.
4. Press and hold ENTER Switch on the left side of the steering wheel for approximately one second.
5. Turn off the ignition.

If the CHANGE ENGINE OIL SOON message comes back on when you start the vehicle, the engine oil life system has not reset. Repeat the procedure.

OIL CHANGE REMINDER RESET - PROCEDURE 10

1. Turn ignition ON, with engine off.
2. Press and release reset stem on instrument panel while OIL LIFE message is displayed.
3. Once the alternating OIL LIFE and RESET messages appear, press and hold stem in until several beeps will sound. This confirms that oil life system has been reset. Turn ignition off or full LOCK position. If CHANGE OIL messages comes back after starting engine, repeat reset procedure.

OIL CHANGE REMINDER RESET - PROCEDURE 11

Reset Procedure

If vehicle is equipped with a Driver Information Center (DIC), reset oil life monitor by pressing the Driver Information Center SELECT button for 5 seconds while ENGINE OIL LIFE is displayed.

Alternate Method

To reset the oil life monitor, turn ignition switch to ON or RUN position with engine off. Depress accelerator pedal slowly to wide open throttle 3 times within 5 seconds. If CHANGE ENG OIL light flashes for 5 seconds, oil life monitor is reset. If the CHANGE ENG OIL light does not flash, oil life monitor has not reset. Repeat this step.

OIL CHANGE REMINDER RESET - PROCEDURE 12

1. CHANGE OIL SOON light will come on when engine oil has broken down enough to require changing. After changing oil, reset oil life display.
2. To reset light, turn ignition on. Open glove box to access oil reset button. Press and hold oil reset button in glove box for at least 5 seconds, but not longer than 60 seconds. The CHANGE OIL SOON light will flash 4 times to indicate light has been reset.

OIL CHANGE REMINDER RESET - PROCEDURE 13

GM Oil Life System calculates when to change your engine oil and filter based on vehicle use. Anytime oil is changed, reset the system so it can calculate when the next oil change is required. If a situation occurs where you change your oil prior to a Change Oil Soon message being turned on, reset the system. After changing the engine oil, reset the system.

1. Display OIL LIFE RESET on the DIC.
2. Press and hold ENTER button for at least one second. An ACKNOWLEDGED display message will appear for 3 seconds or until the next button is pressed. This will tell you the system has been reset.
3. Turn key to OFF.
4. If Change Oil Soon message comes back on when you start your vehicle, engine oil life system has not reset. Repeat the procedure.

OIL CHANGE REMINDER RESET - PROCEDURE 14

1. To display this light, press the GAGE INFO or GAGES button on the Driver Information Center (DIC). When oil life index is less than 10 percent, display will show OIL LIFE INDEX CHANGE OIL. After changing oil, reset system.
2. To reset light, display OIL LIFE INDEX. Hold RESET button for more than 5 seconds. After reset, oil life will change to 100 percent.

OIL CHANGE REMINDER RESET - PROCEDURE 15

1. CHANGE OIL SOON light will come on when engine oil has broken down enough to require changing. After changing oil, reset oil life display.
2. To reset light, locate reset button hole under the dash near passenger door. Use a pencil or similar object to push and hold button (inside hole) for 5 seconds. The CHANGE OIL SOON light will flash 4 times to indicate light has been reset.

OIL CHANGE REMINDER RESET - PROCEDURE 16

Vehicles WITHOUT Driver Information Center (DIC) Buttons

1. Turn the ignition to ON/RUN, with the engine off. The vehicle must be in P (Park) to access this display. Press the trip odometer reset stem until OIL LIFE REMAINING displays.
2. Press and hold the trip odometer reset stem until OIL LIFE REMAINING shows "100%." Three chimes sound and the CHANGE ENGINE OIL SOON message goes off.
3. Turn the key to LOCK/OFF. If the CHANGE ENGINE OIL SOON message comes back on when the vehicle is started, the engine oil life system has not been reset. Repeat the procedure.

Vehicles WITH Driver Information Center (DIC) Buttons

1. Turn the ignition to ON/RUN position, with the engine off.
2. Press the VEHICLE INFORMATION BUTTON (i) until OIL LIFE REMAINING displays.
3. Press and hold the SET/RESET button (check-mark symbol) until "100%" is displayed. Three chimes sound (on some models) and the CHANGE ENGINE OIL SOON message goes off.
4. Turn ignition to LOCK/OFF position. If the CHANGE ENGINE OIL SOON message comes back on when engine is started, repeat reset procedure.

OIL CHANGE REMINDER RESET - PROCEDURE 17

Reset Procedure

1. Turn the ignition to ON, with the engine off.
2. Press the MODE button until the Driver Information Center (DIC) reads OIL LIFE LEFT/HOLD SET TO RESET.
3. Press and hold the SET button until 100% is displayed. You will hear three chimes and the CHANGE ENGINE OIL message will go off. Turn the key to OFF.

4. If the CHANGE ENGINE OIL message comes back on when engine is started, the engine oil life system has not reset. Repeat the procedure.

Alternate Method (Some Models)

1. Turn the ignition key to RUN with the engine off.
2. Fully press the release the accelerator pedal 3 times within 5 seconds. Several beeps sound. This confirms the oil life system has been reset.
3. If the CHANGE/OIL message comes back on when you start the engine, the engine oil life system has not been reset. Repeat the procedure.

OIL CHANGE REMINDER RESET - PROCEDURE 18

When the system has calculated that oil life has been diminished, it will indicate that an oil change is necessary. A CHANGE ENGINE OIL message or light will come on. Change the engine oil as soon as possible within the next 600 miles (1 000 km). It is possible that, if driving under the best conditions, the oil life system may not indicate that an oil change is necessary for over a year. However, the engine oil and filter must be changed at least once a year and at this time the system must be reset.

NOTE: **Be careful not to reset the oil life display accidentally at any time other than after the oil is changed. It cannot be reset accurately until the next oil change.**

Vehicles with Driver Information Center (DIC)

1. Turn the ignition to ON/RUN with the engine off.
2. Press the DIC MENU button on the turn signal lever to enter the Vehicle Information Menu. Use the thumbwheel to scroll through the menu items until you reach REMAINING OIL LIFE. See **Fig. 2**.
3. Press the SET/CLR button (on some models, the check-symbol button) while the oil life display is active. After a few seconds, there will be a single chime (on some models) and the oil life will be reset to 100%.
4. Turn the ignition to LOCK/OFF.

The system is reset when the CHANGE OIL message is off and the REMAINING OIL LIFE 100% message is displayed.

NOTE: **If the CHANGE OIL message comes back on or Code 82 DIC message comes on when the vehicle is started, the engine oil life system has not been reset. Repeat the procedure.**

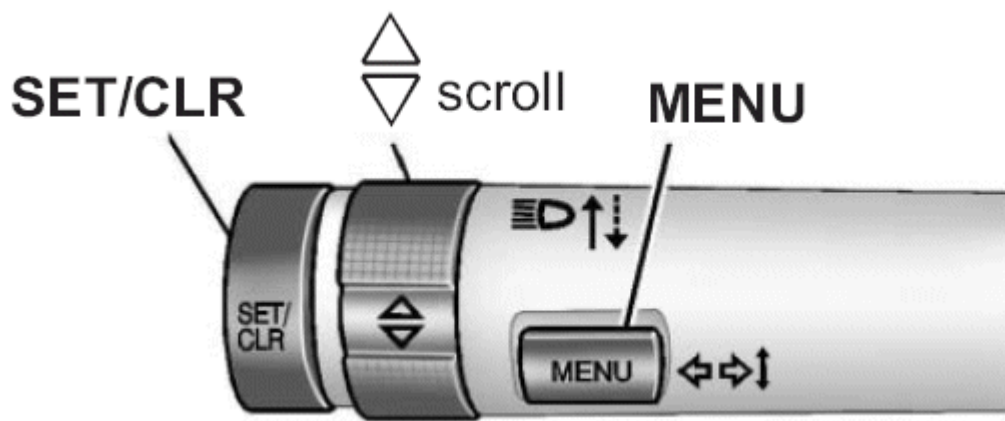


Fig. 2: Identifying DIC Controls (Turn Signal Lever)
Courtesy of GENERAL MOTORS CORP.

Vehicles without DIC (Some Models)

1. With the engine OFF, turn the ignition key to RUN.
2. Fully press and release the accelerator pedal slowly three times within five seconds.
3. Turn the key to OFF, then start the vehicle.

Reset Using Diagnostic Scan Tool (Some Models)

1. Turn on ignition.
2. Connect scan tool.
3. Select Module Diagnosis.
4. Select Engine Control Module.
5. Select Configuration/Reset function.
6. Select Engine Oil System Reset.
7. Push Enter button to run function.
8. Confirm Executed successfully.
9. Turn ignition off and confirm.
10. Turn ignition on and confirm.

OIL CHANGE REMINDER RESET - PROCEDURE 19

1. The Driver Information Center (DIC) will display remaining oil life as a percentage estimate of the useful life of oil.
2. When remaining oil life is 10 percent or less, the system will display CHANGE OIL SOON. When oil life expires, display will show CHANGE ENGINE OIL. After changing oil, reset oil life display.
3. To reset oil life display, press INFORMATION (or INFORMATION SKIP) button to display OIL LIFE LEFT. Press and hold RESET (or RESET NO) button until 100 OIL LIFE LEFT (0.0 OIL LIFE LEFT on some early models) is displayed.

OIL CHANGE REMINDER RESET - PROCEDURE 20

With Base Audio System

Press up or down arrow on the INFO button located to right of Driver Information Center (DIC) display to access DIC menu. Once 100 percent ENGINE OIL LIFE menu item is highlighted, press and hold the CLR button. Percentage will return to 100 and oil life indicator will be reset. Repeat procedure if the percentage does not return to 100.

With Navigation System

Turn the system on by pressing PWR/VOL knob once. PWR/VOL knob is located to lower left of DIC display. Press INFO button located to left of the display to access Vehicle Information menu. Turn TUNE/SEL knob located to lower right of the display until ENGINE OIL LIFE is highlighted. Press TUNE/SEL knob once to select it. When 100 percent Engine Oil Life is displayed, press multifunction button next to reset prompt in upper right corner of the display. Percentage will return to 100 and the oil life indicator will be reset. Repeat procedure if the percentage does not return to 100.

OIL CHANGE REMINDER RESET - PROCEDURE 21

1. Use the SELECT knob to select OIL LIFE on the DIC menu.
2. Press SELECT to start the OIL LIFE reset procedure.
3. The DIC menu will display "Are you sure that you want to reset?" Use SELECT to choose YES to reset oil life or NO to exit and return to the previous menu.
4. If YES is selected, the DIC menu will display RESET OIL LIFE for a short time and then 100% OIL LIFE will be display when OIL LIFE is successfully reset.

OIL CHANGE REMINDER RESET - PROCEDURE 22

With Base Audio System

1. Press the CLR button located to the right of the driver information center (DIC) display to acknowledge the Change Engine Oil message. This will clear the message from the display and reset it.
2. Press the up or down arrow on the INFO button located to the right of the Driver Information Center (DIC) display to access the DIC menu.
3. Once 100% ENGINE OIL LIFE menu item is highlighted, press and hold the CLR button. The percentage will return to 100 and the oil life indicator will be reset. Repeat the steps if the percentage does not return to 100.
4. Turn OFF the key. If the Change Engine Oil message comes back on when you start the vehicle, the engine oil life system has not reset. Repeat the procedure.

Without DIC

1. With the engine OFF, turn the ignition key to RUN.
2. Fully press and release the accelerator pedal slowly three times within five seconds.
3. Turn the key to OFF, then start the vehicle.

With Navigation System

1. Press the multifunction button, next to the OK prompt in the upper right of the display to acknowledge the Change Engine Oil message. This will clear the message from the display and reset it.
2. Turn the system on by pressing the PWR/VOL knob once. The PWR/VOL knob is located to the lower left of the driver information center (DIC) display.
3. Press the INFO button located to the left of the display to access the Vehicle Information menu.
4. Turn the TUNE/SEL knob located to the lower right of the display until Engine Oil Life is highlighted. Press the knob once to select it.
5. Once the 100% Engine Oil Life is displayed, press the multifunction button next to the Reset prompt in the upper right corner of the display. The percentage will return to 100 and the oil life indicator will be reset. Repeat the steps if the percentage does not return to 100.
6. Turn OFF the key. If the Change Engine Oil message comes back on when you start the vehicle, the engine oil life system has not reset. Repeat the procedure.

OIL CHANGE REMINDER RESET - PROCEDURE 23

1. An OIL LIFE INDEX is one of the displays on Driver Information Center (DIC). It will display remaining oil life as a percentage estimate of the useful life of oil.
2. It will show 100 percent when the system is reset. When the oil life is 0 percent, the display will show CHANGE ENGINE OIL. After changing oil, reset oil life display.
3. To reset service reminder on 1989 models, press RANGE button until OIL LIFE INDEX appears on display. Depress and hold in AVG ECON and RANGE buttons for more than 5 seconds or until 100 is displayed. This will reset remaining oil life to 100 percent.
4. On 1990-93 models, press RANGE button until OIL LIFE INDEX appears on DIC display. Depress and hold in AVG SPEED and RANGE buttons for more than 5 seconds or until 100 is displayed. This will reset remaining oil life to 100 percent.

OIL CHANGE REMINDER RESET - PROCEDURE 24

1. An OIL LIFE INDEX is one of 4 displays on Driver Information Center (DIC). It will display remaining oil life as a percentage estimate of the useful life of oil.
2. Display will show 100 percent when the system is reset. When remaining oil life is 10 percent or less, the system will display CHANGE OIL SOON. When the oil life expires, the display will show CHANGE ENGINE OIL. After changing oil, reset oil life display.
3. To reset oil life display, press ENG DATA button until OIL LIFE INDEX appears on DIC display. Depress and hold in ENG DATA and RANGE buttons until 100 is displayed. This will reset remaining oil life to 100 percent.

OIL CHANGE REMINDER RESET - PROCEDURE 25

1. An OIL LIFE INDEX is one of the displays on Driver Information Center (DIC). It will display remaining oil life as a estimated percentage of the useful life of oil.
2. It will show 100 percent when the system is reset. When the oil life is 0 percent, the display will show CHANGE ENGINE OIL. After performing necessary services, reset service reminder.

3. To reset service reminder, turn ignition to on position. Do not start engine. Depress and hold RANGE and FUEL USED buttons until OIL LIFE INDEX appears on DIC display. Depress and hold RANGE and RESET buttons for 5-60 seconds.
4. When CHANGE OIL SOON light flashes 4 times, remaining oil life index is reset to 100 percent. If CHANGE OIL SOON comes on and stays on for 5 seconds, display did not reset. Repeat step 3.

OIL CHANGE REMINDER RESET - PROCEDURE 26

1. Oil change reminder display on the Driver Information Center (DIC) is similar to 1990-91 models, but reset procedures are different. After changing oil, reset oil life display.
2. To reset, press INFORMATION button to display OIL LIFE INDEX. Press and hold STORE/RECALL button until 100 is displayed. This will reset oil life display to 100 percent.

OIL CHANGE REMINDER RESET - PROCEDURE 27

1. The Driver Information Center (DIC) displays estimated percentage of the remaining useful life of engine oil or transaxle fluid. When remaining oil or fluid life is 0 percent, the display will show CHANGE OIL NOW or CHANGE TRNS FLUID NOW. After changing engine oil or transaxle fluid, reset oil life display.
2. To reset the display, turn ignition on with engine off. Press ENG button to select the OIL LIFE or TRNS FLUID LIFE percentage display. Then, press and hold in RESET for at least 5 seconds.
3. The word RESET will appear. Then, OIL LIFE 100 or TRNS FLUID 100 will be displayed.

OIL CHANGE REMINDER RESET - PROCEDURE 28

1. An oil change reminder displays estimated percentage of the remaining useful life of the oil. When engine is started, a tone will sound and approximate distance to next oil change will be displayed.
2. When remaining oil life is 10 percent or less, the system will calculate distance to next oil change. When the oil life is 0 percent, the display will show CHANGE OIL NOW. After changing oil, reset oil life display.
3. To reset the display, press and hold in OIL button to select the oil life display. Then, press and hold in RESET and OIL buttons for at least 5 seconds. This will reset oil life display to 100 percent.

OIL CHANGE REMINDER RESET - PROCEDURE 29

1. To reset the display, press and release the TEST button.
2. Press and release the OIL button.
3. Press and hold the RESET button for at least 7 seconds. This will reset oil life display to 100 percent.

OIL CHANGE REMINDER RESET - PROCEDURE 30

1. To reset the display, press and release RESET button on Driver Information Center (DIC).
2. Press SEL button (with down arrow) to select OIL.
3. Press SEL button (with left and right arrows) to display oil life.

4. Press and hold RESET button for about 5 seconds.
5. A reset message will display, then oil life will display 100 percent.

OIL CHANGE REMINDER RESET - PROCEDURE 31

With Information Center Display

OIL LIFE INDEX is one of 4 engine data displays used on models with Information Center display. It will display remaining oil life as estimated percentage of the useful life of oil. It will show 100 percent when the system is reset. After changing oil, reset oil life display.

1. To reset the display, press ENG DATA button (1989-90) or OPTIONS button (1991-92) until oil life index is displayed.
2. Then, press and hold in ENG DATA and GAGE buttons (1989) or RESET/ENTER button (1990-92) for at least 5 seconds. This will reset remaining oil life to 100 percent.

With Visual Information Center

OIL LIFE is one of the displays used on models with a Visual Information Center (VIC). It will display data regarding previous oil change. A bar graph display shows full when oil is changed. Bar graph will go down as vehicle is driven and oil ages. When bar graph reaches CHANGE OIL mark, oil should be changed. After changing oil, reset oil life display.

1. To reset the display, press INFO hard key and then OIL LIFE soft key to display oil life index.
2. Press RESET soft key.
3. A reset confirmation page will appear and ask if oil has been changed. Press YES soft key to reset bar graph, and update last oil change date and mileage information.

OIL CHANGE REMINDER RESET - PROCEDURE 32

When the system has calculated that oil life has been diminished, it will indicate that an oil change is necessary. A CHANGE ENGINE OIL SOON message will come on. Change the engine oil as soon as possible within the next 600 miles (1000 km). It is possible that, if driving under the best conditions, the oil life system may not indicate that an oil change is necessary for over a year. However, the engine oil and filter must be changed at least once a year and at this time the system must be reset.

To reset the Engine Oil Life System, do the following:

1. With the CHANGE OIL SOON message displayed, press any of the three driver information center (DIC) buttons to clear the CHANGE OIL SOON message.
2. Display OIL LIFE RESET on the DIC.
3. Press and hold the ENTER button for at least one second. An ACKNOWLEDGED display message will appear for three seconds or until the next button is pressed. This will tell you the system has reset.
4. Turn the ignition to OFF.

If the CHANGE ENGINE OIL message comes back on when you start the vehicle the Engine Oil Life System

has not reset. Repeat the procedure.

OIL CHANGE REMINDER RESET - PROCEDURE 33

This vehicle has a computer system that indicates when to change the engine oil and filter. This is based on a combination of factors which include engine revolutions, engine temperature, and miles driven. Based on driving conditions, the mileage at which an oil change is indicated can vary considerably. For the oil life system to work properly, the system must be reset every time the oil is changed. To reset the system:

Reset Procedure

- 1. Using the DIC controls on the right side of the steering wheel, display REMAINING OIL LIFE on the driver information center (DIC).
- 2. Press SEL on the DIC controls and hold SEL down for a few seconds to clear the CHANGE ENGINE OIL SOON message and reset the oil life at 100%.

NOTE: Be careful not to reset the oil life display accidentally at any time other than after the oil is changed. It cannot be reset accurately until the next oil change.

Alternate Method (Some Models)

- 1. Turn the ignition key to RUN with the engine off.
- 2. Fully press the release the accelerator pedal 3 times within 5 seconds. Several beeps sound. This confirms the oil life system has been reset.
- 3. If the CHANGE/OIL message comes back on when you start the engine, the engine oil life system has not been reset. Repeat the procedure.

OXYGEN SENSOR REMINDER FLAG

NOTE: To determine the appropriate reset procedure, refer to OXYGEN SENSOR REMINDER FLAG RESET. Only vehicles listed in this index have an oxygen sensor reminder flag reset.

OXYGEN SENSOR REMINDER FLAG RESET INDEX

Model & Year	Reset Procedure
Some Models	
1980	<u>Oxygen Sensor Reminder Flag - Procedure 1</u>

OXYGEN SENSOR REMINDER FLAG - PROCEDURE 1

- 1. Every 30,000 miles, a reminder flag appears in speedometer face, indicating service of oxygen sensor is necessary. See Fig. 3. Inspect and service oxygen sensor as necessary and reset flag.
- 2. To reset flag, remove instrument panel trim plate. Remove instrument cluster lens. Using pointed tool, apply light downward pressure on notches of flag until it is reset. An alignment mark will appear in left

center of odometer window when flag is fully reset.

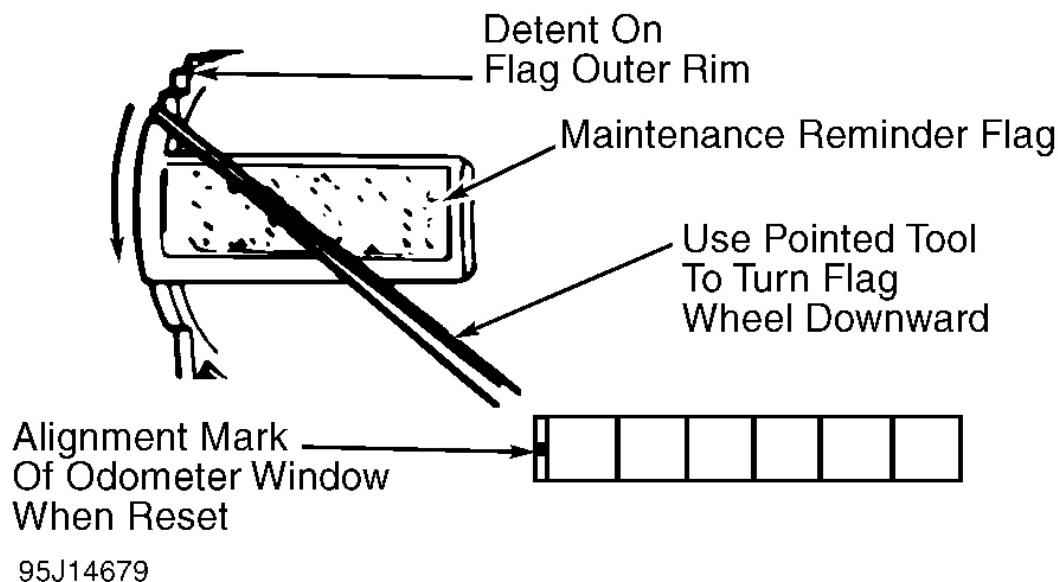


Fig. 3: Resetting Reminder Flag
Courtesy of GENERAL MOTORS CORP.

OXYGEN SENSOR WARNING LIGHT

NOTE: To determine the appropriate reset procedure, refer to OXYGEN SENSOR WARNING LIGHT RESET INDEX. Only vehicles listed in this index have an oxygen sensor warning light reset.

OXYGEN SENSOR WARNING LIGHT RESET INDEX

Model & Year	Reset Procedure
Sprint	
1985-86	<u>Oxygen Sensor Warning Light Reset - Procedure 1</u>

OXYGEN SENSOR WARNING LIGHT RESET - PROCEDURE 1

At 30,000 mile intervals, a SENSOR light in dash will start flashing, indicating oxygen sensor needs replacement. To reset mileage counter (after sensor replacement), locate SENSOR light cancel switch on right side of fuse box. Return cancel switch to OFF position. Start engine to ensure light remains off.

SERVICE REMINDER MESSAGE

NOTE: To determine the appropriate reset procedure, refer to Service Reminder Reset

Index. Only vehicles listed in this index have a Service Reminder reset.

SERVICE REMINDER RESET INDEX

Model & Year	Reset Procedure
6000 STE	
1987-89	<u>Service Reminder Message Reset - Procedure 1</u>
Bonneville	
1988-91	<u>Service Reminder Message Reset - Procedure 1</u>
Caprice	
2011	<u>Service Reminder Message Reset - Procedure 2</u>

SERVICE REMINDER MESSAGE RESET - PROCEDURE 1

The SERVICE REMINDER message light is used on models with a Driver Information Center (DIC). After performing necessary services, reset service reminder light.

1. To reset service reminder, push DIC button until desired service item is displayed.
2. Press and hold down the DIC button. With button pressed, the distance display will decrease in increments of 500 miles.
3. Release button when desired distance is displayed on the DIC.

SERVICE REMINDER MESSAGE RESET - PROCEDURE 2

The displayed service reminder is reset using a scan tool or by the following procedure:

1. Turn the ignition to the OFF position.
2. Press and hold the TRIP button.
3. Turn the ignition to the ON position.
4. Release the TRIP button.
5. Once in the Service Reset screen, press and hold the ENTER switch for 3-5 seconds. A confirmation beep will sound upon reset.
6. Turn the ignition to the OFF position.

NOTE: If the service reminder comes back on when you start the vehicle, the Service Reminder Display has not reset. Repeat the procedure.

TIRE PRESSURE MONITOR SYSTEM (TPMS)

NOTE: To determine the appropriate reset procedure, refer to **TPMS RESET INDEX**. Only vehicles listed in this index have a TPMS reset.

TPMS RESET INDEX

Model	Application	Procedure
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Buick		
Allure	2007	<u>TPMS Reset - Procedure 1</u>
	2008-09	<u>TPMS Reset - Procedure 2</u>
Century	1999-05	(1) <u>TPMS Reset - Procedure 21</u>
Enclave	2008-12	<u>TPMS Reset - Procedure 2</u>
	2013-15	<u>TPMS Reset - Procedure 9</u>
Encore	2013-14	<u>TPMS Reset - Procedure 25</u>
LaCrosse	2006-09	<u>TPMS Reset - Procedure 2</u>
	2010-12	<u>TPMS Reset - Procedure 11</u>
	2013-14	<u>TPMS Reset - Procedure 26</u>
LaSabre	2002-05	(1) <u>TPMS Reset - Procedure 20</u>
Lucerne	2006	(1) <u>TPMS Reset - Procedure 22</u>
	2007-11	<u>TPMS Reset - Procedure 2</u>
Park Avenue	1998-05	(1) <u>TPMS Reset - Procedure 20</u>
Rainier	2006-07	<u>TPMS Reset - Procedure 1</u>
Regal	1999-04	(1) <u>TPMS Reset - Procedure 21</u>
	2011-12	<u>TPMS Reset - Procedure 11</u>
	2013-14	<u>TPMS Reset - Procedure 26</u>
Rendezvous	2003-07	(1) <u>TPMS Reset - Procedure 24</u>
Verano	2012	<u>TPMS Reset - Procedure 11</u>
	2013-14	<u>TPMS Reset - Procedure 26</u>
Cadillac		
ATS	2013-14	<u>TPMS Reset - Procedure 11</u>
CTS	2004-11	<u>TPMS Reset - Procedure 31</u>
	2012	With RPO UH3: <u>TPMS Reset - Procedure 9</u> W/O RPO UH3: <u>TPMS Reset - Procedure 10</u>
	2013-14	<u>TPMS Reset - Procedure 9</u>
Deville	2001-05	<u>TPMS Reset - Procedure 4</u>
DTS	2006-11	<u>TPMS Reset - Procedure 2</u>
ELR	2014	<u>TPMS Reset - Procedure 11</u>
Escalade Series	2004-06	<u>TPMS Reset - Procedure 1</u>
	2008-12	<u>TPMS Reset - Procedure 2</u>
	2013-14	<u>TPMS Reset - Procedure 9</u>
	2015	<u>TPMS Reset - Procedure 11</u>
Seville	2001-04	<u>TPMS Reset - Procedure 4</u>
SRX	2008-11	<u>TPMS Reset - Procedure 2</u>
	2012-14	<u>TPMS Reset - Procedure 11</u>
STS	2005-11	<u>TPMS Reset - Procedure 3</u>

XLR	2008	<u>TPMS Reset - Procedure 2</u>
XTS	2013-14	<u>TPMS Reset - Procedure 11</u>
Chevrolet		
Avalanche	2004-07	<u>TPMS Reset - Procedure 1</u>
	2008-11	<u>TPMS Reset - Procedure 2</u>
	2012	<u>TPMS Reset - Procedure 3</u>
	2013	<u>TPMS Reset - Procedure 9</u>
Aveo	2008-11	⁽²⁾ <u>TPMS Reset - Procedure 7</u>
Camaro	2010-11	<u>TPMS Reset - Procedure 2</u>
	2012	<u>TPMS Reset - Procedure 11</u>
	2013-14	<u>TPMS Reset - Procedure 25</u>
Caprice	2011-13	<u>TPMS Reset - Procedure 31</u>
	2014	<u>TPMS Reset - Procedure 25</u>
Captiva Sport	2012-14	<u>TPMS Reset - Procedure 2</u>
Cobalt	2008-10	<u>TPMS Reset - Procedure 3</u>
Colorado	2006-12	<u>TPMS Reset - Procedure 1</u>
Corvette	1987-96	⁽¹⁾ <u>TPMS Reset - Procedure 20</u>
	1997-04	<u>TPMS Reset - Procedure 6</u>
	2005-06	<u>TPMS Reset - Procedure 3</u>
	2007-13	<u>TPMS Reset - Procedure 9</u>
	2014	<u>TPMS Reset - Procedure 8</u>
Cruze	2011-12	<u>TPMS Reset - Procedure 11</u>
	2013-14	<u>TPMS Reset - Procedure 25</u>
Equinox	2007	<u>TPMS Reset - Procedure 5</u>
	2008-11	<u>TPMS Reset - Procedure 2</u>
	2012	<u>TPMS Reset - Procedure 11</u>
	2013-14	<u>TPMS Reset - Procedure 25</u>
HHR	2008-11	<u>TPMS Reset - Procedure 3</u>
G-Series Van	2008-12	<u>TPMS Reset - Procedure 2</u>
	2013-14	<u>TPMS Reset - Procedure 27</u>
Impala	2000-02	⁽¹⁾ <u>TPMS Reset - Procedure 13</u>
	2003-05	⁽¹⁾ <u>TPMS Reset - Procedure 14</u>
	2006-07	<u>TPMS Reset - Procedure 5</u>
	2008-12	<u>TPMS Reset - Procedure 2</u>
	2013	<u>TPMS Reset - Procedure 9</u>
	2014	<u>TPMS Reset - Procedure 28</u>
Impala Limited	2014	<u>TPMS Reset - Procedure 9</u>
Malibu/Classic	2008-11	<u>TPMS Reset - Procedure 3</u>
	2012	<u>TPMS Reset - Procedure 2</u>
	2013-14	<u>TPMS Reset - Procedure 25</u>

	2015	<u>TPMS Reset - Procedure 28</u>
Monte Carlo	2000-02	(1) <u>TPMS Reset - Procedure 13</u>
	2003-05	(1) <u>TPMS Reset - Procedure 14</u>
	2006-07	<u>TPMS Reset - Procedure 5</u>
Orlando (Canada)	2012	<u>TPMS Reset - Procedure 11</u>
Silverado Series	2006-07	<u>TPMS Reset - Procedure 1</u>
	2008-11	<u>TPMS Reset - Procedure 2</u>
	2012	<u>TPMS Reset - Procedure 3</u>
	2013	<u>TPMS Reset - Procedure 27</u>
	2014-15	<u>TPMS Reset - Procedure 26</u>
Sonic	2012	<u>TPMS Reset - Procedure 11</u>
	2013-14	<u>TPMS Reset - Procedure 25</u>
Spark	2012-14	<u>TPMS Reset - Procedure 29</u>
Spark EV	2014-15	<u>TPMS Reset - Procedure 30</u>
SS	2014	<u>TPMS Reset - Procedure 25</u>
Suburban	2004-07	<u>TPMS Reset - Procedure 1</u>
	2008-11	<u>TPMS Reset - Procedure 2</u>
	2012	<u>TPMS Reset - Procedure 3</u>
	2013-14	<u>TPMS Reset - Procedure 9</u>
	2015	<u>TPMS Reset - Procedure 26</u>
Tahoe	2004-07	<u>TPMS Reset - Procedure 1</u>
	2008-11	<u>TPMS Reset - Procedure 2</u>
	2012	<u>TPMS Reset - Procedure 3</u>
	2013-14	<u>TPMS Reset - Procedure 9</u>
	2015	<u>TPMS Reset - Procedure 26</u>
TrailBlazer	2006-07	<u>TPMS Reset - Procedure 1</u>
Traverse	2009-12	<u>TPMS Reset - Procedure 2</u>
	2013-15	<u>TPMS Reset - Procedure 9</u>
Uplander	2008	<u>TPMS Reset - Procedure 3</u>
Volt	2011-12	<u>TPMS Reset - Procedure 11</u>
	2013-14	<u>TPMS Reset - Procedure 30</u>
GMC		
Acadia	2007-11	<u>TPMS Reset - Procedure 3</u>
	2012	<u>TPMS Reset - Procedure 2</u>
	2013-15	<u>TPMS Reset - Procedure 9</u>
Canyon	2006-12	<u>TPMS Reset - Procedure 1</u>
Envoy	2006-09	<u>TPMS Reset - Procedure 1</u>
Savana Series	2008-12	<u>TPMS Reset - Procedure 2</u>
	2013-14	<u>TPMS Reset - Procedure 27</u>
Sierra Series	2006-07	<u>TPMS Reset - Procedure 1</u>
	2008-11	<u>TPMS Reset - Procedure 2</u>

	2012	<u>TPMS Reset - Procedure 3</u>
	2013	<u>TPMS Reset - Procedure 9</u>
	2014-15	<u>TPMS Reset - Procedure 26</u>
Terrain	2010-11	<u>TPMS Reset - Procedure 2</u>
	2012-14	<u>TPMS Reset - Procedure 12</u>
Yukon Series	2004-07	<u>TPMS Reset - Procedure 1</u>
	2008-11	<u>TPMS Reset - Procedure 2</u>
	2012	<u>TPMS Reset - Procedure 3</u>
	2013-14	<u>TPMS Reset - Procedure 9</u>
	2015	<u>TPMS Reset - Procedure 26</u>
Oldsmobile		
Alero	1999-00	(1) <u>TPMS Reset - Procedure 16</u>
Aurora	2001-03	(1) <u>TPMS Reset - Procedure 17</u>
Pontiac		
Aztek	2003-05	(1) <u>TPMS Reset - Procedure 23</u>
Bonneville	2000-05	(1) <u>TPMS Reset - Procedure 15</u>
G3	2009	<u>TPMS Reset - Procedure 2</u>
G5	2008-09	<u>TPMS Reset - Procedure 2</u>
G6	2008-10	<u>TPMS Reset - Procedure 2</u>
G8	2008-09	<u>TPMS Reset - Procedure 2</u>
Grand Am	1999-05	(1) <u>TPMS Reset - Procedure 18</u>
Grand Prix	2008	<u>TPMS Reset - Procedure 2</u>
Solstice	2008-10	<u>TPMS Reset - Procedure 2</u>
Torrent	2008-09	<u>TPMS Reset - Procedure 2</u>
Wave	2008	<u>TPMS Reset - Procedure 2</u>
Vibe	2005-07	(1) <u>TPMS Reset - Procedure 19</u>
(1) This is an Indirect TPM System. A tire sensor activation tool is not required for this procedure.		
(2) A tire sensor activation tool cannot be used for this procedure.		

TPMS RESET - PROCEDURE 1

NOTE: When the wheels have been rotated, or a tire pressure sensor or EGM/LGM has been replaced, retrain tire pressure sensors.

NOTE: The DIC will display the "SERVICE TIRE MONITOR" message if one or more of the tire pressure sensors has malfunctioned or if all of the sensors have not been programmed successfully. If, after the relearn procedure, the warning indicators are still on, there is a problem in the TPM system.

NOTE: If this procedure is performed following replacement and reprogramming of the Liftgate Module (LGM), DIC may display a low tire pressure fault and all tire pressures read 0 psi. If this problem occurs, see appropriate manufacturer service information.

NOTE: The TPM system will cancel the learn mode if more than 2 minutes have passed and no sensors have been learned, or if the system has been in learn mode for more than 5 minutes. If the learn mode is canceled before any sensor has been learned, the EGM/LGM will remember all current sensor IDs and their locations. As soon as the first sensor ID code is learned, all other IDs are erased from the EGM/LGM's memory. On models that display the individual tire pressure on DIC, updated tire pressures will not be displayed until EGM/LGM receives 2 more valid transmissions from each sensor.

NOTE: Before proceeding with the steps below, ensure that no other sensor learn procedure is being performed simultaneously, or that tire pressures are not being adjusted on a TPM equipped vehicle within close proximity.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn ignition ON with engine OFF. Apply parking brake.

NOTE: If Learn Mode cannot be enabled, TPM system is not enabled in EGM/LGM. See appropriate manufacturer service information.

3. To enable Learn Mode, turn headlight switch from OFF to parking lamps 4 times within 4 seconds. A double horn chirp will sound and the low tire pressure indicator will begin to flash to indicate the learn mode has been enabled.
4. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
5. After horn chirp has sounded, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
6. After left rear sensor has been learned, turn ignition switch to OFF position to exit Learn Mode.
7. Test drive the vehicle above 25 mph for at least 2 minutes before viewing tire pressures on DIC.

TPMS RESET - PROCEDURE 2

NOTE: If a tire pressure sensor or the Remote Control Door Lock Receiver (RCDLR) is replaced, or if wheels have been rotated, tire pressure sensor must be retrained.

NOTE: When the tire pressure warning light illuminates and warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning indicators are still on or display shows dashes instead of a value, there is a problem in the TPM system. See appropriate manufacturer service information.

NOTE: Under the following conditions, the TPM system may not function properly:

- If one or more of the tire pressure sensors are missing or inoperable.
- A compact spare tire is used.

NOTE: If a tire pressure sensor or the Remote Control Door Lock Receiver (RCDLR) is replaced, or if wheels have been rotated, tire pressure sensor must be retrained.

NOTE: The relearn procedure must be completed within 15 minutes from when the vehicle is stationary after being driven at 20 mph (32 km/h), or greater, for 10 seconds.

NOTE: The learn mode will cancel if the ignition is cycled to OFF or if more than 2 minutes has elapsed for any sensor that has not been learned. If the learn mode is cancelled before the first sensor is learned, the original sensor IDs will be maintained. If the learn mode is canceled after the first sensor is learned, the following will occur:

- All stored sensor IDs will be invalidated in the RCDLR memory.
- If equipped, the DIC will display dashes instead of tire pressures.
- DTC C0775 will be set.

These conditions will now require the learn procedure to be repeated for the system to function properly.

IMPORTANT: Ensure that no other learn procedure is being performed simultaneously or that tire pressures are not being adjusted on another TPM equipped vehicle within close proximity. Stray signals from other TPM equipped vehicles just driving by can be inadvertently learned. If any random horn chirps are heard from the vehicle while performing the learn procedure, most likely a stray sensor has been learned and the procedure will need to be cancelled and repeated. Under these circumstances, performing the TPM Learn Procedure away from other vehicles would be highly recommended. In the event a particular sensor activation does not cause the horn to chirp, it may be necessary to rotate the wheel valve stem to a different position due to the sensor signal is being blocked by another component.

1. Turn ignition switch to ACC position. Apply parking brake.
2. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
3. To enable Learn Mode:
 - On vehicles equipped with keyless entry, simultaneously press the keyless entry transmitters lock and unlock buttons until a double horn chirp sounds indicating the Learn Mode has been enabled. On vehicles with DIC, a TIRE LEARN message may be displayed. The left front turn signal will

also be illuminated.

- On vehicles not equipped with keyless entry, press and release the driver information center (DIC) INFO button until the TIRE LEARN message appears on the DIC display. Press and hold the SET/RESET button until a double horn chirp sounds indicating the Learn Mode has been enabled. The left front turn signal will also be illuminated.

4. Ignition ON.
5. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
6. After horn chirp has sounded, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
7. After left rear sensor has been learned, turn ignition switch to OFF position to exit Learn Mode.

TPMS RESET - PROCEDURE 3

NOTE: If a tire pressure sensor or the Remote Control Door Lock Receiver (RCDLR) is replaced, or if wheels have been rotated, tire pressure sensor must be relearned.

NOTE: When the tire pressure warning light illuminates and warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning indicators are still on or display shows dashes instead of a value, there is a problem in the TPM system. See appropriate manufacturer service information.

NOTE: In vehicles without the "UH3" option, each turn signal will illuminate one at a time indicating which location is to be learn.

NOTE: The TPM system will cancel the learn mode if more than 2 minutes have passed and no sensors have been learned, or if the ignition switch is turn to the OFF position. If the learn mode is canceled before the first ID is learned, the RCDLR will remember all previously stored IDs and their locations. As soon as the first sensor ID is learned, all other IDs are erased from the RCDLR's memory. If the learn mode is canceled after the first ID is learned, the RCDLR will store the IDs as invalid and the DIC will display dashes instead of tire pressures.

NOTE: Before proceeding with the registration procedure, ensure that no other sensor learn procedure is being performed simultaneously, or that no tire pressures are being adjusted on another TPM equipped vehicle within close proximity.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn ignition switch to ACC position. Apply parking brake.
3. Simultaneously press the keyless entry transmitter's lock and unlock buttons until a double horn chirp sounds, indicating the Learn Mode has been enabled.

NOTE: The left front turn signal will also illuminate to indicate the learn mode has been enabled.

4. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
5. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
6. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS RESET - PROCEDURE 4

NOTE: If the wheels have been rotated, or tire pressure sensor or Remote Control Door Lock Receiver (RCDLR) is replaced, the TPM system needs to relearn tire pressure sensor IDs.

NOTE: When the tire pressure warning light illuminates and warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning indicators are still on, there is a problem in the TPM system. See appropriate manufacturer service information.

NOTE: The TPM system will cancel Learn Mode if ignition is turned off, if more than 1 or 2 minutes has passed and no sensors have been learned, vehicle battery voltage is less than 8 volts, all 4 sensors have been learned, or if the RCDLR has been in Learn Mode for more than 5 minutes. If Learn Mode is cancelled before any IDs are learned, the RCDLR will remember all previously stored IDs and their locations. As soon as the first sensor ID is learned, all other IDs are erased from the RCDLR's memory.

NOTE: Before proceeding with the registration procedure, ensure that no other sensor learn procedure is being performed simultaneously, or that no tire pressures are being adjusted on another TPM equipped vehicle within close proximity.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn ignition ON with engine OFF.

NOTE: If the TPM Learn Mode cannot be enabled, ensure the TPM option is enabled in the RCDLR. See appropriate manufacturer service information.

3. Simultaneously press the keyless entry transmitter's lock and unlock buttons until a horn chirp sounds, indicating Learn Mode has been enabled.

NOTE: If a horn chirp does not sound after 15 seconds, remove, then re-apply TPM sensor relearn magnet.

4. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
5. After the horn chirp sounds, proceed to the next 3 sensors in the following order: right front, right rear, then left rear.
6. After the left rear sensor ID is learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn the ignition switch to OFF position to exit Learn Mode.

TPMS RESET - PROCEDURE 5

NOTE: If the wheels have been rotated, or tire pressure sensor or Remote Control Door Lock Receiver (RCDLR) is replaced, the TPM system needs to relearn tire pressure sensor IDs.

NOTE: When the tire pressure warning light illuminates and warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning indicators are still on, there is a problem in the TPM system. See appropriate manufacturer service information.

NOTE: The TPM system will cancel Learn Mode if ignition is turned off, if more than 1 or 2 minutes has passed and no sensors have been learned, vehicle battery voltage is less than 8 volts, all 4 sensors have been learned, or if the RCDLR has been in Learn Mode for more than 5 minutes. If Learn Mode is cancelled before any IDs are learned, the RCDLR will remember all previously stored IDs and their locations. As soon as the first sensor ID is learned, all other IDs are erased from the RCDLR's memory.

NOTE: Before proceeding with the registration procedure, ensure that no other sensor learn procedure is being performed simultaneously, or that no tire pressures are being adjusted on another TPM equipped vehicle within close proximity.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn ignition ON with engine OFF.
3. Simultaneously press the keyless entry transmitter's lock and unlock buttons until a horn chirp sounds, indicating Learn Mode has been enabled.
4. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
5. After the horn chirp sounds, proceed to the next 3 sensors in the following order: right front, right rear, then left rear.
6. After the left rear sensor ID is learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn the ignition switch to OFF position to exit Learn Mode.

TPMS RESET - PROCEDURE 6

NOTE: If the wheels have been rotated, or tire pressure sensor or Remote Control Door

Lock Receiver (RCDLR) is replaced, the TPM system needs to relearn tire pressure sensor IDs.

NOTE: When the tire pressure warning light illuminates and warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning indicators are still on, there is a problem in the TPM system. See appropriate manufacturer service information.

NOTE: The TPM system will cancel Learn Mode if ignition is turned off, if more than 1 or 2 minutes has passed and no sensors have been learned, vehicle battery voltage is less than 8 volts, all 4 sensors have been learned, or if the RCDLR has been in Learn Mode for more than 5 minutes. If Learn Mode is cancelled before any IDs are learned, the RCDLR will remember all previously stored IDs and their locations. As soon as the first sensor ID is learned, all other IDs are erased from the RCDLR's memory.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn ignition ON with engine OFF.
3. Press RESET button on DIC in order to clear any warning messages.
4. Press and release OPTIONS button until display is blank.
5. Press and hold RESET button for 3 seconds.

NOTE: If the DIC does not display "TIRE TRAINING" message, ensure TPM option is enabled in the RCDLR. See appropriate manufacturer service information.

6. Press and release OPTIONS button until "TIRE TRAINING" is displayed.
7. Press and release RESET button. The DIC should display "LEARN L FRONT TIRE", verifying Learn Mode has been enabled.
8. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
9. After the horn chirp sounds, proceed to the next 3 sensors in the following order: right front, right rear, then left rear.
10. Turn the ignition switch to OFF position to exit the learn mode.

TPMS RESET - PROCEDURE 7

NOTE: An OEM scan tool or Pressure Increase/Decrease Method is used to perform this procedure.

NOTE: Before proceeding with this process, ensure that no other learn procedure is being performed simultaneously or that tire pressures are not being adjusted on another TPM equipped vehicle within close proximity. Stray signals from

other TPM equipped vehicles just driving by can be inadvertently learned. If any random horn chirps are heard from the vehicle while performing the learn procedure, most likely a stray sensor has been learned and the procedure will need to be cancelled and repeated. Under these circumstances, performing the TPM Learn Procedure away from other vehicles would be highly recommended. In the event a particular sensor activation does not cause the horn to chirp, it may be necessary to rotate the wheel valve stem to a different position due to the sensor signal is being blocked by another component.

1. Ignition ON with engine OFF, apply the parking brake.
2. Using a scan tool, initiate the TPM Learn Mode.
3. Perform the procedure by following the menu selections. A double horn chirp will sound and the IPC tire pressure monitor indicator warning lamp icon will flash indicating Learn Mode is enabled.
4. Starting with the left front tire, active the sensors by one of the following methods:
 - Hold the antenna of the scan tool, aimed upward, against the tire sidewall close to the wheel rim at the valve stem location. Press and release the activate button and wait for a horn chirp. Once the horn chirp has sounded, the sensor information is learned.
 - Increase/decrease the tire pressure for 8-10 seconds then wait for a horn chirp. The horn chirp may occur before or up to 30 seconds after the 8-10 second pressure increase/decrease time period has been reached. Once the horn chirp has sounded, the sensor information has been learned.
5. After the horn chirp has sounded, repeat step 4 for the remaining 3 sensors in the following order: Right front, Right rear, Left rear.
6. After the left rear sensor is learned, a double horn chirp will sound indicating all sensor IDs have been learned and the tire pressure module will exit the Learn mode turning OFF the IPC tire pressure monitor warning indicator lamp icon.
7. Ignition OFF, adjust all tires to the recommended pressures. Refer to the tire placard label.

TPMS RESET - PROCEDURE 8

Automatic Sensor Learn Process

Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the tires or replacing one or more of the TPMS sensors. When a tire is installed, the vehicle must be stationary for about 20 minutes before the system recalculates. The following relearn process takes up to 10 minutes, driving at a minimum speed of 12 mph (19 km/h). A dash (-) or pressure value will display in the DIC. A warning message displays in the DIC if a problem occurs during the relearn process.

TPMS RESET - PROCEDURE 9

NOTE: If a tire pressure sensor or the Remote Control Door Lock Receiver (RCDLR) is replaced, or if wheels have been rotated, tire pressure sensor must be relearned.

NOTE: When the tire pressure warning light illuminates and warning message appears

on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning indicators are still on or display shows dashes instead of a value, there is a problem in the TPM system. See appropriate manufacturer service information.

NOTE: The TPM system will cancel the learn mode if more than 2 minutes have passed and no sensors have been learned, or if the ignition switch is turned to the OFF position. If the learn mode is canceled before the first ID is learned, the RCDLR will remember all previously stored IDs and their locations. As soon as the first sensor ID is learned, all other IDs are erased from the RCDLR's memory. If the learn mode is canceled after the first ID is learned, the RCDLR will store the IDs as invalid and the DIC will display dashes instead of tire pressures.

NOTE: Before proceeding with the registration procedure, ensure that no other sensor learn procedure is being performed simultaneously, or that no tire pressures are being adjusted on another TPM equipped vehicle within close proximity.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn ignition switch to RUN position. Apply parking brake.
3. Simultaneously press the keyless entry transmitter's lock and unlock buttons until a double horn chirp sounds, indicating the Learn Mode has been enabled.
4. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
5. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
6. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS RESET - PROCEDURE 10

NOTE: If a tire pressure sensor or the Remote Control Door Lock Receiver (RCDLR) is replaced, or if wheels have been rotated, tire pressure sensor must be relearned.

NOTE: When the tire pressure warning light illuminates and warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning indicators are still on or display shows dashes instead of a value, there is a problem in the TPM system. See appropriate manufacturer service information.

NOTE: The TPM system will cancel the learn mode if more than 2 minutes have passed and no sensors have been learned, or if the ignition switch is turned to the OFF position. If the learn mode is canceled before the first ID is learned, the RCDLR will remember all previously stored IDs and their locations. As soon as the first

sensor ID is learned, all other IDs are erased from the RCDLR's memory. If the learn mode is canceled after the first ID is learned, the RCDLR will store the IDs as invalid and the DIC will display dashes instead of tire pressures.

NOTE: Before proceeding with the registration procedure, ensure that no other sensor learn procedure is being performed simultaneously, or that no tire pressures are being adjusted on another TPM equipped vehicle within close proximity.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Depending on ignition type:
 - With standard ignition switch, place the switch in the RUN position.
 - With electronic keyless ignition, place the switch in the ACC position.
3. Simultaneously press the keyless entry transmitter's lock and unlock buttons until a double horn chirp sounds, indicating the Learn Mode has been enabled.
4. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
5. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
6. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS RESET - PROCEDURE 11

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Place the vehicle power mode in ON/RUN/START.
4. Make sure the Tire Pressure info display option is turned on. The info displays on the DIC can be turned on and off through the Settings menu.
5. Use the five-way DIC control on the right side of the steering wheel to scroll to the Tire Pressure screen under the DIC info page.
6. Press and hold the SEL button located in the center of the five-way DIC control. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen
7. Start with the driver side front tire. Place a tire sensor activation tool against the tire sidewall, near the valve stem. Then press the button to activate the TPMS sensor. A horn chirp confirms that the sensor identification code has been matched to this tire and wheel position.
8. After horn chirp has sounded, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
9. After left rear sensor has been learned, the horn sounds two times to indicate the sensor identification code has been matched to the driver side rear tire, and the TPMS sensor matching process is no longer active. The TIRE LEARNING ACTIVE message on the DIC display screen goes off.
10. Press STOP to turn the ignition off.

TPMS RESET - PROCEDURE 12

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Turn the ignition to ON/RUN with the engine off.
4. Use the MENU button (center console) to select the Vehicle Information Menu in the Driver Information Center (DIC). Use the arrow keys to scroll to the Tire Pressure screen
5. Press the SET/CLR button to begin the sensor matching process. A message requesting acceptance of the process should display.
6. Press the SET/CLR button again to confirm the selection. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
7. Start with the driver side front tire. Place a tire sensor activation tool against the tire sidewall, near the valve stem. Then press the button to activate the TPMS sensor. A horn chirp confirms that the sensor identification code has been matched to this tire and wheel position.
8. After horn chirp has sounded, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
9. After left rear sensor has been learned, the horn sounds two times to indicate the sensor identification code has been matched to the driver side rear tire, and the TPMS sensor matching process is no longer active. The TIRE LEARNING ACTIVE message on the DIC display screen goes off.
10. Turn the ignition to LOCK/OFF.

TPMS RESET - PROCEDURE 13

LOW TIRE PRESSURE light comes on if air pressure in one tire drops to 12 psi (kPa) less than the other 3 tires, if tires are rotated, if tire(s) are repaired or replaced, if air pressure is adjusted or when vehicle battery is disconnected. Light will stay on until ignition is turned off or RESET button is pressed. Check and adjust air pressure in all 4 tires before resetting system.

1. There are 2 ways to reset the tire inflation monitor. To reset the tire inflation monitor using the exterior or interior lamp controls, go to step 4. To reset tire inflation monitor using the radio, turn the radio off. Turn ignition to ACC or ON, with the engine OFF. Press and hold the TUNE DISP button on the radio for at least 5 seconds until settings is displayed.
2. To scroll through the main menu:
 - On Impala, press the SEEK PTYPE up or down arrow.
 - On Monte Carlo, press the SEEK PSCAN up or down arrow.On all models, scroll until TIRE MON appears on the display. Press the 1 PREV or 2 NEXT button to enter the sub-menu. RESET will be displayed.
3. Press the TUNE DISP button to reset. A chime will sound to verify the new setting and DONE will be displayed for one second. Once the message has been reset, scroll through the menu until EXIT appears on the display. Press the TUNE DISP button to exit the program. A chime will sound to verify the exit.
4. Reset the tire inflation monitor:
 - On Impala, using the interior lighting controls, turn the switch from OFF to ON position 3 times with ignition switch in ON position.

- On Monte Carlo, using the exterior lighting controls, turn the switch from OFF to parking lamps 3 times with ignition switch in ON position.

TPMS RESET - PROCEDURE 14

NOTE: There are 3 different ways to reset the Tire Pressure Monitor (TPM) system. After resetting, the TPM system requires up to 30 minutes of straight line driving in each of the 3 speed ranges to complete the calibration process.

Using Exterior Lamp Switch

1. Adjust all tire pressures to the recommended kPa/psi.
2. Turn ignition ON with engine OFF.
3. Cycle the exterior lamp switch from OFF to parking lamps 3 times within 5 seconds.
4. Use the scan tool in order to clear the TPM DTC.

Using RDS Radio, If Equipped

1. Adjust all tire pressures to the recommended kPa/psi.
2. Turn the ignition to ACC or ON, with the engine OFF.
3. Turn the radio OFF.
4. Press and hold the DISP button until SETTINGS is displayed.
5. Press the SEEK up or down arrows until TIRE MON is displayed.
6. Press the PREV or NEXT button to enter the sub-menu. RESET will be displayed.
7. Press the DISP button, A chime will sound and DONE will be displayed.
8. Scroll until EXIT is displayed.
9. Press the DISP button to exit the TPM reset mode. A chime will sound to verify exit.
10. Use the scan tool in order to clear the TPM DTC.

Using Scan Tool

1. Adjust all tire pressures to the recommended kPa/psi.
2. Install the scan tool.
3. Turn ignition ON with engine OFF.
4. With the scan tool select Special Functions.
5. Select TIM Reset.
6. Press the Reset soft key.
7. Use the scan tool in order to clear the TPM DTC.

TPMS RESET - PROCEDURE 15

CHECK TIRE PRESSURE or TIRE PRESS message will come on if air pressure in one tire is lower than the

other 3 tires, if tires are rotated, if tire(s) are repaired or replaced, or if air pressure is adjusted. Message will stay on until system is recalibrated. Check and adjust air pressure in all 4 tires before recalibrating system.

NOTE: If vehicle is equipped with Systems Monitor, go to step 2.

1. To recalibrate vehicle equipped with Driver Information Center (DIC), turn ignition ON with engine OFF. Using the MODE and SELECT button on DIC, change display until TIRE PRESSURE appears. Press and hold RESET button for 5 seconds. TIRE PRESSURE RESET should now appear on display. If TIRE PRESSURE RESET does not appear on display after 5 seconds, repair system as necessary. Using a scan tool, clear TPM DTC.
2. To recalibrate vehicle equipped with Systems Monitor, turn ignition ON with engine OFF. Press and hold TIRE PRESS RESET button for 5 seconds. TIRE PRESS light on the Systems Monitor should begin to flash. Release the TIRE PRESS RESET button. TIRE PRESS light should go out and system is now reset. If TIRE PRESS light does not begin to flash after 5 seconds, repair system as necessary. Using a scan tool, clear TPM DTC.

TPMS RESET - PROCEDURE 16

CHECK TIRE PRESSURE light comes on if air pressure in one tire drops to 12 psi (kPa) less than the other 3 tires, if tires are rotated, if tire(s) are repaired or replaced, or if air pressure is adjusted. Light will stay on until ignition is turned off or RESET button is pressed. Check and adjust air pressure in all 4 tires before resetting system.

1. To reset tire inflation monitor, turn ignition ON with engine OFF. Press and release the RESET button. RESET button is located inside of driver's side instrument panel fuse block (left end of instrument panel). The CHANGE OIL indicator light will begin to flash.
2. Press and release the RESET button again. The CHANGE OIL indicator light will turn off, and the CHECK TIRE PRESSURE indicator light will begin to flash. While the CHECK TIRE PRESSURE indicator light is flashing, press and hold the RESET button until the chime sounds indicating system is reset. If CHECK TIRE PRESSURE light does not go out, repeat reset procedure. If system still will not reset, repair system as necessary.

TPMS RESET - PROCEDURE 17

NOTE: When a spare tire is mounted, a wheel is replaced or rotated, or tire pressure has been adjusted, TPM system will need to be recalibrated.

NOTE: When the low tire pressure warning messages appear, immediately check air pressure of all tires and adjust to the specified pressure. If warning messages are still displayed, there is a malfunction in the TPM system. See appropriate manufacturer service information.

NOTE: Under the following conditions, the system may not function properly:

- More than one tire is low.

- Only one tire is replaced with a new tire during service.
- Vehicle is moving faster than 65 mph (105 km/h).
- The system is not yet calibrated.
- Tire treadwear is uneven.
- Compact spare tire is installed.
- Tire chains are being used.
- Vehicle is being driven on a rough or frozen road.
- If ABS warning light is on.

CAUTION: DO NOT recalibrate TPM system until all problems are fixed and tire pressure in all 4 tires has been adjusted. If recalibration is done when tire pressures are incorrect, TPM system will not work properly and may not set an alert when a tire pressure is low or high.

NOTE: There are 2 ways to recalibrate the Tire Pressure Monitor (TPM) system:

- *Using DIC Reset Button* (if no scan tool is available)
- *Using Scan Tool* (if an OBD-II compatible scan tool is available).

Using DIC Reset Button

1. Turn ignition switch to OFF position.
2. Ensure all tire pressures are adjusted to the pressure recommended on tire pressure label.
3. Turn ignition ON with engine OFF.
4. Press SELECT right arrow button until "GAGE" is displayed.
5. Press SELECT down arrow button until "TIRE PRESSURE" is displayed.
6. Press and hold RESET button until "TIRE PRESSURE RESET" is displayed.
7. Release RESET button. DIC should display "TIRE PRESSURE NORMAL".
8. After resetting, the TPM system requires up to 30 minutes of straight line driving in each of the following speed ranges to complete calibration process:
 - 15-40 mph (24-64 km/h).
 - 40-70 mph (64-113 km/h).
 - 70-90 mph (113-145 km/h).

NOTE: The EBCM learns tire pressure calibration for each speed range independently. In Monitor Mode 1, EBCM has only partially learned tire pressure calibration for speed range and has limited detection capability for a tire pressure condition. In Monitor Mode 2, EBCM has fully learned tire pressure calibration for speed range and has full detection capability for a tire pressure condition.

NOTE: Learning process does not need to be completed during a single trip.

Using Scan Tool

1. Turn ignition switch to OFF position.
2. Ensure all tire pressures are adjusted to the pressure recommended on tire pressure label.
3. Connect scan tool. Turn ignition ON with engine OFF.
4. Using scan tool, select "SPECIAL FUNCTIONS".
5. Select "TIRE PRESSURE RESET".
6. Press RESET soft key. A "TIRE PRESSURE NORMAL" message should appear on display.
7. If necessary, use scan tool to clear any TPM Diagnostic Trouble Codes (DTCs).
8. After resetting, the TPM system requires up to 30 minutes of straight line driving in each of the following speed ranges to complete calibration process:
 - 15-40 mph (24-64 km/h).
 - 40-70 mph (64-113 km/h).
 - 70-90 mph (113-145 km/h).

NOTE: The EBCM learns tire pressure calibration for each speed range independently. In Monitor Mode 1, EBCM has only partially learned tire pressure calibration for speed range and has limited detection capability for a tire pressure condition. In Monitor Mode 2, EBCM has fully learned tire pressure calibration for speed range and has full detection capability for a tire pressure condition.

NOTE: Learning process does not need to be completed during a single trip.

TPMS RESET - PROCEDURE 18

The Tire Pressure Monitor (TPM) system alerts the driver when a large change in the pressure of one tire exists, while the vehicle is being driven. The TPM system uses the Electronic Brake Control Module (EBCM), ABS wheel speed sensor inputs, class 2 serial data circuit, and the Driver Information Center (DIC) to perform the system functions. The EBCM contains software to calculate relative tire pressure differences. The software requires approximately 30 minutes of straight line driving in 3 different speed ranges to complete the calibration process to have full capability for detecting a tire pressure condition. The speed ranges are 15-40 mph, 40-70 mph and 70-90 mph.

1. LOW TIRE PRESSURE light comes on if air pressure in one tire drops to 12 psi less than the other 3 tires, if tires are rotated, if tire(s) are repaired or replaced, if air pressure is adjusted or if vehicle battery is disconnected. Light will stay on until ignition is turned off or RESET button is pressed. Check and adjust air pressure in all 4 tires before resetting system.
2. To reset tire inflation monitor, turn ignition ON with engine OFF. Press and release the RESET button. RESET button is located inside of driver's side instrument panel fuse block (left end of instrument panel). The CHANGE OIL indicator light will begin to flash.
3. Press and release the RESET button again. The CHANGE OIL indicator light will turn off, and the LOW

TIRE PRESSURE indicator light will begin to flash. While the LOW TIRE PRESSURE indicator light is flashing, press and hold the RESET button until the chime sounds indicating system is reset. If the LOW TIRE PRESSURE indicator light does not go out, repeat reset procedure. If system still will not reset, repair system as necessary.

TPMS RESET - PROCEDURE 19

NOTE: After resetting, the tire pressure monitoring (TPM) system requires 60 minutes or more of driving at a speed of 30 km/h (19 mph) or above to complete the calibration process to have full capability for detecting a tire pressure condition.

1. Adjust all tire pressures to the recommended kPa/psi.
2. Turn ignition ON with engine OFF.
3. Press and hold the tire pressure warning reset switch until the tire pressure warning indicator blinks 3 times at one second intervals.
4. If the tire pressure warning indicator does not blink, repeat the procedure starting at step 2.
5. Drive the vehicle for 60 minutes or more at a speed of 30 km/h (19 mph).
6. Verify the system has initialized. Turn ignition ON with engine OFF and observe the tire pressure warning indicator.
 - System Initialized: light on for 3 seconds.
 - System not initialized: light on for 4 seconds.

TPMS RESET - PROCEDURE 20

NOTE: When a spare tire is mounted, a wheel is replaced or rotated, or tire pressure has been adjusted, TPM system will need to be recalibrated.

CAUTION: DO NOT recalibrate TPM system until all problems are fixed and tire pressure in all 4 tires has been adjusted. If recalibration is done when tire pressures are incorrect, TPM system will not work properly and may not set an alert when a tire pressure is low or high.

NOTE: When the tire pressure warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning message is still displayed, there is a malfunction in the TPM system. See appropriate manufacturer service information.

NOTE: Under the following conditions, the system may not function properly:

- More than one tire is low.
- Vehicle is moving faster than 65 mph (105 km/h).
- The system is not yet calibrated.

- Tire treadwear is uneven.
- Compact spare tire is installed.
- Tire chains are being used.
- Vehicle is being driven on a rough or frozen road.
- If ABS warning light is on.

NOTE: There are 2 ways to recalibrate the Tire Pressure Monitor (TPM) system:

- *Using DIC Reset Button* (if no scan tool is available)
- *Using Scan Tool* (if an OBD-II compatible scan tool is available).

Using DIC Reset Button

1. Turn ignition switch to OFF position.
2. Ensure all tire pressures are adjusted to the pressure recommended on tire pressure label.
3. Turn ignition ON with engine OFF.
4. Press and hold appropriate button (located on left side of steering column) until "TIRE PRESSURE" message appears on display:
 - 1997-99 models: Press and hold GAGES button
 - 2000-05 models: Press and hold GAGES INFO button
5. Press and hold RESET button for 5 seconds. After 5 seconds, "TIRE PRESSURE RESET" message should appear on display.
6. Release RESET button. A "TIRE PRESSURE NORMAL" message should appear on display.
7. After resetting, the TPM system requires up to 30 minutes of straight line driving in each of the following speed ranges to complete calibration process:
 - 15-40 mph (24-64 km/h).
 - 40-70 mph (64-113 km/h).
 - 70-90 mph (113-145 km/h).

NOTE: The EBCM learns tire pressure calibration for each speed range independently. In Monitor Mode 1, EBCM has only partially learned tire pressure calibration for speed range and has limited detection capability for a tire pressure condition. In Monitor Mode 2, EBCM has fully learned tire pressure calibration for speed range and has full detection capability for a tire pressure condition.

NOTE: Learning process does not need to be completed during a single trip.

Using Scan Tool

1. Turn ignition switch to OFF position.
2. Ensure all tire pressures are adjusted to the pressure recommended on tire pressure label.

3. Connect scan tool. Turn ignition ON with engine OFF.
4. Using scan tool, select SPECIAL FUNCTIONS.
5. Select TIM RESET.
6. Press RESET soft key. A "TIRE PRESSURE NORMAL" message should appear on display.
7. If necessary, use scan tool to clear any TPM Diagnostic Trouble Codes (DTCs).
8. After resetting, the TPM system requires up to 30 minutes of straight line driving in each of the following speed ranges to complete calibration process:
 - 15-40 mph (24-64 km/h).
 - 40-70 mph (64-113 km/h).
 - 70-90 mph (113-145 km/h).

NOTE: The EBCM learns tire pressure calibration for each speed range independently. In Monitor Mode 1, EBCM has only partially learned tire pressure calibration for speed range and has limited detection capability for a tire pressure condition. In Monitor Mode 2, EBCM has fully learned tire pressure calibration for speed range and has full detection capability for a tire pressure condition.

NOTE: Learning process does not need to be completed during a single trip.

TPMS RESET - PROCEDURE 21

Using Reset Button (1999-05 Models)

1. Adjust all tire pressures to the recommended Psi (kPa). See vehicle's Loading Information Label for recommended tire pressure. Turn ignition ON with engine OFF.
2. Press and hold the red RESET button located in the passenger side instrument panel fuse block.
3. The LOW TIRE indicator will flash 3 times, then turn off.
4. Use scan tool to clear the TPM DTC.

Using Scan Tool (2003-05 Models)

1. Adjust all tire pressures to the recommended Psi (kPa). See vehicle's Loading Information Label for recommended tire pressure. Turn ignition ON with engine OFF.
2. Install scan tool. Turn ignition ON with engine OFF.
3. With scan tool, select Special Functions.
4. Select TIM Reset.
5. Press Reset soft key.
6. LOW TIRE indicator will flash 3 times, then turn OFF.
7. Clear the TPM DTC.

TPMS RESET - PROCEDURE 22

NOTE: When a spare tire is mounted, a wheel is replaced or rotated, or tire pressure has been adjusted, TPM system will need to be recalibrated.

CAUTION: DO NOT recalibrate TPM system until all problems are fixed and tire pressure in all 4 tires has been adjusted. If recalibration is done when tire pressures are incorrect, TPM system will not work properly and may not set an alert when a tire pressure is low or high.

1. Turn ignition switch to OFF position.
2. Ensure all tire pressures are adjusted to the pressure recommended on tire pressure label.
3. Turn ignition ON with engine OFF.
4. Press and hold the MODE button until DIC display reads "LOW TIRE PRESSURE HOLD SET TO RESET".
5. Press and hold SET button chime sounds and "TIRE PRESSURE RESET" is displayed and a chime sounds 3 times.
6. Release SET button and DIC will display "TIRE PRESSURE NORMAL".

NOTE: If low tire pressure warning message is still set, TPM system has not reset. Repeat procedure. If it does not work after two tries, refer to appropriate service information.

7. After resetting, the TPM system requires up to 5 miles of driving in each of the following speed ranges to complete the calibration process:
 - 25-40 mph (40-64 km/h).
 - 40-60 mph (65-96 km/h).
 - 60-85 mph (96-136 km/h).

NOTE: Learning process does not need to be completed during a single trip.

TPMS RESET - PROCEDURE 23

1. Check and adjust air pressure in all 4 tires before resetting system. Refer to tire placard located on the inside edge of the driver's door. Turn ignition ON, with engine OFF.
2. Press the MODE button on the Driver Information System until LOW TIRE PRESSURE HOLD SET TO RESET is displayed.
3. Press and hold the SET button until a chime sounds and TIRE PRESSURE RESET is displayed and a chime sounds 3 times.
4. Release the SET button and TIRE PRESSURE NORMAL will be displayed.

TPMS RESET - PROCEDURE 24

NOTE: When a spare tire is mounted, a wheel is replaced or rotated, or tire pressure has been adjusted, TPM system will need to be recalibrated.

CAUTION: DO NOT recalibrate TPM system until all problems are fixed and tire pressure in all 4 tires has been adjusted. If recalibration is done when tire pressures are incorrect, TPM system will not work properly and may not set an alert when a tire pressure is low or high.

1. Turn ignition switch to OFF position.
2. Ensure all tire pressures are adjusted to the pressure recommended on tire pressure label.
3. Turn ignition ON with engine OFF.
4. Press and hold the MODE button until DIC display reads "LOW TIRE PRESSURE HOLD SET TO RESET".
5. Press and hold SET button until a chime sounds and "TIRE PRESSURE RESET" is displayed.
6. System will now sound a chime 3 times, and DIC will display "TIRE PRESSURE NORMAL".

NOTE: If low tire pressure warning message is still set, TPM system has not reset. Repeat procedure.

7. After resetting, the TPM system requires up to 5 miles (8 km) of flat, smooth road, straight line driving in each of the 4 speed ranges (about 10-20 minutes in each range) to complete the calibration process:
 - 19-40 mph (31-65 km/h).
 - 40-59 mph (65-95 km/h).
 - 59-74.5 mph (95-120 km/h).
 - 74.5-90 mph (120-145 km/h).

NOTE: The EBCM learns tire pressure calibration for each speed range independently. In Calibration Mode, EBCM has only partially learned tire pressure calibration for speed range and has limited detection capability for a tire pressure condition. In Detection Mode, EBCM has fully learned tire pressure calibration for speed range and has full detection capability for a tire pressure condition.

NOTE: Learning process does not need to be completed during a single trip.

TPMS RESET - PROCEDURE 25

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Turn the ignition to ON/ RUN with the engine OFF or place the vehicle power mode in ON/ RUN/ START. See **Fig. 4**.
4. Use the MENU button to select the VEHICLE INFORMATION MENU in the Driver Information Center (DIC). See **Fig. 5**.
5. Use the thumbwheel (or up and down arrows) to scroll to the TIRE PRESSURE MENU item screen.
6. Press the SET/CLR button to begin the sensor matching process. A message requesting acceptance of the

process should display.

7. Press the SET/CLR button again to confirm the selection. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
8. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
9. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
10. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

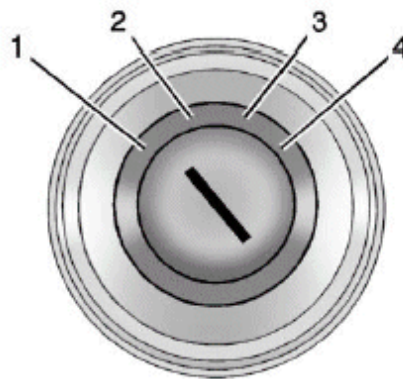
Ignition Positions

Keyless Access



Pressing the button cycles it through three modes: ACC/ACCESSORY, ON/RUN/START, and Stopping the Engine/OFF.

Key Access



The ignition switch has four different positions.

Fig. 4: Ignition Positions (Key & Keyless)
Courtesy of GENERAL MOTORS CORP.

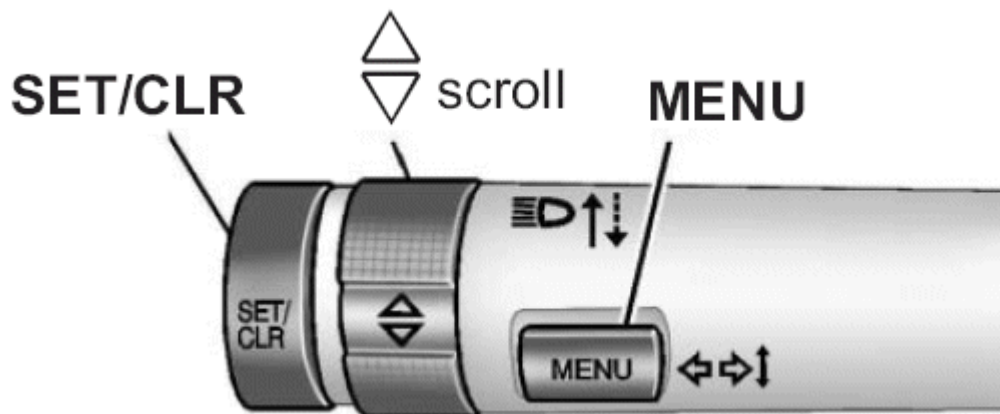


Fig. 5: Identifying DIC Controls (Turn Signal Lever)

Courtesy of GENERAL MOTORS CORP.

TPMS RESET - PROCEDURE 26

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Turn the ignition to ON/RUN with the engine OFF.
4. Up-level Driver Information Center (DIC) Only: Make sure the TIRE PRESSURE INFO page option is turned on. The info pages on the DIC can be turned on and off through the SETTINGS menu.
5. If the vehicle has an up-level DIC, use the DIC controls (arrow buttons) on the right side of the steering wheel to scroll to the TIRE PRESSURE screen under the DIC info page. If the vehicle has a base-level DIC, use the TRIP ODOMETER RESET stem to scroll to the TIRE PRESSURE screen.
6. If the vehicle has an up-level DIC, press and hold the SET/RESET button (check-mark symbol) located in the center of the DIC controls. If the vehicle has a base-level DIC, press and hold the TRIP ODOMETER RESET stem for about five seconds. A message asking if the process should begin should appear. Select YES and press the TRIP ODOMETER RESET stem to confirm the selection.
7. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
8. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
9. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
10. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS RESET - PROCEDURE 27

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn ignition switch to ON/RUN position, with engine OFF.
3. Simultaneously press the keyless entry transmitter's lock and unlock buttons until a horn chirp sounds, indicating Learn Mode has been enabled. The TIRE LEARNING ACTIVE message displays on the DIC screen.

NOTE: If the vehicle does not have RKE, press the Driver Information Center (DIC) vehicle information button until the PRESS (check mark symbol) TO RELEARN TIRE POSITIONS message displays. The horn sounds twice to signal the receiver is in relearn mode and TIRE LEARNING ACTIVE message displays on the DIC screen. If the vehicle does not have RKE or DIC buttons, press the trip odometer reset stem on the instrument cluster until the PRESS (check mark symbol) TO RELEARN TIRE POSITIONS message displays. The horn sounds twice to signal the receiver is in relearn mode and TIRE LEARNING ACTIVE message displays on the DIC screen.

4. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
5. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
6. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS RESET - PROCEDURE 28

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Turn the ignition to ON/ RUN with the engine OFF or place the vehicle power mode in ON/ RUN/ START. See **Fig. 4**.
4. Make sure the Tire Pressure info page option is turned on. The info pages on the Driver Information Center (DIC) can be turned on and off through the Settings menu.
5. Use the DIC controls on the right side of the steering wheel to scroll to the Tire Pressure screen under the DIC info page.
6. Press and hold the SET/RESET button (check mark symbol) located in the center of the DIC controls.
7. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
8. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
9. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
10. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS RESET - PROCEDURE 29

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Turn the ignition to ON/RUN with the engine OFF.
4. Press the MENU button once on the Driver Information Center (DIC).
5. Press the up or down arrow button until the Tire Learn screen is displayed.
6. Press and hold the SET/CLR button to begin the sensor matching process.
7. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
8. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
9. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
10. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have

been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS RESET - PROCEDURE 30

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Put the vehicle in ON/ RUN and place the vehicle in P (Park).
4. If the Driver Information Center (DIC) display is minimized, press the SELECT knob to maximize it.
5. Use the SELECT knob to scroll to the Tire Pressure display screen.
6. Press and hold the SELECT knob for five seconds to begin the sensor matching process. A message displays confirming to begin the process.
7. Use the SELECT knob to select YES with the highlighted selection, and press the SELECT knob again to confirm the selection.
8. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
9. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
10. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
11. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS RESET - PROCEDURE 31

NOTE: **You have two minutes to match the first tire/wheel position, and five minutes overall to match all four tire/wheel positions. If it takes longer, the matching process stops and must be restarted.**

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Turn the ignition to ON/RUN with the engine off.
4. Enter the learn sequence from the TPM Learn screen, located under the Customization Menu in the instrument panel cluster. Press SRCE button until you see Customize Options and then press ENTER (left pointing arrow). Move the thumbwheel up or down to scroll through the available options. Press ENTER to select an item. To exit the current menu, or go back, use the thumbwheel to select BACK (left arrow) at the top of the screen and then press ENTER.
5. Start with the driver side front tire. The driver side front indicator lamp also comes on to indicate that corner's sensor is ready to be learned. Place a tire sensor activation tool against the tire sidewall, near the valve stem. Then press the button to activate the TPMS sensor. A horn chirp confirms that the sensor identification code has been matched to this tire and wheel position
6. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
7. After the driver side rear TPMS sensor has been learned the horn chirps two times. The driver side rear

indicator lamp turns off and the TPMS sensor matching process is done. Turn the ignition switch to LOCK/OFF.

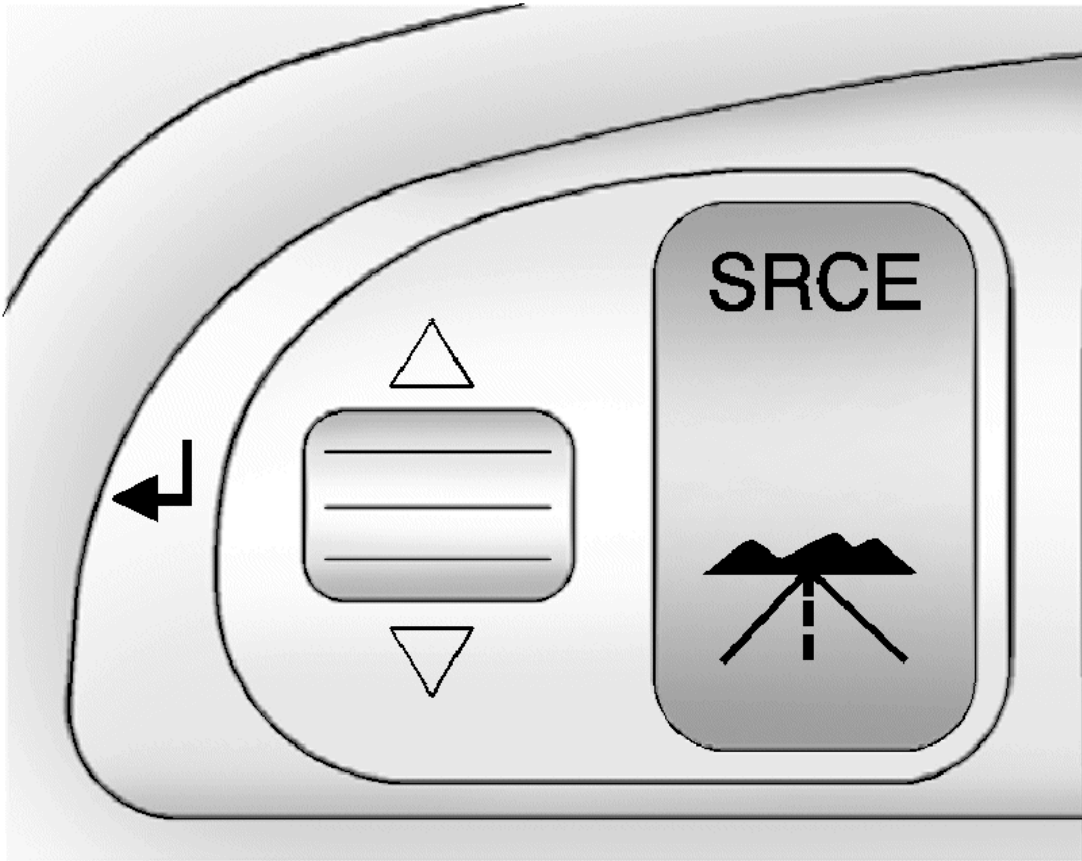


Fig. 6: Identifying DIC Controls
Courtesy of GENERAL MOTORS CORP.

ACCESSORIES & EQUIPMENT

Mirrors - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Inside Rearview Mirror Screw	1.8 N.m	16 lb in
Outside Rearview Mirror Mounting Bolt	9 N.m	80 lb in
Outside Rearview Mirror Motor Screw	3 N.m	27 lb in

SCHEMATIC WIRING DIAGRAMS

OUTSIDE REARVIEW MIRROR WIRING SCHEMATICS

Outside Rearview Mirrors (LHD) Wiring Schematics

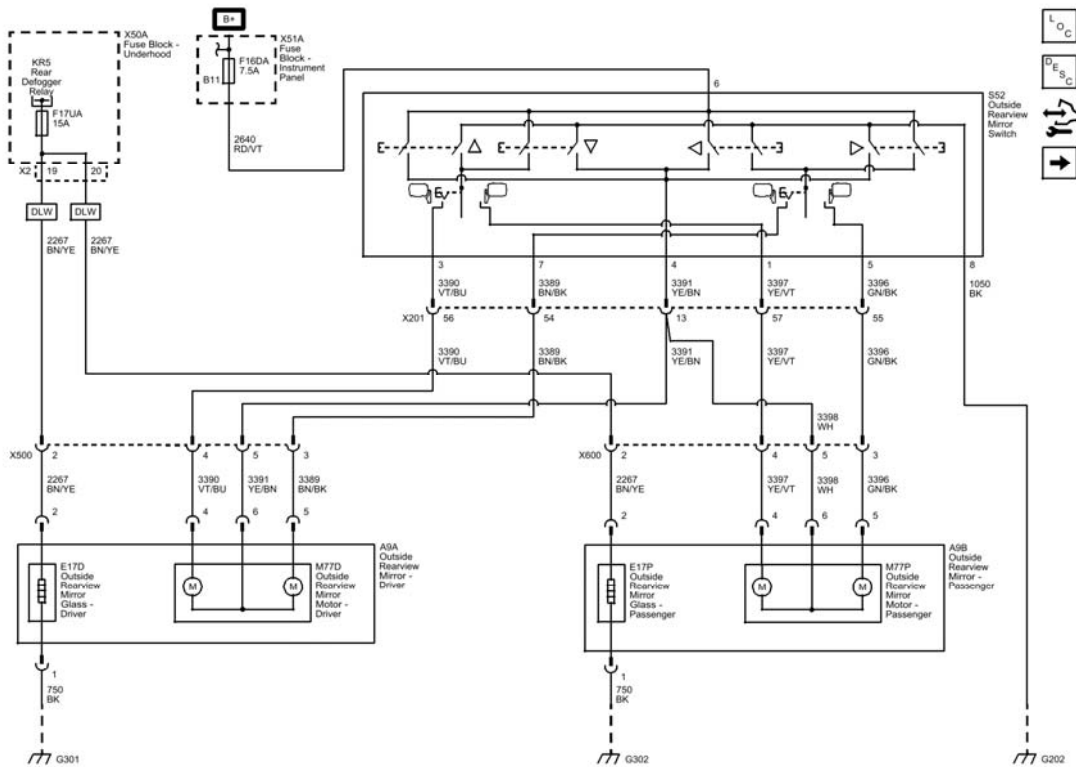


Fig. 1: Outside Rearview Mirrors (LHD) Wiring Schematic

Courtesy of GENERAL MOTORS COMPANY

Outside Rearview Mirrors (RHD) Wiring Schematics

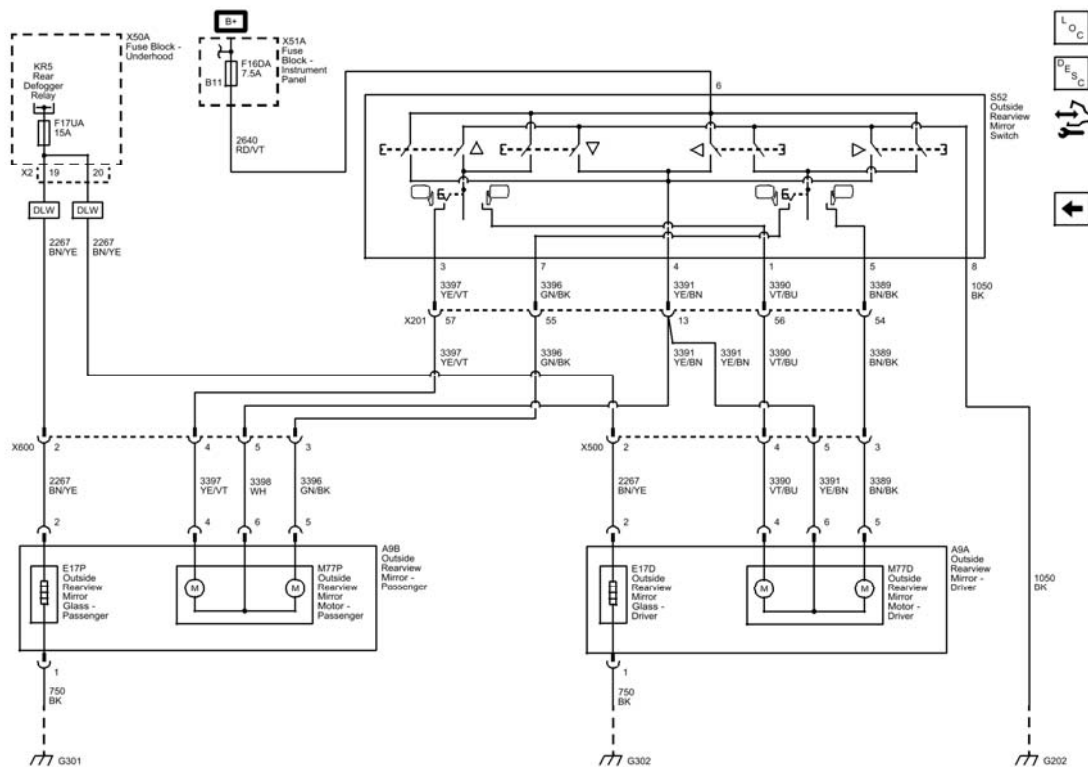


Fig. 2: Outside Rearview Mirrors (RHD) Wiring Schematic

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

SYMPTOMS - MIRRORS

NOTE: The following steps must be completed before using the symptom tables.

1. Perform the **Diagnostic System Check - Vehicle** before using the Symptom Tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Outside Mirror Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the system. Refer to **Checking**

Aftermarket Accessories .

- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections .**

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Heated Mirrors Malfunction**
- **Power Mirror Malfunction**

HEATED MIRRORS MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Left Heated Mirror Element Control	2	1	3	-
Driver Outside Rearview Mirror Ground	-	1	-	-
Right Heated Mirror Element Control	2	1	3	-
Passenger Outside Rearview Mirror Ground	-	1	-	-
1. Single Heated Mirror Inoperative 2. Both Heated Mirrors Inoperative 3. Heated Mirrors Always On				

Circuit/System Description

The rear defogger relay supplies voltage to the outside rearview mirror heater elements based on the current state of the rear window defogger. The relay supplies B+ through the driver/passenger mirror heating element control circuit when a request is seen.

Reference Information

Schematic Reference

Outside Rearview Mirror Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Outside Mirror Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Engine running.
2. Verify the E18 Rear Defogger Grid turns ON and OFF when commanding the Rear Defogger On and Off with a scan tool.
 - **If the E18 Rear Defogger Grid does not turn ON or OFF**

Refer to **Rear Window Defogger Malfunction** .

- **If the E18 Rear Defogger Grid turns ON and OFF**
3. Verify the E17D Outside Rearview Mirror Glass-Driver and the E17P Outside Rearview Mirror Glass-Passenger become warm when commanding the Rear Defogger On with a scan tool.
 - **If the E17D Outside Rearview Mirror Glass-Driver and the E17P Outside Rearview Mirror Glass-Passenger do not become warm**

Refer to Circuit/System Testing.

- **If the E17D Outside Rearview Mirror Glass-Driver and the E17P Outside Rearview Mirror Glass-Passenger become warm**
4. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the appropriate A9 Outside Rearview Mirror. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 1 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Ignition ON, connect a test lamp between the control circuit terminal 2 and the ground circuit terminal 1.
4. Verify the test lamp turns ON and OFF when commanding the Rear Defogger On and Off with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the X50A Fuse Block-Underhood.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the X50A Fuse Block-Underhood.
 - **If the test lamp is always ON**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the X50A Fuse Block-Underhood, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the X50A Fuse Block-Underhood
 - **If the test lamp turns ON and OFF**
5. Test or replace the E17 Outside Rearview Mirror Glass.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Outside Rearview Mirror Glass Replacement

Fuse Block Replacement

POWER MIRROR MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Outside Rearview Mirror Switch B+	1	1	-	-
Driver Mirror Motor Horizontal Control	1	2	2	-
Driver Mirror Motor Vertical Control	1	2	2	-
Passenger Mirror Motor Horizontal Control	1	3	3	-
Passenger Mirror Motor Vertical Control	1	3	3	-
Outside Rearview Mirror Switch Ground	-	1	-	-
1. Both Outside Power Mirrors Inoperative 2. Driver Outside Power Mirror Malfunction 3. Passenger Outside Power Mirror Malfunction				

Circuit/System Description

The outside rearview mirror switch controls the outside rearview mirrors based on the position of the mirror selector switch and which movement position is selected. The outside rearview mirror switch has four positions: up, down, left, and right. B+ is applied to the switch from the power mirror fuse and when a movement position switch is selected, voltage is sent to the commanded mirror via a mirror control circuit. The opposite mirror control circuit acts as a ground circuit for the bi-directional mirror motor. Ground is the applied through the switch.

Reference Information

Schematic Reference

Outside Rearview Mirror Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Outside Mirror Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Circuit/System Verification

1. Verify the mirror glass of the A9A Outside Rearview Mirror-Driver and the A9B Outside Rearview Mirror-Passenger move UP, DOWN, LEFT and RIGHT with the S52 Outside Rearview Mirror Switch.
 - **If both outside mirror glasses do not move**

Refer to Circuit/System Testing - Both Outside Rearview Mirrors Inoperative.
 - **If the driver outside mirror glass does not move UP, DOWN, LEFT or RIGHT**

Refer to Circuit/System Testing - Driver Outside Mirror Movement Malfunction.
 - **If the passenger outside mirror glass does not move UP, DOWN, LEFT or RIGHT**

Refer to Circuit/System Testing - Passenger Outside Mirror Movement Malfunction.
 - **If the mirror glass of the A9A Outside Rearview Mirror-Driver and the A9B Outside Rearview Mirror-Passenger move UP, DOWN, LEFT and RIGHT**
2. All OK.

Circuit/System Testing

Both Outside Rearview Mirrors Inoperative

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S52 Outside Rearview Mirror Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 8 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Verify a test lamp illuminates between the B+ circuit terminal 6 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**

1. Ignition OFF.
2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
1. Ignition OFF.
2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for infinite resistance between each of the control circuit terminals listed below and ground:
 - Control circuit terminal 1
 - Control circuit terminal 3
 - Control circuit terminal 4
 - Control circuit terminal 5
 - Control circuit terminal 7
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the appropriate M77 Outside Rearview Mirror Motor.
 - **If the test lamp illuminates**
4. Test or replace the S52 Outside Rearview Mirror Switch.

Driver Outside Mirror Movement Malfunction

1. Ignition OFF, disconnect the harness connector at the A9A Outside Rearview Mirror-Driver. Ignition ON
2. Connect a test lamp between the control circuit terminal 6 and control circuit terminal 4.
3. Verify the test lamp turns ON when commanding the UP and DOWN states with the S52 Outside Rearview Mirror Switch.
 - **If the test lamp remains OFF during either of the commands**
1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S52 Outside Rearview Mirror Switch.
2. Test for infinite resistance between each control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 ohms in each control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the S52 Outside Rearview Mirror Switch.
 - **If the test lamp is always ON**
1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S52 Outside Rearview Mirror Switch, ignition ON.
2. Test for less than 1 V between each control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, test or replace the S52 Outside Rearview Mirror Switch
- **If the test lamp turns ON during each of the commands**
- 4. Connect a test lamp between the control circuit terminal 6 and control circuit terminal 5.
- 5. Verify the test lamp turns ON when commanding the LEFT and RIGHT states with the S52 Outside Rearview Mirror Switch.
 - **If the test lamp remains OFF during either of the commands**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S52 Outside Rearview Mirror Switch.
 2. Test for infinite resistance between each control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in each control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the S52 Outside Rearview Mirror Switch.
 - **If the test lamp is always ON**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S52 Outside Rearview Mirror Switch, ignition ON.
 2. Test for less than 1 V between each control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, test or replace the S52 Outside Rearview Mirror Switch
 - **If the test lamp turns ON during each of the commands**
- 6. Test or replace the M77D Outside Rearview Mirror Motor-Driver.

Passenger Outside Mirror Movement Malfunction

1. Ignition OFF, disconnect the harness connector at the A9B Outside Rearview Mirror-Passenger. Ignition ON
2. Connect a test lamp between the control circuit terminal 6 and control circuit terminal 4.
3. Verify the test lamp turns ON when commanding the UP and DOWN states with the S52 Outside Rearview Mirror Switch.
 - **If the test lamp remains OFF during either of the commands**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S52 Outside Rearview Mirror Switch.
 2. Test for infinite resistance between each control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in each control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the S52 Outside Rearview Mirror Switch.

- **If the test lamp is always ON**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S52 Outside Rearview Mirror Switch, ignition ON.
 2. Test for less than 1 V between each control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, test or replace the S52 Outside Rearview Mirror Switch
 - **If the test lamp turns ON during each of the commands**
- 4. Connect a test lamp between the control circuit terminal 6 and control circuit terminal 5.
- 5. Verify the test lamp turns ON when commanding the LEFT and RIGHT states with the S52 Outside Rearview Mirror Switch.
 - **If the test lamp remains OFF during either of the commands**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S52 Outside Rearview Mirror Switch.
 2. Test for infinite resistance between each control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in each control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the S52 Outside Rearview Mirror Switch.
 - **If the test lamp is always ON**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S52 Outside Rearview Mirror Switch, ignition ON.
 2. Test for less than 1 V between each control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, test or replace the S52 Outside Rearview Mirror Switch
 - **If the test lamp turns ON during each of the commands**
- 6. Test or replace the M77P Outside Rearview Mirror Motor-Passenger.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Outside Rearview Mirror Remote Control Switch Replacement**
- **Outside Rearview Mirror Motor Replacement**

REPAIR INSTRUCTIONS

OUTSIDE REARVIEW MIRROR REPLACEMENT

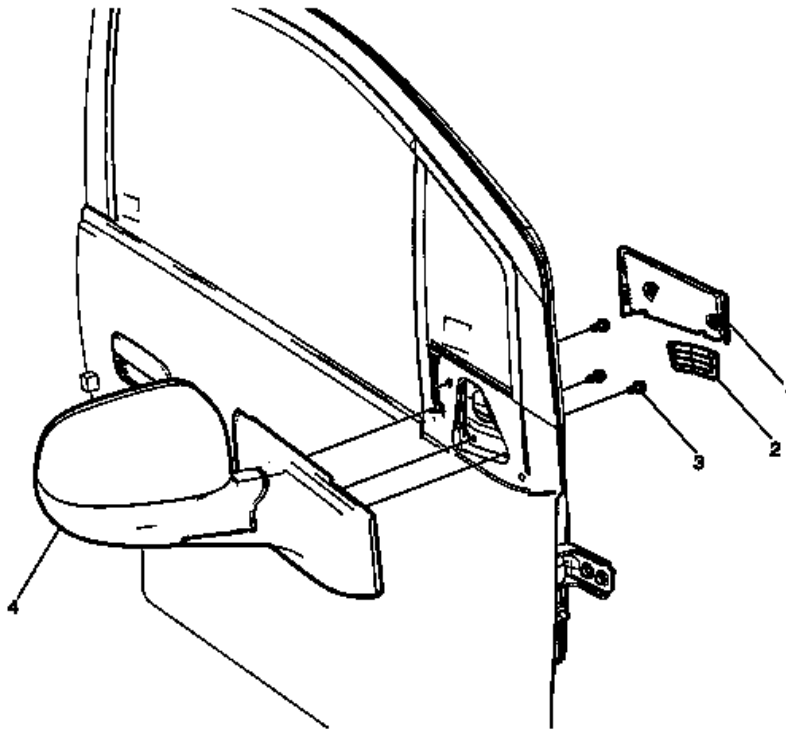


Fig. 3: Outside Rearview Mirror
Courtesy of GENERAL MOTORS COMPANY

Outside Rearview Mirror Replacement

Callout	Component Name
1	Front Side Door Upper Front Trim Panel Assembly TIP: Trim panel is secured to door with clips.
2	Front Side Door Trim Bolt Hole Cover
3	Outside Rearview Mirror Mounting Bolt (Qty: 3) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 9 N.m (80 lb in)
4	Outside Rearview Mirror Assembly

OUTSIDE REARVIEW MIRROR HOUSING COVER REPLACEMENT (WITH SIDE TURN SIGNAL LAMP)

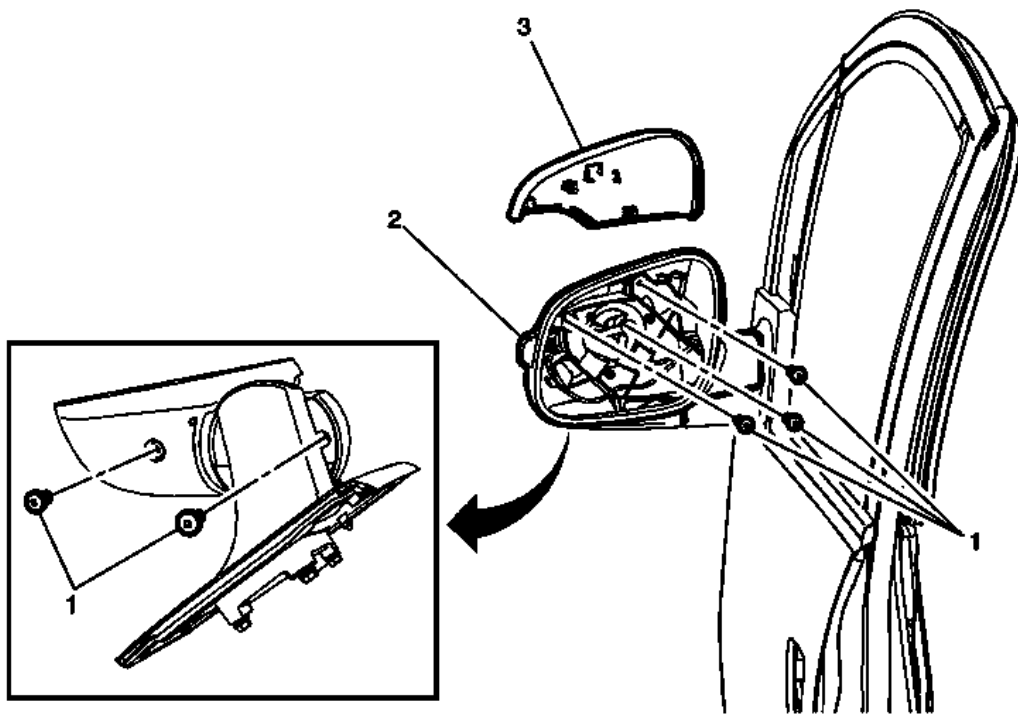


Fig. 4: Outside Rearview Mirror Housing Cover (with Side Turn Signal Lamp)
 Courtesy of GENERAL MOTORS COMPANY

Outside Rearview Mirror Housing Cover Replacement (with Side Turn Signal Lamp)

Callout	Component Name
Preliminary Procedures	
Remove the outside rearview mirror inner actuator. Refer to .	
1	Outside Rearview Mirror Housing Screw (Qty: 5) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2 N.m (18 lb in)
2	Outside Rearview Mirror Housing
3	Outside Rearview Mirror Housing Cover 1. Release the mirror housing cover taps from the mirror housing. 2. After the removal of the mirror housing cover, visually inspect the cover taps for breaking before installation. 3. If the cover taps are broken, replace with new cover. NOTE:

- To access the mirror housing cover taps easily, loosen the mirror housing screws and then move the mirror housing in every direction.
- The mirror housing can not be removed from the outside mirror assembly.

OUTSIDE REARVIEW MIRROR HOUSING COVER REPLACEMENT (WITHOUT SIDE TURN SIGNAL LAMP)

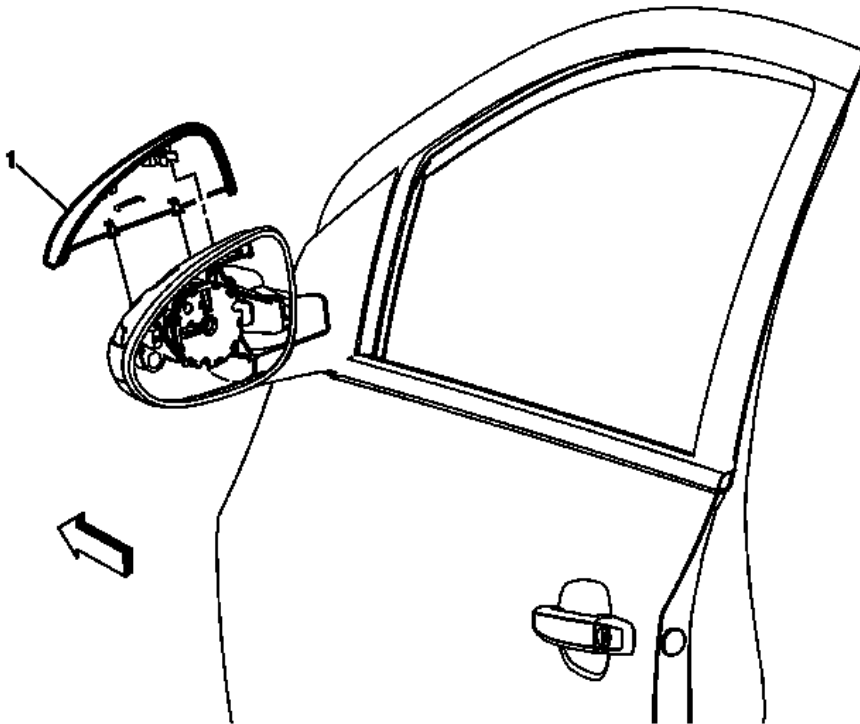


Fig. 5: Outside Rearview Mirror Housing Rear Cover
Courtesy of GENERAL MOTORS COMPANY

Outside Rearview Mirror Housing Cover Replacement (without Side Turn Signal Lamp)

Callout	Component Name
Preliminary Procedures	
Remove the outside rearview mirror glass. Refer to <u>Outside Rearview Mirror Glass Replacement</u> .	
1	Outside Rearview Mirror Housing Cover NOTE: 1. After the mirror glass has been removed the retainers can be accessed to release. 2. Align the housing cover with the slots in the mirror housing, push downward locking retainers in place. 3. Inspect the outside mirror for proper operation.

OUTSIDE REARVIEW MIRROR REMOTE CONTROL SWITCH REPLACEMENT

Refer to Instrument Panel Multifunction Switch Replacement .

OUTSIDE REARVIEW MIRROR MOTOR REPLACEMENT

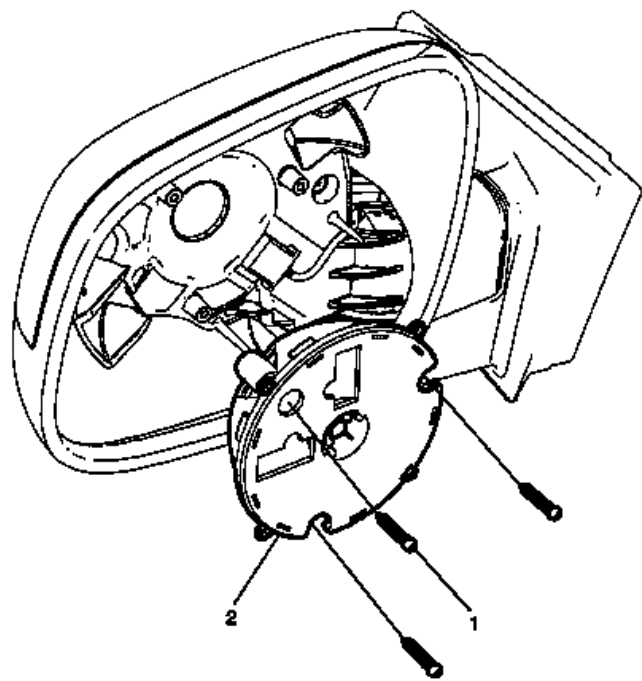


Fig. 6: Outside Rearview Mirror Motor
Courtesy of GENERAL MOTORS COMPANY

Outside Rearview Mirror Motor Replacement

Callout	Component Name
Preliminary Procedure Remove the outside rearview mirror glass. Refer to <u>Outside Rearview Mirror Glass Replacement</u> .	
1	Outside Rearview Mirror Motor Screw (Qty: 3) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 3 N.m (27 lb in)
2	Outside Rearview Mirror Motor TIP: Disconnect the electrical connector.

OUTSIDE REARVIEW MIRROR GLASS REPLACEMENT

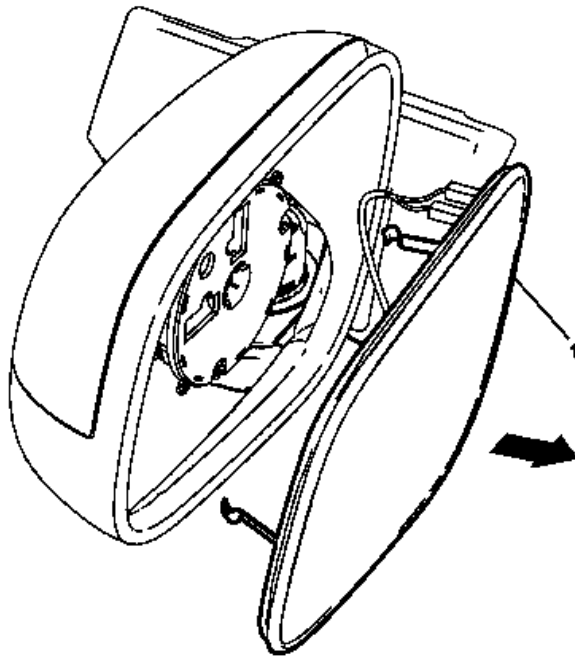


Fig. 7: Outside Rearview Mirror Glass
 Courtesy of GENERAL MOTORS COMPANY

Outside Rearview Mirror Glass Replacement

Callout	Component Name
WARNING: Refer to <u>Glass and Sheet Metal Handling Warning</u> .	
1	Outside Rearview Mirror Glass Procedure Release the mirror glass backing from the mirror housing by pulling outward. TIP: Disconnect the power wire harness electrical connector.

INSIDE REARVIEW MIRROR REPLACEMENT

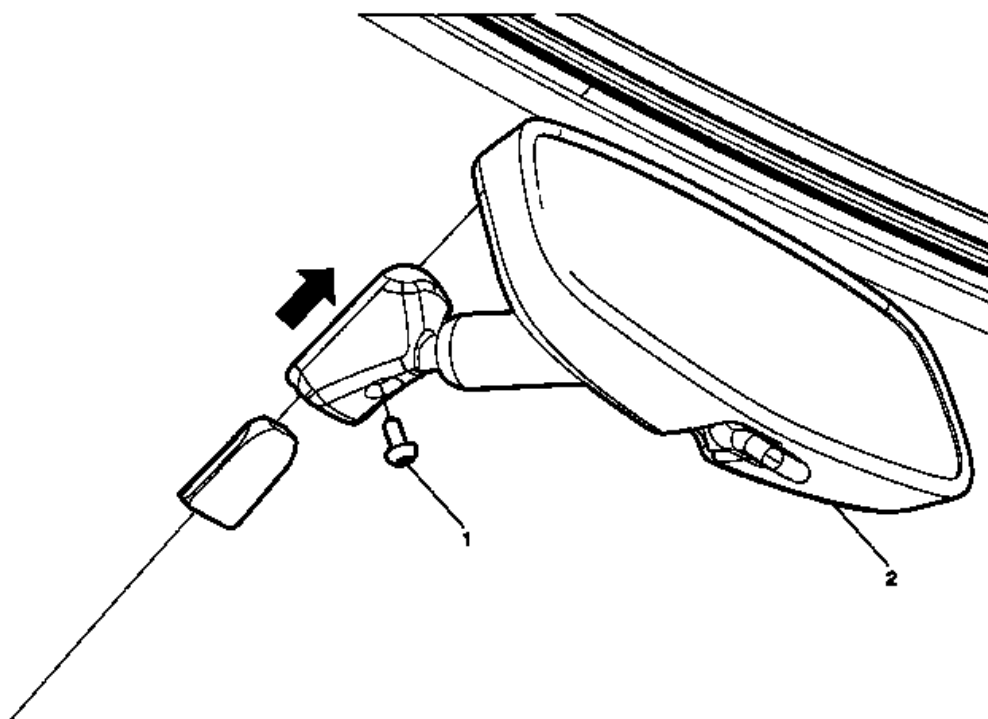


Fig. 8: Inside Rearview Mirror
 Courtesy of GENERAL MOTORS COMPANY

Inside Rearview Mirror Replacement

Callout	Component Name
Preliminary Procedure Adjust the mirror to the full upward position.	
1	Inside Rearview Mirror Screw CAUTION: Refer to <u>Fastener Caution</u> . Tighten 1.8 N.m (16 lb in)
2	Inside Rearview Mirror TIP: Slide the mirror in an upward motion in order to remove.

DESCRIPTION AND OPERATION

OUTSIDE MIRROR DESCRIPTION AND OPERATION

Power Mirror System Components

The power mirror system consists of the following components:

- Mirror direction switch - Controls the left, right, up and down movements of the mirrors
- Mirror select switch - Allows the operator to select the mirror to be moved
- Left outside mirror - Contains both the horizontal and vertical mirror motors
- Right outside mirror - Contains both the horizontal and vertical mirror motors
- 10A fuse - Located in the instrument panel (I/P) fuse block and supplies power for the power mirror system

Each of the outside power mirrors contains 2 motors. The up-down motor operates the vertical directions and the left-right motor operates the horizontal directions. Each of the power mirror motors are internally circuit breaker protected.

Power Mirros Without A45 Block Diagram

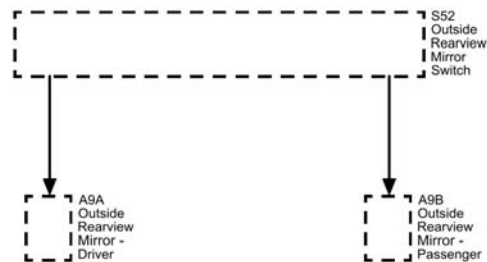


Fig. 9: Power Mirror System Diagram (Without A45)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
HW	Hard-Wired
HW	Hard-Wired
S52	S52 Outside Rearview Mirror Switch
A9A	A9A Outside Rearview Mirror - Driver
A9B	A9B Outside Rearview Mirror - Passenger

Power Mirror System Controls

The outside mirror switch incorporates a mirror select switch and a 4 position mirror direction switch.

The mirror select switch allows the driver to select the mirror to be moved by pressing the switch to L position enabling the left outside mirror or pressing the switch to R position enabling the right outside mirror.

The mirror direction switch is a 4 position switch that allows the operator to move the selected mirror up, down, left or right.

Power Mirror System Operation

The outside mirror switch receives power through the battery positive voltage circuit from the 10A fuse in the instrument panel (I/P) fuse block. The outside mirror switch also receives a constant ground.

The 4 positions of the direction switch have multiple switch contacts. When not in use, the directional contacts are isolated from any circuit. Each of the contacts are connected to opposing sides of the appropriate mirror motors through the selector switch. The selector switch interrupts or completes these circuits depending on the position of the selector switch, L or R.

If the mirror select switch is placed in the L position and the up switch is pressed, battery voltage will be supplied to the driver outside mirror vertical motor through the driver mirror motor up control circuit and return to the mirror switch through the driver mirror motor left/down control circuit, then to ground and the mirror will move up. If the down switch is pressed, the driver mirror motor left/down control circuit supplies battery voltage and the driver mirror motor up control circuit completes the path to the mirror switch, then to ground and the mirror will move down.

The remainder of the mirror functions operate in the same manner as described above. Placing the mirror direction switch in opposing positions, left/right or up/down, will reverse the voltage polarity to the mirror motor, utilizing the same circuits and the mirror will move accordingly.

Heated Mirror System Operation

The rear window defogger system controls the operation of the driver and passenger rearview mirror heaters. When the rear window defogger switch is activated, the DEFOG relay in the IP fuse block is energized sending B+ through the defog mirror 15A fuse to the driver and passenger rearview mirror heaters. The mirror heaters are connected to separate ground circuits.

ACCESSORIES & EQUIPMENT

Object Detection - Spark

SCHEMATIC WIRING DIAGRAMS

OBJECT DETECTION WIRING SCHEMATICS

Object Detection Wiring Schematics

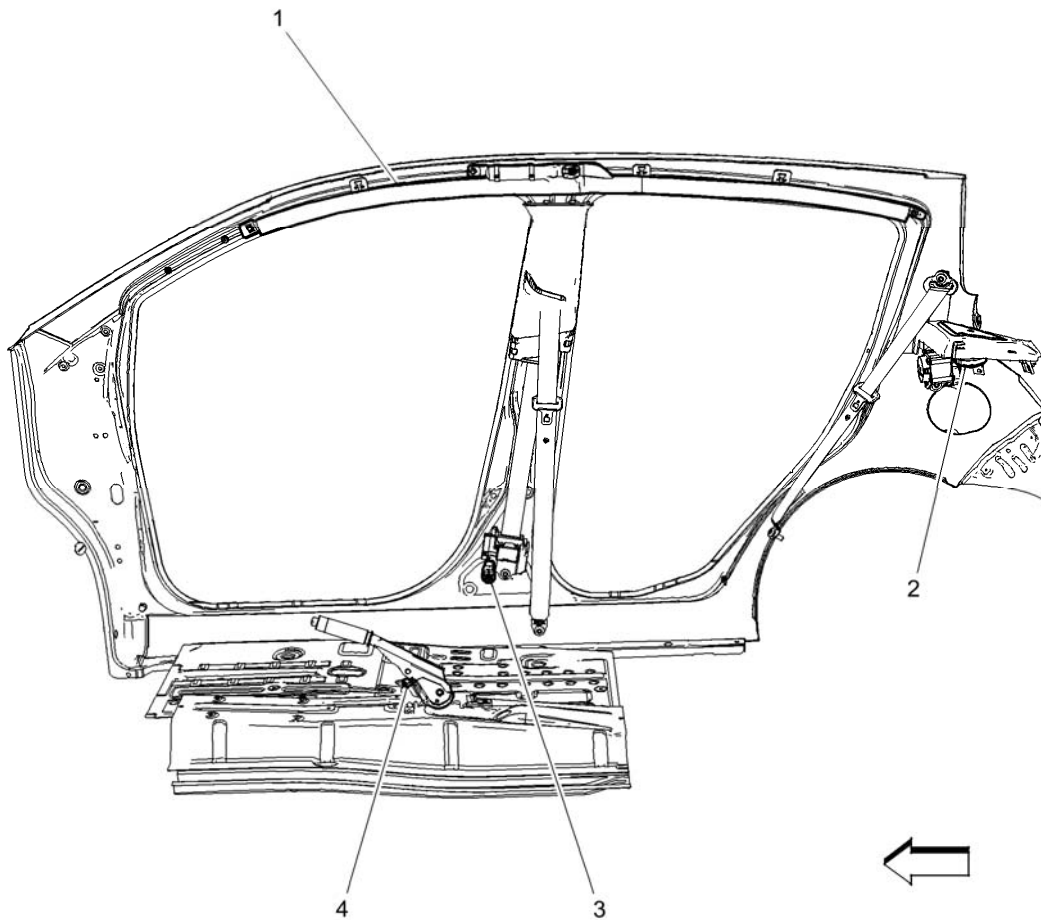


Fig. 1: Object Detection Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Rearview Camera (UVC) Wiring Schematics

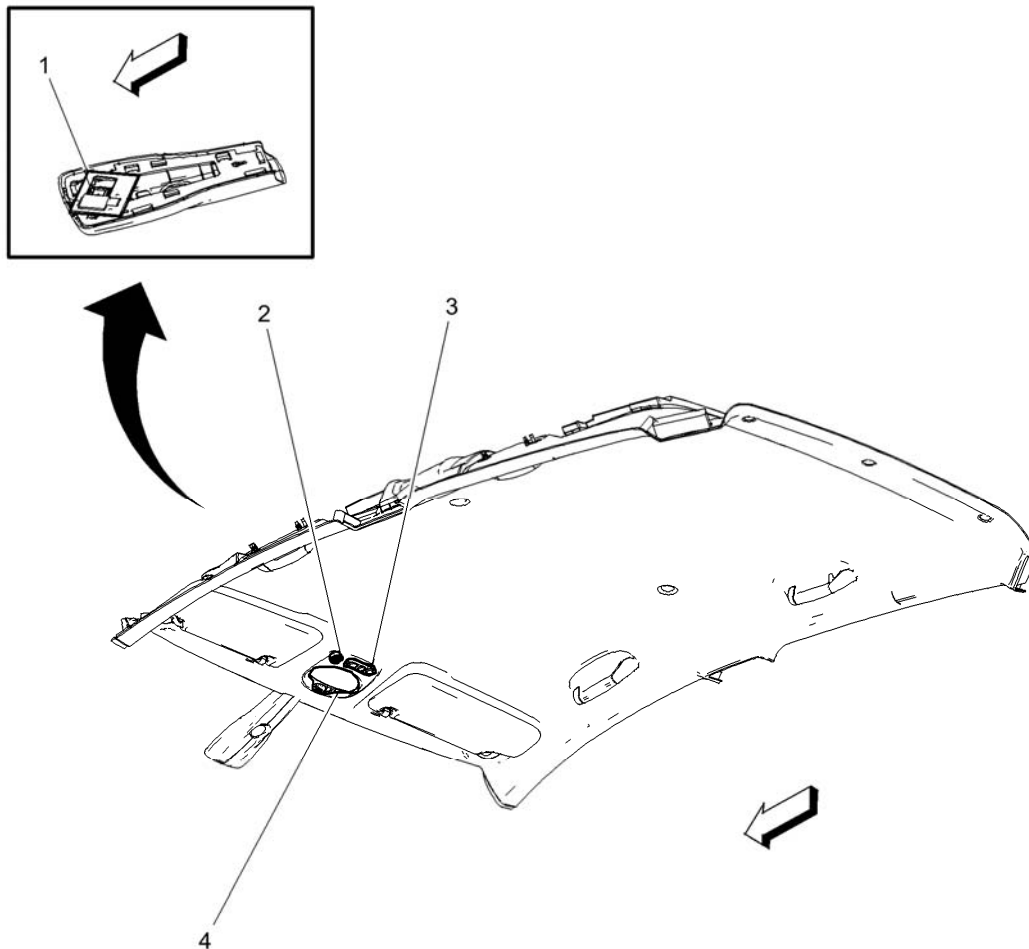


Fig. 2: Rearview Camera (UVC) Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

SYMPTOMS - OBJECT DETECTION

NOTE: The following steps must be completed before using the symptom tables:

1. Perform the **Diagnostic System Check - Vehicle** before using the Symptom Tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control module can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Object Detection Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which may affect the operation of the system. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which may cause the symptom.
- This system can use various sensors that need to be clean in order to function properly. Make sure to check the following sensors for obstructions:
 - Parking assist sensors located in the rear bumper cover

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

- **Parking Assist System Malfunction**

PARKING ASSIST SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The Rear Parking Assist Control Module is supplied ignition voltage from the I/P fuse block. When the transmission is in reverse, the system is turned ON, ignition voltage is supplied from the BCM. The Rear Object Sensors are supplied with signal circuits referenced from 8 volts and low reference by the Rear Parking Assist Control Module. The Speaker - Parking Assist is provided with B+ from the Rear Parking Assist Control Module provides a PWM low signal to the speaker to provide an audible alert.

Diagnostic Aids

The park assist system is capable of performing an object detection sensor self test. When the vehicle is shifted into reverse, the system will enter the sensor self test mode and the park assist module will verify inputs from the object detection sensors. The park assist module indicates sensor status using the system alarm. If both sensor signals are being received by the rear park assist, module 1 single short tone will be activated. When one or both sensor signals are not received, the module will respond by activating the alarm with 1 tone repeated for a left sensor fault, and 2 tones repeated for a right sensor fault. If both sensors are faulted, the module will respond by activating the alarm with 3 tones continuously.

Circuit/System Verification

1. Ignition ON.

2. Verify the object alarm sounds 1 short tone when shifting the transmission into reverse.

- **If the object alarm sounds 1 or 2 tones repeated**

Refer to Circuit/System Testing - Rear Object Sensor Malfunction.

- **If the object alarm sounds 3 tones continuously or no tones**

Refer to Circuit/System Testing - Rear Parking Assist Control Module/Speaker Malfunction

- **If the object alarm sounds 1 short tone**

3. All OK.

Circuit/System Testing

Rear Object Sensor Malfunction

1. Ignition OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Disconnect the harness connector at the appropriate B78 Rear Object Sensor.

2. Test for less than 10 ohms between the low reference circuit terminal 2 and ground.

- **If 10 ohms or greater**

1. Ignition OFF, disconnect the harness connector at the K41R Rear Parking Assist Control Module.

2. Test for less than 2 ohms in the low reference circuit end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, replace the K41R Rear Parking Assist Control Module.

- **If less than 10 ohms**

3. Ignition ON.

4. Test for 7.5-9.5 V between the 8 V reference circuit terminal 1 and ground.

- **If less than 7.5 V**

1. Ignition OFF, disconnect the harness connector at the K41R Rear Parking Assist Control Module.

2. Test for infinite resistance between the 8 V reference circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance

3. Test for less than 2 ohms in the 8 V reference circuit end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, replace the K41R Rear Parking Assist Control Module.

- **If greater than 9.5 V**

1. Ignition OFF, disconnect the harness connector at the K41R Rear Parking Assist Control Module, ignition ON.

2. Test for less than 1 V between the 8 V reference circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.

- If less than 1 V, replace the K41R Rear Parking Assist Control Module.

- **If between 7.5-9.5 V**

5. Replace the appropriate B78 Rear Object Sensor.

Rear Parking Assist Control Module/Speaker Malfunction

1. Ignition OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Disconnect the harness connector at the K41R Rear Parking Assist Control Module.
2. Test for less than 10 ohms between the ground circuit terminal 9 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the K41R Rear Parking Assist Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K41R Rear Parking Assist Control Module.
 - **If less than 10 ohms**
3. Ignition ON.
4. Verify a test lamp illuminates between the ignition circuit terminal 1 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K41R Rear Parking Assist Control Module.
 - **If the test lamp illuminates**
5. Ignition ON, park brake applied, transmission in REVERSE.
6. Verify a test lamp illuminates between the control circuit terminal 4 and ground.
 - **If the test lamp does not illuminate**
 1. Ignition OFF, disconnect the X7 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If the test lamp illuminates**
7. Ignition OFF, disconnect the harness connector at the P28 Speaker - Parking Assist.

8. Test for less than 10 ohms between the low reference circuit terminal 1 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the K41R Rear Parking Assist Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K41R Rear Parking Assist Control Module.
 - **If less than 10 ohms**
9. Test for 7.5-9.5 V between the 8 V reference circuit terminal 3 and ground.
 - **If less than 7.5 V**
 1. Ignition OFF, disconnect the harness connector at the K41R Rear Parking Assist Control Module.
 2. Test for infinite resistance between the 8 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the 8 V reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K41R Rear Parking Assist Control Module.
 - **If greater than 9.5 V**
 1. Ignition OFF, disconnect the harness connector at the K41R Rear Parking Assist Control Module, ignition ON.
 2. Test for less than 1 V between the 8 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K41R Rear Parking Assist Control Module.
 - **If between 7.5-9.5 V**
10. Ignition OFF. Place an object less than 0.4m away from the rear bumper. Connect a test lamp between reference voltage terminal 3 and control circuit terminal 2.
11. Verify the test lamp illuminates when the vehicle is started and the transmission is shifted into reverse.
 - **If the test lamp does not illuminate**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K41R Rear Parking Assist Control Module.
 - **If the test lamp illuminates**
12. Test or replace the P28 Speaker - Parking Assist.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Rear Parking Assist Alarm Sensor Replacement**

- **Control Module References** for Rear Parking Assist Control Module replacement, setup and programming.

REAR VISION CAMERA SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

When the transmission is placed into REVERSE, a 12 V signal is sent to the rearview camera indicating that camera operation is requested. Ignition voltage and ground are supplied to the rearview camera. The rearview camera sends video information to the radio through a video signal + and a video signal - circuit. A grounded shielding also wraps the video signal circuits to reduce electronic interference which may degrade the video signal and cause a distorted or otherwise degraded image.

Diagnostic Aids

A poor video image can be caused by ice, snow, and mud buildup on the lens of the rearview camera. Also, extreme lighting conditions can affect performance, such as operating in the dark or with bright sunlight shining on the camera. Extreme high or low temperatures can also affect the image quality. An open in the shield of the video signal circuit can also cause a distorted screen.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Object Detection Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC B2545 is not set.
 - **If the DTC is set**
3. Verify the rearview camera there is no debris on the lens and that the bezel or bezel seal is not damaged.
 - **If debris are found on the lens**

Refer to **DTC B2545** .

- **If the DTC is not set**

Clean the lens. If the lens, bezel, or bezel seal are damaged, replace as necessary.

- **If no debris on the lens**

4. Ignition ON, transmission in REVERSE.
5. Verify the backup lamps are On.
 - **If the backup lamps are not ON**

Refer to **Backup Lamps Malfunction (Automatic Transmission)** , **Backup Lamps Malfunction (Manual Transmission)** .

- **If the backup lamps are ON**

6. Engine running, transmission in REVERSE.
7. Verify a clear rear vision image is displayed on the radio.
 - **If a clear image is not displayed**

Refer to Circuit/System Testing.

- **If a clear image is displayed**

8. All OK.

Circuit/System Testing

NOTE: **Circuit/System Verification must be performed before Circuit/System Testing.**

1. Ignition OFF, disconnect the harness connector at the B87 Rearview Camera.
2. Test for less than 10 ohms between the ground circuit terminal 5 and ground.
 - **If 10 ohms or greater**

Test for less than 2 ohms in the ground circuit end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.
- If less than 2 ohms, repair the open/high resistance in the ground connection.
- **If less than 10 ohms**

3. Ignition ON.

4. Verify a test lamp illuminates between the ignition circuit terminal 6 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Ignition OFF.

2. Test for less than 2 ohms in the ignition circuit end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Ignition OFF.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance, test or replace the KR74 Ignition Run Relay.

- **If the test lamp illuminates**

5. Engine running, park brake applied, transmission in REVERSE.

6. Test for greater than 11 V between the control circuit terminal 3 and ground.

- **If less than 11 V**

1. Ignition OFF, disconnect the X7 harness connector at the K9 Body Control Module.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance

3. Test for less than 2 ohms in the control circuit end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, replace the K9 Body Control Module.

- **If greater than 11 V**

7. Ignition OFF, disconnect the X4 harness connector at the A11 Radio, ignition ON.

8. Test for less than 1 V between the signal circuit terminal listed below and ground:

- Signal (+) circuit terminal 1 at the B87 Rearview Camera.

- Signal (-) circuit terminal 4 at the B87 Rearview Camera.

- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

9. Test for infinite resistance between the signal circuit terminal listed below and ground:

- Signal (+) circuit terminal 1 at the B87 Rearview Camera.
- Signal (-) circuit terminal 4 at the B87 Rearview Camera.
- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

10. Test for less than 2 ohms in the signal (+) circuit end to end.

- **If 2 ohms or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 ohms**

11. Test for less than 2 ohms in the signal (-) circuit end to end.

- **If 2 ohms or greater**

Test the signal circuit for an open/high resistance.

- **If less than 2 ohms**

12. Replace the B87 Rearview Camera.

13. Engine running, transmission in REVERSE, verify a clear rear vision image is displayed on the A11 Radio.

- **If a clear rear vision image is not displayed on the A11 Radio**

Replace the A11 Radio.

- **If a clear rear vision image displayed on the A11 Radio**

14. All Ok.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Rearview Camera Image Display Module Replacement**
- **Control Module References** for body control module or radio replacement, programming and setup

REPAIR INSTRUCTIONS

REAR OBJECT ALARM CONTROL MODULE REPLACEMENT

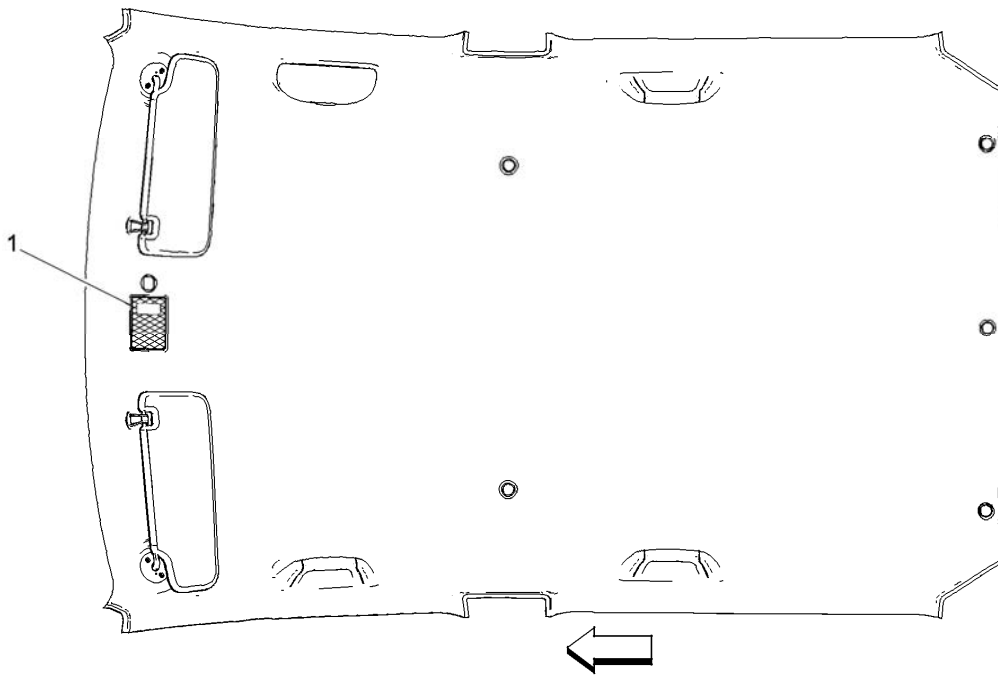


Fig. 3: Rear Object Alarm Control Module
 Courtesy of GENERAL MOTORS COMPANY

Rear Object Alarm Control Module Replacement

Callout	Component Name
Preliminary Procedure Remove the rear wheelhouse trim finish. Refer to <u>Rear Wheelhouse Trim Finish Panel Replacement</u> .	
1	Rear Object Alarm Module Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 6 N.m (53 lb in)
2	Rear Object Alarm Module Procedure 1. Loosen the bolts and remove the rear object alarm and module assembly. 2. Disconnect the electrical connector. 3. Remove the module from the bracket.

TIP: The bolt is integral to the sensor assembly, DO NOT remove separately.

REAR OBJECT ALARM REPLACEMENT



Fig. 4: Rear Object Alarm

Courtesy of GENERAL MOTORS COMPANY

Rear Object Alarm Replacement

Callout	Component Name
Preliminary Procedure	
Remove the rear wheelhouse trim finish. Refer to <u>Rear Wheelhouse Trim Finish Panel Replacement</u> .	
1	Rear Object Alarm Nut CAUTION: Refer to <u>Fastener Caution</u> .

	Tighten 4.5 N.m (40 lb in)
2	Rear Object Alarm Procedure 1. Disconnect the electrical connector. 2. Remove the rear object alarm.

REAR PARKING ASSIST ALARM SENSOR REPLACEMENT

Removal Procedure

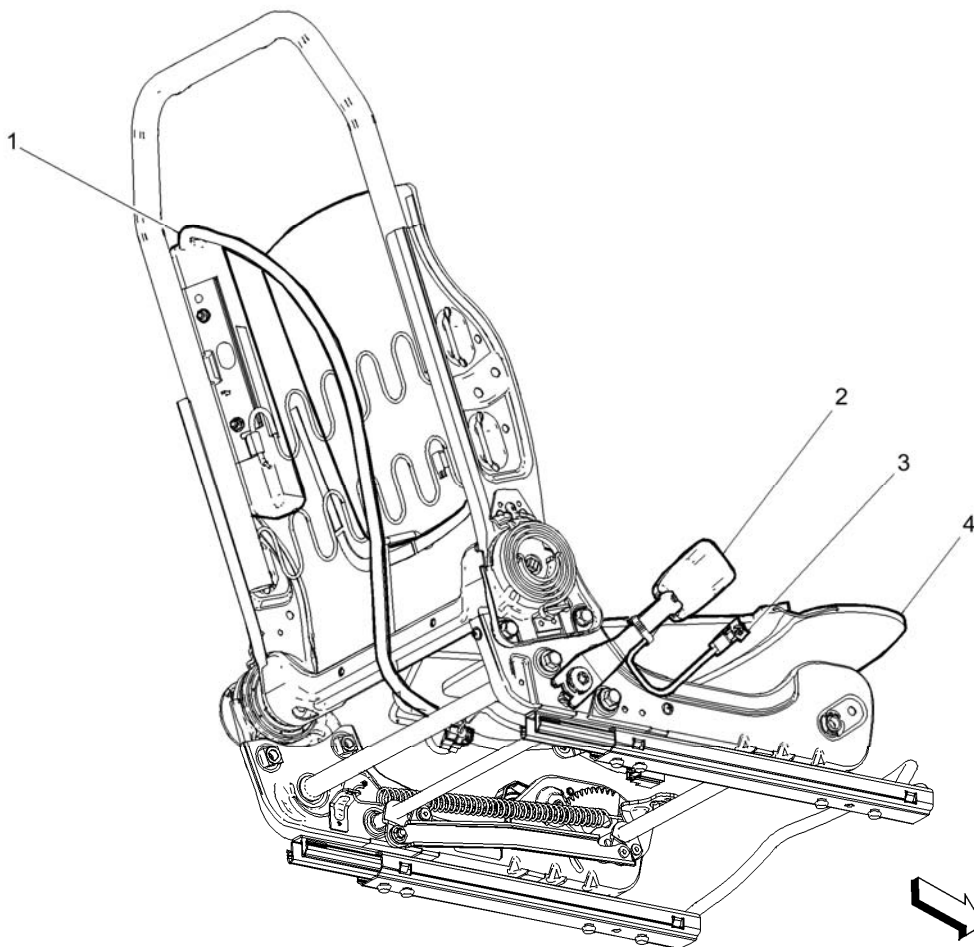


Fig. 5: Rear Bumper Fascia
Courtesy of GENERAL MOTORS COMPANY

1. Remove the rear bumper fascia. Refer to **Rear Bumper Fascia Replacement** .

2. Disconnect electrical connector from the rear object sensor.
3. Rotate the housing counterclockwise and remove the rear object sensor.

Installation Procedure

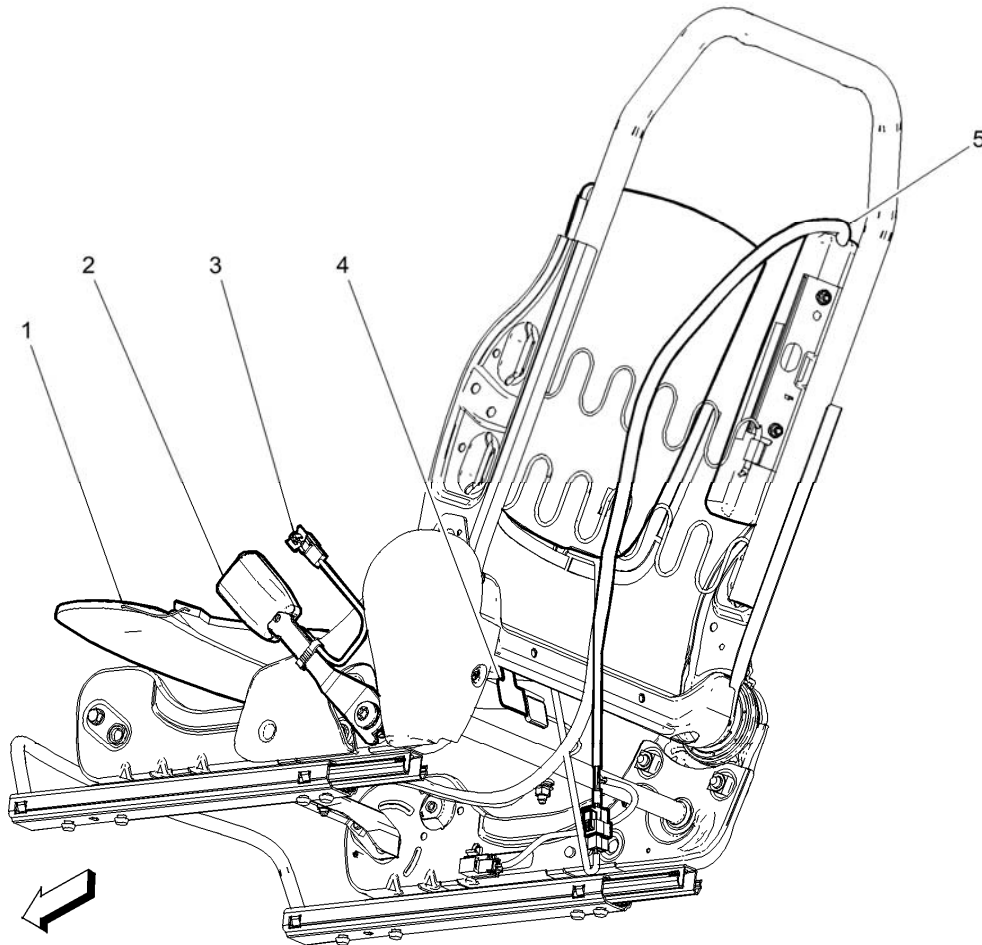


Fig. 6: Rear Bumper Fascia

Courtesy of GENERAL MOTORS COMPANY

1. Insert the sensor into the housing and lock the sensor by rotating the housing clockwise.
2. Connect the electrical connector to the rear object sensor.
3. Install the rear bumper fascia. Refer to **Rear Bumper Fascia Replacement** .

REARVIEW CAMERA IMAGE DISPLAY MODULE REPLACEMENT

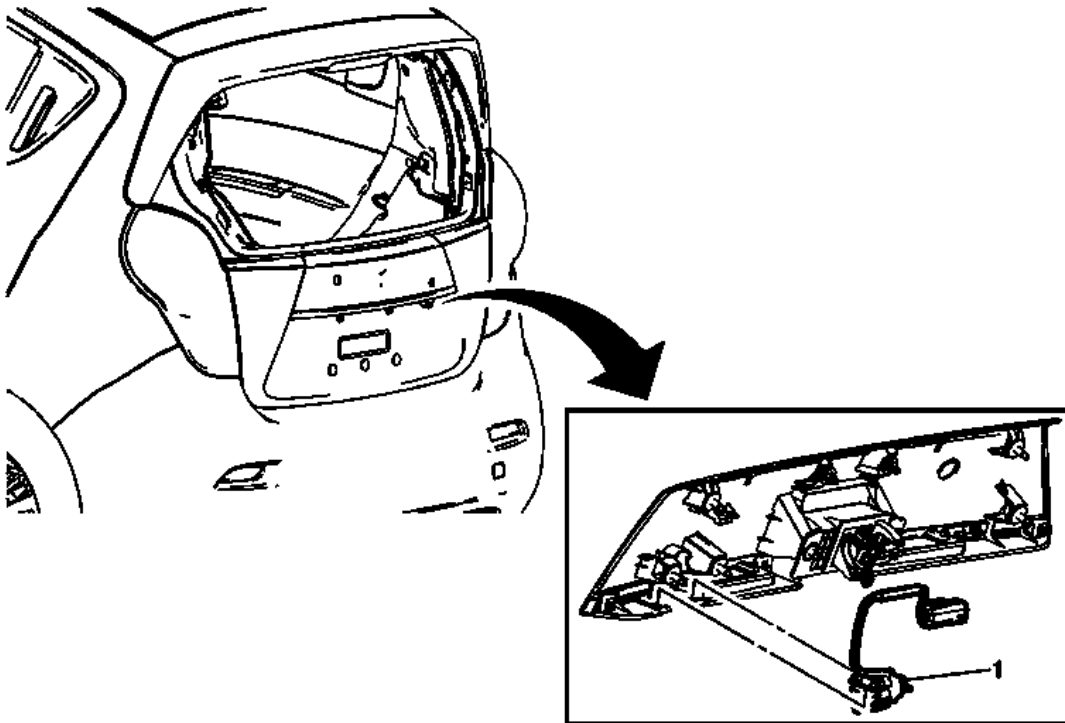


Fig. 7: Rearview Camera Image Display Module
 Courtesy of GENERAL MOTORS COMPANY

Rearview Camera Image Display Module Replacement

Callout	Component Name
Preliminary Procedure	
Remove the liftgate outside handle. Refer to Liftgate Outside Handle Replacement .	
1	Rearview Camera Image Display Module Procedure 1. Disconnect the electrical connector. 2. Depress the clip fingers and push outward to remove the rearview camera from the applique.

DESCRIPTION AND OPERATION

OBJECT DETECTION DESCRIPTION AND OPERATION

Object Detection Description and Operation (Parking Assist)

The ultrasonic parking assist system is designed to identify and notify the driver of an object in the vehicle's path when reversing. The distance and location of the object is determined by 2 Rear Object Sensors located in the rear bumper. The Rear Parking Assist Control Module will notify the driver using an audible beep signal through an external speaker.

Object Detection Components

The parking assist system is made up of the following components:

- K41R Rear Parking Assist Control Module
- Two Rear Object Sensors

Rear Parking Assist Control Module

The object alarm module provides an 8V reference and a low reference to the Rear Object Sensors. The Rear Parking Assist Control Module receives individual signals from each of the sensors and determines the location and distance of an object based on these inputs. When an object is detected, the Rear Parking Assist Control Module will send a signal to an external speaker to provide an audible alert.

Rear Object Sensors

The Rear Object Sensors are located in the rear bumper of the vehicle. The sensors are used to determine the distance between an object and the bumper. Each sensor emits an ultrasonic frequency which is reflected off any object located in front of or behind the vehicle. These reflections are received by the sensors. The time difference between the emission of the frequency and when the reflection is received is known as sensor ring time, it is used to determine the distance to the object. The sensors report this information to the Rear Parking Assist Control Module.

Parking Assist Operation

When an object is within the measuring range of the sensor, the ultrasonic pulse is reflected and is received by the sending or a neighboring sensor. The sensor converts this signal into a voltage signal and sends this signal to the Rear Parking Assist Control Module. The Rear Parking Assist Control Module evaluates the received sensor signals. As soon as an object is within the measuring range, the Rear Parking Assist Control Module sends a signal to an external speaker in order to give out the acoustic distance signal. The measuring range is between 40-120 cm (15.74-47.24 in). From a distance of 120 cm (15.74 in), the acoustic signal is active. The frequency of the beep sound increases with decreasing distance. From a distance less than 40 cm (15.74 in), the sound becomes continuous.

The parking assist can be activated and deactivated by engaging the reverse gear.

The object alarm module carries out a self test and monitors the sensors for electrical and mechanical faults. Monitored is the power supply of each sensor and the sensor signals, which need to alter when the vehicle moves. If this is not the case, the sensor is acoustically blocked or faulty. Mud, ice and snow may cause obstruction of the function of the sensors. The Rear Parking Assist Control Module will also check whether the correct type of sensor is installed.

ACCESSORIES & EQUIPMENT

Paint and Coatings - Spark

INTRODUCTION

BASECOAT/CLEARCOAT PAINT SYSTEMS

WARNING: Exposure to isocyanates during paint preparation and application processes can cause severe breathing problems. Read and follow all of the instructions from the manufacturers of painting materials, equipment and protective gear.

All paint finish repairs of rigid exterior surfaces must meet GM standards. Refer to the latest revision of the GM Approved Refinish Materials book to identify the paint systems you may use that have been engineered to meet GM standards. The GM Approved Refinish Materials book supplies all approved products, including volatile organic compound (VOC) compliant regulations recommended by the individual manufacturer and detailed procedures for materials used in their paint system.

The latest revision of the GM Approved Refinish Materials booklet is located on the Goodwrench website at www.gmgoodwrench.com.

ANTI-CORROSION TREATMENT AND REPAIR

WARNING: When applying sound deadeners or anti-corrosion materials due care and preventative measures must be exercised to prevent any material from being sprayed into door and quarter panel mechanisms such as door locks, window run channels, window regulators and seat belt retractors, as well as any moving or rotating mechanical or suspension parts on the underbody, particularly the parking brake cable. After material application, be sure that all body drain holes are open. Improper application may increase chance of corrosion damage or limit the operation of moving parts, resulting in personal injury.

Any procedure that disturbs these special treatments, such as panel replacement or collision damage repair operations, may leave the metal unprotected and result in corrosion. Proper recoating of these surfaces with service-type anti-corrosion material is essential.

After repair and/or replacement parts are installed, all accessible bare metal surfaces must be treated with metal conditioner and reprimed. Refer to the GM Approved Refinish Materials book which identifies the paint systems you may use.

The latest revision of the GM Approved Refinish Materials booklet is located on the Goodwrench website at www.gmgoodwrench.com.

Anti-corrosion compounds are light-bodied materials designed to penetrate between metal-to-metal surfaces, such as pinch-weld joints, hem flanges and integral panel attaching points where metal surfaces are difficult to

coat with conventional undercoating materials and are inaccessible for painting. The materials that are suitable for interior and exterior are listed in the chart below. Conventional undercoating is recommended in order to coat large areas, such as replacement door and quarter outer panels, floor pan sections, lids, hoods, fenders, etc. During undercoating operations, care should be taken to prevent the material from being sprayed into door and quarter panel hardware mechanisms, such as door locks, window run channels, window regulators and seat belt retractors. On the underbody, the material should not be applied to any moving or rotating part, energy absorbing bumper components or shock absorbers. After undercoating, ensure that all body drain holes are open.

Interior Protectant

The following products are available from GM Dealer Equipment. For technical information, call 187-Permatex (1-877-376-2839):

Permatex Part Number	Description
310-JDI-UCA1	Permatex Canister and Wand Assembly
310-81881	Permatex Amber Rust Proofing (24 oz) (Qty of 12)
310-81882	Permatex Amber Rust Proofing (1 gal)

Exterior Protectants

The following product is available from *ECP, Inc. Contact them at 1-800-323-3521 or www.ecpinc.net.

Part Number	Description
178660	Nox Rust X-121B (12 cans per case)

The following products are available from your local *3M® distributor or call 1-800-521-8180, ext. 779-5165.

3M® Part Number	Description
08804	Water-Based Undercoat
08801	No Clean-Up Applicator Gun
05917	Weld-Thru Coating
08891	Rust Fighter-I

The following product is available from *Transtar Autobody Technologies. Contact the company at 1-800-824-2843 or www.tat-co.com.

Part Number	Description
4353	Weld-Through Primer

*We believe these sources and their products to be reliable. There may be additional manufacturers of such material. General Motors does not endorse, indicate any preference for or assume any responsibility for the products from these firms or for any such items which may be available from other sources.

These sealers are intended to prevent water and dust from entering the vehicle and also are anti-corrosion

barriers. Sealers are applied to such areas as rear compartment lid hem flanges, wheelhouse, quarter outer, floor, cowl, roof and various other panel to panel attaching points. The originally sealed joints are obvious and any damage to these sealed locations should be corrected by resealing. Attaching points of new replacement panels should be resealed. Replacement lids and doors will also require sealing in the hem flange areas.

Flanged joints, overlap joints and seams should be sealed using a quality sealer of medium-bodied consistency. The sealer used must retain its flexible characteristics after curing and be paintable.

Open joints which require bridging of the sealer in order to close a gap should be sealed using a heavy-bodied caulking material. Follow the label directions for the material selected.

Color application may be required in order to restore repaired areas such as hood, fenders, doors, quarters, lid, roof, engine compartment, underbody and inner panels to original appearance. When this is necessary, conventional refinishing preparation, undercoat buildup and color application techniques should be followed.

Deadener materials, spray-on type, are used on various metal panels in order to provide corrosion resistance and joint sealing. They control the general noise level inside the passenger area of the vehicle. When deadeners are disturbed because of damage, are removed during repair operations or a new replacement panel is installed, the deadener material must be replaced by a service equivalent material. The application pattern and location of deadener materials can be determined by observing the original production installation.

Cleaning of the interior and underbody panel surfaces is necessary when original galvanized or other anti-corrosion materials have been burned off during welding or heating operations. Removal of the residue from burning will require additional care in such areas as interior surfaces of box-type construction and when configurations of the metal panels limit access to interior surfaces.

REPAIR INSTRUCTIONS

CLEARCOAT REPAIR WITHOUT REPAINTING

1. Thoroughly wash the repair area with Liquid Wash and Wax GM P/N 1052870 or the equivalent.
2. Environmental damage may be corrected. Refer to **Environmental Fallout (Acid Rain)** or **Rail Dust Damage Repair**.

NOTE: Follow all of the instructions from the manufacturer of the polishing material.

3. Use a paint gauge before, during and after sanding and/or polishing, to avoid removing too much clearcoat. Refer to **Paint Gauges**.

ENVIRONMENTAL FALLOUT (ACID RAIN)

CAUTION: Refer to **Clearcoat/Ultraviolet Screeners Caution** .

NOTE: Always refer to the manufacturer's packaged instructions for the detailed

procedures of materials used for compounding and/or polishing.

Since the severity of the condition varies from area to area, proper diagnosis of the contamination extent is critical to the success of the repairs. Perform the diagnosis under high intensity fluorescent lighting on the horizontal surfaces (hood, roof panel, rear compartment lid), after the surfaces have been properly cleaned by washing the vehicle with GM Wash and Wax GM P/N 1237841 (Canadian P/N 10953203) or equivalent.

There are 3 basic types of acid rain damage:

Surface Level Contamination

May be repaired by simply washing the vehicle, cleaning the surface with a silicone wax and grease remover, neutralizing acidic residue and finesse polishing. Refer to Surface Level Contamination Repair.

Clearcoat Etching

Slight etching is still noticeable after the above washing and finesse polishing procedure. Refer to Slight Clearcoat Damage - Wet Sanding, Finesse Polishing.

Basecoat Etching

Severe etching beyond the clearcoat into the basecoat in the affected areas will require refinishing. Refer to **Basecoat/Clearcoat Paint Systems**.

Surface Level Contamination Repair

1. Thoroughly wash and dry the contaminated area with GM Wash and Wax GM P/N 1237841 (Canadian P/N 10953203) or equivalent.
2. Clean the affected area with silicone, wax and grease remover.
3. Remove and neutralize acidic residue by cleaning the contaminated areas with a mixture of baking soda and water (1 tablespoon of baking soda per 1 liter or 1 quart of water). Rinse thoroughly and dry the panel completely.
4. Apply finesse-type polish with a foam panel. If damage has been repaired, remove any swirl marks with a dual action orbital polisher and foam pad.
5. If some damage remains, refer to Slight Clearcoat Damage - Wet Sanding, Finesse Polishing.

Slight Clearcoat Damage - Wet Sanding, Finesse Polishing

1. Select a small contaminated test area.
2. Film thickness should be taken prior to the sanding and polishing. Refer to **Paint Gauges**.
3. Wet sand and finesse polish the contaminated test area. If during the polishing you suspect or observe that etching has penetrated into the basecoat, too much clearcoat has been removed during sanding or base color is transferred to the polishing pad during polishing, then the affected areas will require refinishing. Refer to **Basecoat/Clearcoat Paint Systems**.

PAINT GAUGES

Paint thickness gauges measure the total thickness of the vehicle finish. It is important to accurately measure the thickness of the finish on each vehicle as the thickness of the finish will vary on each vehicle. Use a paint gauge before the sanding process in order to accurately measure how much finish there is to remove before, during and after the sanding process. Paint gauges range from magnetic pull type to sophisticated electronic types and are available from a variety of sources. The older magnetic type gauges, at best have a 5 percent accuracy range and are not sensitive enough to detect removal of 0.02 mm 0.5 mil (0.0005 in) clearcoat. The newer type magnetic gauges have improved accuracy ranges. Most gauges are confined to checking either ferrous metal, steel, non-ferrous metal or aluminum panel. At this time, there are no viable gauges for reading film thickness on composite (SCM doors, RIM fenders) panels. The more sophisticated electronic paint thickness gauges (ETG) digital type gauges are able to read film thickness on both ferrous and non-ferrous metal panel. Digital ETG gauges may have an accuracy range of 1 percent and include thickness standards for recalibration. The following paint thickness gauges are available. Call 1-800-GM-TOOLS for information:

Paint Thickness Gauges

- 147-5437-ETG Standard model
- 147-5437-ETG-P Standard model with print option
- 147-5437-N-ETG-N Non-ferrous model for aluminum panels
- 147-5437-NP-ETG-NP Non-ferrous model with print option
- 147-54437-SD-ETG Steel and aluminum gauge

CLEARCOAT THICKNESS

The clearcoat on the vehicle is typically 0.059-0.078 mm (1.5-2 mils [0.0015-0.0020 in]) thick. The clearcoat contains ultraviolet screeners. Removing more than 0.5 mils (0.019 in) of the clearcoat may result in early paint failure.

RAIL DUST DAMAGE REPAIR

WARNING: Refer to Eye Protection Warning .

NOTE: If rail dust has penetrated into the basecoat, the panel requires refinishing. Ensure all the rail dust has been removed prior to refinishing or the rust spots will return.

Rail dust damage comes from the tiny iron particles produced from the friction between the train wheels and the track. It can also be deposited on vehicles if stored near any operation producing iron dust (i.e., steel ore yards). This dust can either lay on top of or embed into the paint surface. It is usually diagnosed as bumps in the paint surface or rust colored spots in the paint.

1. Move the vehicle to a cool shaded area and ensure the vehicle surfaces are cool during the removal process.
2. Thoroughly wash the repair area with Liquid Wash and Wax GM P/N 1052870 or equivalent.
3. Wipe the area dry.

4. Clean the affected area with silicone, wax and grease remover.
5. Perform the removal process according to the manufacturer's directions of the type of repair material used (Gel Type Oxalic Acid or Clay Type Non-Acid Based). If, upon inspection, some particles are still present, the process may be repeated. If the damage has been repaired, complete the repair to the entire panel.
6. Polish the entire panel after the removal process. If small pits remain in the clearcoat after all of the damage has been repaired, refer to **Clearcoat Repair without Repainting**.

BRAKES

Park Brake - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Park Brake Cable Mounting Clamp to Floor Panel Cross Bar Retaining Nut	22 N.m	16 lb ft
Park Brake Cable Mounting Clamp to Rear Axle Bracket Retaining Nut	9 N.m	80 lb in
Park Brake Cable Mounting Clamp to Rear Side Rail Retaining Nut	22 N.m	16 lb ft
Park Brake Indicator Switch Mounting Screw	1.5 N.m	13 lb in
Park Brake Lever Assembly Mounting Nuts	22 N.m	16 lb ft

DIAGNOSTIC INFORMATION AND PROCEDURES

SYMPTOMS - PARK BRAKE

NOTE: Review the system operation in order to familiarize yourself with the system functions. Refer to Park Brake System Description and Operation

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the park brake system.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- Park Brake Will Not Hold or Release
- Park Brake System Diagnosis

PARK BRAKE WILL NOT HOLD OR RELEASE

Park Brake Will Not Hold or Release

Step	Action	Yes	No

1	Were you sent here from a Park Brake Symptom table?	Go to Step 2	Go to Symptoms - Park Brake
2	Inspect the park brake system for proper operation. Refer to <u>Park Brake System Diagnosis</u> . Did you find and correct a condition?	Go to Step 6	Go to Step 3
3	Inspect the drum brake system for proper operation. Refer to <u>Drum Brake System Diagnosis</u> . Did you find and correct a condition?	Go to Step 6	Go to Step 4
4	Inspect the disc brake system for proper operation. Refer to <u>Disc Brake System Diagnosis</u> . Did you find and correct a condition?	Go to Step 6	Go to Step 5
5	Inspect the hydraulic brake system for proper operation. Refer to <u>Hydraulic Brake System Diagnosis</u> . Did you find and correct a condition?	Go to Step 6	Go to Symptoms - Park Brake
6	Road test the vehicle in order to confirm correct operation. Refer to <u>Brake System Vehicle Road Test</u> . Is the condition still present?	Go to Step 2	System OK

PARK BRAKE SYSTEM DIAGNOSIS

Park Brake System Diagnosis

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the PARK brake system in order to determine if the PARK brake system is operating properly. You will be directed by the appropriate Symptom table to go to other brake system diagnostic tables as appropriate.			
1	Were you sent here from a Hydraulic Brake Symptom table?	Go to Step 4	Go to Step 2
2	Were you sent here from a Park Brake Symptom table?	Go to Step 4	Go to Step 3
3	Is the symptom related to the ability of the park brake system to hold and/or release?	Go to Symptoms - Park Brake	Go to Symptoms - Hydraulic Brakes
4	1. Raise and support the vehicle with the rear axle supported by jack stands. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Shift the transmission into NEUTRAL. 3. With the park brake RELEASED, attempt to rotate the rear wheels to check the rear brakes for a significant amount of drag.		
	Do the rear brakes have a substantial amount of drag?	Go to Step 11	Go to Step 5
5	1. With the transmission still in NEUTRAL, apply the park brake. 2. Attempt to rotate the rear wheels to check the rear brakes for a significant amount of drag.		

	Do the rear brakes have a significant amount of drag?	Go to Step 6	Go to Step 7
6	1. Release the park brake. 2. Rotate the rear wheels to check the rear brakes for a significant reduction in the amount of drag. Did the rear brakes exhibit a significant reduction in the amount of drag?	Go to Step 20	Go to Step 11
7	1. Remove the brake drums. Refer to <u>Brake Drum Replacement</u>. 2. Visually check the park brake cable connections and the cables that are accessible on the UNDERSIDE of the vehicle for disconnections and/or damage. Were any or the park brake cables disconnected and/or damaged?	Go to Step 8	Go to Step 9
8	Reconnect or replace the park brake cables as necessary. Refer to <u>Parking Brake Cable Replacement</u>. Did you complete the repair and/or replacement?	Go to Step 9	-
9	Check the adjustment of the park brake. Refer to <u>Parking Brake Adjustment</u>. Was the park brake adjusted properly?	Go to Step 11	Go to Step 10
10	Adjust the park brake. Refer to <u>Parking Brake Adjustment</u>. Were you able to attain adjustment of the park brake?	Go to Step 16	Go to Step 11
11	CAUTION: Do not depress the brake pedal with the brake rotors and/or the brake drums removed or with the brake calipers repositioned away from the brake rotors or damage to the brake system may result. 1. Remove the brake drums. Refer to <u>Brake Drum Replacement</u>. 2. Inspect the park brake hardware for loose, damaged, broken or missing components. Refer to <u>Park Brake Hardware Inspection</u>. 3. Check the drum brake adjusters for a seized condition. Do the park brake hardware and/or the drum brake adjusters require replacement?	Go to Step 12	Go to Step 13
12	1. Replace park brake hardware components as necessary. Refer to <u>Brake Shoe Replacement</u>. 2. Replace the drum brake adjusting hardware as necessary. Refer to <u>Drum Brake Adjusting Hardware Replacement</u>.		-

	Did you complete the replacement?	Go to Step 13	
13	Have an assistant apply and release the park brake, while you observe the park brake cables for free movement. Do the park brake cables move freely?	Go to Step 14	Go to Step 17
14	Check the adjustment of the park brake. Refer to <u>Parking Brake Adjustment</u> . Was the park brake adjusted properly?	Go to Step 16	Go to Step 15
15	Adjust the park brake. Refer to <u>Parking Brake Adjustment</u> . Were you able to attain adjustment of the park brake?	Go to Step 16	Go to Step 25
16	1. With the transmission still in NEUTRAL, apply the park brake. 2. Attempt to rotate the rear wheels to check the rear brakes for a significant amount of drag. 3. Release the park brake. 4. Rotate the rear wheels to check the rear brakes for a significant reduction of drag. Does the park brake apply and release properly?	Go to Step 27	Return to Symptom Table
17	1. Remove the brake drums. Refer to <u>Brake Drum Replacement</u>. 2. Disconnect the park brake cable connections that are accessible on the UNDERSIDE of the vehicle one at a time and check each cable for free movement. Did any of the park brake cables accessible on the underside of the vehicle require replacement?	Go to Step 18	Go to Step 19
18	Replace any of the park brake cables that do not have free movement - not releasing properly. Refer to <u>Parking Brake Cable Replacement</u> . Did you complete the replacement?	Go to Step 23	-
19	Replace the park brake lever assembly - not releasing properly. Refer to <u>Parking Brake Lever Replacement</u> . Did you complete the replacement?	Go to Step 24	-
20	Check the adjustment of the park brake. Refer to <u>Parking Brake Adjustment</u> . Was the park brake adjusted properly?	Go to Step 27	Go to Step 21
21	Adjust the park brake. Refer to <u>Parking Brake Adjustment</u> . Were you able to attain adjustment of the park brake system?	Go to Step 26	Go to Step 22
	1. Remove the brake drums. Refer to <u>Brake Drum Replacement</u>. 2. Check the drum brake adjuster for a seized condition.		

22	3. Replace the drum brake adjusting hardware as necessary. Refer to <u>Drum Brake Adjusting Hardware Replacement</u> . Did you find and correct a condition?	Go to Step 23	Go to Step 25
23	Adjust the park brake. Refer to <u>Parking Brake Adjustment</u>. Were you able to attain adjustment of the park brake system?	Go to Step 26	Go to Step 25
24	Adjust the park brake. Refer to <u>Parking Brake Adjustment</u>. Were you able to attain adjustment of the park brake system?	Go to Step 26	Return to Symptom Table
25	1. Replace the component that is used to adjust the park brake system. Refer to <u>Parking Brake Lever Replacement</u>. 2. Adjust the park brake. Refer to <u>Parking Brake Adjustment</u>. Did you complete the replacement and adjustment?	Go to Step 26	Return to Symptom Table
26	1. With the transmission in NEUTRAL, apply the park brake. 2. Attempt to rotate the rear wheels to check the rear brakes for a significant amount of drag. 3. Release the park brake. 4. Rotate the rear wheels to check the rear brakes for a significant reduction of drag. Did the park brake apply and release properly?	Go to Step 27	Return to Symptom Table
27	Install or connect any components that were removed or disconnected during diagnosis. Did you complete the operation?	Park Brake System OK Return to Symptom Table	-

PARK BRAKE HARDWARE INSPECTION

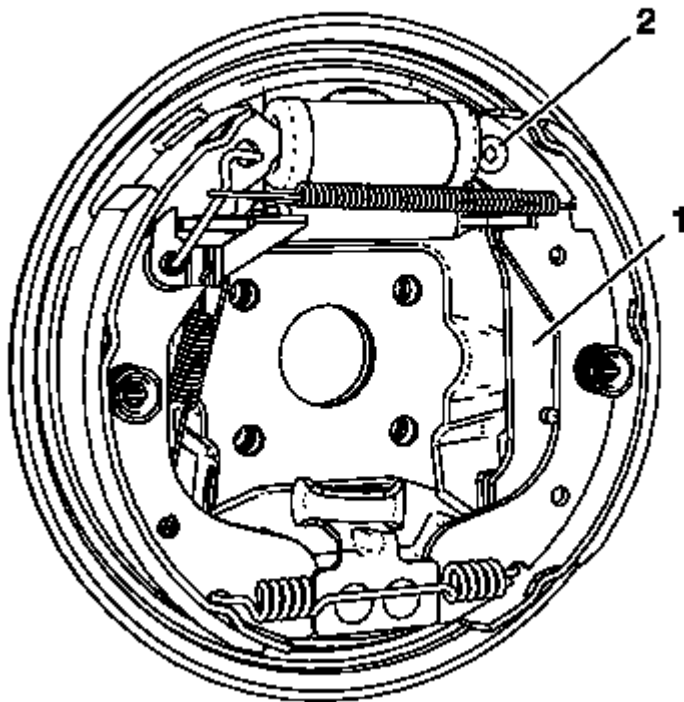


Fig. 1: Park Brake Lever And Pivot Pin
Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to Brake Dust Warning .

1. Visually inspect the park brake lever (1) and the lever pivot pin (2) for the following conditions:
 - The lever being bent or broken at any point - particularly at the cable attachment
 - A seized or binding condition at lever pivot pin
 - A broken lever pivot pin

NOTE: **The brake shoe and park brake lever are not serviced separately. If either component requires replacement, they must be replaced as an assembly.**

2. If any of the conditions listed were found, the park brake lever and brake shoe assembly requires replacement.

REPAIR INSTRUCTIONS

PARKING BRAKE LEVER REPLACEMENT

Removal Procedure

1. Remove the front floor console. Refer to **Front Floor Console Replacement** .
2. Ensure that the park brake lever is in the fully released position.

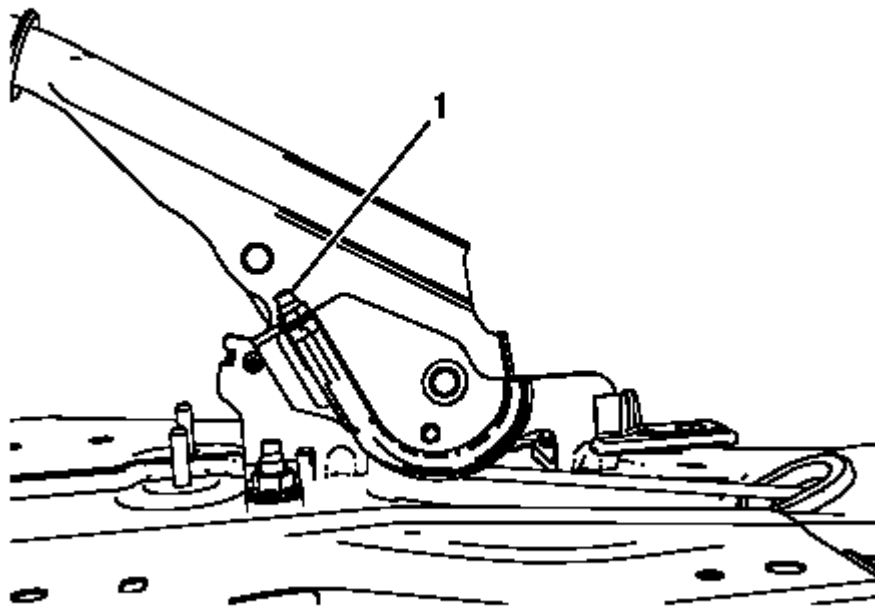


Fig. 2: Front Park Brake Cable Adjusting Nut
Courtesy of GENERAL MOTORS COMPANY

3. Release the tension from the park brake cables.

Using ONLY HAND TOOL, loosen the adjusting nut (1) completely to the end of the front cable threaded rod.

4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

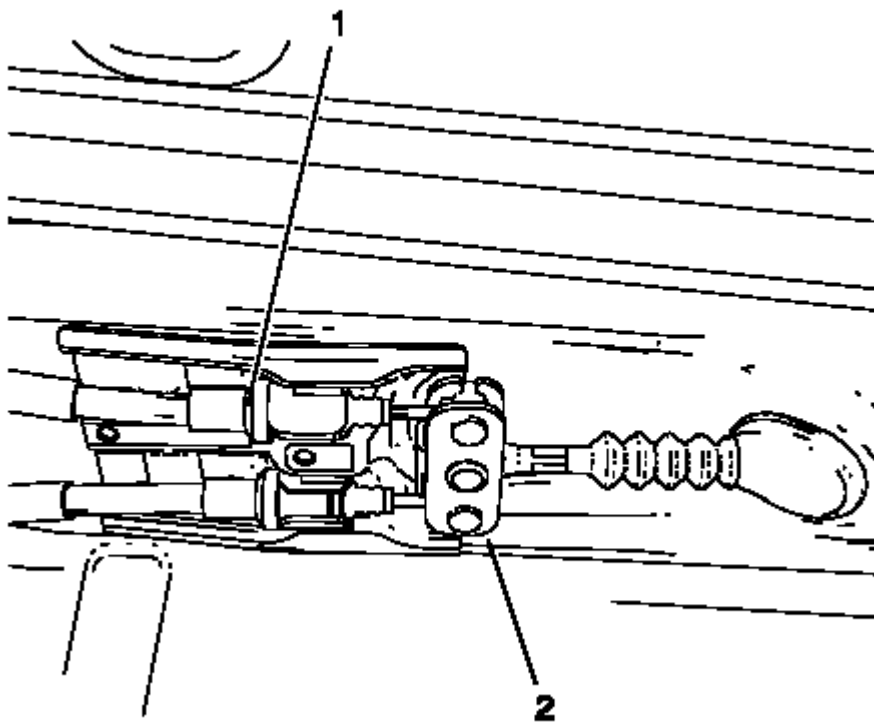


Fig. 3: Left And Right Parking Brake Cables And Cable Equalizer
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect the left and right parking brake cables (1) from the cable equalizer (2).

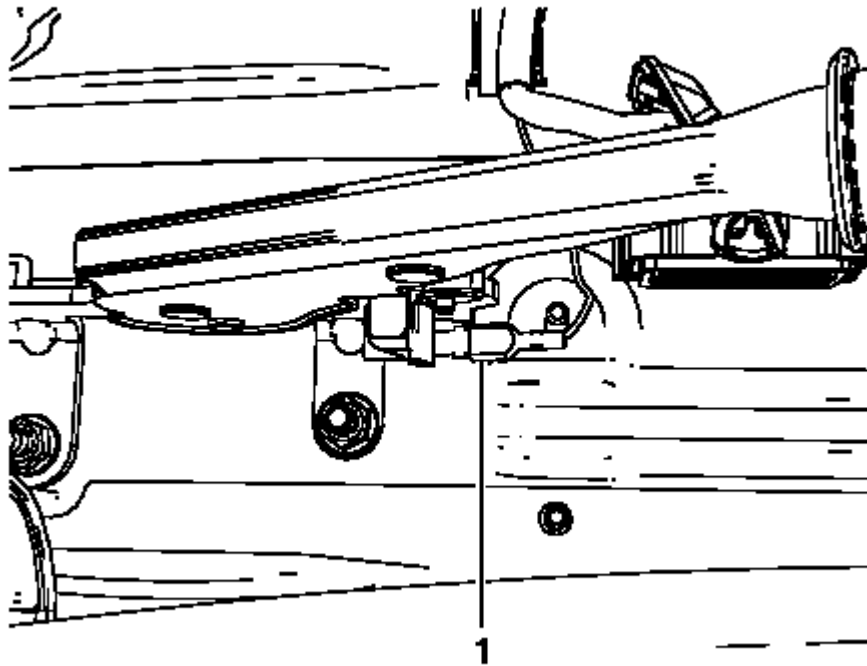


Fig. 4: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

6. Lower the vehicle.
7. Disconnect the electrical connector (1) from the park brake indicator switch.

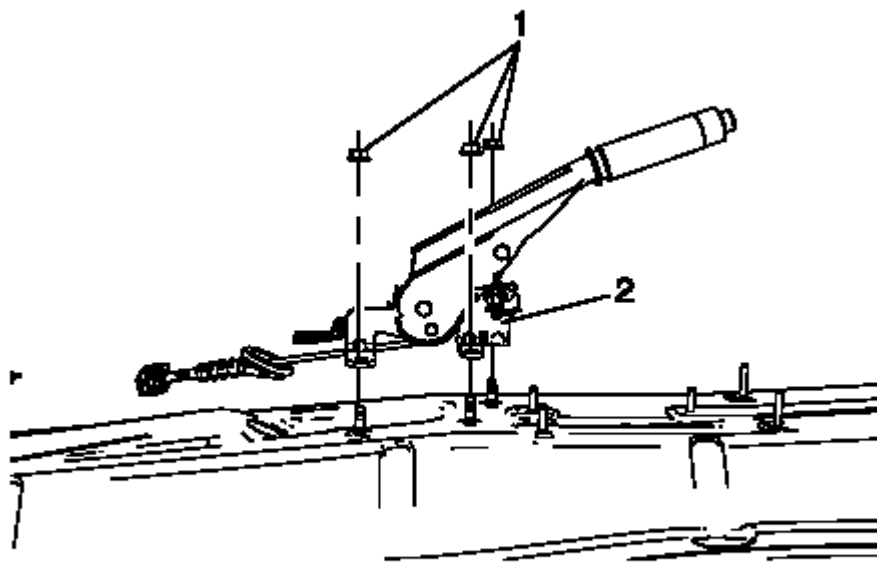


Fig. 5: Park Brake Lever Mounting Nuts
Courtesy of GENERAL MOTORS COMPANY

8. Remove the park brake lever mounting nuts (1).
9. Disconnect the parking brake cable grommet from the floor panel and remove the park brake lever assembly (2) from the vehicle.

Installation Procedure

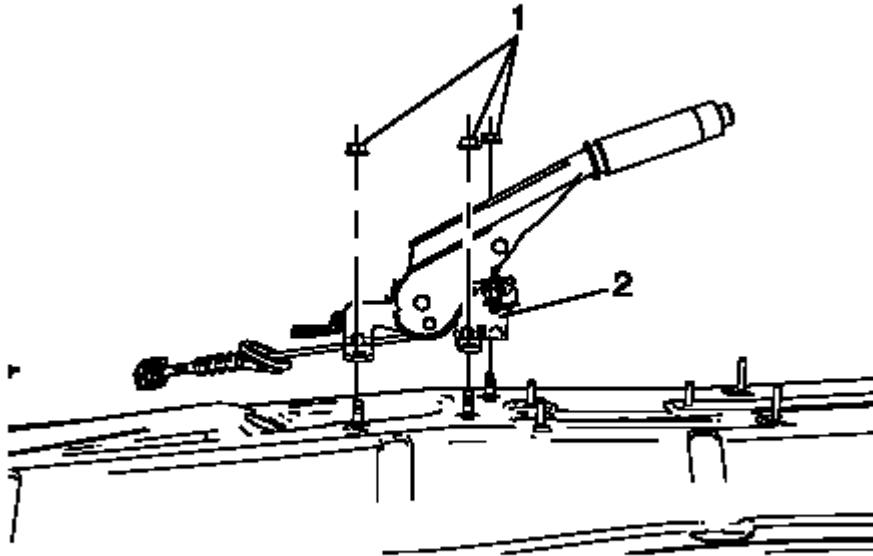


Fig. 6: Park Brake Lever Mounting Nuts
Courtesy of GENERAL MOTORS COMPANY

1. Install the park brake lever assembly (2) to the vehicle and install the parking brake cable grommet to the floor panel.

CAUTION: Refer to Fastener Caution .

2. Install the park brake lever assembly mounting nuts (1) and tighten to 22 N.m (16 lb ft).

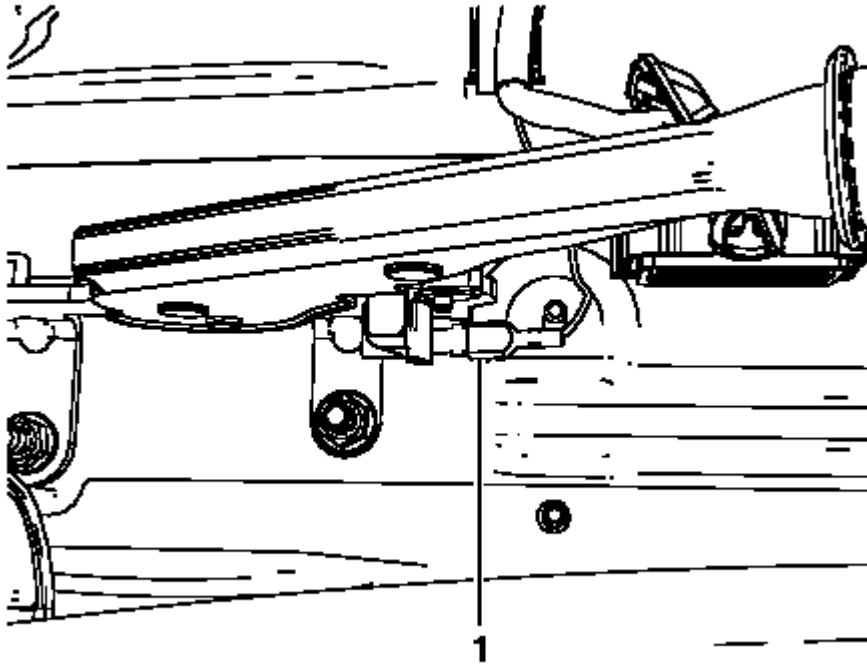


Fig. 7: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

3. Connect the electrical connector (1) to the park brake indicator switch.
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

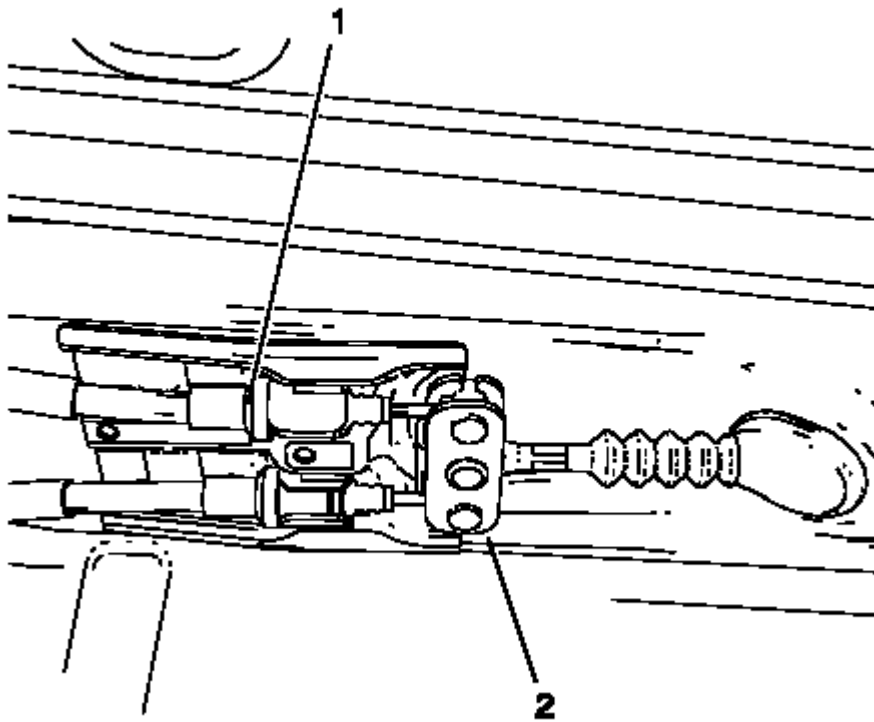


Fig. 8: Left And Right Parking Brake Cables And Cable Equalizer
Courtesy of GENERAL MOTORS COMPANY

5. Install the left and right parking brake cables (1) to the cable equalizer (2).
6. Lower the vehicle.
7. Adjust the park brake cable tension. Refer to **Parking Brake Adjustment**.
8. Install the front floor console. Refer to **Front Floor Console Replacement** .

PARKING BRAKE INDICATOR SWITCH REPLACEMENT

Removal Procedure

1. Remove the front floor console. Refer to **Front Floor Console Replacement** .

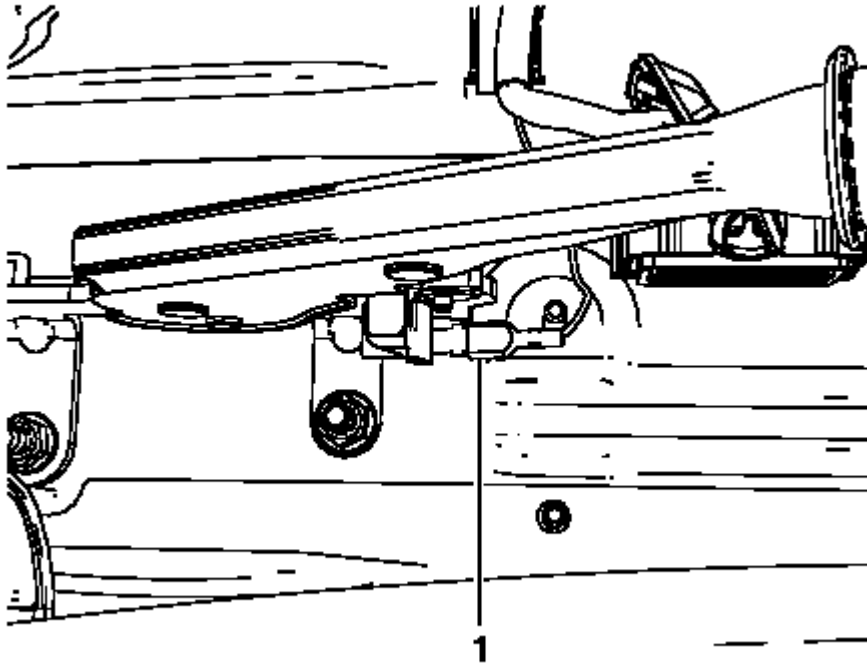


Fig. 9: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the electrical connector (1) from the parking brake indicator switch.

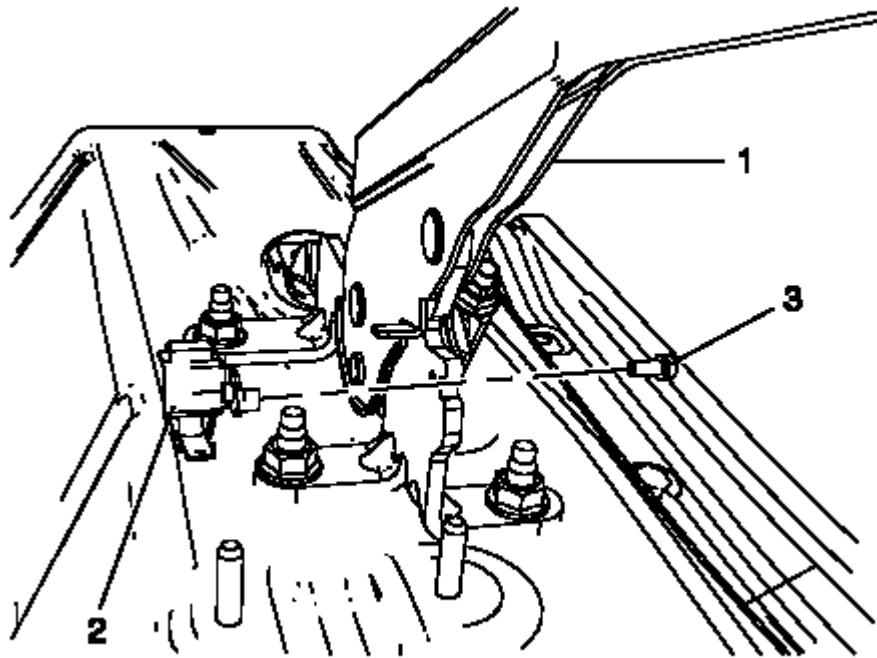


Fig. 10: Parking Brake Indicator Switch
Courtesy of GENERAL MOTORS COMPANY

3. Remove the parking brake indicator switch screw (3).
4. Remove the parking brake indicator switch (2) from the park brake lever assembly (1).

Installation Procedure

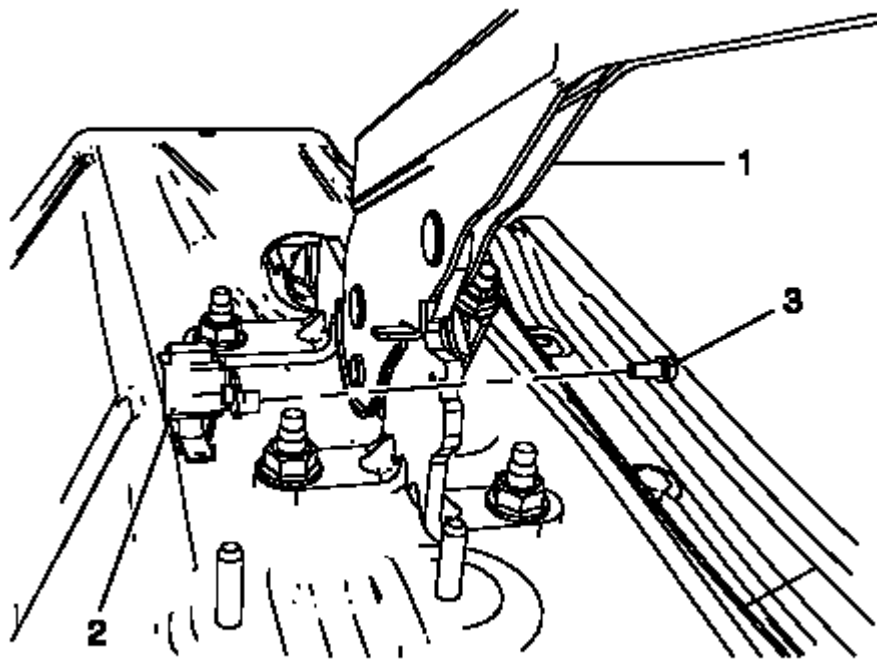


Fig. 11: Parking Brake Indicator Switch
Courtesy of GENERAL MOTORS COMPANY

1. Install the parking brake indicator switch (2) to the park brake lever assembly (1).

CAUTION: Refer to Fastener Caution .

2. Install the parking brake indicator switch screw (3) and tighten to 1.5 N.m (13 lb in).

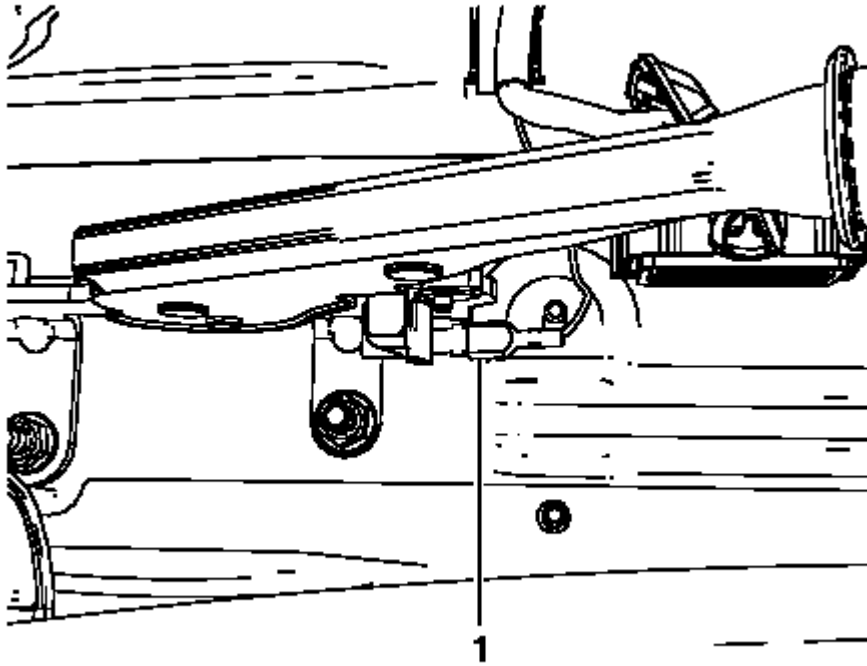


Fig. 12: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

3. Connect the electrical connector (1) to the parking brake indicator switch.
4. Install the front floor console. Refer to **Front Floor Console Replacement** .
5. Check the operation of the parking brake indicator switch.

PARKING BRAKE CABLE REPLACEMENT

Removal Procedure

WARNING: Refer to **Brake Dust Warning** .

1. Ensure that the park brake is in the fully released position.
2. Release the park brake lever boot from the floor console by applying light pressure inward on the sides of the boot retainer and pull the boot back.

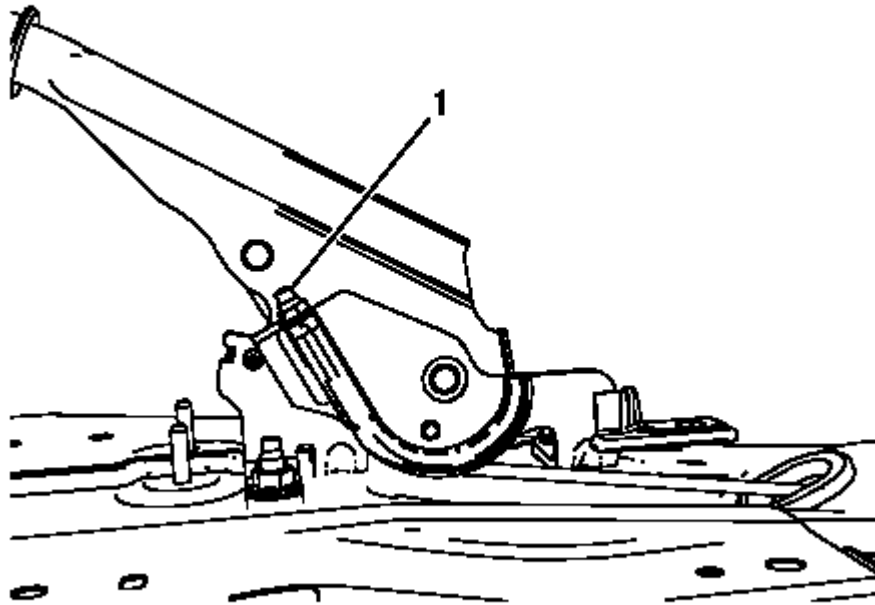


Fig. 13: Front Park Brake Cable Adjusting Nut
Courtesy of GENERAL MOTORS COMPANY

3. With the park brake lever in the released position, loosen the adjusting nut (1) enough to completely relieve tension on the front cable.
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
5. Remove the wheel and tire assembly. Refer to **Tire and Wheel Removal and Installation** .
6. Remove the brake drum. Refer to **Brake Drum Replacement** .

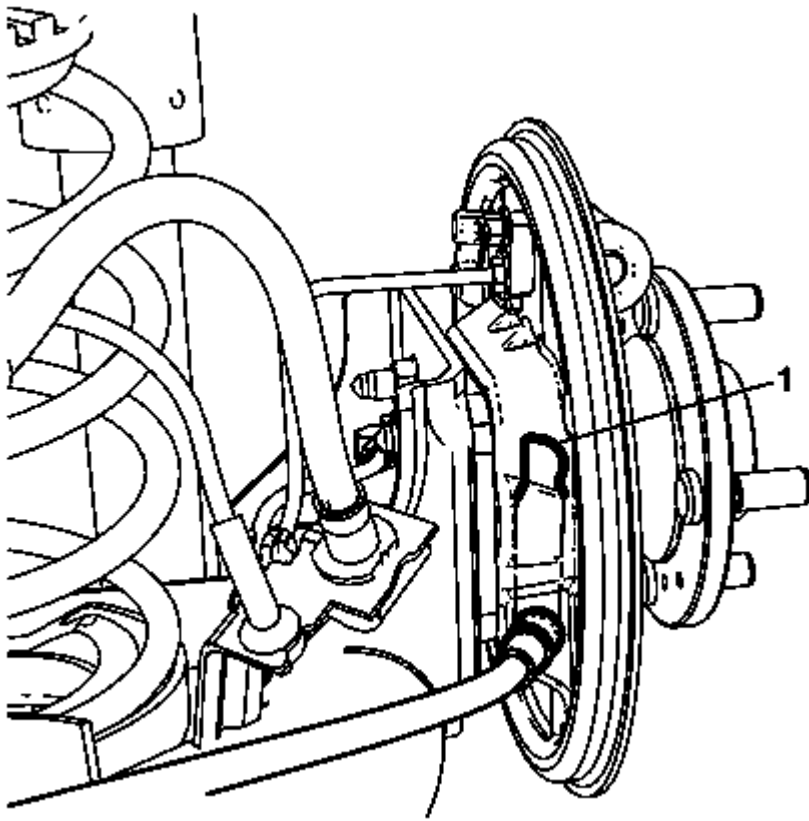


Fig. 14: Rear Park Brake Cable Retaining Clip
Courtesy of GENERAL MOTORS COMPANY

7. Remove the rear park brake cable retaining clip (1) from the drum brake backing plate.
8. Using a flat-bladed screwdriver, disconnect the park brake cable from the park brake lever of the drum brake shoe.

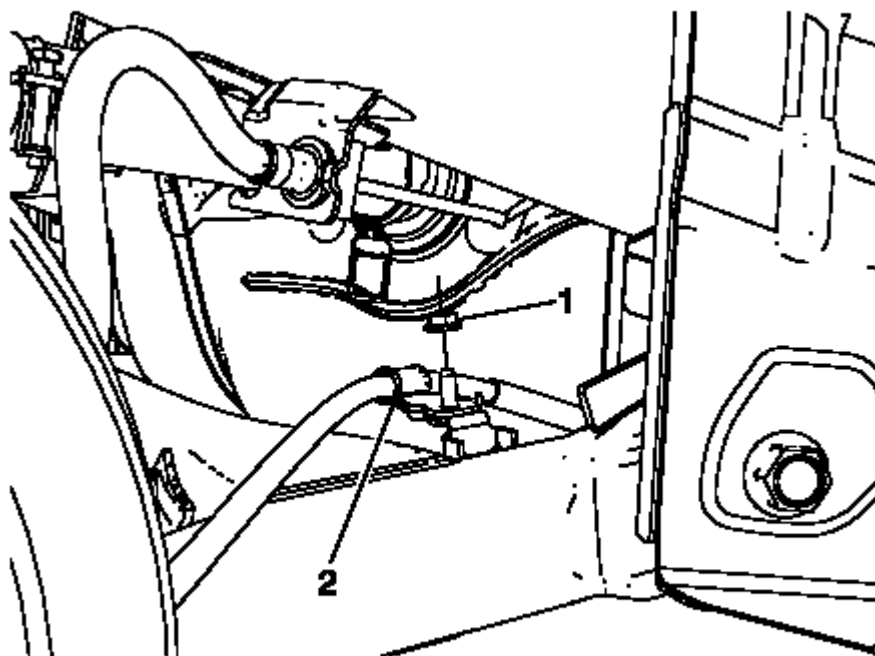


Fig. 15: Park Brake Cable Mounting Clamp Nut
Courtesy of GENERAL MOTORS COMPANY

9. Remove the park brake cable mounting clamp nut (1) and remove the park brake cable mounting clamp (2) from the rear axle bracket.

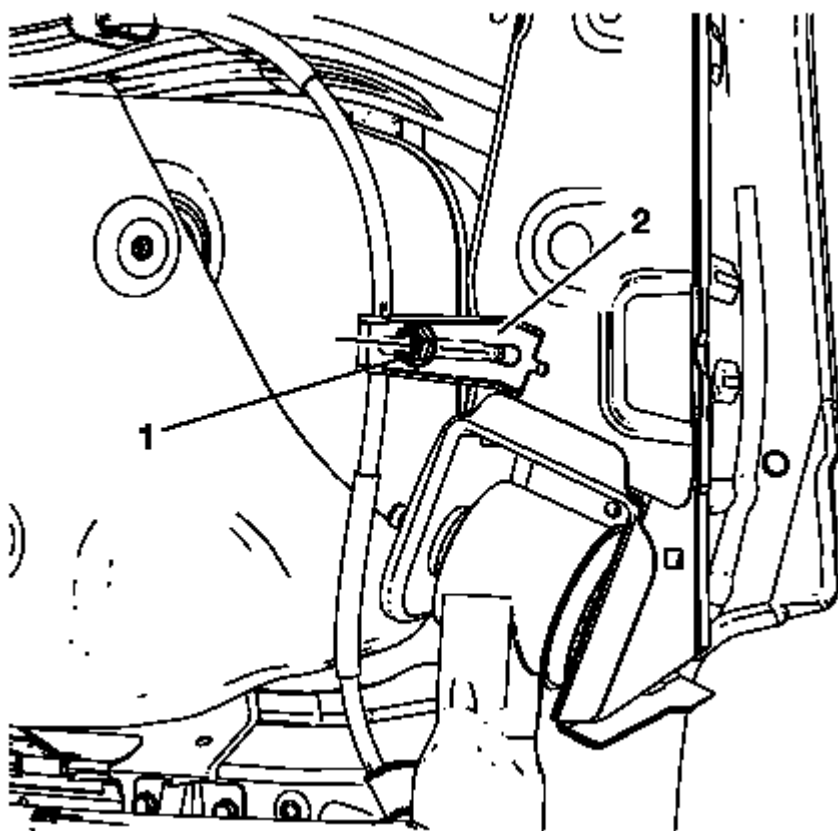


Fig. 16: Park Brake Cable Mounting Clamp Nut
Courtesy of GENERAL MOTORS COMPANY

10. Remove the park brake cable mounting clamp nut (1) and remove the park brake cable mounting clamp (2) from the rear side rail.

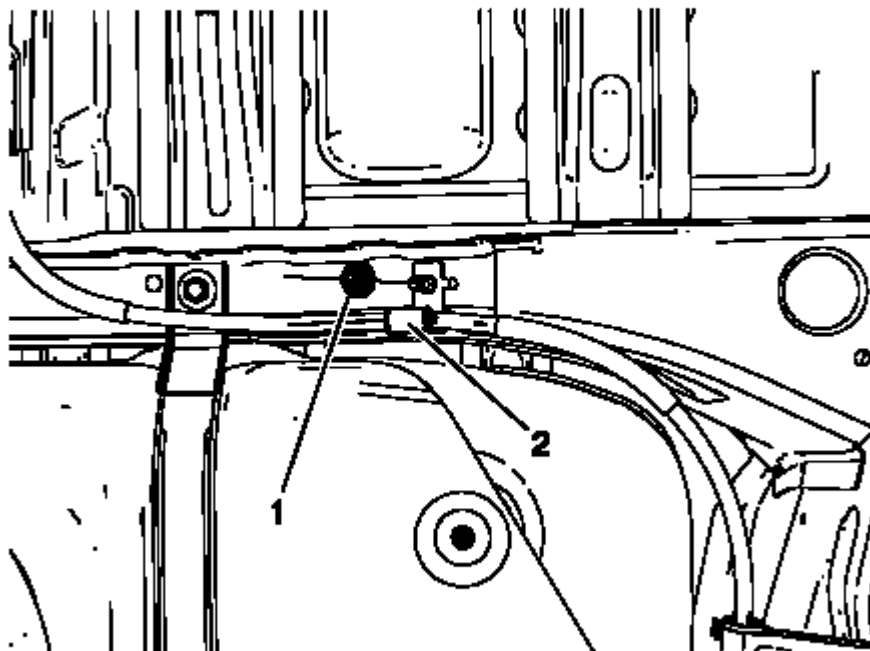


Fig. 17: Park Brake Cable Mounting Clamp Nut
Courtesy of GENERAL MOTORS COMPANY

11. Remove the park brake cable mounting clamp nut (1) and remove the park brake cable mounting clamp (2) from the floor panel cross bar.

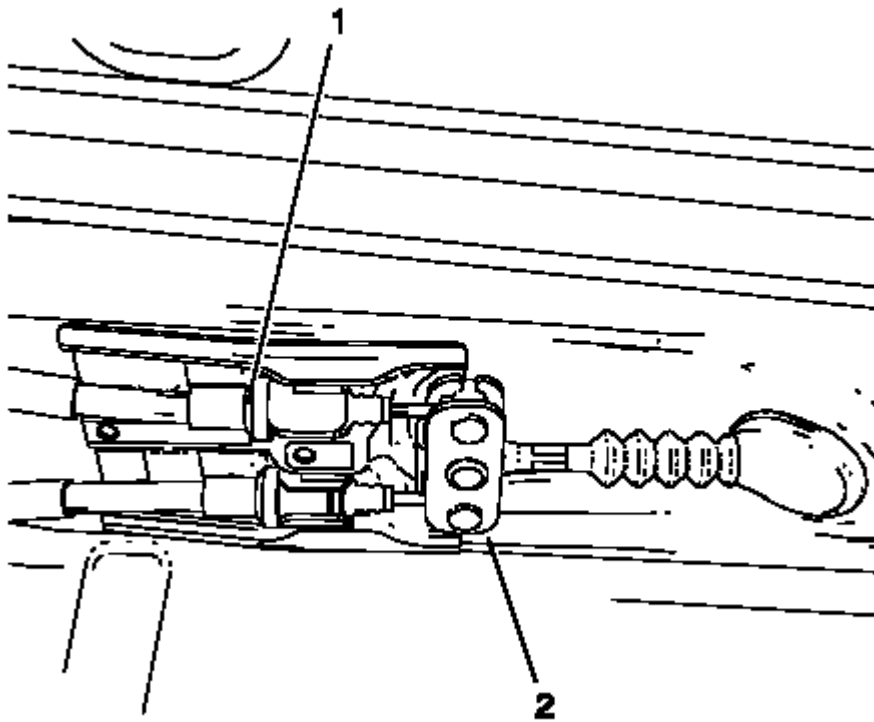


Fig. 18: Left And Right Parking Brake Cables And Cable Equalizer
Courtesy of GENERAL MOTORS COMPANY

12. Detach the park brake cable (1) from the bracket on the floor panel.
13. Separate the park brake cable (1) from the park brake cable equalizer (2) and remove the park brake cable from the vehicle.

Installation Procedure

1. Using a flat-bladed screwdriver, connect the park brake cable from the park brake lever of the drum brake shoe.

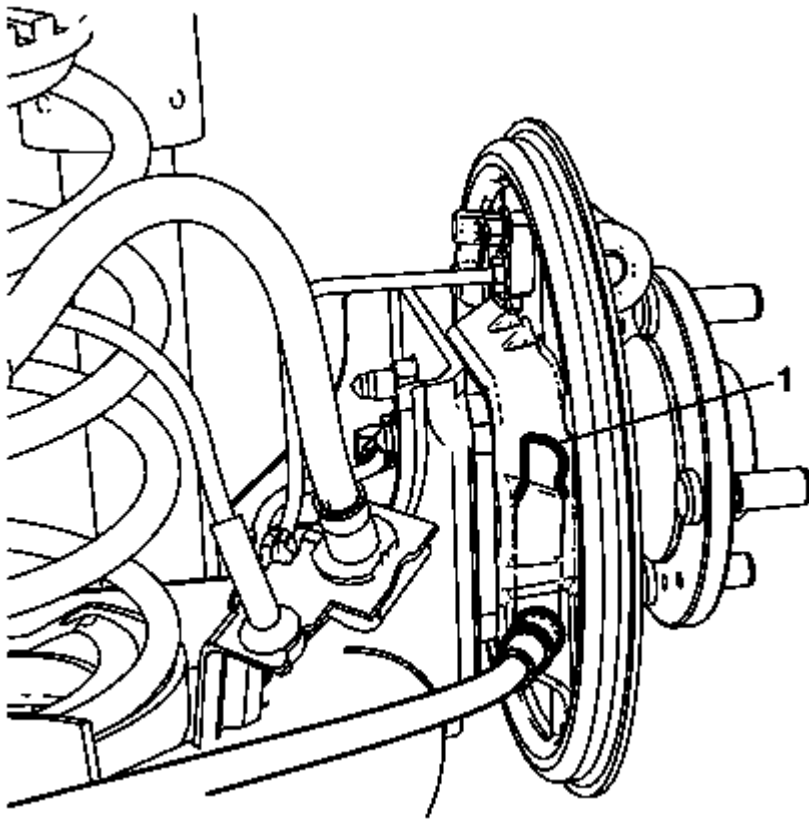


Fig. 19: Rear Park Brake Cable Retaining Clip
Courtesy of GENERAL MOTORS COMPANY

2. Install the rear park brake cable retaining clip (1) to the drum brake backing plate.

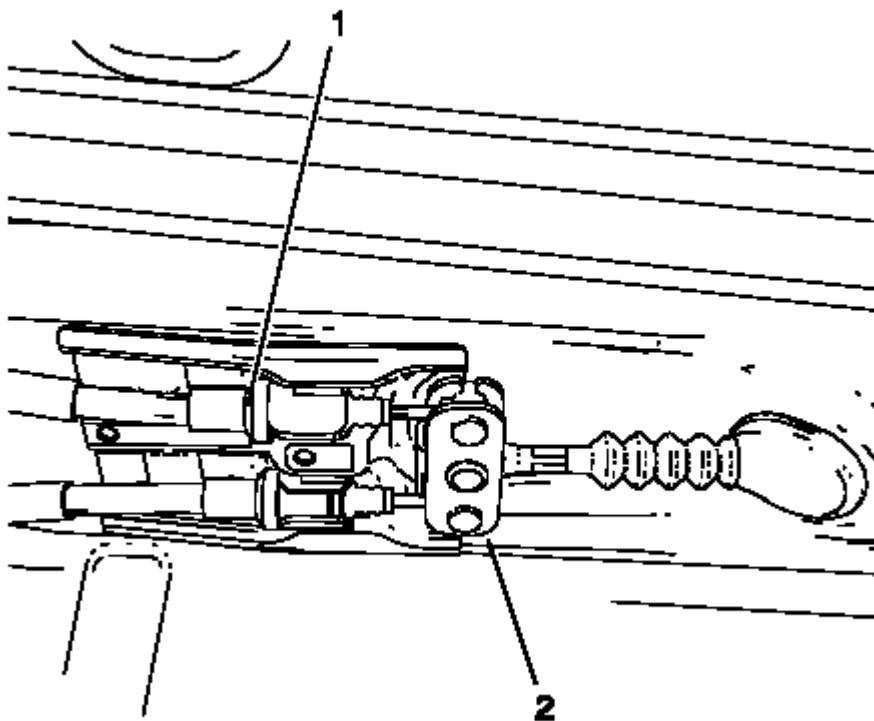


Fig. 20: Left And Right Parking Brake Cables And Cable Equalizer
Courtesy of GENERAL MOTORS COMPANY

3. Connect the park brake cable (1) to the park brake cable equalizer (2) and install the park brake cable (1) to the mounting bracket on the floor panel.

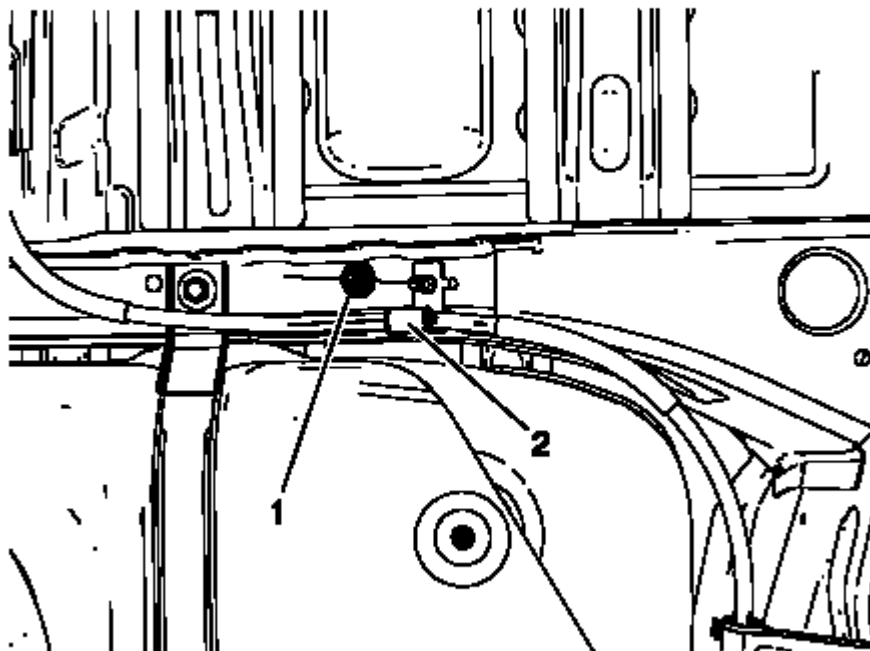


Fig. 21: Park Brake Cable Mounting Clamp Nut
Courtesy of GENERAL MOTORS COMPANY

4. Install the park brake cable mounting clamp (2) to the floor panel cross bar.

CAUTION: Refer to Fastener Caution .

5. Install the park brake cable mounting clamp nut (1) and tighten to 22 N.m (16 lb ft).

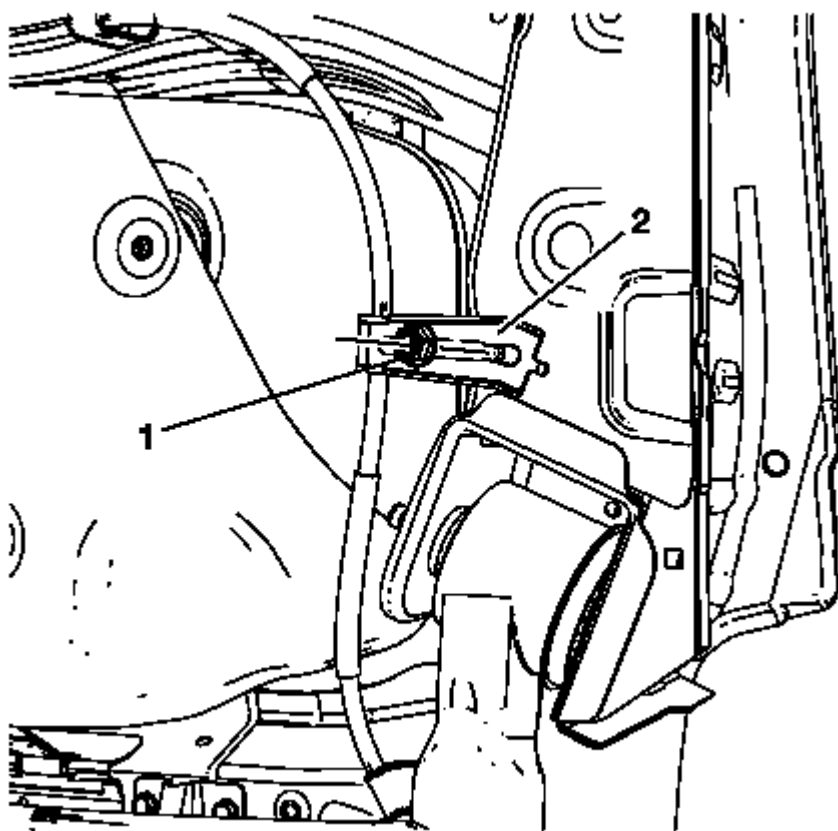


Fig. 22: Park Brake Cable Mounting Clamp Nut
Courtesy of GENERAL MOTORS COMPANY

6. Install the park brake cable mounting clamp (2) to the rear side rail.
7. Install the park brake cable mounting clamp nut (1) and tighten to 22 N.m (16 lb ft).

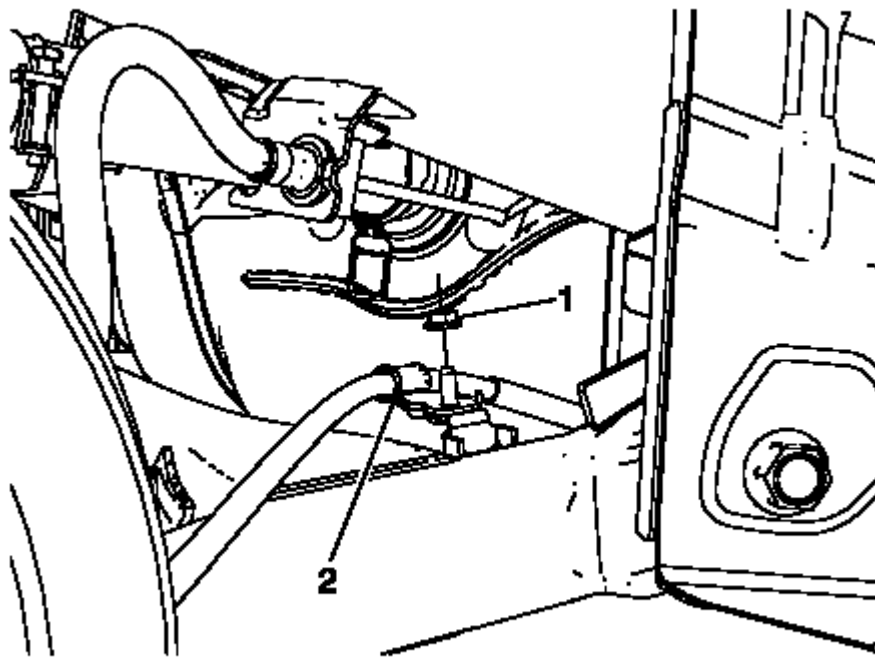


Fig. 23: Park Brake Cable Mounting Clamp Nut
Courtesy of GENERAL MOTORS COMPANY

8. Install the park brake cable mounting clamp (2) to the rear axle bracket.
9. Install the park brake cable mounting clamp nut (1) and tighten to 9 N.m (80 lb in).
10. Install the brake drum. Refer to **Brake Drum Replacement**.
11. Install the wheel and tire assembly. Refer to **Tire and Wheel Removal and Installation**.
12. Adjust the park brake cable tension. Refer to **Parking Brake Adjustment**.

PARKING BRAKE ADJUSTMENT

WARNING: Refer to **Brake Dust Warning**.

NOTE: Use **ONLY HAND TOOLS** whenever tightening or loosening the adjusting nut.

1. Apply and fully release the park brake several times. Verify that the park brake lever releases completely.
2. Turn ON the ignition. Verify the red BRAKE warning lamp is not illuminated.
3. If the red BRAKE warning lamp is illuminated, verify the following:

- The park brake lever is in the fully released position and against the stop.
 - There is no slack in the park brake cables.
4. If the red BRAKE warning lamp remained illuminated and there were no other visible causes, refer to **Symptoms - Hydraulic Brakes** .
 5. Turn OFF the ignition.
 6. Release the park brake lever boot from the floor console by applying light pressure inward on the sides of the boot retainer and pull the boot back.

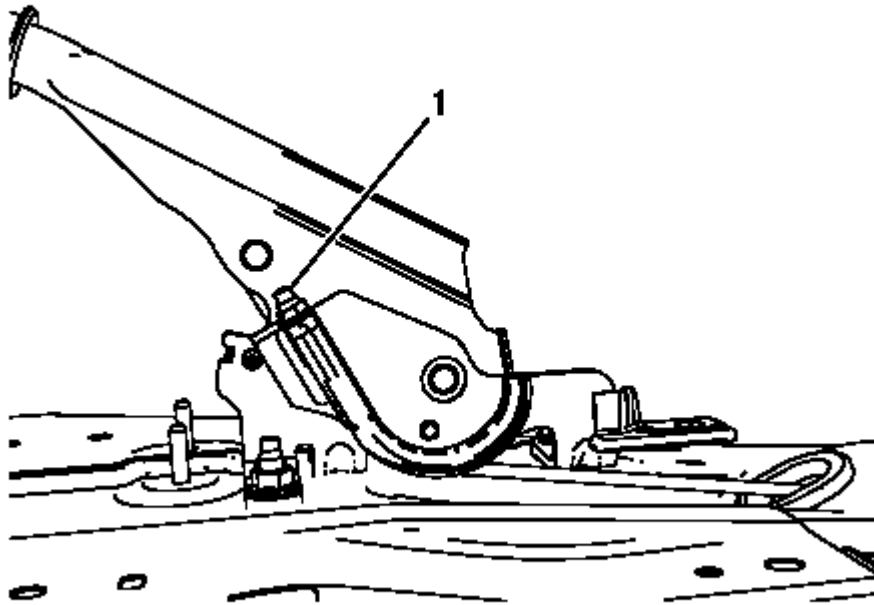


Fig. 24: Front Park Brake Cable Adjusting Nut
Courtesy of GENERAL MOTORS COMPANY

7. With the park brake lever in the released position, loosen the adjusting nut (1) enough to completely relieve tension on the front cable.

CAUTION: Refer to Vehicle Lifting and Jacking Caution .

8. Raise and support the vehicle. Raise the vehicle just enough to allow rear tire and wheel assembly removal and rear drum adjustment.
9. Remove the rear tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** .

10. Adjust the rear drum brakes. Refer to **Drum Brake Adjustment** .
11. Ensure there is no brake shoe drag after adjustment by rotating the brake drums. If drag exists, re-center the brake shoes and perform the brake shoe adjustment again.
12. Raise the park brake lever 6 detent positions.

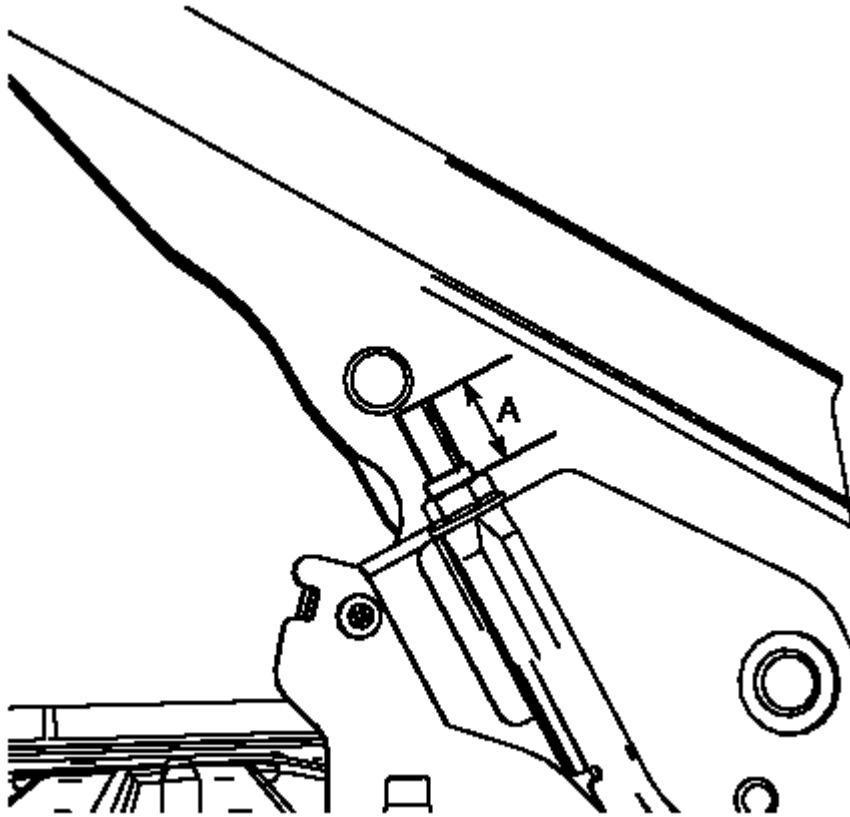


Fig. 25: Installing Park Brake Cable Adjusting Nut Until Projection Amount (A)
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

13. Install the park brake cable adjusting nut until the projection amount (A) of the adjusting rod reaches 21 mm from the adjusting nut.
14. Attempt to rotate the rear brake drums. There should be no rotation forward or rearward.
15. Fully release the park brake lever.
16. Verify the park brake is released by rotating the rear brake drums. The drums should rotate freely and exhibit no brake shoe drag.
17. If the drums do not rotate freely, repeat the park brake cable adjustment procedure.
18. Raise the park brake lever 3 detent positions and attempt to rotate the rear brake drums:
 - One of the brake drums should not rotate forward or rearward.

- The other brake drum should not rotate forward or rearward or should require substantial effort to rotate.
19. Raise the park brake lever one additional detent position and attempt to rotate the rear brake drums.
 20. Verify that the left and right brake drums cannot be rotated.
 21. Install the rear tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** .
 22. Lower the vehicle.
 23. Position the park brake lever boot to the floor console and press the boot retainer into place to secure.
 24. Release the park brake lever.

DESCRIPTION AND OPERATION

PARK BRAKE SYSTEM DESCRIPTION AND OPERATION

System Component Description

The park brake system consists of the following:

Park Brake Lever Assembly

Receives, multiplies and transfers park brake system apply input force from driver to park brake cable system. Releases applied park brake system when lever release button is depressed and lever is returned to the at-rest position.

Park Brake Cables

Transfers input force received from park brake lever, through park brake cable equalizer, to park brake apply levers.

Park Brake Cable Equalizer

Evenly distributes input force to both the left and right park brake units. Threaded front park brake cable adjuster is also used to remove slack in park brake cables.

Park Brake Apply Lever

Multiplies and transfers input force to park brake actuator/adjuster.

Drum Brake Actuator/Adjuster

Uses multiplied input force from park brake apply lever to expand drum brake shoes toward the friction surface of the brake drum. Threaded drum brake actuators/adjusters are also used to control clearance between the drum brake shoes and the friction surface of the brake drum.

System Operation

Park brake apply input force is received by the park brake lever assembly being applied. The input force is multiplied by the lever assembly, transferred and evenly distributed, through the park brake cables and the park brake cable equalizer, to the left and right park brake apply levers. The park brake apply levers multiply and transfer the apply input force to the drum brake actuators/adjusters which expand the drum brake shoes toward the friction surface of the brake drum in order to prevent the rotation of the rear tire and wheel assemblies. The park brake lever assembly releases an applied park brake system when it is released and returned to the at-rest position.

ACCESSORIES & EQUIPMENT

Plastic Panel Information and Repair - Spark

REPAIR INSTRUCTIONS

GENERAL PLASTIC REPAIR

WARNING: In order to reduce the risk of personal injury when exposed to toxic fumes while grinding, cutting or applying repair material on any type of sheet molded compound or RIM rigid plastic, observe the following guidelines:

- Work in a properly ventilated area
- Apply protective cream to any exposed skin
- Remove any mixture that comes into contact with skin
- Wash skin with cold water to remove glass and resin dust
- Use a sander with a vacuum attachment
- Follow the repair material manufacturer's instructions

Also, always wear the following:

- An approved respirator or air supplied respirator
- Eye protection
- Rubber gloves
- Earplugs
- Protective clothing

The following procedures should be followed when repairing all types of thermoset plastic:

- Follow the manufacturer's application and curing recommendations.
- Do not intermix systems. Use the supplies and the repair materials from the same manufacturer.
- Clean the inner and outer surfaces of the repair area with a soap impregnated scouring pad in order to remove any dirt or mold release agent.
- Clean the area with a wax and grease remover, using only enough of the remover to dampen a cloth. Allow the panel to dry thoroughly.
- Remove the surface finish from the area to be repaired. Adhesives are designed to adhere to the plastic substrate, not the finish.
- Prime a metal surface before applying the repair material.
- Inspect the rear side of the work area before making repairs in order to avoid possible damage to wires, motors, etc.

DESCRIPTION AND OPERATION

HOW TO IDENTIFY PLASTIC PARTS

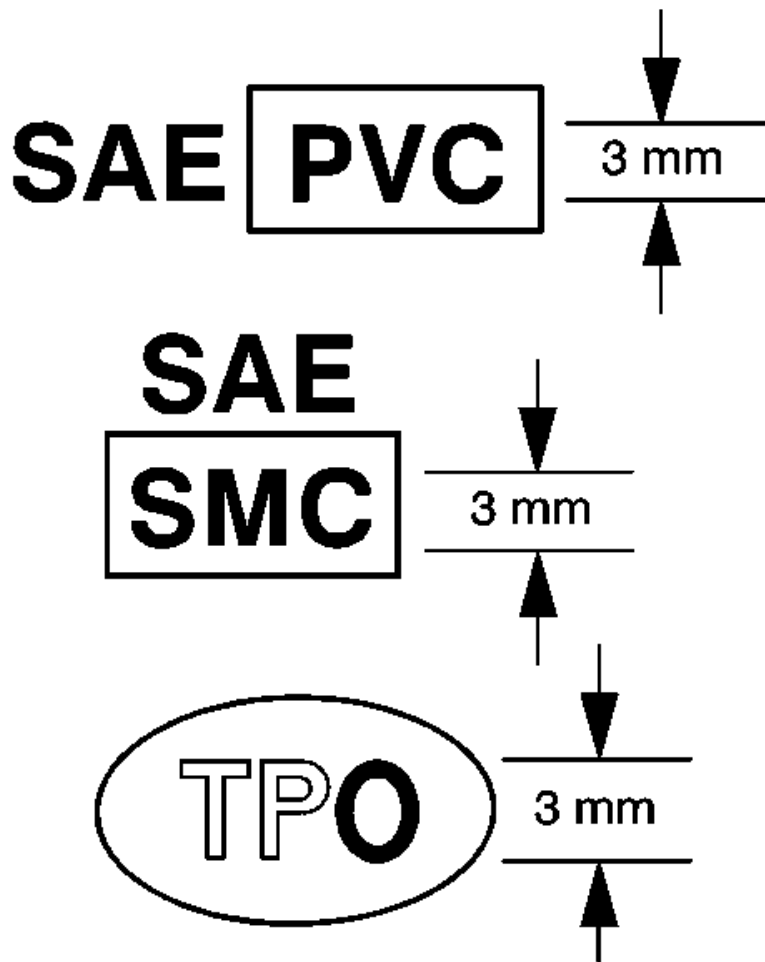


Fig. 1: Identifying SAE Code

Courtesy of GENERAL MOTORS COMPANY

Plastic parts can be identified by the SAE code, which is usually found on the rear of the part, and/or by the characteristics of the plastic. Knowing the type of plastic aids in selecting the proper repair materials and in selecting the proper repair procedure.

Look for the SAE code stamped into the part.

Code Found

Match the code to those in the plastic identification chart to determine whether the plastic is thermoplastic or thermoset plastic and whether the plastic is rigid or flexible. Refer to **Plastic Identification and Refinishing Systems**.

No Code Found

WARNING: Do NOT use a plastic burn test to distinguish the type of plastic. The burn test produces vapors which are harmful.

Perform one or both of the following tests to determine if the part is thermoplastic polyolefin or thermoset non-polyolefin.

Float Test

1. Cut a shaving of plastic from the back of the part.

The shaving should be free of mold release agents and paint.

2. Place the shaving in a container of water.
 - Thermoplastic polyolefin floats
 - Thermoset non-polyolefin sinks

Abrasion Test

- Sand a spot near the damaged area with Grade 36 Roloc Disc.
- Thermoplastic polyolefin material melts or frays when sanded.
- Thermoset non-polyolefin material sands cleanly.

Thermoplastic and thermoset plastics can be either rigid or flexible. Thermoplastic plastic parts are best repaired with a hot iron plastic material-feed welder, but are usually replaced. Thermoset plastic can be repaired with epoxy or other more rigid 2 package repair material.

For general repair instructions, refer to **General Plastic Repair**.

PLASTIC IDENTIFICATION AND REFINISHING SYSTEMS

Plastic Identification and Refinishing Systems

Identifying Symbol - Old Symbol in ()s	Chemical Composition or Plastic Family Name	Typical Area(s) Where Part is Used	Examples of Common/ Trade Names	Type of Plastic
ABS	Acrylonitrile/ Butadiene-Styrene	Armrest Support, Console, IPC, Steering Column Bracket/ Jacket, Trim Molding	ABS, Absafil, Magnum, Cyclolac, Dyel, Kralastic, Lustran	Thermoplastic
ABS + PC	Acrylonitrile / Butadiene-Styrene + Polycarbonate	Instrument Panel, IPC	Bayblend, Cycloloy, KHA, Pulse	Rigid
ABS/PVC	ABS/Vinyl (Soft)	Head Rest Cover, Instrument Panel Pad, Trim Molding/ Panel	ABS Vinyl	Flexible, Vinyl

EPDM	Ethylene Propylene Diene Monomer	Body Panel, Bumper Impact Strip	EPDM, Nordel	Rigid
EVA (EVAC)	Ethylene / Vinyl Acetate	Head Rest Cover, Misc Soft Trim	Elvax, Microthane	Flexible
PA	Polyamide	Headlamp Bezels, Quarter Panel Extensions, Exterior Finish Trim Panels	Nylon, Capron, Zytel, Rilsan, Minion, Vydine, Welland	Rigid
PA, PAG, PAGG	Polyamide	Exterior Finish Trim Panel, Headlamp Bezel, Quarter Panel Extension	Capron, Minlon, Nylon, Rilsan, Vydine, Wellamid, Zytel	Rigid, Thermoset
PA + PPE	Polymide + Polyphenylene Ether	Exterior Trim, Fender	GTX	Rigid, Thermoset
PBT + TEEE (PBTP + EEBC)	Polybutylene, Terephthalate + Ether, Ester Block Compound	Fascia, Rocker Panel Molding	Bexloy M	Rigid
PC	Polycarbonate	Interior Rigid/Hard Trim Panel, Valance Panel	Calibre, Lexan, Merlon, Makrolon	Rigid, Thermoset
PC + PETP	Polycarbonate + Polybutylene, Terephthalate	Bumper Fascia	Macroblend, Valox, Xenoy	Flexible, Thermoset
PE	Polyethylene	Fuel Tank Shield, Inner Fender Panel, Interior Trim Panel, Seat Belt Cover, Spoiler, Valance	Alathon, Dylan, Foriflex, Hi-fax, Hosalen, Marlex, Paxon	Rigid, Thermoplastic
PF	Phenol Formaldehyde	Ashtray	Amberol, Bakelite, Durez, Genal, Phenolic, Plyophen, Resinox	Rigid, Thermoset
PP	Polypropylene	Bumper Fascia, Cowl Panel, Deflector Panel, Door Panel, Inner Fender, Interior Molding, Kick Panel, Load Floor, Radiator Shroud, Wheel Cover	Azdel, Daplen, Escorene, Marlex, Novolen, Oleflo, Profax, Tenite	Flexible, Thermoplastic
		Bezels, Chromed	Noryl, Oleflo,	

PPE (PPO)	Polyphenylene Ether	Plastic, Headlamp Door, Ornaments	Prevex	Rigid, Thermoset
PS	Polystyrene	Dash Panel, Door Panel	Durathon, Dylan, Lustrex, Polystyrol, Styron	Flexible, Soft
PUR	Polyurethane, Thermoset (Unsaturated)	Bumper Fascia, Filler Panel, Front/Rear Body Panel, Pickup Box	Bayflex, Castethane, RIM, RRIM, SRIM	Thermoset
PVC	Polyvinyl Chloride (Vinyl)	Interior Soft Trim, I/P Skins, Roof Cover	Geon, Pliovic, Unichem, Vinoflex, Vinyl, Vinylite	Flexible, Vinyl
SAN (SA)	Styrene Acrylonitrile	Center Console, Glove Box Door, Interior Trim Panel	Foracryl, Lustran, Tyril	Rigid
TEO (EP, EPM, TPO)	Ethylene / Propylene (Rubber)	Air Dam, Bumper Fascia, Valance Panel	EPI, EPII, TPO, TPR (Thermoplastic Rubber)	Flexible, Thermoplastic
TPO	Thermal Plastic Oletin	Bumper Covers	TPO	Flexible Thermoplastic
TPU (TPUR)	Polyurethane, Polyolefin	Bumper Fascia, Gravel Deflector, Soft Filler Panel, Window Molding	Estane, Pellethane, Roylar, Toxin	Flexible, Thermoplastic
UP	Polyester / Thermoset	Air Scoop, Air Spoiler, Fascia Extension, Hood, Instrument Housing, Rear Compartment Lid, Roof, Ventilation Grid	Fiberglass, Premiglass, Selectron, SMC, Vibrinmat	Rigid, Thermoset

For symbols not listed in this table, contact the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

ACCESSORIES & EQUIPMENT

Vehicle Access - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Front Side Door Inside Handle Screw	1.5 N.m	13 lb in
Front Side Door Lock Cylinder Bolt	4.5 N.m	40 lb in
Front Side Door Lock Screw	8.5 N.m	75 lb in
Front Side Door Lock Striker Screw	25 N.m	18 lb ft
Front Side Door Outside Handle Bolt	4.5 N.m	40 lb in
Fuel Tank Filler Door Latch Release Cable Lever Bolt	8 N.m	71 lb in
Liftgate Latch Bolt	12 N.m	106 lb in
Liftgate Lock Actuator Nut	9 N.m	80 lb in
Liftgate Lock Cylinder Nut	5 N.m	44 lb in
Liftgate Lock Striker Screw	20 N.m	15 lb ft
Liftgate Outside Handle Nut	5 N.m	44 lb in
Rear Side Door Lock Screw	8.5 N.m	75 lb in
Rear Side Door Outside Handle Bolt	4.5 N.m	40 lb in

SCHEMATIC WIRING DIAGRAMS

DOOR LOCK/INDICATOR WIRING SCHEMATICS

Switches and Door Ajar Indicator Wiring Schematics

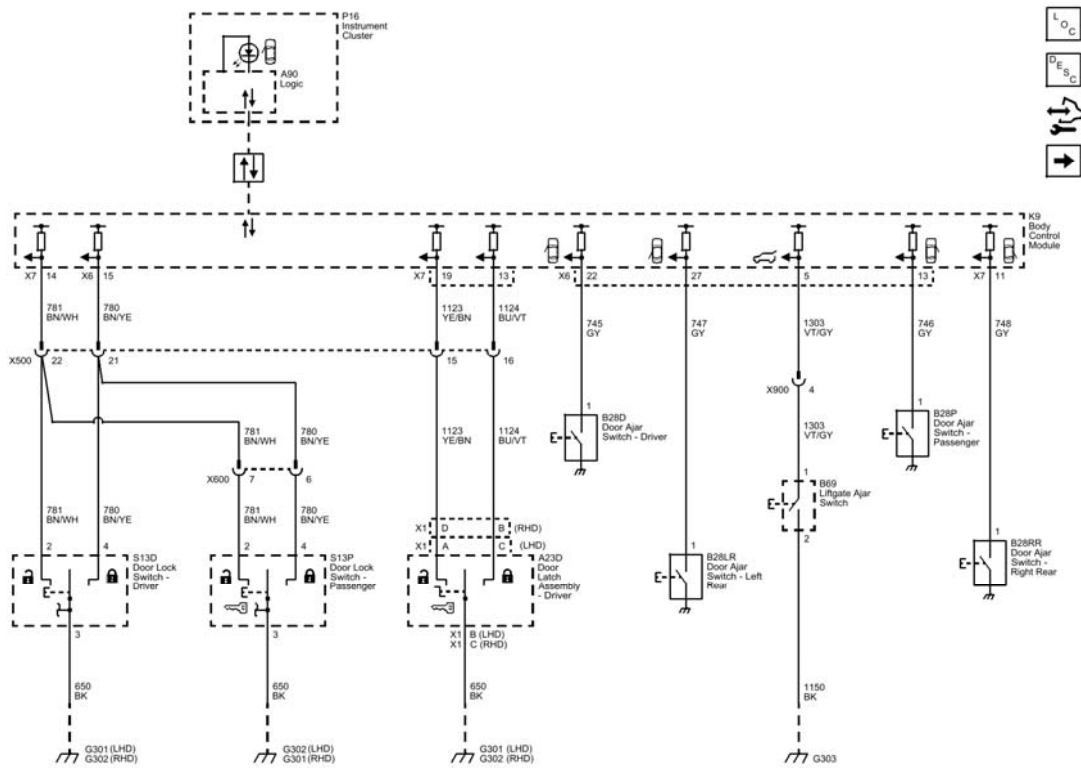


Fig. 1: Switches and Door Ajar Indicator Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Door Lock Actuators Wiring Schematics

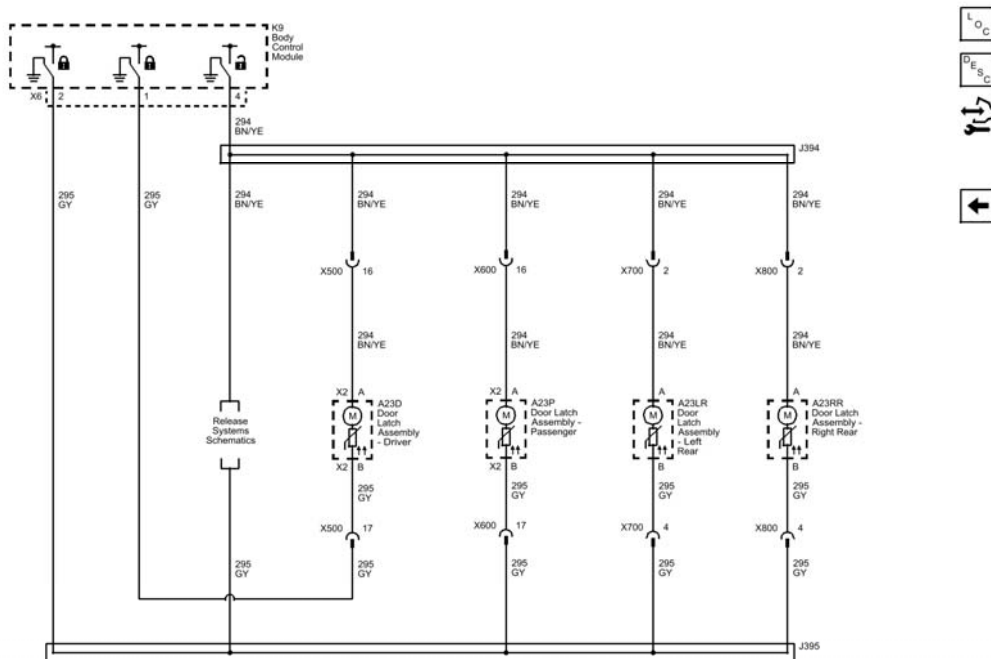


Fig. 2: Door Lock Actuators Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

RELEASE SYSTEMS WIRING SCHEMATICS

Liftgate Release Wiring Schematics

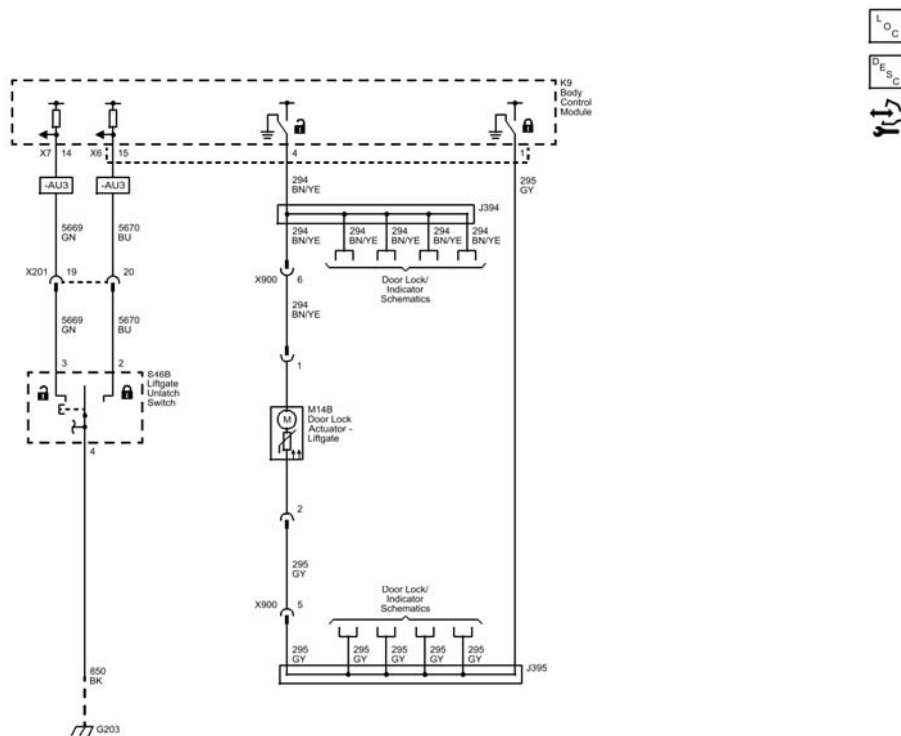


Fig. 3: Liftgate Release Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC B3125, B3130 or B3135 (With AU3)</u>	DTC B3125 Driver Door Only Unlock Circuit DTC B3130 All Doors Unlock Circuit DTC B3135 All Doors Lock Circuit
<u>DTC B3125, B3130 or B3135 (Without AU3)</u>	DTC B3125 Driver Door Only Unlock Circuit DTC B3130 All Doors Unlock Circuit DTC B3135 All Doors Lock Circuit
<u>DTC B3140 or B3150 (With AU3)</u>	DTC B3140 00 Driver Door Unlock Switch Circuit DTC B3150 00 Driver Front Door Lock Switch Circuit
<u>DTC B3140 or B3150 (Without AU3)</u>	DTC B3140 00 Driver Door Unlock Switch Circuit DTC B3150 00 Left Front Door Lock Switch Circuit

DTC B3125, B3130 OR B3135: DRIVER DOOR ONLY UNLOCK/ALL DOORS LOCK AND UNLOCK (WITH AU3)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B3125

Driver Door Only Unlock Circuit

DTC B3130

All Doors Unlock Circuit

DTC B3135

All Doors Lock Circuit

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
BCM B+	B3125 02, B3130 02, B3135 02	B3125 02, B3130 02, B3135 02	-	-
Door Latch Control	B3125 02, B3130 02, B3135 02	B3125 04, B3130 04, B3135 04	B3125 01, B3130 01, B3135 01	-
Driver Door Lock Motor Lock Control	B3125 02, B3130 02, B3135 02	B3125 04, B3130 04, B3135 04	B3125 01, B3130 01, B3135 01	-
Door Lock Actuator Unlock Control	B3125 02, B3130 02, B3135 02	B3125 04, B3130 04, B3135 04	B3125 01, B3130 01, B3135 01	-

Circuit/System Description

The body control module (BCM) powers the reversible liftgate and door latch assemblies by providing battery positive voltage and ground to the appropriate lock and unlock control circuits of the liftgate and door latch assemblies. The lock and unlock control circuits of the liftgate, rear doors and passenger door latch assemblies are all connected together. When the door latch assemblies are not active, all actuator lock and unlock control circuits are supplied a floating voltage used by the BCM to perform diagnostic functions on the circuits.

Transitioning of the lock actuators to the lock or unlocked position depends upon which control circuits receive voltage and which control circuits receive ground.

Conditions for Running the DTC

Ignition ON

Conditions for Setting the DTC

B3125 01, B3130 01, B3135 01

The BCM detects a short to battery on a door latch control circuit

B3125 02, B3130 02 and B3135 02

- A short to ground or an open/high resistance in the BCM B+ circuit.
- The BCM detects a short to ground on a door latch control circuit.

B3125 04, B3130 04, B3135 04

The BCM detects an open/high resistance on a door latch control circuit

Action Taken When the DTC Sets

The BCM will disable the lock and unlock functions of the door latches.

Conditions for Clearing the DTC

- This DTC will be current for as long as the fault is present.
- When the fault is no longer present, the DTC will be a history DTC.
- A history DTC will clear after 50 ignition cycles.

Reference Information

Schematic Reference

- **Door Lock/Indicator Schematics**
- **Release Systems Schematics**
- **Body Control System Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Door Locks Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify all vehicle doors and liftgate lock and unlock when commanding the All Doors Lock/Unlock with a scan tool.
 - **If only the driver door does not lock and unlock**

Refer to Circuit/System Testing - Driver Door Lock Malfunction.
 - **If one or more passenger doors or the liftgate does not lock and unlock**

Refer to Circuit/System Testing - Passenger Door Lock Malfunction.
 - **If the liftgate and all doors do not lock and unlock**

Refer to Circuit/System Testing - All Door Lock Inoperative.
 - **If all doors lock and unlock**
3. All OK.

Circuit/System Testing

Driver Door Lock Malfunction

1. Ignition OFF, disconnect the X6 harness connector at the K9 Body Control Module, ignition ON.
2. Test for less than 1 V between the control circuit terminal 1 and ground.
 - **If 1 V or greater**
 1. Ignition OFF, disconnect the harness connector at the A23D Door Latch Assembly - Driver, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.

- **If less than 1 V**

3. Ignition OFF, connect the X6 harness connector at the K9 Body Control Module. Disconnect the harness connector at the A23D Door Latch Assembly-Driver, ignition ON.

NOTE: Leaving the DMM connected between a control circuit and ground for greater than 20 s may cause the K9 Body Control Module to interpret the test as a system fault and will cause the voltage on the control circuit to drop to 0 V. If the voltage drops to 0 V, operate the door locks using the door lock switch to restore the voltage for testing.

4. Test for greater than 3 V between the control circuit terminals listed below and ground:
 - Control circuit terminal A
 - Control circuit terminal B
 - **If 3 V or less**
 1. Ignition OFF, disconnect the X6 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance on the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If greater than 3 V**

NOTE: When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.

5. Install a DMM between the control circuit terminal A and control circuit terminal B Set the DMM to capture DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 00.00 V.
6. Lock and unlock the vehicle doors using the S13D Door Lock Switch-Driver.
7. Verify the MAX voltage captured by the DMM is greater than 10 V.
 - **If 10 V or less**

Replace the K9 Body Control Module.

- **If greater than 10 V**

8. Test or replace the A23D Door Latch Assembly-Driver.

Passenger Door Lock Malfunction

1. Ignition OFF, disconnect the X6 harness connector at the K9 Body Control Module, ignition ON.

2. Test for less than 1 V between the control circuit terminal 2 and ground.
 - **If 1 V or greater**
 1. Ignition OFF, disconnect the harness connector at the A23P Door Latch Assembly - Passenger, A23LR Door Latch Assembly - Left Rear, A23RR Door Latch Assembly - Right Rear and M14B Door Lock Actuator-Liftgate, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - **If less than 1 V**
3. Ignition OFF, connect the X6 harness connector at the K9 Body Control Module. Disconnect the harness connector at the appropriate M14B Door Lock Actuator-Liftgate or the A23P Door Latch Assembly-Passenger or A23 Door Latch Assembly-Rear.

NOTE: Leaving the DMM connected between a control circuit and ground for greater than 20 s may cause the K9 Body Control Module to interpret the test as a system fault and will cause the voltage on the control circuit to drop to 0 V. If the voltage drops to 0 V, operate the door locks using the door lock switch to restore the voltage for testing.

4. Test for greater than 3 V between the control circuit terminal listed below and ground:
 - A23P Door Latch Assembly-Passenger - control circuit terminal A
 - A23P Door Latch Assembly-Passenger - control circuit terminal B
 - A23RR Door Latch Assembly-Right Rear - control circuit terminal A
 - A23RR Door Latch Assembly-Right Rear - control circuit terminal B
 - A23LR Door Latch Assembly-Left Rear - control circuit terminal A
 - A23LR Door Latch Assembly-Left Rear - control circuit terminal B
 - M14B Door Lock Actuator-Liftgate - control circuit terminal 1
 - M14B Door Lock Actuator-Liftgate - control circuit terminal 2
 - **If 3 V or less**
 1. Ignition OFF, disconnect the X6 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance on the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If greater than 3 V**

NOTE: When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.

5. Install a DMM between the control circuits listed below. Set the DMM to capture DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 00.00 V.
 - A23P Door Latch Assembly-Passenger - control circuit terminal A and control circuit terminal B
 - A23RR Door Latch Assembly-Right Rear - control circuit terminal A and control circuit terminal B
 - A23LR Door Latch Assembly-Left Rear - control circuit terminal A and control circuit terminal B
 - M14B Door Lock Actuator-Liftgate - control circuit terminal 1 and control circuit terminal 2
6. Lock and unlock the vehicle doors using the door lock switch.
7. Verify the MAX voltage captured by the DMM is greater than 10 V.
 - **If 10 V or less**

Replace the K9 Body Control Module.

- **If greater than 10 V**
8. Test or replace the A23 Door Latch Assembly or M14B Door Lock Actuator-Liftgate.

All Door Locks Inoperative

1. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module, ignition ON.
2. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
3. Ignition OFF.
4. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
5. Disconnect the harness connector at each of the A23 Door Latch Assemblies and the M14B Door Lock Actuator-Liftgate.
6. Test for infinite resistance between each control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the appropriate A23 Door Latch Assembly or M14B Door Lock Actuator-Liftgate.
- **If the test lamp illuminates**
3. Ignition OFF, connect the X2 harness connector at the K9 Body Control Module. Disconnect the X6 harness connector at the K9 Body Control Module, ignition ON.
4. Test for less than 1 V between the control circuit terminals listed below and ground:
 - Control circuit terminal 1 X6

- Control circuit terminal 2 X6
- Control circuit terminal 4 X6
- **If 1 V or greater**
- 1. Ignition OFF, disconnect the harness connector at the A23D Door Latch Assembly - Driver, A23P Door Latch Assembly - Passenger, A23LR Door Latch Assembly - Left Rear, A23RR Door Latch Assembly - Right Rear and M14B Door Lock Actuator-Liftgate, ignition ON.
- 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
- **If less than 1 V**
- 5. Test for infinite resistance between the control circuit terminals listed below and ground:
 - Control circuit terminal 1 X6
 - Control circuit terminal 2 X6
 - Control circuit terminal 4 X6
 - **If less than infinite resistance**
 - 1. Ignition OFF, disconnect the harness connector at the A23D Door Latch Assembly - Driver, A23P Door Latch Assembly - Passenger, A23LR Door Latch Assembly - Left Rear, A23RR Door Latch Assembly - Right Rear and M14B Door Lock Actuator-Liftgate.
 - 2. Test for less than infinite resistance between the control circuit and ground.
 - If 1 V or greater, repair the short to ground on the circuit.
 - **If infinite resistance**
- 6. Test for less than 10 ohms between the control circuit terminal 1 and the control circuit terminal 4.
 - **If 10 ohms or greater**
 - 1. Ignition OFF, disconnect the harness connector at the A23D Door Latch Assembly - Driver.
 - 2. Test for less than 2 ohms between the K9 Body Control Module control circuit terminal 4 and the A23D Door Latch Assembly - Driver control circuit terminal A.
 - If 2 ohms or greater, repair the open/high resistance on the circuit.
 - **If less than 10 ohms**
- 7. Test or replace the K9 Body Control Module.

Component Testing

1. Ignition OFF, disconnect the harness connector at the appropriate A23 Door Latch Assembly.
2. Install a 25 A fused jumper wire between one of the control terminals and 12 V. Momentarily install a jumper wire between the other control terminal and ground. Reverse the jumper wires at least two times, the A23 Door Latch Assembly should perform the LOCK and UNLOCK function.
 - **If the actuator does not perform the LOCK and UNLOCK function**
 - Replace the A23 Door Latch Assembly.
 - **If the actuator performs the LOCK and UNLOCK function**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Front Side Door Lock Replacement**
- **Rear Side Door Lock Replacement**
- **Liftgate Lock Actuator Replacement**
- **Control Module References** for BCM replacement, programming and setup

DTC B3125, B3130 OR B3135: DRIVER DOOR ONLY UNLOCK/ALL DOORS LOCK AND UNLOCK (WITHOUT AU3)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B3125

Driver Door Only Unlock Circuit

DTC B3130

All Doors Unlock Circuit

DTC B3135

All Doors Lock Circuit

For symptom byte information refer to: **Symptom Byte List**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
BCM B+	B3125 02, B3130 02, B3135 02	B3125 02, B3130 02, B3135 02	-	-
Lock Control	B3125 02, B3130 02, B3135 02	B3125 04, B3130 04, B3135 04	B3125 01, B3130 01, B3135 01	-
Unlock Control	B3125 02, B3130 02,	B3125 04, B3130	B3125 01, B3130 01,	-

	B3135 02	04, B3135 04	B3135 01	
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Circuit/System Description

The body control module (BCM) powers the reversible liftgate door lock actuator by providing battery positive voltage and ground to the appropriate lock and unlock control circuits of the liftgate door lock actuator. When the liftgate door lock actuator is not active, the actuator lock and unlock control circuits are supplied a floating voltage by the BCM. Transitioning of the liftgate door lock actuator to the lock or unlocked position depends upon which control circuits receive voltage and which control circuits receive ground.

Conditions for Running the DTC

Ignition ON

Conditions for Setting the DTC

B3125 01, B3130 01, B3135 01

The BCM detects a short to battery on the liftgate latch control circuit

B3125 02, B3130 02, B3135 02

- A short to ground or an open/high resistance in the BCM B+ circuit.
- The BCM detects a short to ground on the liftgate door lock actuator control circuit.

B3125 04, B3130 04, B3135 04

The BCM detects an open/high resistance on the liftgate door lock actuator control circuit

Action Taken When the DTC Sets

The BCM will disable the liftgate lock and unlock commands.

Conditions for Clearing the DTC

- This DTC will be current for as long as the fault is present.
- When the fault is no longer present, the DTC will be a history DTC.
- A history DTC will clear after 50 ignition cycles.

Reference Information

Schematic Reference

- **Release Systems Schematics**
- **Body Control System Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Rear Hatch/Gate Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Door Lock Switch parameter changes from Inactive to Lock and Unlock when cycling the S46B Liftgate Unlatch Switch between LOCK and UNLOCK.

- **If the parameter does not change**

Refer to **Trunk/Liftgate Lock Malfunction.**

- **If the parameter changes**

3. Verify the M14B Door Lock Actuator-Liftgate will LOCK and UNLOCK when commanding the All Doors Lock/Unlock with a scan tool.

- **If the M14B Door Lock Actuator-Liftgate LOCK or UNLOCK functions do not work**

Refer to Circuit/System Testing.

- **If the M14B Door Lock Actuator-Liftgate LOCK and UNLOCK function works**

4. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module, ignition ON.
2. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
- **If the test lamp does not illuminate and the circuit fuse is open**
- 1. Ignition OFF.
- 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
- 3. Disconnect the harness connector at the M14B Door Lock Actuator-Liftgate.
- 4. Test for infinite resistance between each control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the M14B Door Lock Actuator-Liftgate.
- **If the test lamp illuminates**
- 3. Ignition OFF, disconnect the harness connector at the M14B Door Lock Actuator-Liftgate.
- 4. Connect a test lamp between the control circuit terminal 1 and control circuit terminal 2, ignition ON.
- 5. Verify the test lamp turns ON and OFF when commanding the Lock and Unlock states with a scan tool.
 - **If the test lamp is always OFF**
 - 1. Ignition OFF, remove the test lamp, disconnect the X6 harness connector at the K9 Body Control Module.
 - 2. Test for infinite resistance between each control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 - 3. Test for less than 2 ohms in each control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 - 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module, Ignition ON.
 - 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
- 6. Test or replace the M14B Door Lock Actuator-Liftgate.

Component Testing

1. Ignition OFF, disconnect the harness connector at the M14B Door Lock Actuator-Liftgate.
2. Install a 25 A fused jumper wire between one of the control terminals and 12 V. Momentarily install a jumper wire between the other control terminal and ground. Reverse the jumper wires at least two times, the M14B Door Lock Actuator-Liftgate should perform the LOCK and UNLOCK function.
 - **If the actuator does not perform the LOCK and UNLOCK function**

Replace the M14B Door Lock Actuator-Liftgate.

- If the actuator performs the LOCK and UNLOCK function

3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Liftgate Lock Actuator Replacement**
- **Control Module References** for BCM replacement, programming and setup

DTC B3140 OR B3150: DRIVER DOOR LOCK/UNLOCK SWITCH (WITH AU3)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B3140 00

Driver Door Unlock Switch Circuit

DTC B3150 00

Driver Front Door Lock Switch Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Driver Door Lock Switch Lock Signal	B3150 00	2	2	-
Driver Door Lock Switch Unlock Signal	B3140 00	3	3	-
Driver Door Lock Switch Ground	-	1	-	-
Passenger Door Lock Switch Lock Signal	B3150 00	4	4	-
Passenger Door Lock Switch Unlock Signal	B3140 00	5	5	-
Passenger Door Lock Switch Ground	-	6	-	-

- | |
|--|
| <ol style="list-style-type: none">1. Driver Door Lock Switch Inoperative2. Driver Door Lock Switch Lock Function Inoperative3. Driver Door Lock Switch Unlock Function Inoperative4. Passenger Door Lock Switch Lock Function Inoperative5. Passenger Door Lock Switch Unlock Function Inoperative6. Passenger Door Lock Switch Inoperative |
|--|

Circuit/System Description

The body control module (BCM) supplies a 12 V signal to each of the door lock and door unlock signal circuits. When the door lock switches are in the open position, the voltage level in the signal circuit will be near 12 V. When any door lock switch is pressed to the lock or unlock position, the voltage level in the appropriate signal circuit will drop to 0 V and the BCM will detect the voltage drop and command the door latches to perform the requested lock or unlock command.

Conditions for Running the DTC

The system voltage is 9-16 V.

Conditions for Setting the DTC

B3140 00

The BCM detects short to ground in the lock signal circuit for greater than 60 seconds.

B3150 00

The BCM detects a short to ground in the lock signal circuit for greater than 60 seconds.

Action Taken When the DTC Sets

B3140 00

The BCM will ignore the unlock signal and the doors will not unlock when using the passenger or driver door unlock switch.

B3150 00

The BCM will ignore the lock signal and the doors will not lock when using the passenger or driver door lock switch.

Conditions for Clearing the DTC

- The DTC will be current for as long as the fault is present.
- When the fault is no longer present, the DTC will be a history DTC.
- A history DTC will clear after 50 ignition cycles.

Reference Information

Schematic Reference

Door Lock/Indicator Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Door Locks Description and Operation

Electrical Information Reference

- **Testing for Intermittent Conditions and Poor Connections**
- **Circuit Testing**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Door Lock Switch parameter changes from Inactive to Lock and Unlock when pushing the appropriate switch on the S13D Door Lock Switch-Driver.
 - **If the parameter is always Inactive**

Refer to Circuit/System Testing - Door Lock Switch Inoperative.
 - **If the parameter changes between Inactive and Lock only**

Refer to Circuit/System Testing - Door Lock Switch Malfunction.
 - **If the parameter changes between Inactive and Unlock only**

Refer to Circuit/System Testing - Door Lock Switch Malfunction.
 - **If the parameter is always Lock**

Refer to Circuit/System Testing - Lock/Unlock Signal Circuit Test.

- **If the parameter is always Unlock**

Refer to Circuit/System Testing - Lock/Unlock Signal Circuit Test.

- **If the parameter changes**

3. Verify the scan tool Door Lock Switch parameter changes from Inactive to Lock and Unlock when pushing the appropriate switch on the S13P Door Lock Switch-Passenger.

- **If the parameter is always Inactive**

Refer to Circuit/System Testing - Door Lock Switch Inoperative.

- **If the parameter changes between Inactive and Lock only**

Refer to Circuit/System Testing - Door Lock Switch Malfunction.

- **If the parameter changes between Inactive and Unlock only**

Refer to Circuit/System Testing - Door Lock Switch Malfunction.

- **If the parameter is always Lock**

Refer to Circuit/System Testing - Lock/Unlock Signal Circuit Test.

- **If the parameter is always Unlock**

Refer to Circuit/System Testing - Lock/Unlock Signal Circuit Test.

- **If the parameter changes**

4. All OK.

Circuit/System Testing

Door Lock Switch Inoperative

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the appropriate S13 Door Lock Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 3 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Test or replace the S13 Door Lock Switch.

Door Lock Switch Malfunction

1. Ignition OFF, disconnect the harness connector at the appropriate S13 Door Lock Switch. Ignition ON
2. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 3.
3. Verify the scan tool Door Lock Switch parameter is Unlock.
 - **If not Unlock**
 1. Ignition OFF, remove the 3 A fused jumper wire, disconnect the harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If Unlock**
4. Install a 3 A fused jumper wire between the signal circuit terminal 4 and the ground circuit terminal 3.
5. Verify the scan tool Door Lock Switch parameter is Lock.
 - **If not Lock**
 1. Ignition OFF, remove the 3 A fused jumper wire, disconnect the harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If Lock**
6. Test or replace the S13 Door Lock Switch.

Lock/Unlock Signal Circuit Test

1. Ignition OFF, disconnect the harness connector at the S13D Door Lock Switch-Driver.
2. Disconnect the harness connector at the S13P Door Lock Switch-Passenger.
3. Verify the scan tool Door Lock Switch parameter is Inactive.
 - **If Lock**
 1. Ignition OFF, disconnect the X6 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal 15 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module

- **If Unlock**

1. Ignition OFF, disconnect the X7 harness connector at the K9 Body Control Module.
2. Test for infinite resistance between the signal circuit terminal 14 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance, replace the K9 Body Control Module

- **If Inactive**

4. Connect the harness connector at the S13P Door Lock Switch-Passenger.
5. Verify the scan tool Door Lock Switch parameter changes from Inactive to Lock and Unlock when pushing the appropriate switch on the S13P Door Lock Switch-Passenger.

- **If Lock**

Test or replace the S13P Door Lock Switch-Passenger.

- **If Unlock**

Test or replace the S13P Door Lock Switch-Passenger.

- **If the parameter changes**

6. Connect the harness connector at the S13D Door Lock Switch-Driver.
7. Verify the scan tool Door Lock Switch parameter changes from Inactive to Lock and Unlock when pushing the appropriate switch on the S13D Door Lock Switch-Driver.

- **If Lock**

Test or replace the S13D Door Lock Switch-Driver.

- **If Unlock**

Test or replace the S13D Door Lock Switch-Driver.

- **If the parameter changes**

8. All OK.

Component Testing

1. Ignition OFF, disconnect the harness connector at the appropriate S13 Door Lock Switch.
2. Test for infinite resistance between the signal terminal 2 and the ground terminal 3 with the switch in the open position.

- **If less than infinite resistance**

Replace the S13 Door Lock Switch.

- **If infinite resistance**

3. Test for infinite resistance between the signal terminal 4 and the ground terminal 3 with the switch in the

open position.

- **If less than infinite resistance**

Replace the S13 Door Lock Switch.

- **If infinite resistance**

4. Test for less than 2 ohms between the signal terminal 4 and the ground terminal 3 with the switch in the Lock position.

- **If 2 ohms or greater**

Replace the S13 Door Lock Switch.

- **If less than 2 ohms**

5. Test for less than 2 ohms between the signal terminal 2 and the ground terminal 3 with the switch in the Unlock position.

- **If 2 ohms or greater**

Replace the S13 Door Lock Switch.

- **If less than 2 ohms**

6. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References BCM replacement, programming and setup

DTC B3140 OR B3150: DRIVER DOOR LOCK/UNLOCK SWITCH (WITHOUT AU3)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B3140 00

Driver Door Unlock Switch Circuit

DTC B3150 00

Left Front Door Lock Switch Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Lock Signal	B3150 00	1	1	-
Unlock Signal	B3140 00	2	2	-
Ground	-	3	-	-
1. Liftgate Lock Switch Lock Function Inoperative 2. Liftgate Lock Switch Unlock Function Inoperative 3. Liftgate Lock Switch Lock and Unlock Functions Inoperative				

Circuit/System Description

When the vehicle is equipped with out power door locks, it will be provided with a Liftgate Unlatch Switch to lock or unlock the liftgate. The Body Control Module monitors the voltage level of the liftgate lock and liftgate unlock signal circuits. When the Liftgate Unlatch Switch is in the open position, the voltage level in the signal circuit will be near 12 V. When the Liftgate Unlatch Switch is pressed to the lock or unlock position the voltage will drop to 0V and the Body Control Module will detect the voltage drop in the appropriate circuit and will lock or unlock the liftgate.

Conditions for Running the DTC

The system voltage is 9-16 V.

Conditions for Setting the DTC

B3140 00

The Body Control Module detects short to ground in the unlock signal circuit for greater than 60 seconds.

B3150 00

The Body Control Module detects a short to ground in the lock signal circuit for greater than 60 seconds.

Action Taken When the DTC Sets

B3140 00

The Body Control Module will ignore the unlock signal and the liftgate will not unlock when using the Liftgate Unlatch Switch.

B3150 00

The Body Control Module will ignore the lock signal and the liftgate will not lock when using the Liftgate Unlatch Switch.

Conditions for Clearing the DTC

- The DTC will be current for as long as the fault is present.
- When the fault is no longer present, the DTC will be a history DTC.
- A history DTC will clear after 50 ignition cycles.

Reference Information

Schematic Reference

Release Systems Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Rear Hatch/Gate Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Door Lock Switch parameter changes from Inactive to Lock and Unlock when pushing the appropriate switch on the S46B Liftgate Unlatch Switch.
 - **If the parameter does not change**

Refer to Circuit/System Testing.
 - **If the parameter changes**
3. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S46B Liftgate Unlatch Switch. It may take up to 2 minutes for all vehicle systems to power down.

2. Test for less than 10 ohms between the ground circuit terminal 4 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Ignition ON.
4. Verify the scan tool Door Lock Switch parameter is Inactive.
 - **If not Inactive**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal listed below and ground:
 - Signal circuit terminal 2
 - Signal circuit terminal 3
 3. If less than infinite resistance, repair the short to ground on the circuit.
 4. If infinite resistance, replace the K9 Body Control Module.
 - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the ground circuit terminal 4.
6. Verify the scan tool Door Lock Switch parameter is Unlock.
 - **If not Unlock**
 1. Ignition OFF, remove the 3 A fused jumper wire, disconnect the harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit terminal 3 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If Unlock**
7. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 4.
8. Verify the scan tool Door Lock Switch parameter is Lock.
 - **If not Lock**
 1. Ignition OFF, remove the 3 A fused jumper wire, disconnect the harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit terminal 2 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.
- If less than 2 ohms, replace the K9 Body Control Module.

- **If Lock**

9. Test or replace the S46B Liftgate Unlatch Switch.

Component Testing

1. Ignition OFF, disconnect the harness connector at the S46B Liftgate Unlatch Switch.
2. Test for infinite resistance between the signal terminal 2 and the ground terminal 4 with the switch in the open position.

- **If less than infinite resistance**

Replace the S46B Liftgate Unlatch Switch.

- **If infinite resistance**

3. Test for infinite resistance between the signal terminal 3 and the ground terminal 4 with the switch in the open position.

- **If less than infinite resistance**

Replace the S46B Liftgate Unlatch Switch.

- **If infinite resistance**

4. Test for less than 2 ohms between the signal terminal 2 and the ground terminal 4 with the switch in the Lock position.

- **If 2 ohms or greater**

Replace the S46B Liftgate Unlatch Switch.

- **If less than 2 ohms**

5. Test for less than 2 ohms between the signal terminal 3 and the ground terminal 4 with the switch in the Unlock position.

- **If 2 ohms or greater**

Replace the S46B Liftgate Unlatch Switch.

- **If less than 2 ohms**

6. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Instrument Panel Multifunction Switch Replacement**
- **Control Module References** for Body Control Module replacement, programming and setup

SYMPTOMS - VEHICLE ACCESS

Important Preliminary Checks Before Starting

1. Perform the **Diagnostic System Check - Vehicle** before using the Symptom Tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data link.
2. Review the following description and operations below in order to familiarize yourself with the system functions:
 - **Power Door Locks Description and Operation**
 - **Rear Hatch/Gate Description and Operation**
 - **Door Ajar Indicator Description and Operation**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the system. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Power Door Locks Malfunction**
- **Door Ajar Indicator Malfunction**
- **Trunk/Liftgate Lock Malfunction**
- **Power Door Lock Key Cylinder Switches Malfunction**

DOOR AJAR INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Driver Door Ajar Switch Signal	1	2	1	-
Left Rear Door Ajar Switch Signal	1	2	1	-
Liftgate Latch Ajar Switch Signal	1	2	1	-
Liftgate Latch Ground	-	2	-	-
Passenger Door Ajar Switch Signal	1	2	1	-
Right Rear Door Ajar Switch Signal	1	2	1	-
1. Ajar Indicator Always Illuminated 2. Ajar Indicator Inoperative When Door or Liftgate Is Open				

Circuit/System Description

The Body Control Module provides a 12 V signal to each of the door ajar switch signal circuits and to the liftgate ajar switch signal circuit. When a door or liftgate is opened, the normally open contacts of the ajar switch closes. With the ajar switch closed, ground is provided to the ajar switch signal circuit. The Body Control Module interprets this and communicates via serial data with the instrument panel cluster which will display the door ajar icon.

Reference Information

Schematic Reference

Door Lock/Indicator Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Door Ajar Indicator Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Driver Door Ajar Switch parameter changes between Inactive and Active when opening and closing the driver door.
 - **If the parameter does not change**

Refer to Circuit/System Testing - Door Ajar Switch.
 - **If the parameter changes**
3. Verify the scan tool Passenger Door Ajar Switch parameter changes between Inactive and Active when opening and closing the passenger door.
 - **If the parameter does not change**

Refer to Circuit/System Testing - Door Ajar Switch.
 - **If the parameter changes**
4. Verify the scan tool Left Rear Door Ajar Switch parameter changes between Inactive and Active when opening and closing the left rear door.
 - **If the parameter does not change**

Refer to Circuit/System Testing - Door Ajar Switch.
 - **If the parameter changes**
5. Verify the scan tool Right Rear Door Ajar Switch parameter changes between Inactive and Active when opening and closing the right rear door.
 - **If the parameter does not change**

Refer to Circuit/System Testing - Door Ajar Switch.
 - **If the parameter changes**
6. Verify the scan tool Rear Closure Ajar Switch parameter changes between Inactive and Active when opening and closing the liftgate.
 - **If the parameter does not change**

Refer to Circuit/System Testing - Liftgate Ajar Switch.
 - **If the parameter changes**
7. All OK.

Circuit/System Testing

Door Ajar Switch

1. Ignition OFF, disconnect the harness connector at the appropriate B28 Door Ajar Switch. Ignition ON
2. Verify the appropriate scan tool Door Ajar Switch parameter is Inactive.
 - **If not Inactive**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If Inactive**
3. Install a 3 A fused jumper wire between the signal circuit terminal 1 and ground.
4. Verify the scan tool Door Ajar Switch parameter is Active.
 - **If not Active**
 1. Ignition OFF, remove the 3 A fused jumper wire, disconnect the harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If Active**
5. Test or replace the B28 Door Ajar Switch.

Liftgate Ajar Switch

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the A23C Liftgate Latch Assembly. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal A and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Ignition ON.
4. Verify the scan tool Rear Closure Ajar Switch parameter is Inactive.
 - **If not Inactive**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal B and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance, replace the K9 Body Control Module.
- **If Inactive**
- 5. Install a 3 A fused jumper wire between the signal circuit terminal A and the ground circuit terminal B.
- 6. Verify the scan tool Rear Closure Ajar Switch parameter is Active.
 - **If not Active**
 1. Ignition OFF, remove the 3 A fused jumper wire, disconnect the harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If Active**
- 7. Test or replace the A23C Liftgate Latch Assembly.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Liftgate Latch Replacement**
- **Control Module References** for Body Control Module replacement, programming and setup

POWER DOOR LOCK KEY CYLINDER SWITCHES MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Lock Signal	2	2	2	-
Unlock Signal	1	1	1	-
Ground	-	3	-	-
1. Key Cylinder Lock Function Inoperative 2. Key Cylinder Unlock Function Inoperative 3. Key Cylinder Switch Inoperative				

Circuit/System Description

The body control module (BCM) monitors the voltage level of the key switch lock and unlock signal circuits. When the key is inserted into the driver door key cylinder and turned to the Lock or Unlock position, a switch within the key cylinder closes causing the voltage to drop within the key switch unlock signal circuit. The BCM will detect the drop in voltage will command the driver door to unlock or for all doors to lock.

Reference Information

Schematic Reference

Door Lock/Indicator Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Door Locks Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Circuit/System Verification

1. Verify the A23 Door Latch Assemblies LOCK when inserting the key into the driver door lock key cylinder and turning the key to the lock position.
 - **If the A23 door latch assemblies do not LOCK**

Refer to Circuit/System Testing.

- **If the A23 Door Latch Assemblies LOCK**
2. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the A23D Door Latch Assembly-Driver. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal listed below and ground:
 - Ground circuit terminal B - left hand drive
 - Ground circuit terminal C - right hand drive

- **If 10 ohms or greater**
- 1. Ignition OFF.
- 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
- **If less than 10 ohms**
- 3. Ignition ON.
- 4. Test for greater than 10 V between the signal circuit terminals listed below and ground:
 - Signal circuit terminal D - right hand drive
 - Signal circuit terminal B - right hand drive
 - Signal circuit terminal A - left hand drive
 - Signal circuit terminal C - left hand drive
- **If 10 V or less**
- 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
- 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
- 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
- **If greater than 10 V**
- 5. Test or replace the A23D Door Latch Assembly-Driver.

Component Testing

1. Ignition OFF, disconnect the harness connector at the A23D Door Latch Assembly-Driver.
2. Test for infinite resistance between the terminals listed below with the switch in the open position:
 - Signal terminal D and ground terminal C - right hand drive
 - Signal terminal B and ground terminal C - right hand drive
 - Signal terminal A and ground terminal B - left hand drive
 - Signal terminal C and ground terminal B - left hand drive
- **If less than infinite resistance**
- Replace the A23D Door Latch Assembly-Driver.
- **If infinite resistance**
3. Test for less than 2 ohms between the terminal listed below with the switch in the Lock position:
 - Signal terminal B and ground terminal C - right hand drive
 - Signal terminal C and ground terminal B - left hand drive
- **If 2 ohms or greater**

Replace the A23D Door Latch Assembly-Driver.

- **If less than 2 ohms**

4. Test for less than 2 ohms between the terminals listed below with the switch in the Unlock position:

- Signal terminal D and ground terminal C - right hand drive
- Signal terminal A and ground terminal B - left hand drive

- **If 2 ohms or greater**

Replace the A23D Door Latch Assembly-Driver.

- **If less than 2 ohms**

5. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Front Side Door Lock Replacement**
- **Control Module References** for BCM replacement, programming and setup

POWER DOOR LOCKS MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
BCM B+	B3125 02, B3130 02, B3135 02	B3125 02, B3130 02, B3135 02	-	-
Driver Door Lock Switch Lock Signal	B3150 00	2	2	-
Driver Door Lock Switch Unlock Signal	B3140 00	3	3	-
Driver Door Lock Switch Ground	-	1	-	-
Passenger Door Lock Switch Lock Signal	B3150 00	4	4	-
Passenger Door Lock Switch	B3140 00	5	5	-

Unlock Signal				
Passenger Door Lock Switch Ground	-	6	-	-
Door Latch Control	B3125 02, B3130 02, B3135 02	B3125 04, B3130 04, B3135 04	B3125 01, B3130 01, B3135 01	-
Driver Door Lock Motor Lock Control	B3125 02, B3130 02, B3135 02	B3125 04, B3130 04, B3135 04	B3125 01, B3130 01, B3135 01	-
Door Lock Actuator Unlock Control	B3125 02, B3130 02, B3135 02	B3125 04, B3130 04, B3135 04	B3125 01, B3130 01, B3135 01	-
1. Driver Door Lock Switch Inoperative 2. Driver Door Lock Switch Lock Function Inoperative 3. Driver Door Lock Switch Unlock Function Inoperative 4. Passenger Door Lock Switch Lock Function Inoperative 5. Passenger Door Lock Switch Unlock Function Inoperative 6. Passenger Door Lock Switch Inoperative				

Circuit/System Description

The body control module (BCM) supplies a 12 V signal to each of the door lock and door unlock signal circuits. When the door lock switches are in the open position, the voltage level in the signal circuit will be near 12 V. When any door lock switch is pressed to the lock or unlock position, the voltage level in the appropriate signal circuit will drop to 0 V and the BCM will detect the voltage drop and command the door latches to perform the requested lock or unlock command.

The body control module (BCM) powers the reversible door latch assemblies by providing battery positive voltage and ground to the appropriate lock and unlock control circuits of the door latch assemblies. The lock and unlock control circuits of the rear doors and passenger door latch assemblies are all connected together. When the door latch assemblies are not active, all actuator lock and unlock control circuits are supplied a floating voltage door driver by the BCM. Transitioning of the lock actuators to the lock or unlocked position depends upon which control circuits receive voltage and which control circuits receive ground.

Reference Information

Schematic Reference

Door Lock/Indicator Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Door Locks Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Door Lock Switch parameter changes from Inactive to Lock and Unlock when pushing the appropriate switch on the S13D Door Lock Switch-Driver.
 - **If the parameter is always Inactive**

Refer to Circuit/System Testing - Door Lock Switch Inoperative.
 - **If the parameter changes between Inactive and Lock only**

Refer to Circuit/System Testing - Door Lock Switch Malfunction.
 - **If the parameter changes between Inactive and Unlock only**

Refer to Circuit/System Testing - Door Lock Switch Malfunction.
 - **If the parameter is always Lock or always Unlock**

Refer to Circuit/System Testing - Lock/Unlock Signal Circuit Test.
 - **If the parameter changes**
3. Verify the scan tool Door Lock Switch parameter changes from Inactive to Lock and Unlock when pushing the appropriate switch on the S13P Door Lock Switch-Passenger.
 - **If the parameter is always Inactive**

Refer to Circuit/System Testing - Door Lock Switch Inoperative.
 - **If the parameter changes between Inactive and Lock only**

Refer to Circuit/System Testing - Door Lock Switch Malfunction.
 - **If the parameter changes between Inactive and Unlock only**

Refer to Circuit/System Testing - Door Lock Switch Malfunction.

- **If the parameter is always Lock or always Unlock**

Refer to Circuit/System Testing - Lock/Unlock Signal Circuit Test.

- **If the parameter changes**

4. Verify all vehicle doors LOCK and UNLOCK when commanding the All Doors Lock/Unlock with a scan tool.

- **If only the driver door LOCK or UNLOCK functions do not work**

Refer to Circuit/System Testing - Driver Door Lock Malfunction.

- **If one or more, but not all, passenger door LOCK or UNLOCK functions do not work**

Refer to Circuit/System Testing - Passenger Door Lock Malfunction.

- **If all door LOCK and UNLOCK functions do not work**

Refer to Circuit/System Testing - All Door Lock Inoperative.

- **If the LOCK and UNLOCK function for all doors works**

5. All OK.

Circuit/System Testing

Door Lock Switch Inoperative

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the appropriate S13 Door Lock Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 3 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Test or replace the S13 Door Lock Switch.

Door Lock Switch Malfunction

1. Ignition OFF, disconnect the harness connector at the appropriate S13 Door Lock Switch. Ignition ON
2. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 3.
3. Verify the scan tool Door Lock Switch parameter is Unlock.

- **If not Unlock**

1. Ignition OFF, remove the 3 A fused jumper wire, disconnect the harness connector at the K9 Body Control Module, ignition ON.
2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.

- **If Unlock**

4. Install a 3 A fused jumper wire between the signal circuit terminal 4 and the ground circuit terminal 3.
5. Verify the scan tool Door Lock Switch parameter is Lock.

- **If not Lock**

1. Ignition OFF, remove the 3 A fused jumper wire, disconnect the harness connector at the K9 Body Control Module, ignition ON.
2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.

- **If Lock**

6. Test or replace the S13 Door Lock Switch.

Lock/Unlock Signal Circuit Test

1. Ignition OFF, disconnect the harness connector at the S13D Door Lock Switch-Driver.
2. Disconnect the harness connector at the S13P Door Lock Switch-Passenger. Ignition ON
3. Verify the scan tool Door Lock Switch parameter is Inactive.

- **If Lock**

1. Ignition OFF, disconnect the X6 harness connector at the K9 Body Control Module.
2. Test for infinite resistance between the K9 Body Control Module signal circuit terminal 15 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module

- **If Unlock**

3. Ignition OFF, disconnect the X7 harness connector at the K9 Body Control Module.
4. Test for infinite resistance between the K9 Body Control Module signal circuit terminal 14 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module
 - **If Inactive**
4. Connect the harness connector at the S13P Door Lock Switch-Passenger.
 5. Verify the scan tool Door Lock Switch parameter changes from Inactive to Lock and Unlock when pushing the appropriate switch on the S13P Door Lock Switch-Passenger.
 - **If the parameter does not change**

Test or replace the S13P Door Lock Switch-Passenger.

- **If the parameter changes**
6. Connect the harness connector at the S13D Door Lock Switch-Driver.
 7. Verify the scan tool Door Lock Switch parameter changes from Inactive to Lock and Unlock when pushing the appropriate switch on the S13D Door Lock Switch-Driver.
 - **If the parameter does not change**

Test or replace the S13D Door Lock Switch-Driver.

- **If the parameter changes**
8. All OK.

Driver Door Lock Malfunction

1. Ignition OFF, disconnect the X2 harness connector at the A23D Door Latch Assembly-Driver. Ignition ON.

NOTE: Leaving the DMM connected between a control circuit and ground for greater than 20 seconds will cause the K9 Body Control Module to interpret the test as a system fault and will cause the voltage on the control circuit to drop to 0 V. If the voltage drops to 0 V, operate the door locks using the driver door lock switch to restore the voltage for testing.

2. Test for greater than 7 V between the control circuit terminal A and ground.
 - **If 7 V or less**
 1. Ignition OFF, disconnect the X6 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance on the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
- **If greater than 7 V**

NOTE: Leaving the DMM connected between a control circuit and ground for greater than 20 seconds will cause the K9 Body Control Module to interpret the test as a system fault and will cause the voltage on the control circuit to drop to 0 V. If the voltage drops to 0 V, operate the door locks using the driver door lock switch to restore the voltage for testing.

3. Test for greater than 7 V between the control circuit terminal B and ground.
 - **If 7 V or less**
 1. Ignition OFF, disconnect the X6 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance on the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If greater than 7 V**
4. Test or replace the A23D Door Latch Assembly-Driver.

Passenger Door Lock Malfunction

1. Ignition OFF, disconnect the harness connector at the appropriate passenger or rear A23 Door Latch Assembly. Ignition ON.

NOTE: Leaving the DMM connected between a control circuit and ground for greater than 20 seconds will cause the K9 Body Control Module to interpret the test as a system fault and will cause the voltage on the control circuit to drop to 0 V. If the voltage drops to 0 V, operate the door locks using the driver door lock switch to restore the voltage for testing.

2. Test for greater than 7 V between the control circuit terminal listed below and ground:
 - Control circuit terminal A
 - Control circuit terminal B
 - **If 7 V or less**
 1. Ignition OFF, disconnect the X6 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance on the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If greater than 7 V**

3. Test or replace the A23 Door Latch Assembly.

All Door Locks Inoperative

1. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module, ignition ON.
2. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 - 1. Ignition OFF.
 - 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 - 3. Ignition OFF.
 - 4. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 - 5. Disconnect the harness connector at each of the A23 Door Latch Assemblies.
 - 6. Test for infinite resistance between each control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the appropriate A23 Door Latch Assembly.
 - **If the test lamp illuminates**
3. Ignition OFF, connect the X2 harness connector at the K9 Body Control Module. Disconnect the X2 harness connector at the A23D Door Latch Assembly-Driver, ignition ON.

NOTE: Leaving the DMM connected between a control circuit and ground for greater than 20 seconds will cause the K9 Body Control Module to interpret the test as a system fault and will cause the voltage on the control circuit to drop to 0 V. If the voltage drops to 0 V, operate the door locks using the driver door lock switch to restore the voltage for testing.

4. Test for greater than 7 V between the control circuit terminal A and ground.
 - **If 7 V or less**
 - 1. Ignition OFF, disconnect the X6 harness connector at the K9 Body Control Module.
 - 2. Test for infinite resistance between the control circuit terminal listed below and ground:
 - Control circuit terminal 1 X6
 - Control circuit terminal 2 X6
 - Control circuit terminal 4 X6
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If greater than 7 V**

5. Replace the K9 Body Control Module.

Component Testing

Door Lock Switch

1. Ignition OFF, disconnect the harness connector at the appropriate S13 Door Lock Switch.
2. Test for infinite resistance between the signal terminal 2 and the ground terminal 3 with the switch in the open position.
 - **If less than infinite resistance**

Replace the S13 Door Lock Switch.
 - **If infinite resistance**
3. Test for infinite resistance between the signal terminal 4 and the ground terminal 3 with the switch in the open position.
 - **If less than infinite resistance**

Replace the S13 Door Lock Switch.
 - **If infinite resistance**
4. Test for less than 2 ohms between the signal terminal 4 and the ground terminal 3 with the switch in the Lock position.
 - **If 2 ohms or greater**

Replace the S13 Door Lock Switch.
 - **If less than 2 ohms**
5. Test for less than 2 ohms between the signal terminal 2 and the ground terminal 4 with the switch in the Unlock position.
 - **If 2 ohms or greater**

Replace the S13 Door Lock Switch.
 - **If less than 2 ohms**
6. All OK

Door Latch Assembly

1. Ignition OFF, disconnect the harness connector at the appropriate A23 Door Latch Assembly.
2. Install a 25 A fused jumper wire between one of the control terminals and 12 V. Momentarily install a jumper wire between the other control terminal and ground. Reverse the jumper wires at least two times, the A23 Door Latch Assembly should perform the LOCK and UNLOCK function.
 - **If the actuator does not perform the LOCK and UNLOCK function**

Replace the A23 Door Latch Assembly.

- If the actuator performs the LOCK and UNLOCK function

3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Front Side Door Lock Replacement**
- **Rear Side Door Lock Replacement**
- **Control Module References** for BCM replacement, programming and setup

TRUNK/LIFTGATE LOCK MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
BCM B+	B3125 02, B3130 02, B3135 02	B3125 02, B3130 02, B3135 02	-	-
Lock Signal	B3150 00	1	1	-
Unlock Signal	B3140 00	2	2	-
Ground	-	3	-	-
Lock Control	B3125 02, B3130 02, B3135 02	B3125 04, B3130 04, B3135 04	B3125 01, B3130 01, B3135 01	-
Unlock Control	B3125 02, B3130 02, B3135 02	B3125 04, B3130 04, B3135 04	B3125 01, B3130 01, B3135 01	-
1. Liftgate Lock Switch Lock Function Inoperative 2. Liftgate Lock Switch Unlock Function Inoperative 3. Liftgate Lock Switch Lock and Unlock Functions Inoperative				

Circuit/System Description

When the vehicle does not have power door locks, it will be provided with a liftgate unlatch switch to lock or unlock the liftgate. The body control module (BCM) monitors the voltage level of the liftgate lock and liftgate

unlock signal circuits. When the liftgate unlatch switch is in the open position, the voltage level in the signal circuit will be near 0 V. When the liftgate unlatch switch is pressed to the lock or unlock position, a signal will be sent to the BCM requesting a lock or unlock. command. When the liftgate door lock actuator is not active, both lock and unlock control circuits are supplied a floating voltage used by the BCM to perform diagnostic functions on the circuits. Transitioning of the liftgate door lock actuator to the lock or unlocked position depends upon which control circuits receive voltage and which control circuits receive ground

Reference Information

Schematic Reference

- **Release Systems Schematics**
- **Body Control System Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Rear Hatch/Gate Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Door Lock Switch parameter changes from Inactive to Lock and Unlock when cycling the S46B Liftgate Unlatch Switch between LOCK and UNLOCK.
 - **If the parameter does not change**

Refer to Circuit/System Testing - Liftgate Unlatch Switch Malfunction

- **If the parameter changes**
3. Verify the M14B Door Lock Actuator-Liftgate will LOCK and UNLOCK when commanding the All Doors Lock/Unlock with a scan tool.

- **If the M14B Door Lock Actuator-Liftgate LOCK or UNLOCK functions do not work**

Refer to Circuit/System Testing - Liftgate Lock Actuator Malfunction.

- **If the M14B Door Lock Actuator-Liftgate LOCK and UNLOCK function works**

4. All OK.

Circuit/System Testing

Liftgate Unlatch Switch Malfunction

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S46B Liftgate Unlatch Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 4 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Ignition ON.
4. Verify the scan tool Door Lock Switch parameter is Inactive.
 - **If not Inactive**
 1. Ignition OFF, disconnect the harness connector at the K9 body control module.
 2. Test for infinite resistance between the signal circuit terminal 2 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 3. Test for infinite resistance between the signal circuit terminal 3 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the ground circuit terminal 4.
6. Verify the scan tool Door Lock Switch parameter is Unlock.
 - **If not Unlock**
 1. Ignition OFF, remove the 3 A fused jumper wire, disconnect the harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit terminal 3 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, replace the K9 Body Control Module.
- **If Unlock**
- 7. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 4.
- 8. Verify the scan tool Door Lock Switch parameter is Lock.
 - **If not Lock**
 1. Ignition OFF, remove the 3 A fused jumper wire, disconnect the harness connector at the K9 body control module, ignition ON.
 2. Test for less than 1 V between the signal circuit terminal 2 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If Lock**
- 9. Test or replace the S46B Liftgate Unlatch Switch.

Liftgate Lock Actuator Malfunction

1. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module, ignition ON.
2. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Disconnect the harness connector at the M14B Door Lock Actuator-Liftgate.
 4. Test for infinite resistance between each control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the M14B Door Lock Actuator-Liftgate.
 - **If the test lamp illuminates**
3. Ignition OFF, disconnect the harness connector at the M14B Door Lock Actuator-Liftgate.
4. Connect a test lamp between the control circuit terminal 1 and control circuit terminal 2, ignition ON.
5. Verify the test lamp turns ON and OFF when commanding the Lock and Unlock states with a scan tool.
 - **If the test lamp is always OFF**

1. Ignition OFF, remove the test lamp, disconnect the X6 harness connector at the K9 Body Control Module.
2. Test for infinite resistance between each control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 ohms in each control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.

- **If the test lamp is always ON**

1. Ignition OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module, Ignition ON.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.

- **If the test lamp turns ON and OFF**

6. Test or replace the M14B Door Lock Actuator-Liftgate.

Component Testing

Liftgate Unlatch Switch

1. Ignition OFF, disconnect the harness connector at the S46B Liftgate Unlatch Switch.
2. Test for infinite resistance between the signal terminal 2 and the ground terminal 4 with the switch in the open position.

- **If less than infinite resistance**

Replace the S46B Liftgate Unlatch Switch.

- **If infinite resistance**

3. Test for infinite resistance between the signal terminal 3 and the ground terminal 4 with the switch in the open position.

- **If less than infinite resistance**

Replace the S46B Liftgate Unlatch Switch.

- **If infinite resistance**

4. Test for less than 2 ohms between the signal terminal 2 and the ground terminal 4 with the switch in the Lock position.

- **If 2 ohms or greater**

Replace the S46B Liftgate Unlatch Switch.

- **If less than 2 ohms**

5. Test for less than 2 ohms between the signal terminal 3 and the ground terminal 4 with the switch in the Unlock position.

- **If 2 ohms or greater**

Replace the S46B Liftgate Unlatch Switch.

- **If less than 2 ohms**

6. All OK

Liftgate Lock Actuator

1. Ignition OFF, disconnect the harness connector at the M14B Door Lock Actuator-Liftgate.
2. Install a 25 A fused jumper wire between one of the control terminals and 12 V. Momentarily install a jumper wire between the other control terminal and ground. Reverse the jumper wires at least two times, the M14B Door Lock Actuator-Liftgate should perform the LOCK and UNLOCK function.

- **If the actuator does not perform the LOCK and UNLOCK function**

Replace the M14B Door Lock Actuator-Liftgate.

- **If the actuator performs the LOCK and UNLOCK function**

3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Instrument Panel Multifunction Switch Replacement**
- **Liftgate Lock Actuator Replacement**
- **Control Module References** for BCM replacement, programming and setup

REPAIR INSTRUCTIONS

LIFTGATE LOCK ACTUATOR REPLACEMENT

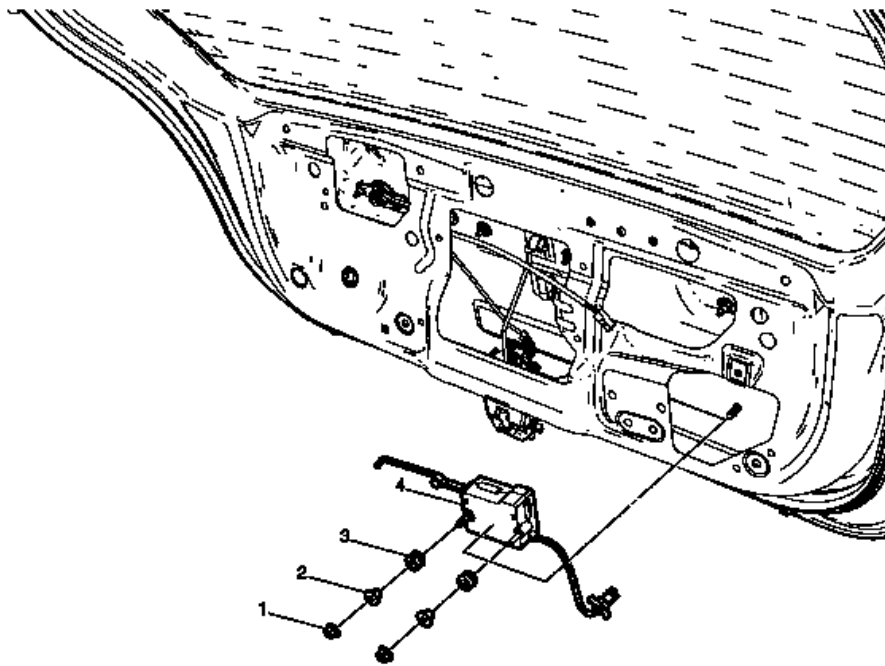


Fig. 4: Liftgate Lock Actuator
 Courtesy of GENERAL MOTORS COMPANY

Liftgate Lock Actuator Replacement

Callout	Component Name
Preliminary Procedure Remove the liftgate trim panel. Refer to <u>Liftgate Trim Panel Replacement</u> .	
1	Liftgate Lock Actuator Nut (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> .
2	Liftgate Lock Actuator Rubber Bush (Qty: 2)
3	Liftgate Lock Actuator Plastic Bush (Qty: 2)
4	Liftgate Lock Actuator Procedure 1. Disconnect the liftgate lock actuator electrical connector. 2. Release the liftgate lock actuator rod from the latch.

FUEL TANK FILLER DOOR LATCH RELEASE CABLE REPLACEMENT

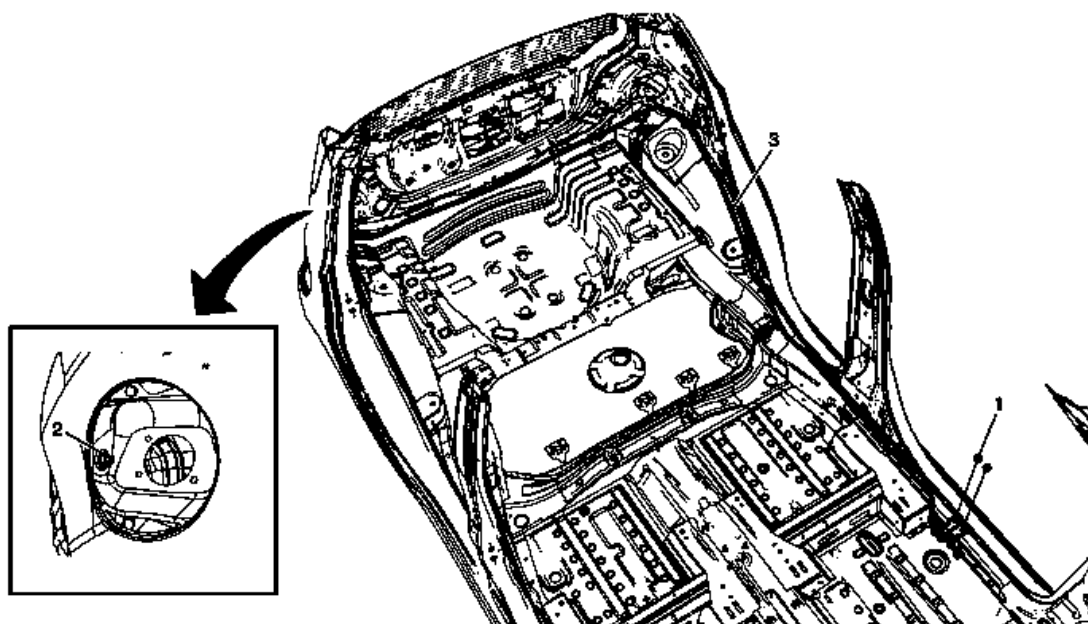


Fig. 5: Fuel Tank Filler Door Latch Release Cable
 Courtesy of GENERAL MOTORS COMPANY

Fuel Tank Filler Door Latch Release Cable Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the front side door sill trim plate. Refer to <u>Front Side Door Sill Trim Plate Replacement</u> . 2. Remove the center pillar lower trim panel. Refer to <u>Center Pillar Lower Trim Panel Replacement</u> . 3. Remove the rear side door sill trim plate. Refer to <u>Rear Side Door Sill Trim Plate Replacement</u> . 4. Remove the rear wheelhouse trim finish panel. Refer to <u>Rear Wheelhouse Trim Finish Panel Replacement</u> .	
1	Fuel Tank Filler Door Latch Release Cable Lever Bolt (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 8 N.m (71 lb in)
2	Fuel Tank Filler Door Latch TIP: Remove the rear wheelhouse trim finish panel to access the fuel tank filler door latch.

FRONT SIDE DOOR LOCK CYLINDER REPLACEMENT

Removal Procedure

1. Remove the front side door trim panel. Refer to Front Side Door Trim Panel Replacement .
2. Remove the water deflector.
3. Remove the front side door lock cylinder rod.

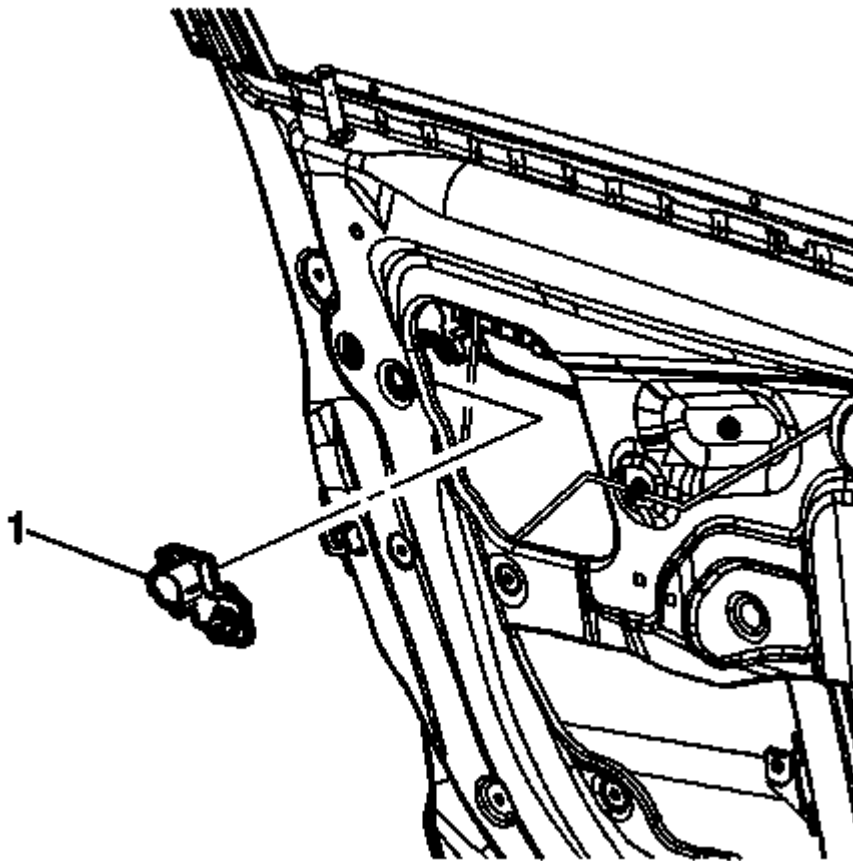


Fig. 6: Front Side Door Lock Rod Holder
Courtesy of GENERAL MOTORS COMPANY

4. Remove the front side door lock rod holder (1).

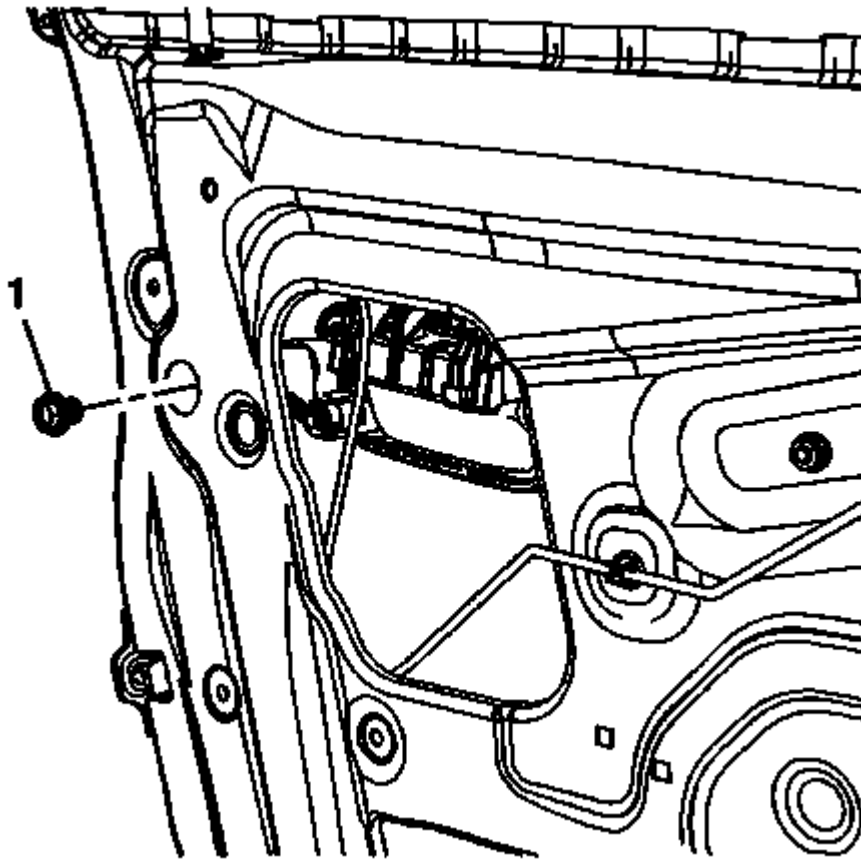


Fig. 7: Front Side Door Lock Cylinder Bolt
Courtesy of GENERAL MOTORS COMPANY

5. Remove the front side door lock cylinder bolt (2).

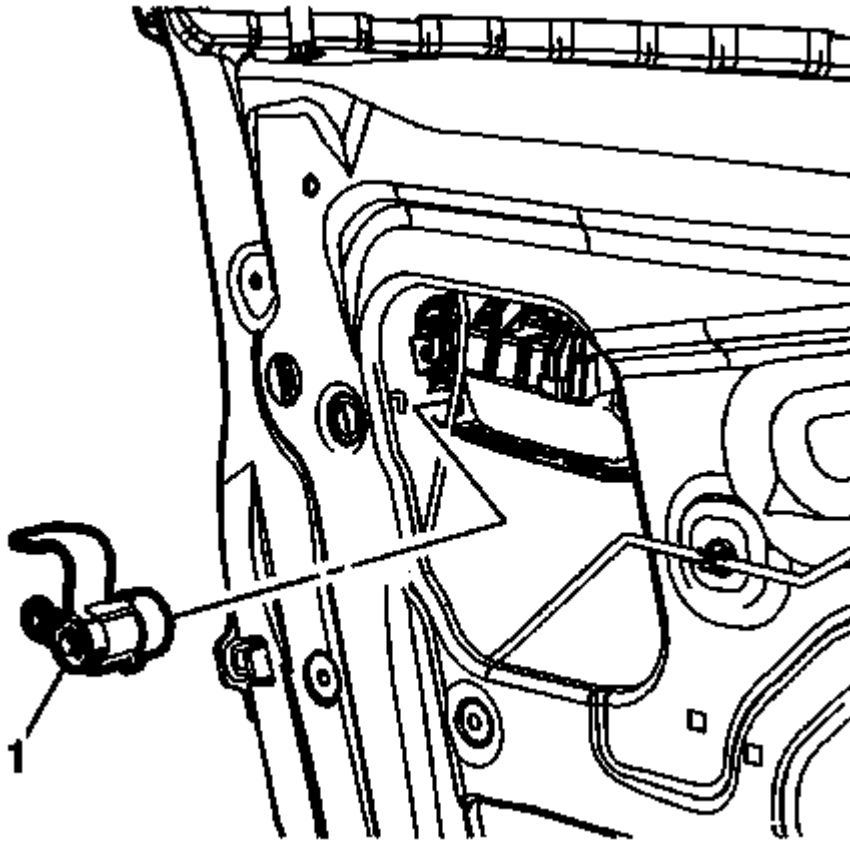


Fig. 8: Front Side Door Lock Cylinder
Courtesy of GENERAL MOTORS COMPANY

6. Remove the front side door lock cylinder (3).

Installation Procedure

NOTE: If you are installing a new lock cylinder, refer to Key and Lock Cylinder Coding .

1. Install the front side door lock cylinder.

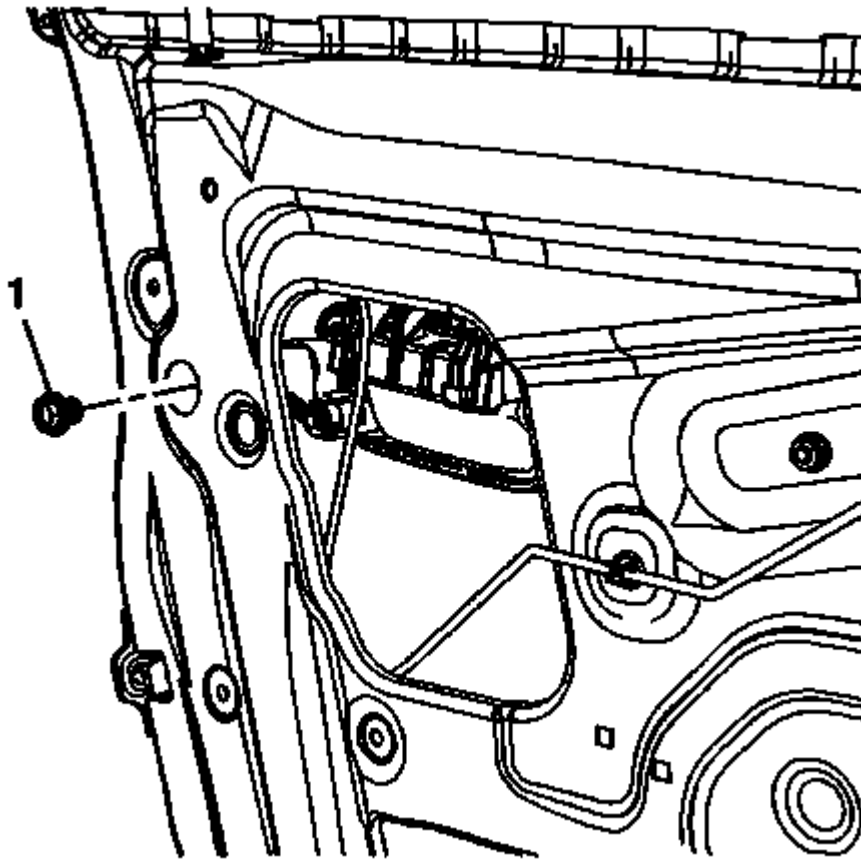


Fig. 9: Front Side Door Lock Cylinder Bolt
Courtesy of GENERAL MOTORS COMPANY

2. Install the front side door lock cylinder bolt (2) and tighten to 4.5 N.m (40 lb in).
3. Install the front side door lock rod holder.

LIFTGATE LOCK CYLINDER REPLACEMENT

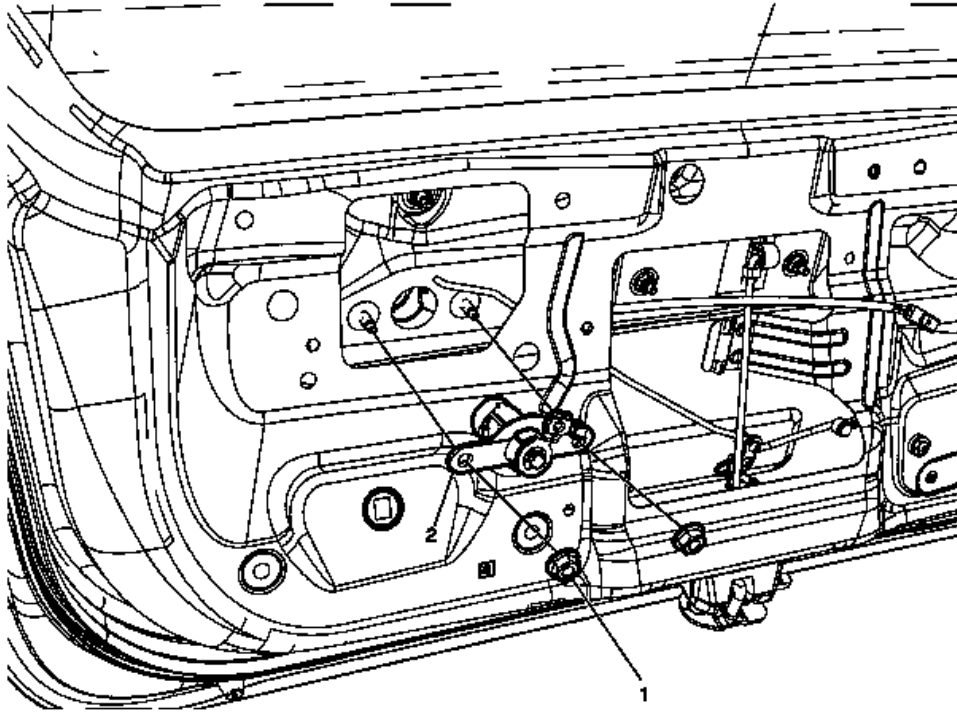


Fig. 10: Liftgate Lock Cylinder
 Courtesy of GENERAL MOTORS COMPANY

Liftgate Lock Cylinder Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the liftgate trim panel. Refer to <u>Liftgate Trim Panel Replacement</u> . 2. Remove the liftgate lock cylinder rod.	
1	Liftgate Lock Cylinder Nut (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 5 N.m (44 lb in)
2	Liftgate Lock Cylinder Assembly TIP: If you are installing a new lock cylinder, refer to <u>Key and Lock Cylinder Coding</u> .

FRONT SIDE DOOR INSIDE HANDLE REPLACEMENT

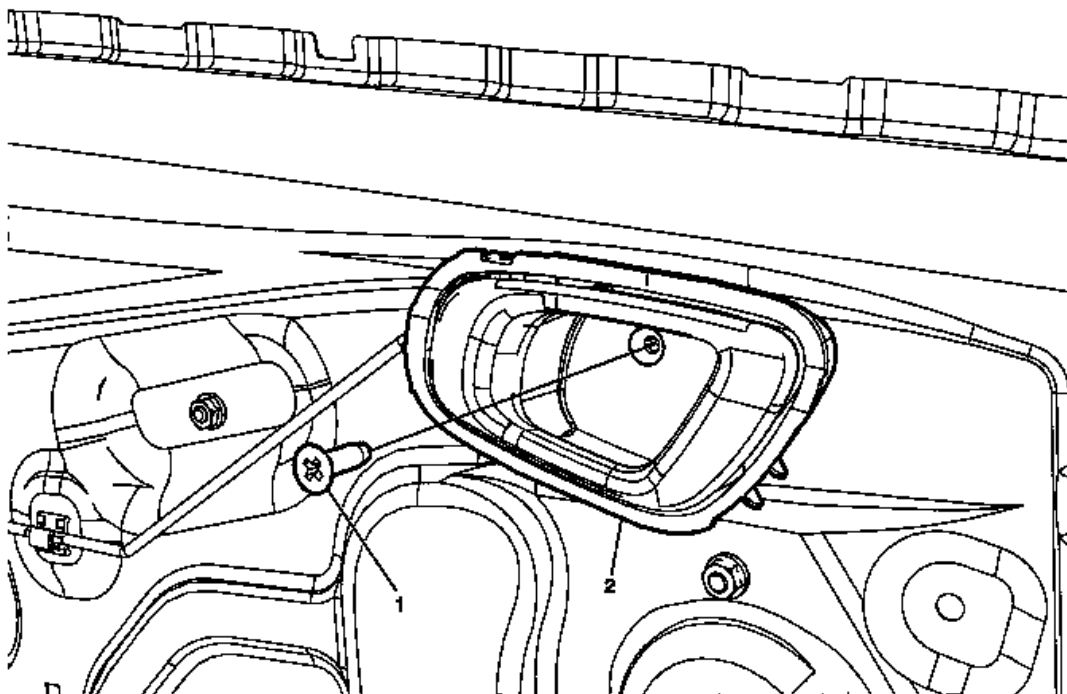


Fig. 11: Front Side Door Inside Handle
 Courtesy of GENERAL MOTORS COMPANY

Front Side Door Inside Handle Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the front side door trim panel. Refer to <u>Front Side Door Trim Panel Replacement</u> . 2. Remove the water deflector. 3. Remove the front side door inside handle rod.	
1	Front Side Door Inside Handle Screw (Qty: 1) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 1.5 N.m (13 lb in)
2	Front Side Door Inside Handle

FRONT SIDE DOOR OUTSIDE HANDLE REPLACEMENT

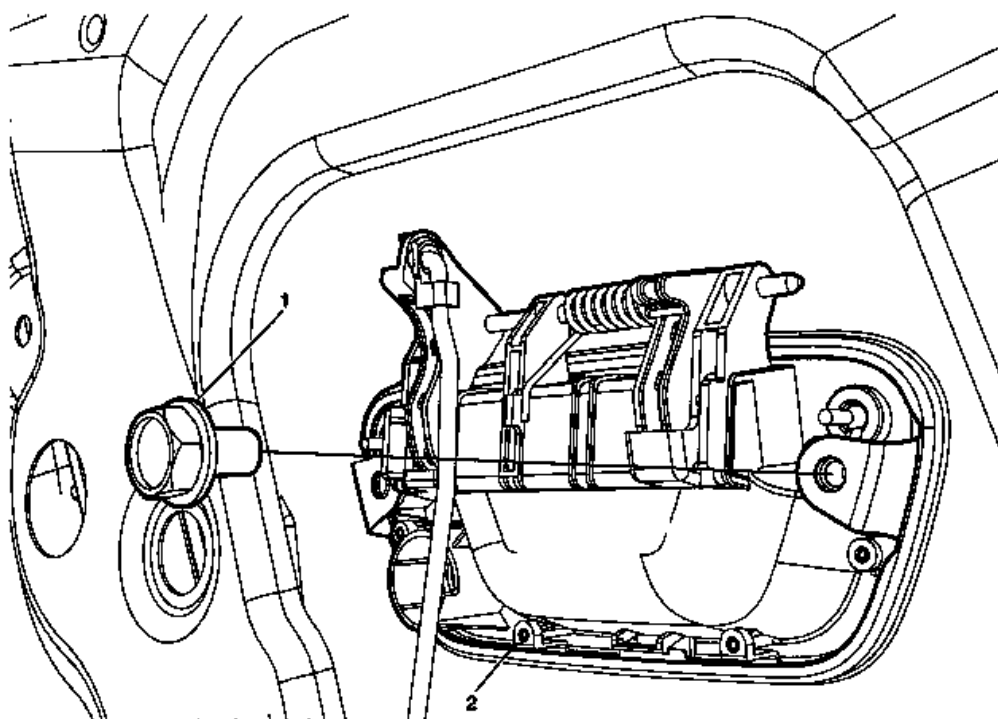


Fig. 12: Front Side Door Outside Handle
 Courtesy of GENERAL MOTORS COMPANY

Front Side Door Outside Handle Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the front side door trim panel. Refer to <u>Front Side Door Trim Panel Replacement</u> . 2. Remove the water deflector. 3. Remove the front side door lock cylinder. Refer to <u>Front Side Door Lock Cylinder Replacement</u>.	
1	Front Side Door Outside Handle Bolt (Qty: 1) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 4.5 N.m (40 lb in)
2	Front Side Door Outside Handle

LIFTGATE OUTSIDE HANDLE REPLACEMENT

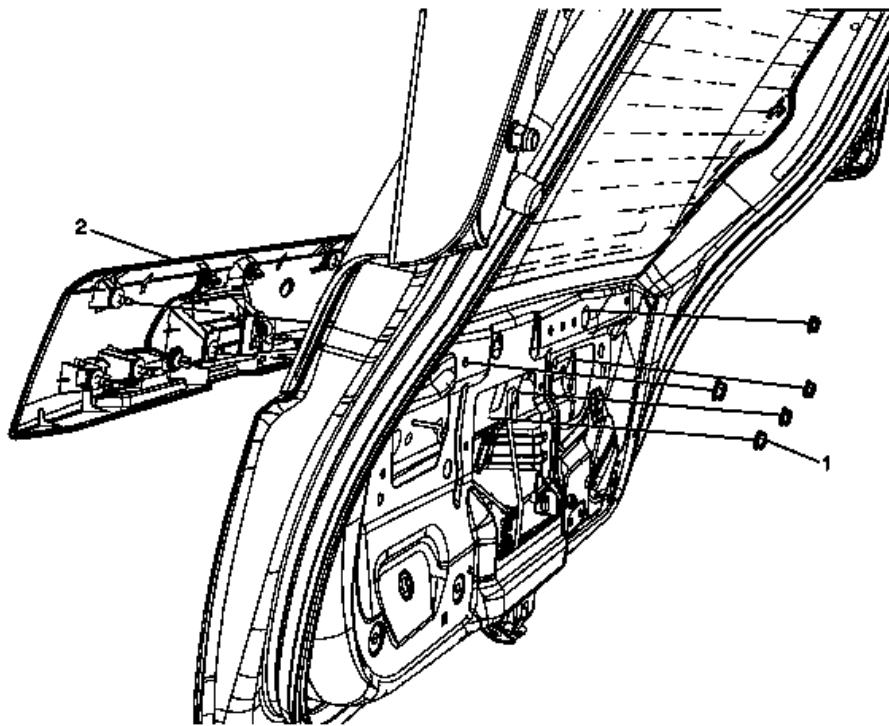


Fig. 13: Liftgate Outside Handle
 Courtesy of GENERAL MOTORS COMPANY

Liftgate Outside Handle Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the liftgate trim panel. Refer to <u>Liftgate Trim Panel Replacement</u> . 2. Remove the liftgate lock cylinder. Refer to <u>Liftgate Lock Cylinder Replacement</u>.	
1	Liftgate Outside Handle Nut (Qty: 5) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 5 N.m (44 lb in)
2	Liftgate Outside Handle Procedure Disconnect the license plate lamp electrical connector. Refer to <u>Rear License Plate Lamp Replacement</u> .

LIFTGATE LATCH REPLACEMENT

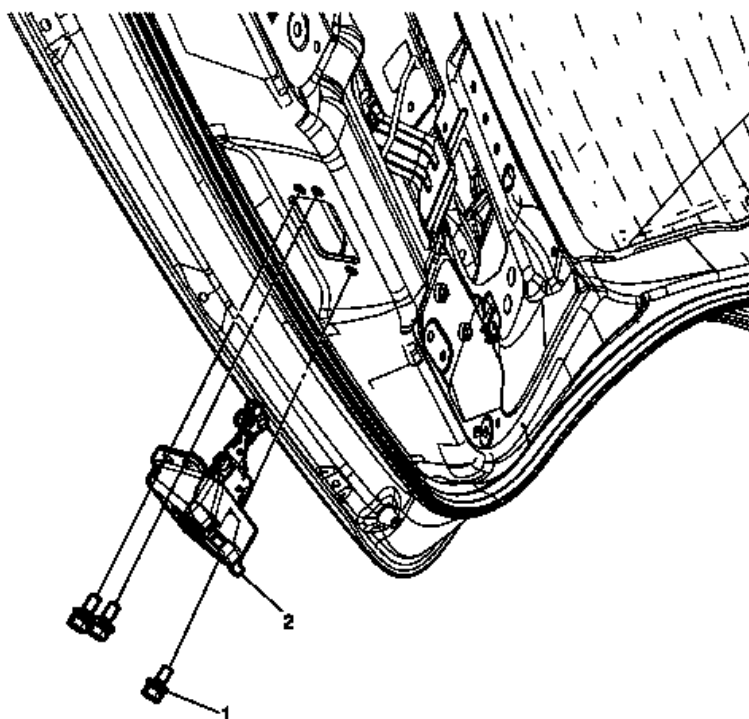


Fig. 14: Liftgate Latch

Courtesy of GENERAL MOTORS COMPANY

Liftgate Latch Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the liftgate trim panel. Refer to <u>Liftgate Trim Panel Replacement</u> . 2. Remove the liftgate lock cylinder rod. 3. Remove the liftgate outside handle rod.	
1	Liftgate Latch Bolt (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 12 N.m (106 lb in)
2	Liftgate Latch Assembly

REAR SIDE DOOR OUTSIDE HANDLE REPLACEMENT

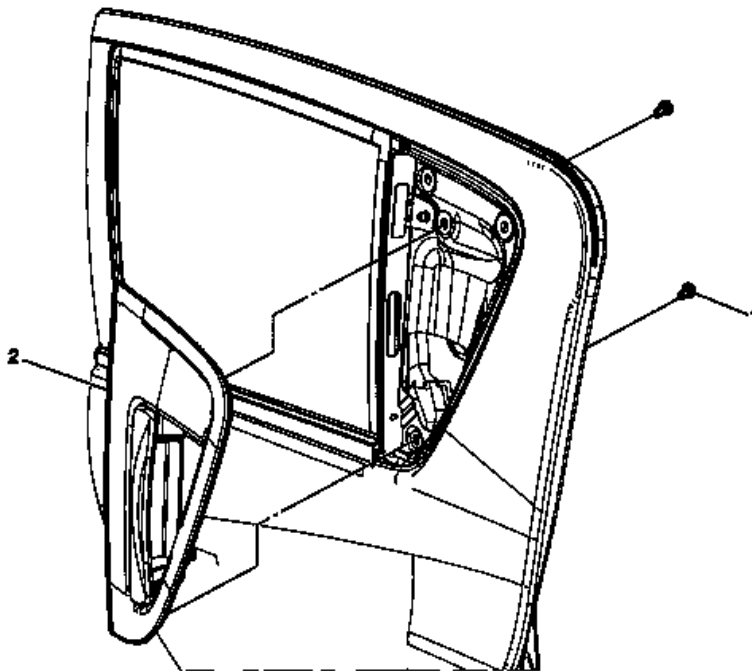


Fig. 15: Rear Side Door Outside Handle
 Courtesy of GENERAL MOTORS COMPANY

Rear Side Door Outside Handle Replacement

Callout	Component Name
Preliminary Procedure Remove the rear side door upper rear trim panel. Refer to <u>Rear Side Door Upper Rear Trim Panel Replacement</u> .	
1	Rear Side Door Outside Handle Bolt (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 4.5 N.m (40 lb in)
2	Rear Side Door Outside Handle Procedure 1. Remove the rear side door outside handle clip (Qty: 2). 2. Remove the rear side door outside handle rod.

FRONT SIDE DOOR LOCK REPLACEMENT

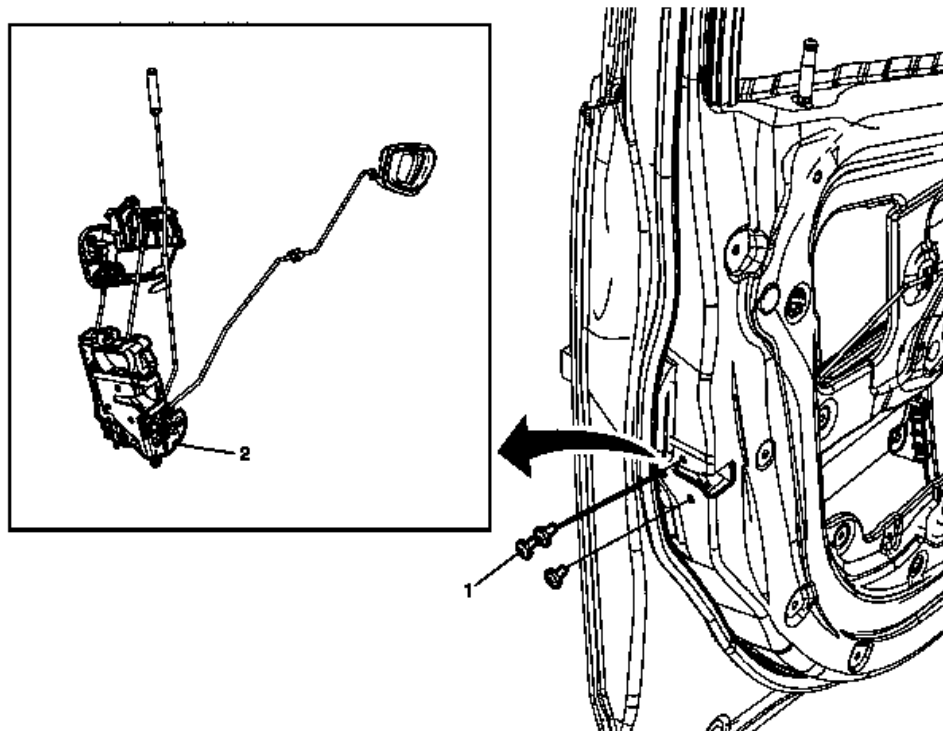


Fig. 16: Front Side Door Lock
 Courtesy of GENERAL MOTORS COMPANY

Front Side Door Lock Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the front side door trim. Refer to Front Side Door Trim Panel Replacement . 2. Remove the water deflector. 3. Disconnect the front side door outside handle rod, inside handle rod and lock rod.	
1	Front Side Door Lock Screw (Qty: 3) CAUTION: Refer to Fastener Caution . Tighten 8.5 N.m (75 lb in)
2	Front Side Door Lock Assembly Procedure Disconnect the door lock electrical connector.

REAR SIDE DOOR LOCK REPLACEMENT

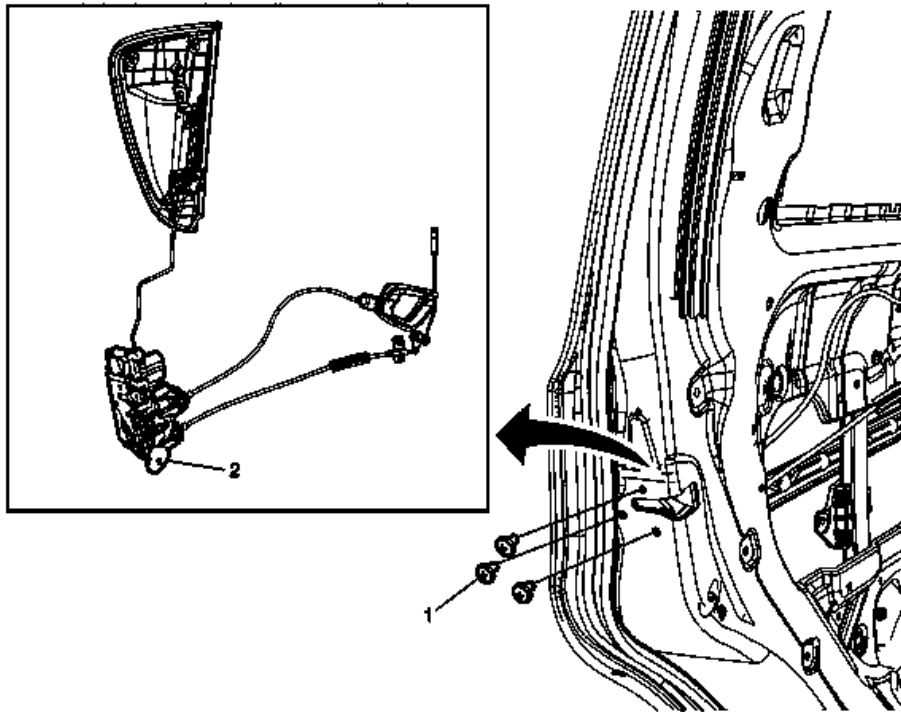


Fig. 17: Rear Side Door Lock
 Courtesy of GENERAL MOTORS COMPANY

Rear Side Door Lock Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the rear side door trim panel. Refer to Rear Side Door Trim Panel Replacement . 2. Remove the rear side door water deflector. 3. Disconnect the rear side door outside handle rod, inside handle rod and lock rod.	
1	Rear Side Door Lock Screw (Qty: 3) CAUTION: Refer to Fastener Caution . Tighten 8.5 N.m (75 lb in)
2	Rear Side Door Lock Assembly Procedure Disconnect the door lock electrical connector.

DOOR LOCK STRIKER ADJUSTMENT

Fore/Aft Adjustment

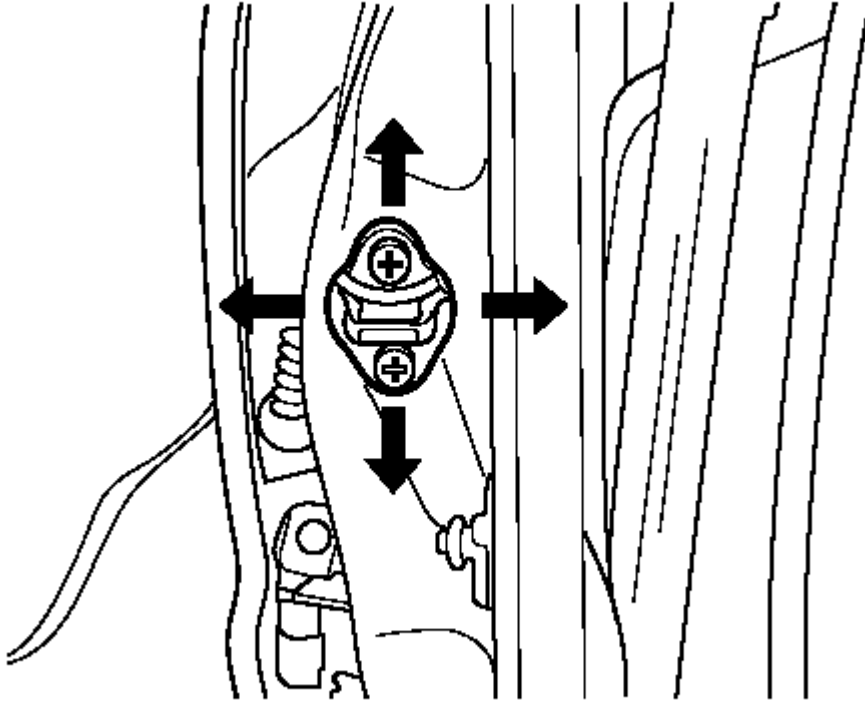


Fig. 18: Door Lock Striker

Courtesy of GENERAL MOTORS COMPANY

CAUTION: When replacing the door lock striker, only use the manufactures replacement part. Do not use a replacement part of a lesser quality or a substitute design. The use of a lesser quality part could lead to an improperly operating door retention system.

1. The door must be properly aligned.

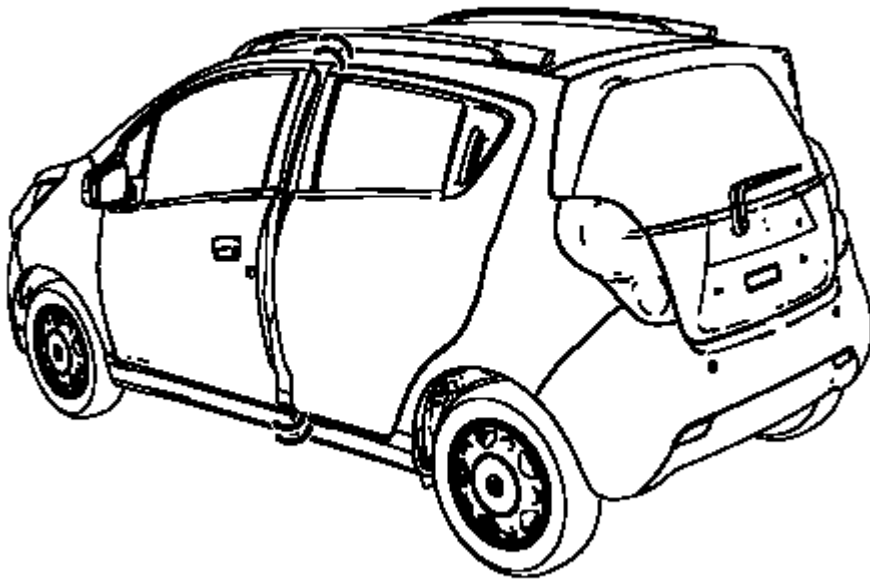


Fig. 19: Door Lock Striker

Courtesy of GENERAL MOTORS COMPANY

2. Close the door until the lock fork contacts the striker.
3. Stand next to the door opening and move the door slowly in and out, just touching the striker each time.

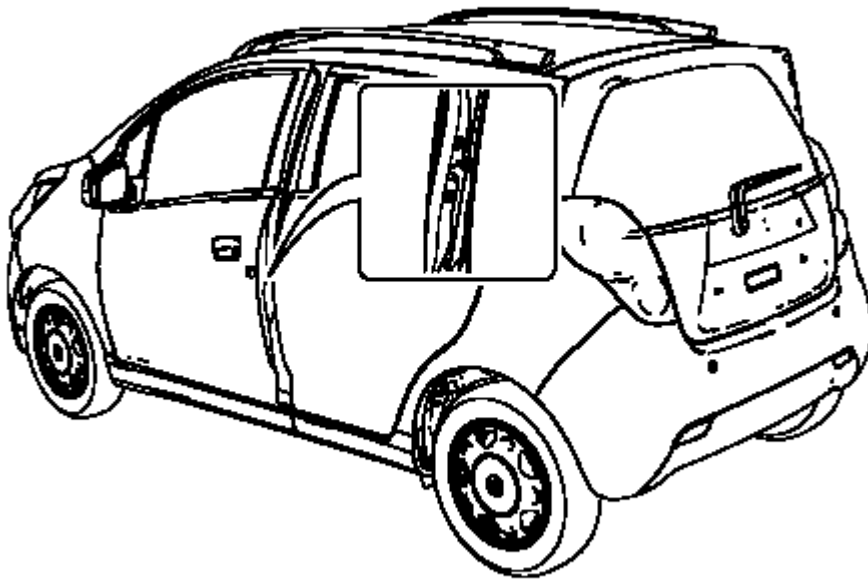


Fig. 20: Lock Fork And Striker

Courtesy of GENERAL MOTORS COMPANY

4. The alignment of the lock fork and the striker can be easily seen. The lock fork should be perpendicular to and fall near the middle of the striker. The lock fork should fall near the middle of the striker between the upper/lower center pillar and the end of the striker.

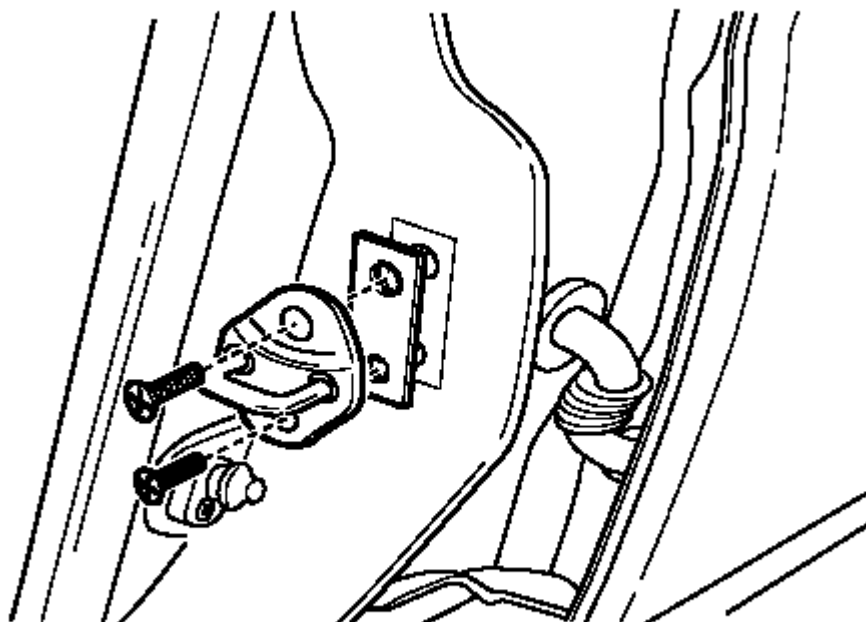


Fig. 21: Striker Screws And Spacer
Courtesy of GENERAL MOTORS COMPANY

5. If a fore or aft adjustment is required, use the following steps:
 1. Remove the striker screws.
 2. Remove the spacer in order to move the striker toward the rear of the vehicle.
 3. Add a 2 mm (0.08 in) spacer in order to move the striker toward the front of the vehicle.
 4. Install the striker screws.
6. Perform the up/down or the in/out adjustment.

Up/Down or In/Out Adjustment

An adjustment of the striker in the up and down or in and out directions may be necessary for a number of reasons:

- Vehicle frame damage as the result of a collision
- Installation of new door weather-stripping
- Customer complaints of excessive windnoise
- Difficulty in opening or closing the door

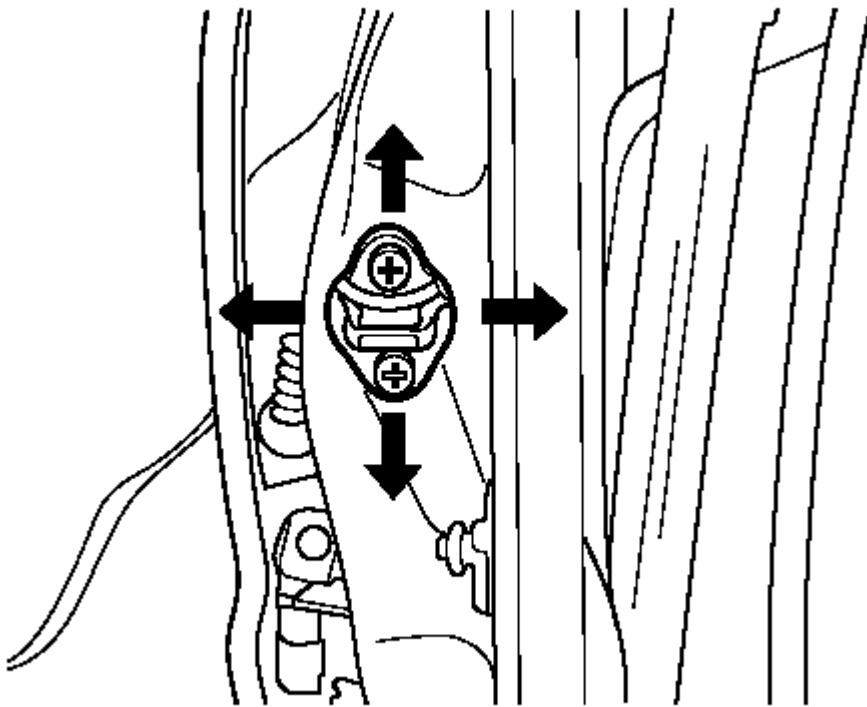


Fig. 22: Door Lock Striker

Courtesy of GENERAL MOTORS COMPANY

In order to adjust the door striker in an up and down or in and out direction, perform the following procedure:

1. The door must be properly aligned.
2. Loosen the striker screws.

CAUTION: In order to oblong the striker mounting hole to assist in further striker adjustment, use a die grinder with a flat-headed grinding bit. This type of bit will help to prevent damage to the tapered floating cage plate. The striker and the tapered floating cage plate are important attaching parts that could affect operation of the door closing and latching systems.

3. The floating cage plate can be moved slightly using the ends of the striker screws. Move the floating cage plate to the desired position.
4. If proper adjustment requires that the floating cage plate be moved more than is possible, use an electric hand drill and a 9.5 mm (0.375 in) rotary file with a flat head in order to enlarge the body opening in the direction required.
5. Tighten the striker screws to the correct position.

FRONT SIDE DOOR LOCK STRIKER REPLACEMENT

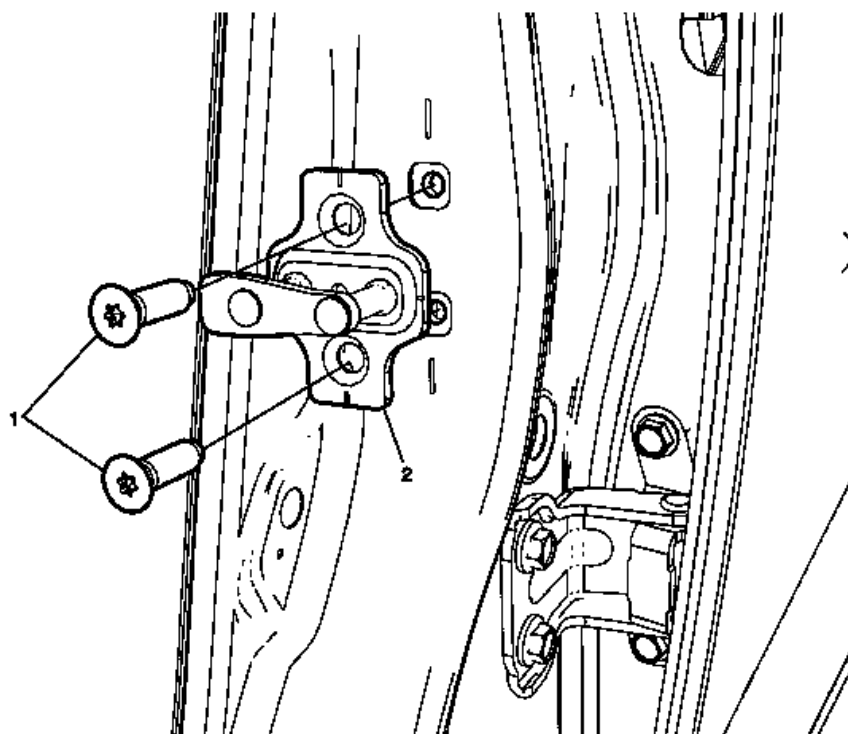


Fig. 23: Front Side Door Lock Striker
Courtesy of GENERAL MOTORS COMPANY

Front Side Door Lock Striker Replacement

Callout	Component Name
1	Front Side Door Lock Striker Screw (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 25 N.m (18 lb ft)
2	Front Side Door Lock Striker TIP: When the striker bolts have been removed, the striker anchor plate could slip down in the door pillar or quarter panel and the trim will need to be removed to gain access.

LIFTGATE LOCK STRIKER REPLACEMENT

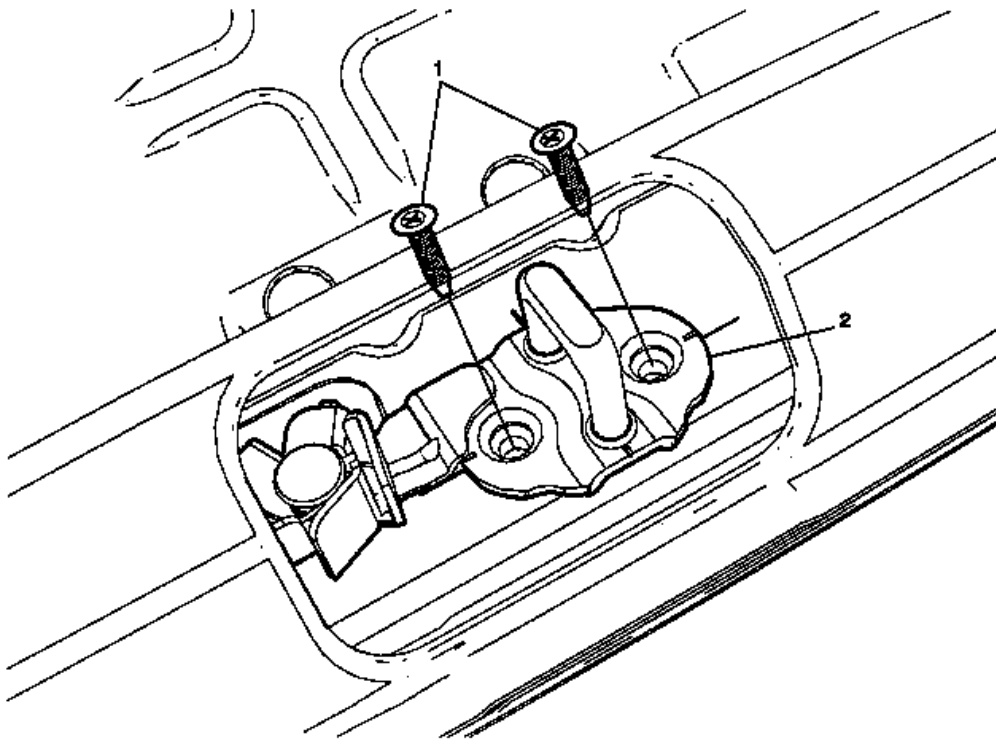


Fig. 24: Liftgate Lock Striker
 Courtesy of GENERAL MOTORS COMPANY

Liftgate Lock Striker Replacement

Callout	Component Name
Preliminary Procedure Open the liftgate.	
1	Liftgate Lock Striker Screw (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 20 N.m (15 lb ft)
2	Liftgate Lock Striker Procedure Disconnect the lock cable.

DESCRIPTION AND OPERATION

DOOR AJAR INDICATOR DESCRIPTION AND OPERATION

Door Ajar Indicator System Components

The door ajar indicator system consists of the following components:

- The body control module (BCM)
- The instrument cluster
- The driver door ajar switch
- The passenger door ajar switch
- The left rear door ajar switch
- The right rear door ajar switch
- The liftgate ajar switch

Door Ajar Indicator Block Diagram

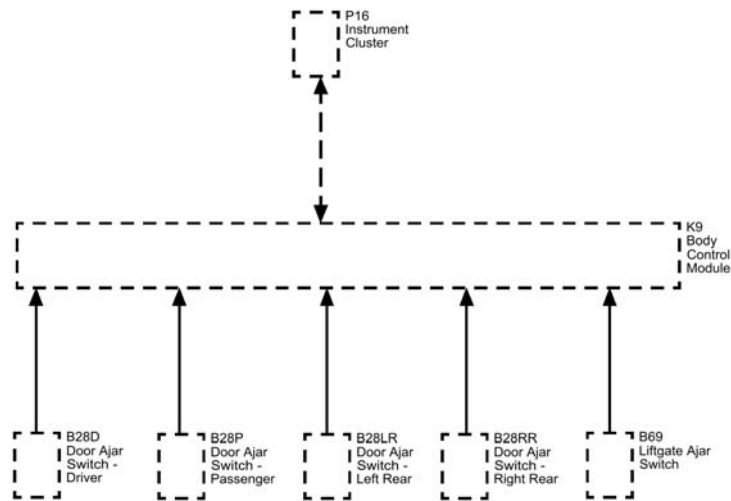


Fig. 25: Door Ajar Indicator Description
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
DA	Serial Data
HW	Hard-Wired
HW	Hard-Wired
HW	Hard-Wired
HW	Hard-Wired
HW	Hard-Wired
P16	P16 Instrument Cluster

K9	K9 Body Control Module
B28D	B28D Door Ajar Switch - Driver
B28P	B28P Door Ajar Switch - Passenger
B28RR	B28RR Door Ajar Switch - Right Rear
B28LR	B28LR Door Ajar Switch - Left Rear
B69	B69 Liftgate Ajar Switch

Driver and Passenger Door Ajar Operation

The body control module (BCM) provides a 12V signal to each door ajar switch and the liftgate ajar switch via the ajar switch signal circuit. The door ajar switches are normally open when the door is fully closed. When a door or liftgate is opened, the ajar switch contacts close providing a path to ground. The driver information center displays door ajar icon when the BCM detects that one of the doors or liftgate are open. The instrument cluster receives a serial data message from the BCM indicating the door ajar status.

FUEL FILL DOOR DESCRIPTION AND OPERATION

The fuel filler door attaches to the fuel tank pocket on the right side of the vehicle.

POWER DOOR LOCKS DESCRIPTION AND OPERATION

Door Lock System Components

The power door lock system consists of the following components:

- Driver door lock switch
- Passenger door lock switch
- Body control module (BCM)
- Driver door latch
- Passenger door latch
- Left rear door latch
- Right rear door latch

Power Door Locks Block Diagram

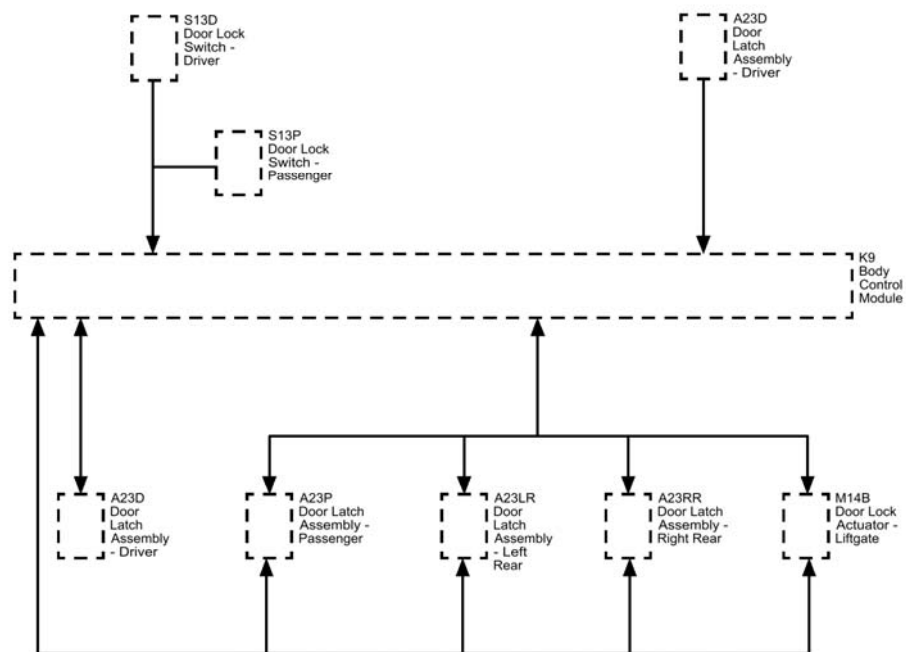


Fig. 26: Power Door Locks Block Diagram
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
HW	Hard-Wired
HW	Hard-Wired
HW	Hard-Wired
HW	Hard-Wired
HW	Hard-Wired
S13D	S13D Door Lock Switch - Driver
S13P	S13P Door Lock Switch - Passenger
A23D	A23D Door Latch Assembly - Driver
K9	K9 Body Control Module
M14B	M14B Door Lock Actuator - Liftgate
A23RR	A23RR Door Latch Assembly - Right Rear
A23LR	A23LR Door Latch Assembly - Left Rear

A23P	A23P Door Latch Assembly - Passenger
A23D	A23D Door Latch Assembly - Driver

Door Lock Switch Operation

The body control module supplies a 12 V signal to each of the door lock and door unlock signal circuits. When the door lock switches are in the open position, the voltage level in the signal circuit will be near 12 V. When any door lock switch is pressed to the lock or unlock position, the voltage level in the appropriate signal circuit will drop to 0 V and the BCM will detect the voltage drop and command the door latches to perform the requested lock or unlock command.

Door Lock and Unlock Operation

The body control module powers the reversible door latch assemblies by providing battery positive voltage and ground to the appropriate lock and unlock control circuits of the door latch assemblies. The lock and unlock control circuits of the rear doors and passenger door latch assemblies are all connected together. When the door latch assemblies are not active, all actuator lock and unlock control circuits are supplied a floating voltage door driver by the BCM. Transitioning of the lock actuators to the lock or unlocked position depends upon which control circuits receive voltage and which control circuits receive ground.

The following three circuits are used to operate the lock:

- Driver door only unlock
- All passenger doors unlock
- All doors lock

REAR HATCH/GATE DESCRIPTION AND OPERATION

Liftgate

The liftgate may be operated by one of the following methods:

- Inserting the key into the liftgate lock.
- Operating the power door lock switches.
- Operating the rear hatch lock switch.
- Using the keyless entry fob.

Functional Operation

The liftgate operates in the same manner as the power door locks. If the vehicle is equipped with power door locks, the lock and unlock circuits for the liftgate are shared with the passenger lock/unlock control circuits. If the vehicle is not equipped with power door locks, the liftgate will have it's own lock/unlock switch and will have it's own lock and unlock control circuits commanded by the BCM.

ELECTRICAL

Power Outlets - Spark

SCHEMATIC WIRING DIAGRAMS

CIGAR LIGHTER/POWER OUTLET WIRING SCHEMATICS

Power Outlets Wiring Schematics

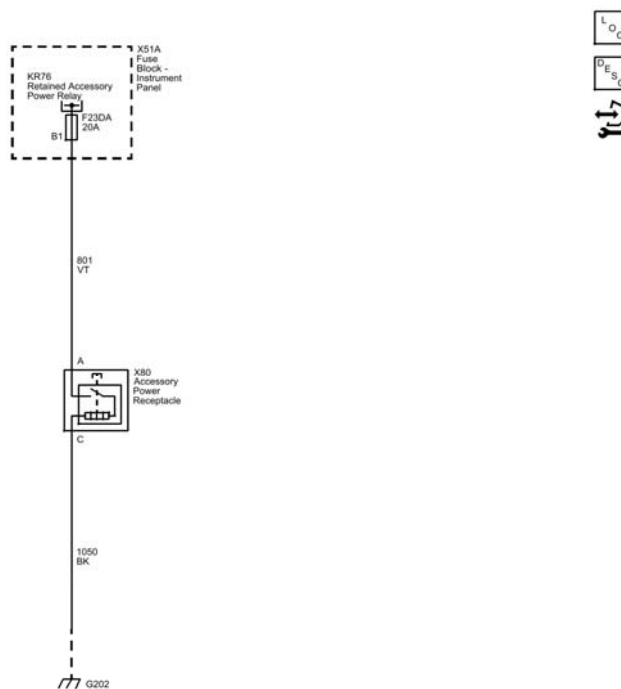


Fig. 1: Power Outlets Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

SYMPTOMS - POWER OUTLETS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Visual/Physical Inspection

- Inspect for aftermarket devices which can affect the operation of the power outlets. Refer to **Checking Aftermarket Accessories**
- Inspect the accessible system components or the visible system components for obvious damage or for obvious conditions which can cause the symptom.

Intermittent

Electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections**

Symptom List

Refer to **Power Outlet Receptacle Malfunction** in order to diagnose the system.

POWER OUTLET RECEPTACLE MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	1	1	-	-
Ground	-	1	1	-
1. Accessory Power Receptacle Malfunction				

Circuit/System Description

The vehicle is fitted with a 12 V accessory power receptacle. The accessory power outlets are controlled by an ignition operated relay. The accessory power receptacle is operational when the ignition is turned to either the On or the Accessories positions.

Diagnostic Aids

It may be helpful to discuss with the customer the usage of any device that may have drawn too much current and caused an open fuse.

Reference Information

Schematic Reference

Cigar Lighter/Power Outlet Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Outlets Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Circuit/System Verification

1. Ignition ON, connect an appropriate device to the X80 Accessory Power Receptacle.
2. Verify the device is powered by the X80 Accessory Power Receptacle.
 - **If the device is not powered**

Refer to Circuit/System Testing

- **If the device is powered**
3. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the appropriate X80 Accessory Power Receptacle. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal C and ground.
 - **If greater than 10 ohms**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Ignition ON.
4. Verify that a test lamp illuminates between the control circuit terminal A and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.

2. Test for less than 2 ohms in the control circuit end to end.
 - If greater than 2 ohms, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse. Refer to **Retained Accessory Power Malfunction** .
 - **If the test lamp does not illuminate and the circuit fuse is open**
1. Ignition OFF.
2. Test for infinite resistance between the control circuit terminal A and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the appropriate X80 Accessory Power Receptacle.
 - **If the test lamp illuminates**
5. Test or replace the X80 Accessory Power Receptacle.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Accessory Power Receptacle Replacement.

REPAIR INSTRUCTIONS

ACCESSORY POWER RECEPTACLE RETAINER REPLACEMENT

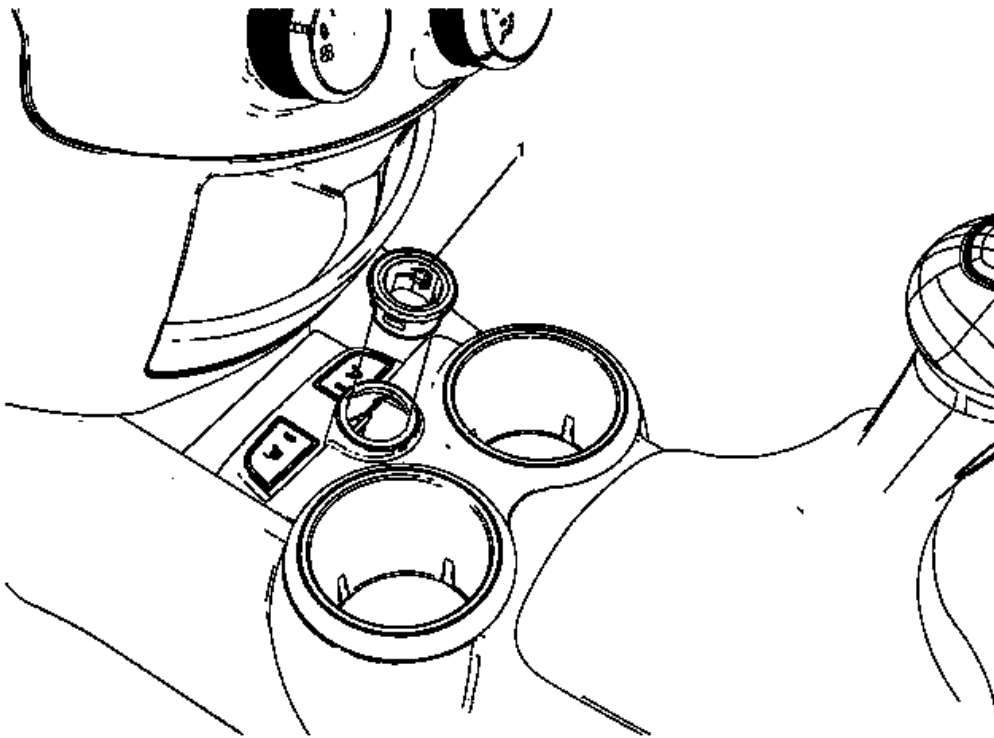


Fig. 2: Accessory Power/Cigarette Lighter Receptacle Retainer

Courtesy of GENERAL MOTORS COMPANY

Accessory Power Receptacle Retainer Replacement

Callout	Component Name
WARNING: Refer to <u>Battery Disconnect Warning</u> .	
Preliminary Procedure 1. Disconnect battery negative cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Remove accessory power/cigar lighter receptacle. Refer to <u>Accessory Power Receptacle Replacement</u> .	
1	Accessory Power/Cigarette Lighter Receptacle Retainer

ACCESSORY POWER RECEPTACLE REPLACEMENT

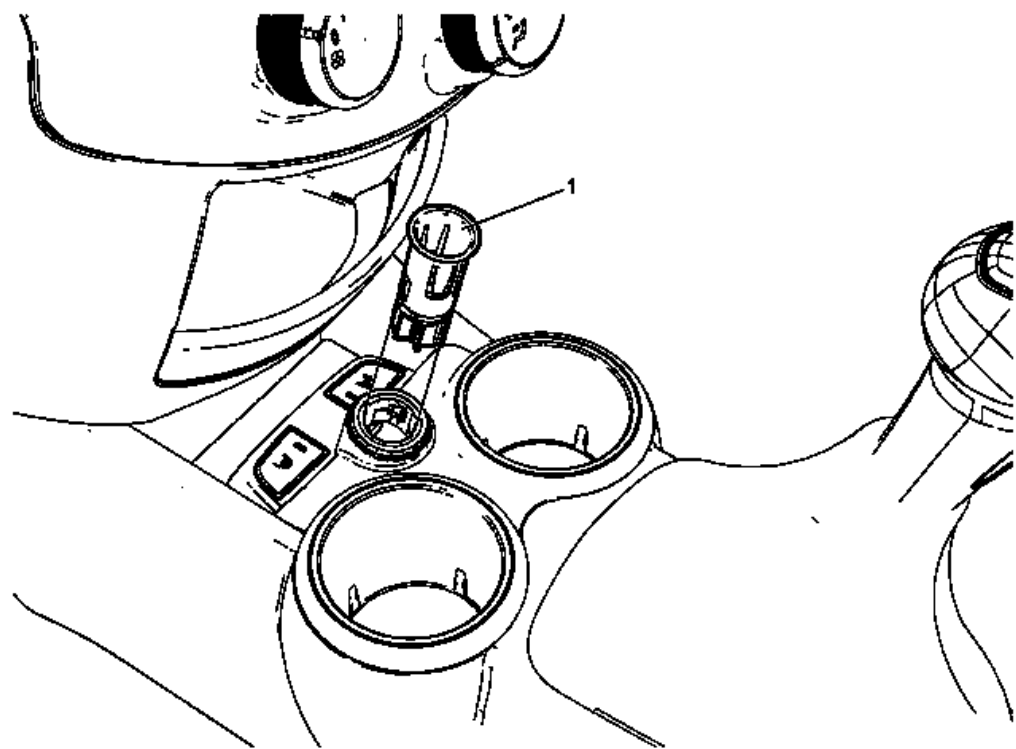


Fig. 3: Accessory Power/Cigarette Lighter Receptacle
Courtesy of GENERAL MOTORS COMPANY

Accessory Power Receptacle Replacement

Callout	Component Name
Preliminary Procedure Disconnect battery negative cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> .	

1	Accessory Power/Cigarette Lighter Receptacle Procedure Disconnect electrical connectors. Special Tools BO-48871 Cigar Lighter Socket Remover For equivalent regional tools, refer to Special Tools .
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DESCRIPTION AND OPERATION

POWER OUTLETS DESCRIPTION AND OPERATION

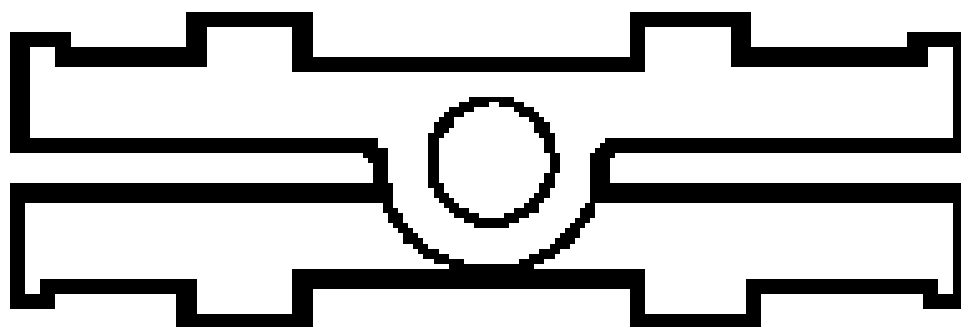
System Description

The vehicle is fitted with either a cigarette lighter or with 12 V accessory power outlets. The power outlet is operational when the ignition is turned to either the On or the Accessories positions. The cigarette lighter is operational whenever the ignition is in the On position. To operate the cigarette lighter, press in the lighter knob. When the element is hot, the lighter automatically pops out and is ready for use.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description
	BO-48871 Cigar Lighter Socket Remover



STEERING

Power Steering - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Electric Power Steering Module to Bracket Bolts	3	27 lb in
Electric Power Steering Module Bracket Bolts	18	13 lb ft
Intermediate Steering Shaft Lower Bolt	25	18 lb ft
Steering Gear Bolt	100	74 lb ft
Steering Gear to Steering Knuckle Nut	50	37 lb ft
Steering Linkage Tie Rod Nut	75	55 lb ft

SCHEMATIC WIRING DIAGRAMS

POWER STEERING WIRING SCHEMATICS

Electric Power Steering (NJ1) Wiring Schematics

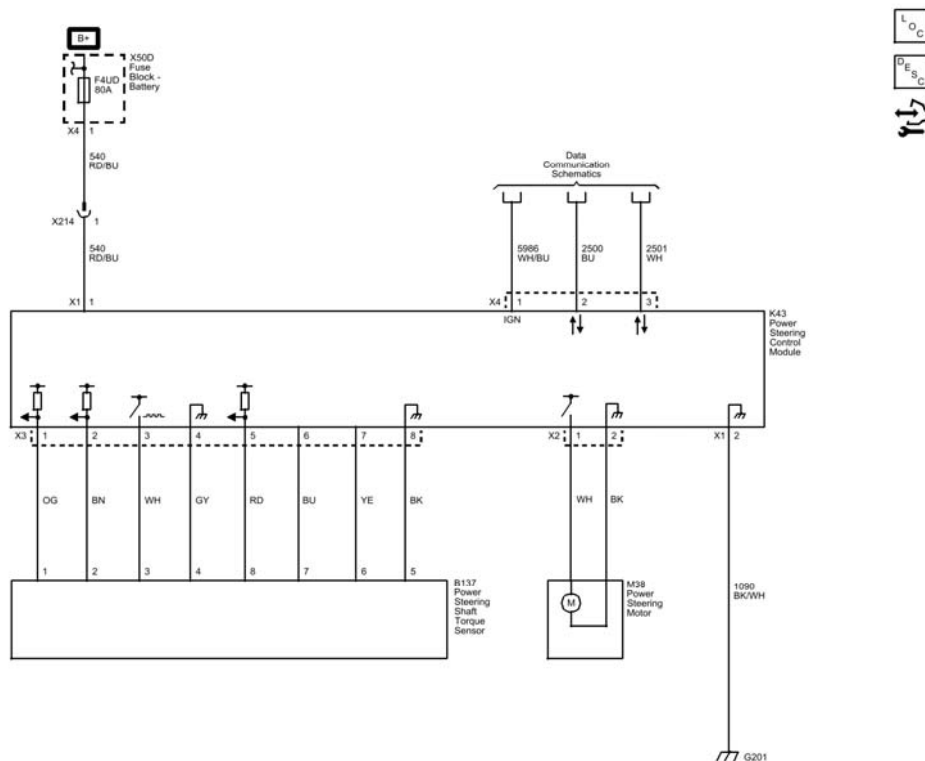


Fig. 1: Electric Power Steering (NJ1) Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC C0176</u>	DTC C0176 54 Control Module Temperature Sensor High Temperature
<u>DTC C0460</u>	DTC C0460 00 Steering Wheel Angle Sensor Malfunction DTC C0460 4B Steering Wheel Angle Sensor Calibration Not Learned
<u>DTC C0475</u>	DTC C0475 00 Electric Steering Motor Circuit Malfunction

DTC C0176: CONTROL MODULE TEMPERATURE SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC C0176 54

Control Module Temperature Sensor High Temperature

Circuit/System Description

The power steering control module monitors the temperature of the power steering system. The power steering control module uses voltage, current levels and input from an internal temperature sensor to calculate an estimated system temperature. If the power steering control module detects a high system temperature event is occurring, the amount of assist is decreased to reduce system temperature, in effort to prevent thermal damage to the power steering components.

Conditions for Running the DTC

- Ignition ON, engine running.
- Power steering system voltage is 9-16 V.
- Repetitive steering input applied.

Conditions for Setting the DTC

The power steering control module detects a high system temperature.

Action Taken When the DTC Sets

- DTC C0176 54 is stored in memory.
- Steering assist is reduced.

Conditions for Clearing the DTC

A current DTC will clear on the next malfunction-free ignition cycle.

Diagnostic Aids

- DTC C0176 54 does not indicate that a malfunction has occurred. Rather that the power steering control module had to limit current to the power steering motor to avoid thermal damage to the power steering system components. Discuss with the customer about driving conditions when the steering assist was reduced.
- Ensure that no steering components down stream of the power steering column assembly, such as ball joints, tie rod ends, universal joints, or the steering gear assembly, are mechanically binding.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Steering System Description and Operation (Electric Power Steering)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Verify that the DTC sets outside of the conditions for running and setting. Since most occurrences of this DTC are caused by excessive driver inputs, review with the customer the conditions under which the DTC set.
 - **If the DTC did not set outside of the conditions for running and setting**
1. Ignition ON.
2. Operate the vehicle within the conditions that the customer experienced, avoiding excessive inputs, and verify the DTC does not reset.
 - If the DTC is set
1. Verify that no steering components down stream of the power steering column assembly are mechanically binding. Refer to
 - If steering components are mechanically binding, replace the mechanically binding steering components.
 - If no steering components are mechanically binding, replace the steering column assembly.
- If the DTC is not set
3. All OK.
 - **If the DTC set outside of the conditions for running and setting**
2. All OK. The power steering is operating as designed.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Steering Column Replacement (Electric Power Steering)**
- **Control Module References** for Power Steering Control Module replacement, programming and setup.

DTC C0460: STEERING WHEEL ANGLE SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC C0460 00

Steering Wheel Angle Sensor Malfunction

DTC C0460 4B

Steering Wheel Angle Sensor Calibration Not Learned

Circuit/System Description

The power steering control module contains the steering wheel angle sensor. The steering wheel angle sensor identifies the position and direction of the steering wheel rotation. The steering wheel angle signal is sending a serial data to the GMLAN high speed bus.

Conditions for Running the DTC

- Ignition ON, engine running.
- Power steering system voltage is 9-16 V.

Conditions for Setting the DTC

DTC C0460 00

- Steering angle signal is not valid.
- Steering angle signal line is open.
- Steering angle signal cycle time is out of range.
- Steering angle signal duty cycle is out of range.

DTC C0460 4B

Steering sensor zero position is not set.

Action Taken When the DTC Sets

- DTC C0460 is stored in memory.
- No steering assist.

Conditions for Clearing the DTC

A current DTC will clear on the next malfunction-free ignition cycle.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Steering System Description and Operation (Electric Power Steering)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Ignition ON.
2. Verify the DTC is not set.
 - **If the DTC is set**
 1. Calibrate the K43 Power Steering Control Module. Refer to **Power Steering Control Module Programming and Setup**
 2. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC

- If the DTC sets, replace the steering column assembly.
- If the DTC is not set

3. All OK.

- **If the DTC is not set**

3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Steering Column Replacement (Electric Power Steering)**
- **Control Module References** for Power Steering Control Module replacement, programming and setup.

DTC C0475: ELECTRIC STEERING MOTOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC C0475 00

Electric Steering Motor Circuit Malfunction

Circuit/System Description

The power steering control module continuously monitors the voltage and current levels being commanded to the 3-phase steering motor. The power steering control module compares the desired and actual current levels to detect malfunctions in the internal power steering motor circuits.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

The power steering control module detects a short to ground, short to voltage, or an open/high resistance on any of the internal power steering motor circuits.

Action Taken When the DTC Sets

- The DTC is stored in memory.
- No steering assist.

Conditions for Clearing the DTC

A history DTC will clear after 40 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Steering System Description and Operation (Electric Power Steering)

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Testing

1. Ignition ON.
2. Verify that DTC C0475 is not set.
 - **If the DTC is set**

Replace the steering column assembly.
 - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Steering Column Replacement (Electric Power Steering)
- Control Module References for Power Steering Control Module replacement, programming and setup.

SYMPTOMS - POWER STEERING SYSTEM (ELECTRIC POWER STEERING)

NOTE: Review the system description and operation in order to familiarize yourself with the system functions. Refer to Power Steering System Description and Operation (Electric Power Steering).

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the power steering system.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Symptoms List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- Increase in Effort While Turning Steering Wheel (Electronic Power Steering)
- Poor Return of Steering Wheel (Electronic Power Steering)
- Steering Wheel Surges/Jerks While Turning (Electric Power Steering)
- Rattle, Clunk, or Shudder Noise from the Power Steering System
- Whine or Growl Noise from the Power Steering System (Electric Power Steering)

RATTLE, CLUNK, OR SHUDDER NOISE FROM THE POWER STEERING SYSTEM

Rattle, Clunk, or Shudder Noise from the Power Steering System

Step	Action	Yes	No
1	Did you review the Power Steering System Symptoms and perform the necessary inspections?	Go to Step 2	Go to <u>Symptoms - Power Steering System (Electric Power Steering)</u>
2	Verify that a rattle, clunk or shudder noise is present. Is a rattle, clunk or shudder noise present?	Go to Step 3	System OK
3	Inspect the power steering gear for the proper installation. Refer to <u>Steering Gear Replacement (Electric Power Steering)</u> . Is the power steering gear installation incorrect?	Go to Step 6	Go to Step 4
4	Inspect the intermediate shaft. Is the intermediate shaft worn?	Go to Step 8	Go to Step 5
5	Inspect the suspension. Is the suspension worn?	Go to Step 7	Go to <u>Noise Diagnosis - Front Suspension</u>
6	Install the power steering gear correctly. Refer to <u>Steering Gear Replacement (Electric Power Steering)</u> . Did you complete the repair?	Go to Step 9	-

7	Replace the worn suspension components. Did you complete the repair?	Go to Step 9	-
8	Replace the intermediate shaft. Refer to <u>Intermediate Steering Shaft Replacement</u> . Did you complete the repair?	Go to Step 9	-
9	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

WHINE OR GROWL NOISE FROM THE POWER STEERING SYSTEM (ELECTRIC POWER STEERING)

Whine or Growl Noise from the Power Steering System (Electric Power Steering)

Step	Action	Yes	No
1	Did you review the Power Steering System Symptoms and perform the necessary inspections?	Go to Step 2	Go to <u>Symptoms - Power Steering System (Electric Power Steering)</u> .
2	Verify that a whine or a growl noise is present. Is a whine or a growl noise present?	Go to Step 3	System OK
3	Inspect the power steering gear for the proper installation. Refer to <u>Steering Gear Replacement (Electric Power Steering)</u> . Is the power steering gear installation incorrect?	Go to Step 6	Go to Step 4
4	Inspect the intermediate shaft. Is the intermediate shaft worn?	Go to Step 8	Go to Step 5
5	Inspect the suspension. Is the suspension worn?	Go to Step 7	Go to <u>Noise Diagnosis - Front Suspension</u> .
6	Install the power steering gear correctly. Refer to <u>Steering Gear Replacement (Electric Power Steering)</u> . Did you complete the repair?	Go to Step 9	-
7	Replace the worn suspension components. Did you complete the repair?	Go to Step 9	-
8	Replace the intermediate shaft. Refer to <u>Intermediate Steering Shaft Replacement</u> . Did you complete the repair?	Go to Step 9	-
9	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

INCREASE IN EFFORT WHILE TURNING STEERING WHEEL (ELECTRONIC POWER STEERING)

Increase in Effort While Turning Steering Wheel (Electronic Power Steering)

Step	Action	Yes	No
	Did you review the Power Steering System		Go to <u>Power</u>

1	Description and Operation and perform the necessary inspections?	Go to Step 2	<u>Steering System Description and Operation (Electric Power Steering)</u>
2	Verify that there is an increase in effort while turning is present. Does the system operate normally?	System OK	Go to Step 3
3	Check for the following conditions: • Incorrect tire inflation - Refer to <u>Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label</u> . • Improper tire size Did you find and correct the condition?	Go to Step 10	Go to Step 4
4	1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Check for a binding or worn steering linkage outer tie rod. Is the tie rod binding or worn?	Go to Step 7	Go to Step 5
5	Check for a worn or binding intermediate steering shaft. Is the intermediate steering shaft worn or binding?	Go to Step 8	Go to Step 6
6	Check for a worn or binding steering gear. Is the steering gear worn or binding?	Go to Step 9	System OK
7	Replace the steering linkage outer tie rod. Refer to <u>Steering Linkage Outer Tie Rod Replacement</u> . Did you complete the repair?	Go to Step 10	-
8	Replace the intermediate steering shaft. Refer to <u>Intermediate Steering Shaft Replacement</u> . Did you complete the repair?	Go to Step 10	-
9	Replace the steering gear. Refer to <u>Steering Gear Replacement (Electric Power Steering)</u> . Did you complete the repair?	Go to Step 10	-
10	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

POOR RETURN OF STEERING WHEEL (ELECTRONIC POWER STEERING)

Poor Return of Steering Wheel (Electronic Power Steering)

Step	Action	Yes	No
DEFINITION: After completing a turn, extra steering input is required for the steering wheel to return to center.			

1	Did you review the General Description and perform the necessary inspections?	Go to Step 2	Go to <u>Power Steering System Description and Operation (Electric Power Steering)</u>
2	Verify that poor return of the steering wheel is present. Does the system operate normally?	System OK	Go to Step 3
3	1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Lubricate the tie rod ends and ball joints, if applicable. 3. Inspect the suspension system for worn or damaged components. 4. Repair as necessary. Did you find and correct the condition?	Go to Step 12	Go to Step 4
4	1. Rotate the steering wheel ONE revolution in both directions. 2. Rotate the steering wheel back to the original position. Was the steering wheel abnormally difficult to rotate in either direction?	Go to Step 5	Go to Step 10
5	NOTE: Position the wheels straight ahead. Do NOT rotate the steering wheel more than one complete revolution from center. 1. Disconnect the intermediate shaft from the steering column. 2. Note the position of the steering wheel and rotate the steering wheel ONE revolution in both directions. 3. Rotate the steering wheel back to the original position. Was the steering wheel abnormally difficult to rotate in either direction?	Go to Step 11	Go to Step 6
6	Inspect the intermediate shaft for stiff or loose joints. Repair or replace as necessary. Refer to <u>Intermediate Steering Shaft Replacement</u> . Did you find and complete the repair?	Go to Step 12	Go to Step 7
	1. Remove the front tire and wheel assemblies.		

7	Refer to <u>Tire and Wheel Removal and Installation</u> . 2. Disconnect both outer tie rod ends from the steering knuckles. 3. Use your hands in order to move the tie rod end studs. 4. If abnormally difficult to move, replace the tie rod end. Refer to <u>Steering Linkage Outer Tie Rod Replacement</u>.		
	Did you find and complete the repair?	Go to Step 12	Go to Step 8
8	1. Use your hands to rotate the steering knuckle inboard and outboard in order to inspect for a binding strut bearings, ball joints, or axle. 2. Repair or replace any abnormally stiff or loose components.		
	Did you find and complete the repair?	Go to Step 12	Go to Step 9
9	Inspect for binding in the steering gear. If a binding is present repair or replace the steering gear. Refer to <u>Steering Gear Replacement (Electric Power Steering)</u>.		
	Did you find and complete the repair?	Go to Step 12	Go to Step 10
10	Inspect the wheel alignment and adjust as necessary. Refer to <u>Wheel Alignment Measurement</u> .		
	Did you find and complete the repair?	Go to Step 12	-
11	Inspect the steering column for a binding. If a binding is present, repair or replace the steering column as necessary. Refer to <u>Steering Column Replacement (Electric Power Steering)</u> .		
	Did you find and complete the repair?	Go to Step 12	-
12	Operate the system in order to verify the repair.		
	Did you correct the condition?	System OK	-

STEERING WHEEL SURGES/JERKS WHILE TURNING (ELECTRIC POWER STEERING)

Steering Wheel Surges/Jerks While Turning (Electric Power Steering)

Step	Action	Yes	No
1	Did you perform the Diagnostic Starting Point - Power Steering System?	Go to Step 2	Go to <u>Symptoms - Power Steering System (Electric Power Steering)</u>
2	Verify that the steering wheel surges/jerks while turning. Does the system operate normally?	System OK	Go to Step 3

3	Check for worn or binding front suspension components. Did you find and correct the condition?	Go to Step 14	Go to Step 4
4	1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Check for a binding or worn rack and pinion outer tie rod end. Is the rack and pinion outer tie rod end binding or worn?	Go to Step 10	Go to Step 5
5	Check for a worn or binding intermediate steering shaft. Is the intermediate steering shaft worn or binding?	Go to Step 11	Go to Step 6
6	Check for a worn or binding steering gear. Is the steering gear worn or binding?	Go to Step 12	Go to Step 7
7	Check for a worn or binding steering column. Is the steering column worn or binding?	Go to Step 13	Go to Step 8
8	Check for excessive heat in the electric power steering (EPS) motor. Does the EPS motor appear to be overheated?	Go to Step 9	Go to Step 13
9	NOTE: Do not perform excessive parking lot maneuvers during testing, that can cause the EPS motor to heat up. Allow the EPS motor to cool and retest the system. Did you correct the condition?	Go to Step 14	Go to Step 13
10	Replace the steering linkage outer tie rod end. Refer to <u>Steering Linkage Outer Tie Rod Replacement</u> . Did you complete the repair?	Go to Step 14	-
11	Replace the intermediate steering shaft. Refer to <u>Intermediate Steering Shaft Replacement</u> . Did you complete the repair?	Go to Step 14	-
12	Replace the steering gear. Refer to <u>Steering Gear Replacement (Electric Power Steering)</u> . Did you complete the repair?	Go to Step 14	-
13	Replace the steering column. Refer to <u>Steering Column Replacement (Electric Power Steering)</u> . Did you complete the repair?	Go to Step 14	-
14	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

REPAIR INSTRUCTIONS

STEERING LINKAGE OUTER TIE ROD REPLACEMENT

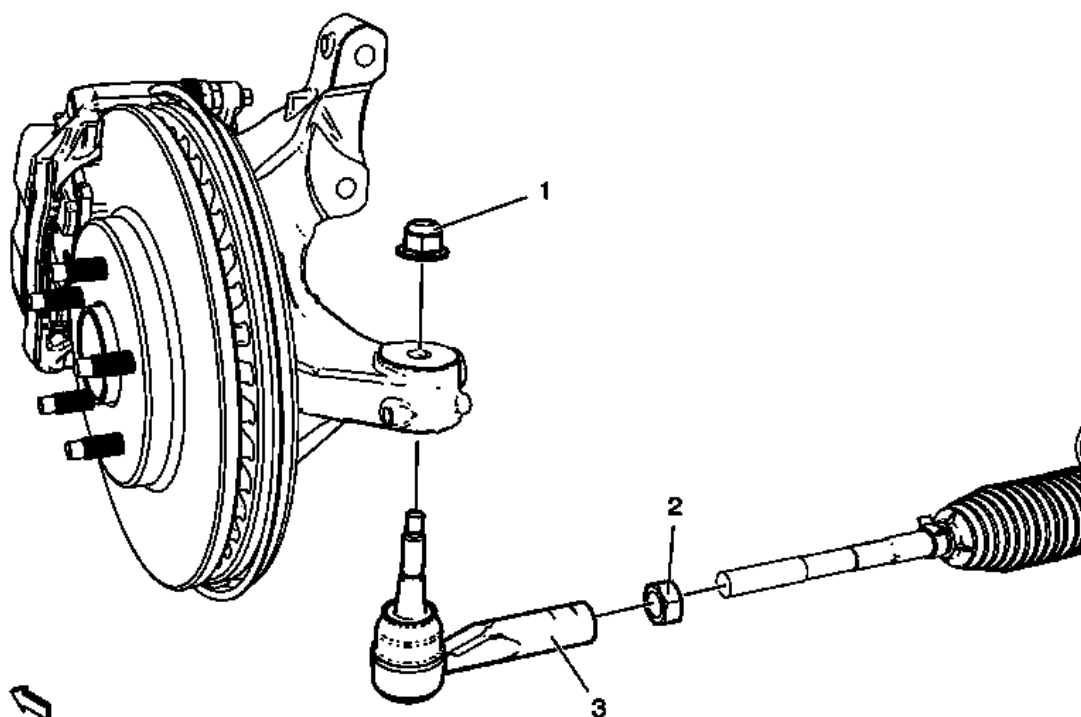


Fig. 2: Steering Linkage Outer Tie Rod And Nuts
 Courtesy of GENERAL MOTORS COMPANY

Steering Linkage Outer Tie Rod Replacement

Callout	Component Name
Preliminary Procedure Remove the tire and wheel assembly. Refer to <u>Tire and Wheel Removal and Installation</u> .	
1	Steering Linkage Tie Rod Nut CAUTION: Refer to <u>Fastener Caution</u> . Tighten 50 N.m (37 lb ft)
2	Steering Linkage Inner Tie Rod Nut Tighten 75 N.m (55 lb ft)
	Steering Linkage Outer Tie Rod Procedure 1. Use CH-161-B puller to separate the steering linkage outer tie rod from the steering knuckle.

3

2. Inspect the steering linkage inner tie rod for bent or damaged threads.
3. Clean the tapered surface of the steering knuckle.
4. Lubricate the steering linkage inner tie rod threads with chassis lubricant.
5. Adjust the front toe. Refer to **Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment** .

Special Tools

CH-161-B Puller

For equivalent regional tools, refer to **Special Tools**.

STEERING GEAR BOOT REPLACEMENT

Special Tools

CH-804 Drive Axle Seal Clamp Pliers

For equivalent regional tools, refer to **Special Tools**.

Removal Procedure

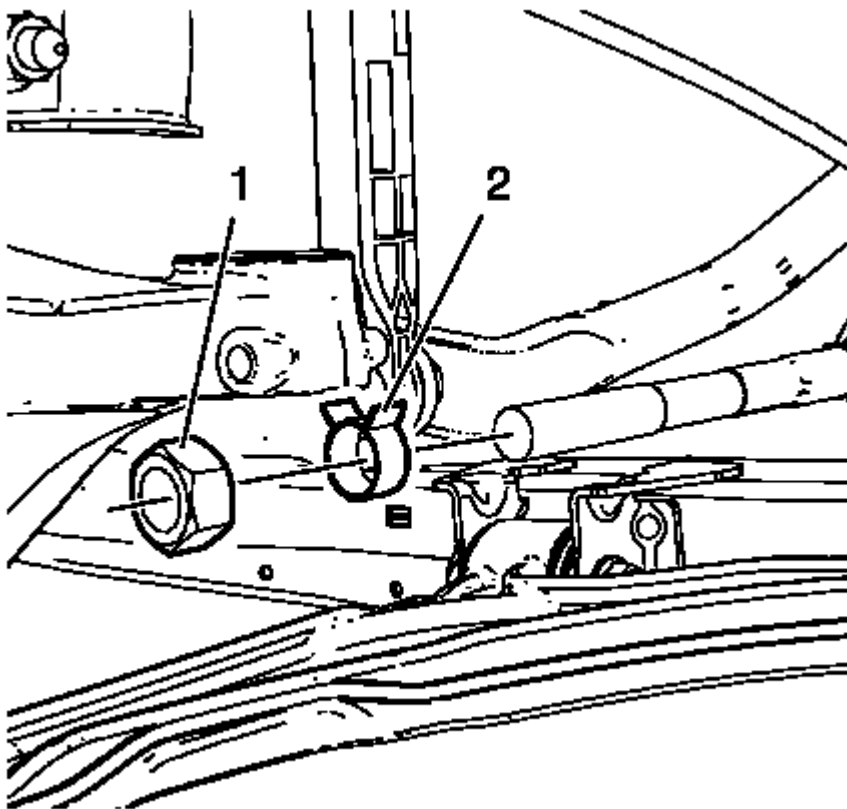


Fig. 3: Steering Linkage Inner Tie Rod Nut

Courtesy of GENERAL MOTORS COMPANY

1. Remove the steering linkage outer tie rod. Refer to Steering Linkage Outer Tie Rod Replacement.
2. Remove the steering linkage inner tie rod nut (1).
3. Remove the steering gear outer boot clamp (2).

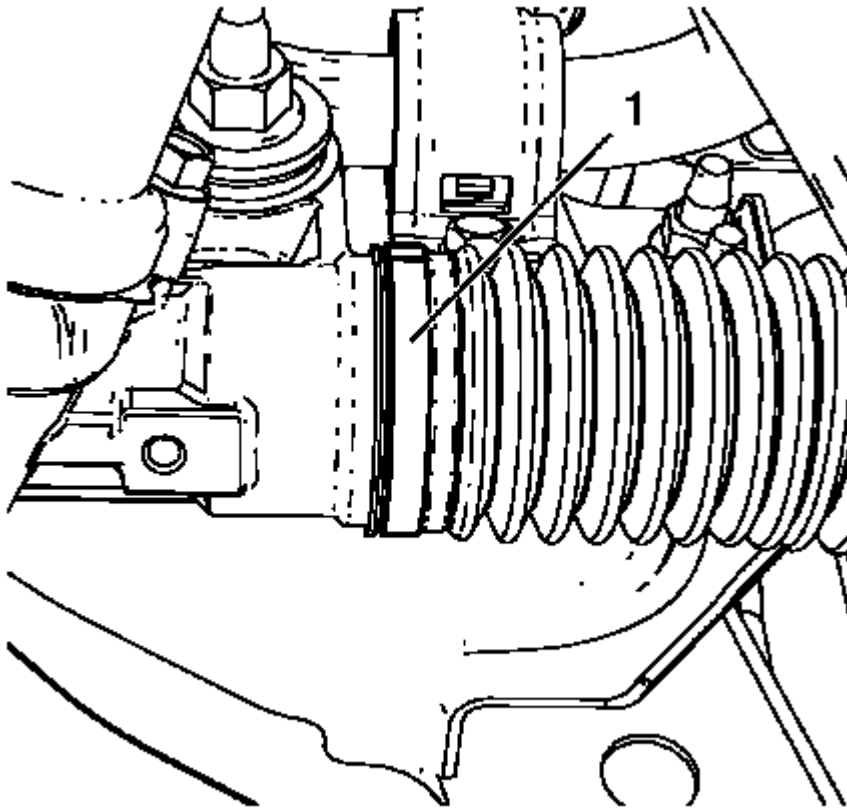


Fig. 4: Steering Gear Inner Boot Clamp

Courtesy of GENERAL MOTORS COMPANY

4. Loosen the steering gear inner boot clamp (1).

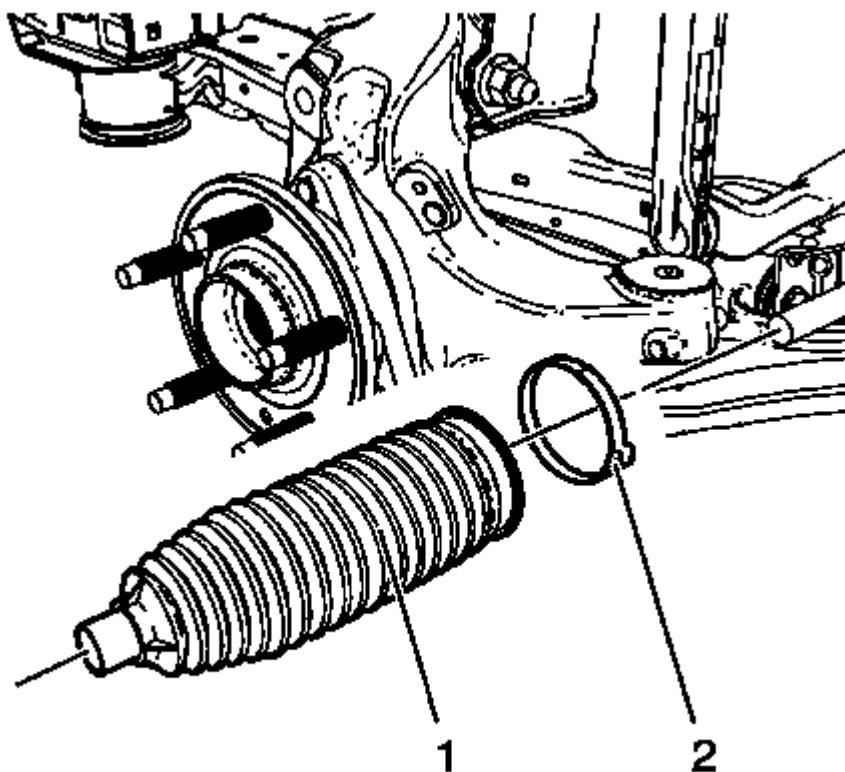


Fig. 5: Steering Gear Boot

Courtesy of GENERAL MOTORS COMPANY

NOTE: After removing the boot, inspect the steering linkage inner tie rod for evidence of corrosion or contamination. If none is evident, continue with the repair. If corrosion or contamination is evident, replace the inner tie rod.

5. Remove the steering gear boot (1).
6. Remove the steering gear inner boot clamp (2).

Installation Procedure

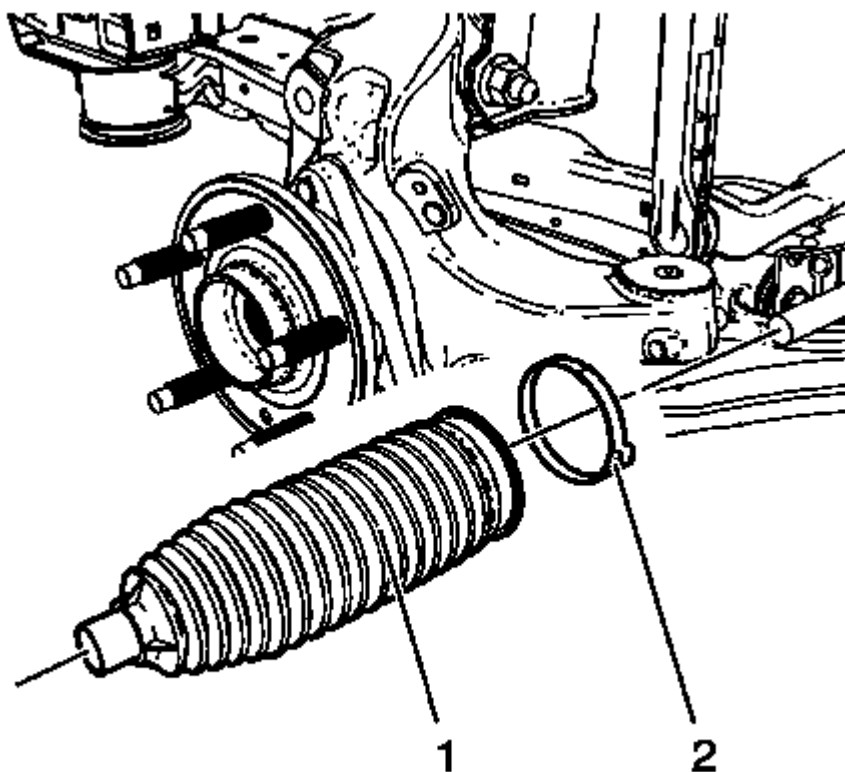


Fig. 6: Steering Gear Boot

Courtesy of GENERAL MOTORS COMPANY

1. Install a new clamp (2) loosely on the inner part of the steering gear boot.
2. Apply grease from the service kit to the indicated locations.

NOTE: **The steering gear boot must seat in the appropriate groove on the steering gear.**

3. Install the steering gear boot (1) over the steering linkage inner tie rod and onto the steering gear.

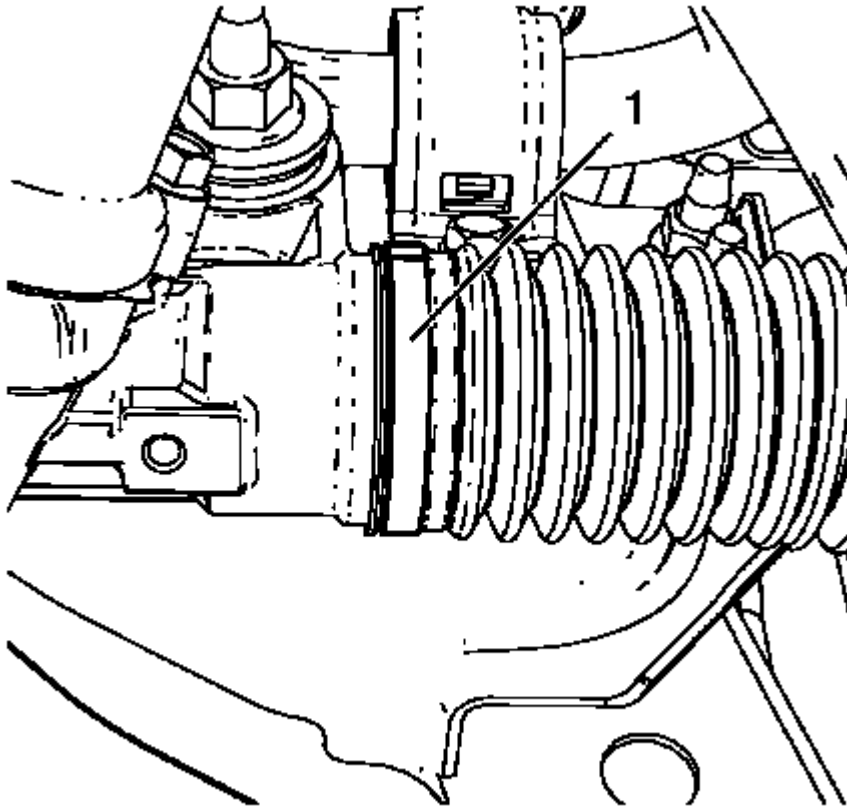


Fig. 7: Steering Gear Inner Boot Clamp
Courtesy of GENERAL MOTORS COMPANY

4. Using **CH-804** pliers crimp the inner steering gear boot clamp (1).

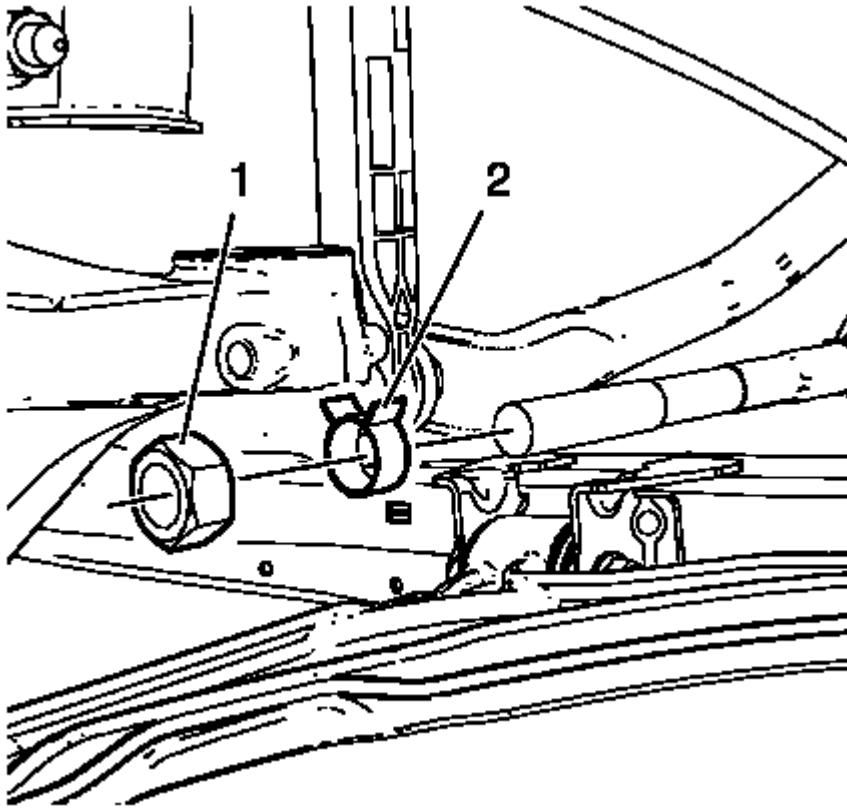


Fig. 8: Steering Linkage Inner Tie Rod Nut
Courtesy of GENERAL MOTORS COMPANY

5. Install the steering gear outer boot clamp (2).
6. Install the steering linkage inner tie rod nut (1).
7. Install the steering linkage outer tie rod. Refer to **Steering Linkage Outer Tie Rod Replacement**.

POWER STEERING CONTROL MODULE REPLACEMENT

Removal Procedure

1. Remove the steering column lower trim cover. Refer to **Steering Column Lower Trim Cover Replacement**.
2. Remove the inflatable restraint instrument panel lower module replacement of driver side, if equipped. Refer to **Instrument Panel Lower Airbag Replacement - Driver Side**.
3. Remove the steering column opening filler. Refer to **Steering Column Opening Filler Replacement**.
4. Remove the instrument panel lower reinforcement bracket. Refer to **Instrument Panel Lower Reinforcement Bracket Replacement**.
5. Disconnect the electric power steering module connectors.

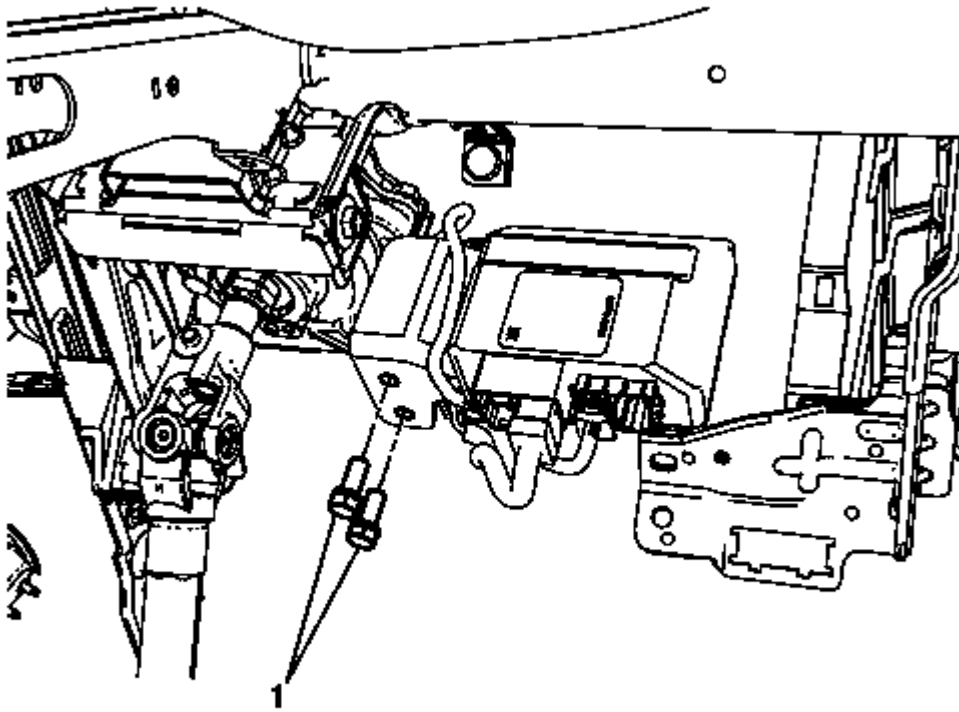


Fig. 9: Electric Power Steering Module Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Remove the electric power steering module bracket bolts (1).
7. Remove the electric power steering module and bracket assembly from the vehicle.

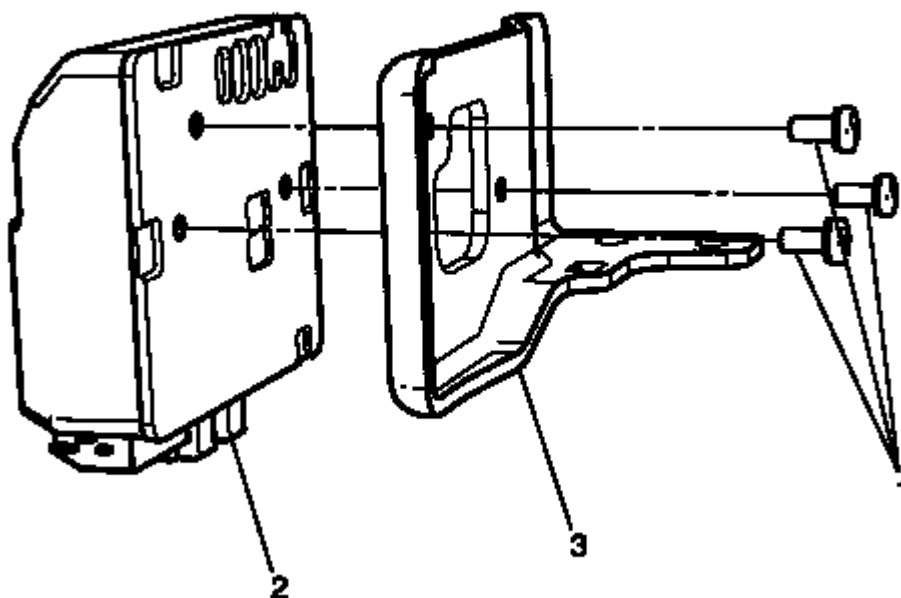


Fig. 10: Electric Power Steering Module And Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

8. Remove the electric power steering module to bracket bolts (1).
9. Remove the electric power steering module (2) from the electric power steering module bracket (3).

Installation Procedure

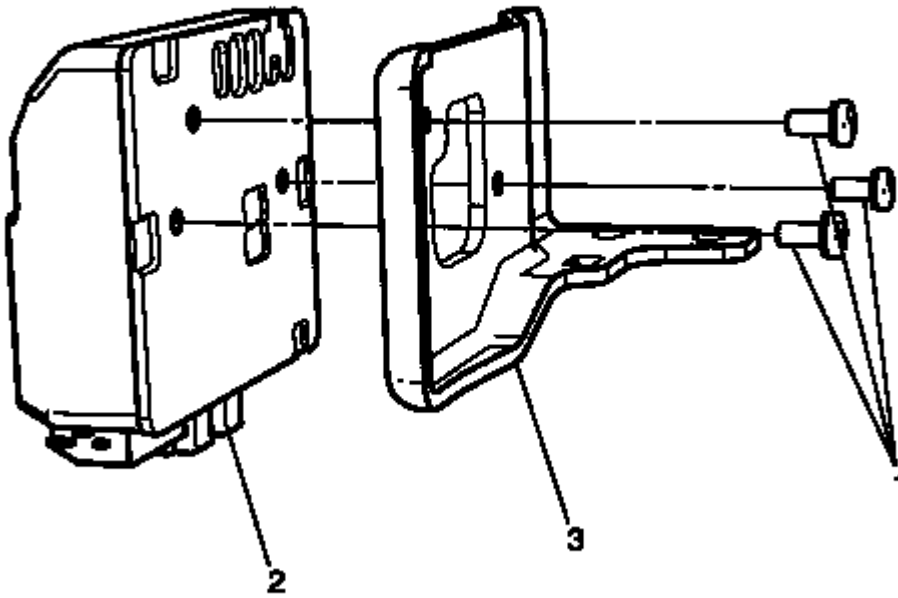


Fig. 11: Electric Power Steering Module And Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the electric power steering module (2) to the electric power steering module bracket (3).
2. Install the electric power steering module to bracket bolts (1) and tighten to 3 (27 lb in).
3. Install the electric power steering module and bracket assembly to the vehicle.

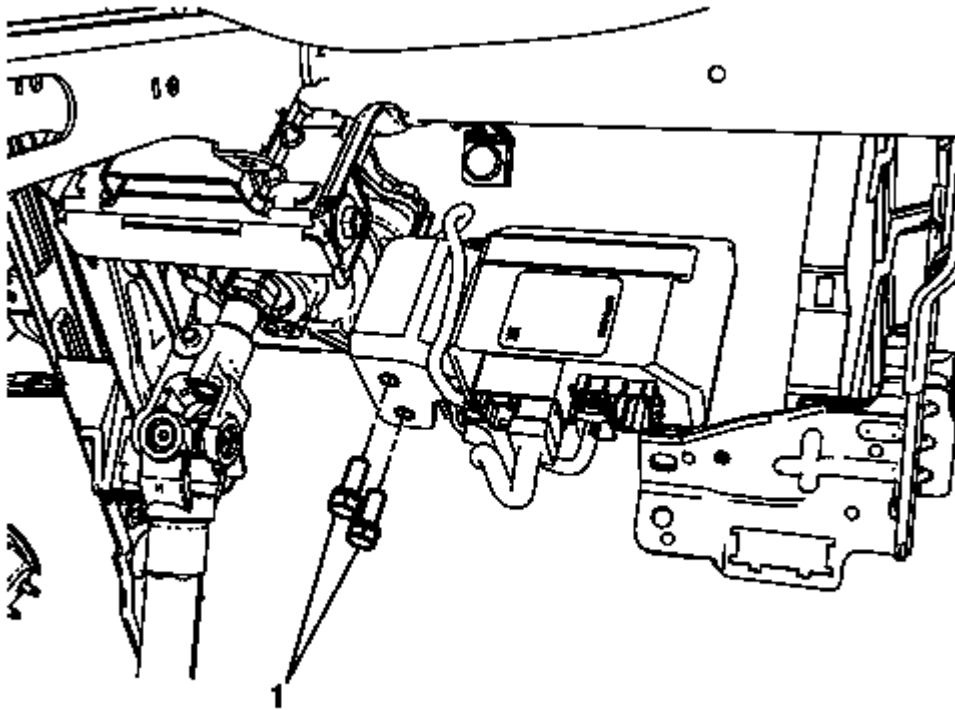


Fig. 12: Electric Power Steering Module Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Install the electric power steering module bracket bolts (1) and tighten to 18 (13 lb ft).
5. Connect the electric power steering module connectors.
6. Install the instrument panel lower reinforcement bracket. Refer to **Instrument Panel Lower Reinforcement Bracket Replacement** .
7. Install the steering column opening filler. Refer to **Steering Column Opening Filler Replacement**
8. Install the inflatable restraint instrument panel lower module replacement of driver side, if equipped. Refer to **Instrument Panel Lower Airbag Replacement - Driver Side** .
9. Install the steering column lower trim cover. Refer to **Steering Column Lower Trim Cover Replacement** .
10. If a new electric power steering control module is installed, program the electric power steering control module. Refer to **Power Steering Control Module Programming and Setup** .

STEERING GEAR REPLACEMENT (ELECTRIC POWER STEERING)

Removal Procedure

CAUTION: With wheels of the vehicle facing straight ahead, secure the steering wheel utilizing steering column anti-rotation pin, steering column

lock, or a strap to prevent rotation. Locking of the steering column will prevent damage and a possible malfunction of the SIR system. The steering wheel must be secured in position before disconnecting the following components:

- The steering column
- The intermediate shaft(s)
- The steering gear

After disconnecting these components, do not rotate the steering wheel or move the front tires and wheels. Failure to follow this procedure may cause the SIR coil assembly to become un-centered and cause possible damage to the SIR coil. If you think the SIR coil has become un-centered, refer to your specific SIR coil's centering procedure to re-center SIR Coil.

1. Turn the steering wheel to the straight ahead position and lock it in place.
2. Remove the front tire/wheel assemblies. Refer to **Tire and Wheel Removal and Installation** .

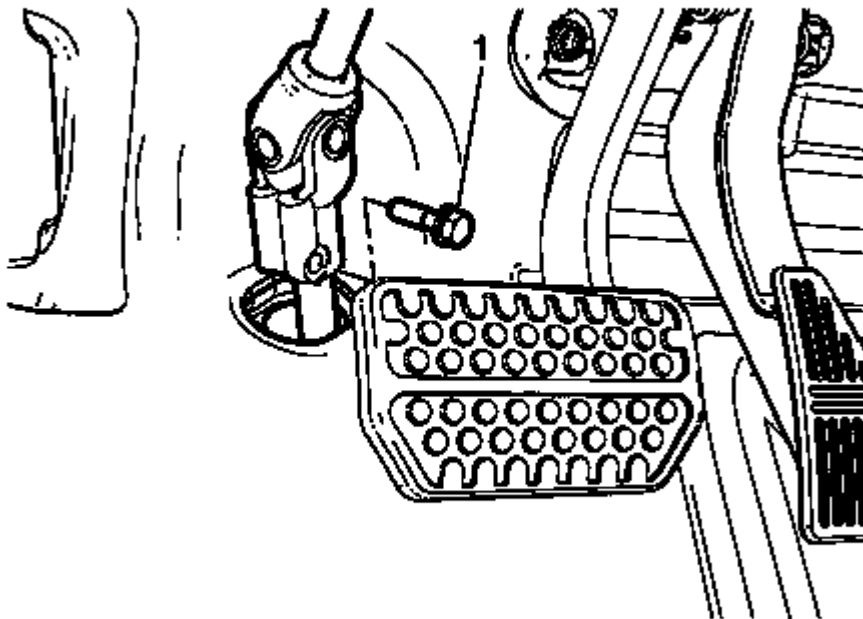


Fig. 13: Intermediate Steering Shaft Lower Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Remove the intermediate steering shaft lower bolt (1) and disconnect the intermediate steering shaft from the steering gear assembly. Refer to **Intermediate Steering Shaft Replacement** .
4. Separate both of the steering linkage outer tie rod ends. Refer to **Steering Linkage Outer Tie Rod Replacement**.
5. Remove both of the upper stabilizer shaft link nuts and separate the left and right stabilizer shaft link from the strut. Refer to **Stabilizer Shaft Link Replacement**
6. Remove the transmission rear mount. Refer to **Transmission Rear Mount Replacement (MX2, MFM)** .
7. Using a suitable support, lower the drivetrain and front suspension frame to replace the power steering gear. Refer to **Drivetrain and Front Suspension Frame Replacement (with EN-49802)** , **Drivetrain and Front Suspension Frame Replacement (with CH-49289)** .

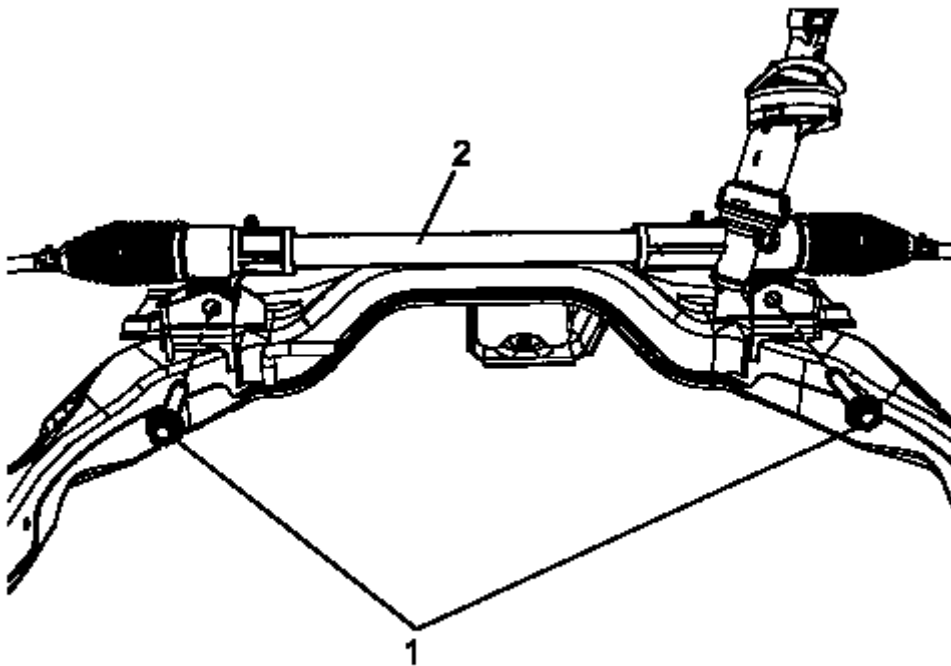


Fig. 14: Steering Gear
Courtesy of GENERAL MOTORS COMPANY

8. Remove the steering gear bolts (1).
9. Remove the steering gear (2) from the drivetrain and front suspension frame.

Installation Procedure

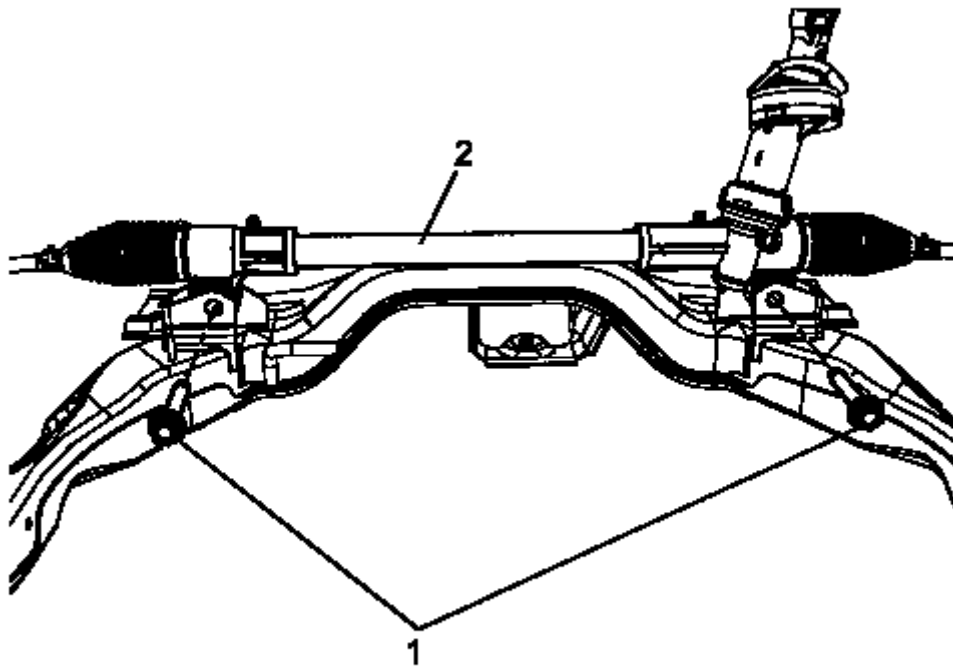


Fig. 15: Steering Gear

Courtesy of GENERAL MOTORS COMPANY

1. Install the steering gear (2) from the drivetrain and front suspension frame.

CAUTION: Refer to Fastener Caution .

2. Install the steering gear bolts (1) and tighten to 110 (81 lb ft).
3. Install the drivetrain and front suspension frame to the vehicle. Refer to **Drivetrain and Front Suspension Frame Replacement (with EN-49802)** , **Drivetrain and Front Suspension Frame Replacement (with CH-49289)** .
4. Install the transmission rear mount. Refer to **Transmission Rear Mount Replacement (MX2, MFM)** .
5. Install the left and right stabilizer shaft link to the strut. Refer to **Stabilizer Shaft Link Replacement** .
6. Install both of the steering linkage outer tie rod ends. Refer to **Steering Linkage Outer Tie Rod Replacement**.

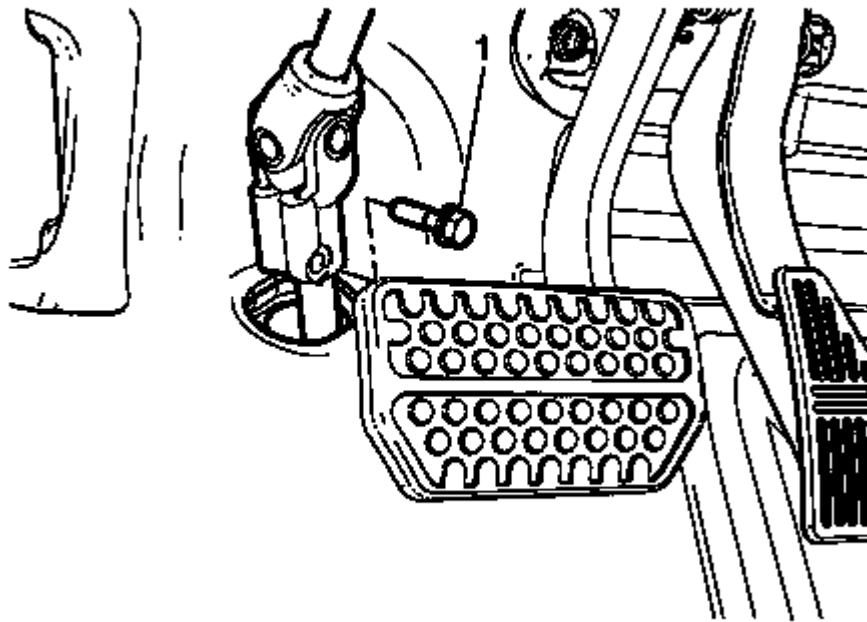


Fig. 16: Intermediate Steering Shaft Lower Bolt
Courtesy of GENERAL MOTORS COMPANY

7. Install the lower intermediate steering shaft to the steering gear and install the intermediate steering shaft lower bolt (1). Refer to **Intermediate Steering Shaft Replacement** .
8. Install the front tire/wheel assemblies. Refer to **Tire and Wheel Removal and Installation** .
9. Adjust the front toe. Refer to **Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment** .

DESCRIPTION AND OPERATION

POWER STEERING SYSTEM DESCRIPTION AND OPERATION (ELECTRIC POWER STEERING)

The electric power steering system reduces the amount of effort needed to steer the vehicle. The system uses the body control module, power steering control module, torque sensor, discrete battery voltage supply circuit, electric power steering motor, serial data bus, and the instrument panel cluster message center to perform the system functions. Any electric power steering components diagnosed to be malfunctioning requires replacement of the steering column assembly, also known as the electric power steering assembly.

Torque Sensor

The power steering control module uses a torque sensor as it's main input for determining the amount of steering assist. The steering column has an input shaft, from the steering wheel to the torque sensor, and an output shaft, from the torque sensor to the steering shaft coupler. The input and output shafts are separated by a torsion bar, where the torque sensor is located. The sensor consists of a compensation coil, detecting coil and 3 detecting rings. These detecting rings have toothed edges that face each other. Detecting ring 1 is fixed to the output shaft, detecting rings 2 and 3 are fixed top the input shaft. The detecting coil is positioned around the toothed edges of detecting rings 1 and 2. As torque is applied to the steering column shaft the alignment of the teeth between detecting rings 1 and 2 changes, which causes the detecting coil signal voltage to change. The power steering control module recognizes this change in signal voltage as steering column shaft torque. The compensation coil is used to compensate for changes in electrical circuit impedance due to circuit temperature changes from the electrical current and voltage levels as well as ambient temperatures for accurate torque detection.

EPS Motor

The electric power steering motor is a 12-volt brushed DC reversible motor. The motor assists steering through a worm shaft and reduction gear located in the steering column housing.

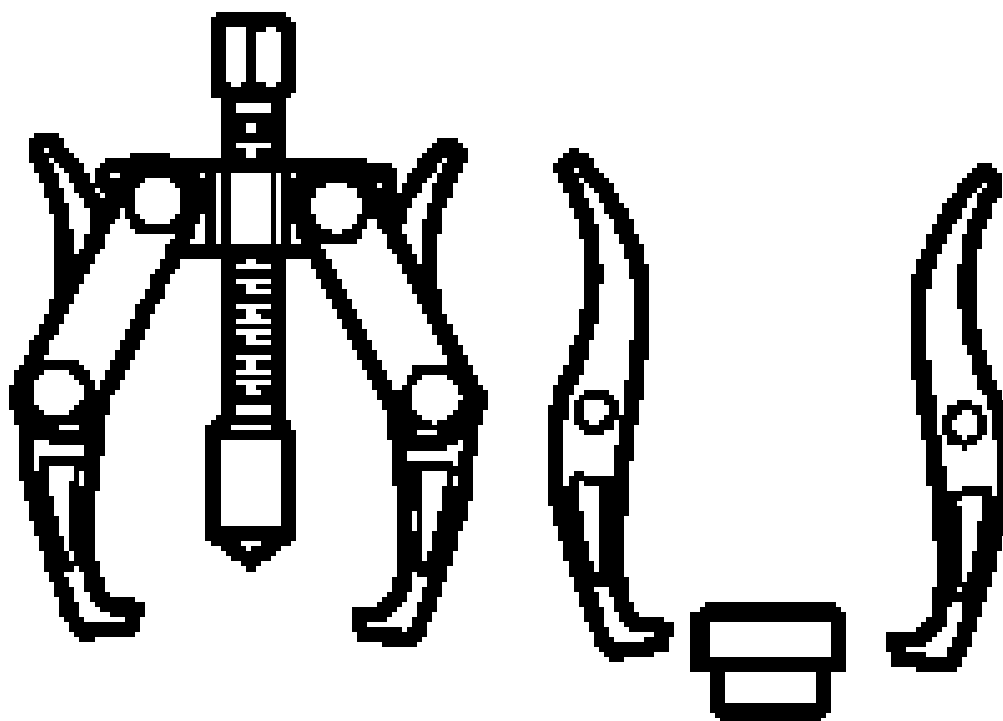
Power Steering Control Module

The power steering control module uses a combination of torque sensor inputs, vehicle speed, calculated system temperature and the steering calibration to determine the amount of steering assist. When the steering wheel is turned, the power steering control module uses signal voltage from the torque sensor to detect the amount of torque being applied to the steering column shaft and the amount of current to command to the electric power steering motor. The power steering control module receives serial data from the engine control module to determine vehicle speed. At low speeds more assist is provided for easy turning during parking maneuvers. At high speeds, less assist is provided for improved road feel and directional stability. In this mode the power steering control module will limit the amount of current commanded to the electric power steering motor which reduces steering assist levels. The power steering control module also chooses which steering calibration to use when the ignition is turned ON, based on the production map number stored in the body control module. The power steering control module contains all 8 of the steering calibrations which are different in relation to the vehicles RPOs. The power steering control module has the ability to detect malfunctions within the electric power steering system. Any malfunction detected will cause the instrument panel cluster message center to display a warning message.

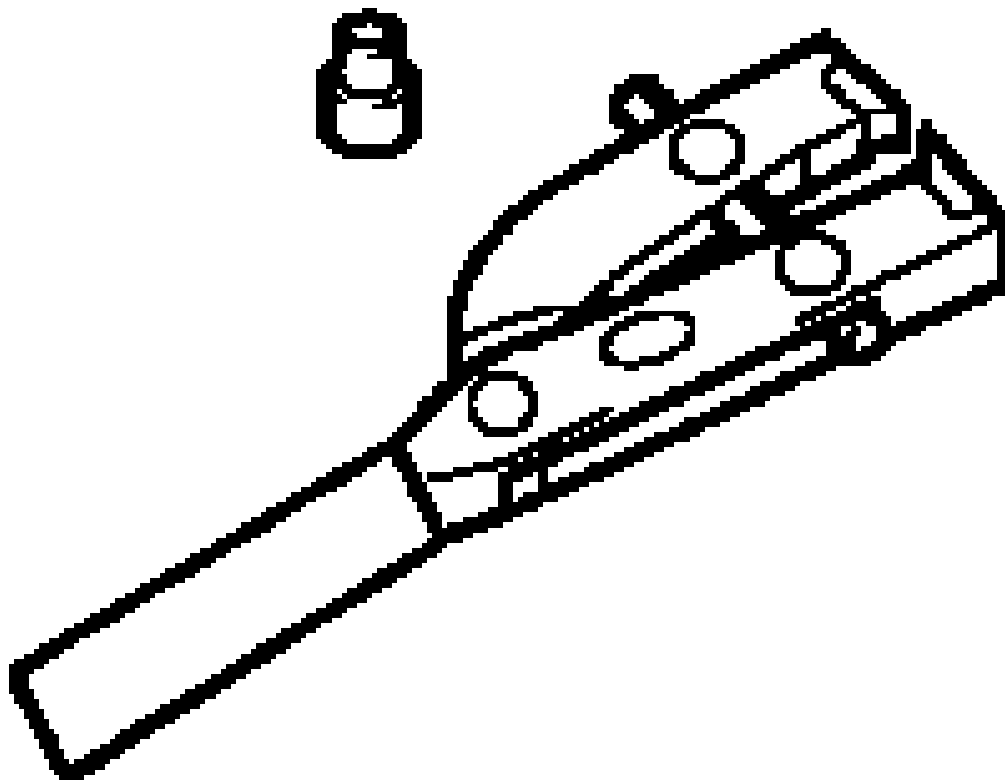
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Descrip



CH-161-B
KM-161-B
87-91-343
J-22888-20A
J-22888-35
Bearing Puller



CH-804
MKM-804
J-35566
Drive Axle Separator
Clamp Pliers

GENERAL INFORMATION

Programming and Setup - Spark

DIAGNOSTIC INFORMATION AND PROCEDURES

CONTROL MODULE REFERENCES

Reference Information

- Data Link References
- Diagnostic System Check - Vehicle
- Diagnostic Trouble Code (DTC) List - Vehicle
- Symptoms - Vehicle

Control Module References

Code	Control Module/Scan Tool Information	Schematic	Repair Instruction	Programming and Setup
A11	<u>Radio Scan Tool Information</u>	<u>Radio/Navigation System Schematics</u>	<u>Radio Replacement</u>	<u>Radio Programming and Setup (2GB, UM7), Radio Programming and Setup (UF7, UH7)</u>
K9	<u>Body Control Module Scan Tool Information</u>	<u>Body Control System Schematics</u>	<u>Body Control Module Replacement</u>	<u>Body Control Module Programming and Setup</u>
K17	<u>Electronic Brake Control Module Scan Tool Information (Without FX3) , Electronic Brake Control Module Scan Tool Information (With FX3)</u>	<u>Antilock Brake System Schematics</u>	<u>Electronic Brake Control Module Replacement</u>	<u>Electronic Brake Control Module Programming and Setup</u>
K20	<u>K20 Engine Control Module: Scan Tool Information (LEB) , K20 Engine Control Module: Scan Tool Information (Without FX3) , K20 Engine Control Module: Scan Tool Information (FX3) ,</u>	<u>Engine Controls Schematics (LL0-M4M) , Engine Controls Schematics (LFM/LL0+M4M)</u>	<u>Engine Control Module Replacement</u>	<u>K20 Engine Control Module: Programming and Setup (LC5), K20 Engine Control Module: Programming and</u>

	<u>K20 Engine Control Module: Scan Tool Information (LL0)</u>			<u>Setup (LL0)</u>
K36	<u>Inflatable Restraint Sensing and Diagnostic Module Scan Tool Information</u>	<u>SIR Schematics</u>	<u>Airbag Sensing and Diagnostic Module Replacement</u>	<u>Inflatable Restraint Sensing and Diagnostic Module Programming and Setup</u>
K41	<u>Object Alarm Module Scan Tool Information</u>	<u>Object Detection Schematics</u>	<u>Rear Object Alarm Control Module Replacement</u>	<u>Object Alarm Module Programming and Setup</u>
K43	<u>Power Steering Control Module Scan Tool Information</u>	<u>Power Steering Schematics</u>	<u>Power Steering Control Module Replacement</u>	<u>Power Steering Control Module Programming and Setup</u>
K71	Control Solenoid Valve and Transmission Control Module Assembly <u>Transmission Control Module Scan Tool Information (CVT)</u>	<u>Automatic Transmission Controls Schematics</u>	<u>Transmission Control Module Replacement</u>	<u>Control Solenoid Valve and Transmission Control Module Assembly Programming and Setup (CVT)</u>
K73	<u>Telematics Communication Interface Control Module Scan Tool Information</u>	<u>OnStar/Telematics Schematics</u>	<u>Communication Interface Module Replacement</u>	<u>Telematics Communication Interface Control Module Programming and Setup</u>
K77	Remote Control Door Lock Receiver	<u>Remote Function Schematics</u>	<u>Remote Control Door Lock Receiver Replacement</u>	<u>Remote Control Door Lock Receiver Programming and Setup</u>
K85	<u>Inflatable Restraint Passenger Presence System Scan Tool Information</u>	<u>SIR Schematics</u>	<u>Airbag Front Passenger Presence Sensor Replacement</u>	<u>Passenger Presence System Programming and Setup</u>
K89	Immobilizer Control Module	<u>Immobilizer Schematics</u>	<u>Theft Deterrent Module Replacement</u>	<u>Immobilizer Control Module Programming and Setup</u>
P16	<u>Instrument Cluster Scan Tool Information</u>	<u>Instrument Cluster Schematics</u>	<u>Instrument Cluster Replacement</u>	<u>Instrument Cluster Programming and Setup</u>

REPAIR INSTRUCTIONS

BODY CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT** program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. **DO NOT** connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.

Reference Information

Special Tools

- **EL-49642** SPS Programming Support Tool
- **EL-46079** Tire Pressure Monitor Diagnostic Tool

For equivalent regional tools, refer to **Special Tools**.

Replace and Program Control Module

To program a replacement K9 Body Control Module (BCM), perform the following procedure:

1. Install **EL-49642** SPS programming support tool.

NOTE:

Make sure the vehicle ignition switch state is in appropriate position for the following step.

- For Key Ignition System, begin with the ignition in the RUN position.

- **For Push Button Start System, begin with the vehicle in vehicle OFF power mode. The Service Programming System will power mode the vehicle.**

2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K9 Body Control Module - Programming and follow the on-screen instructions.
4. Perform the following for the appropriate ignition type prior to proceeding with the next step:
 - Key Ignition System: Key in the ignition and any additional keys must be away from the vehicle at least 3 m.
 - Push Button Start System: Keyless entry transmitter must be in the programming pocket. Refer to the owner manual for the exact pocket location. All additional transmitters must be away from the vehicle at least 3 m.

NOTE: The following programming step may take between 10-12 min and progress will appear to have stopped during this process. This is a normal security timer response and a restart should not be performed. If the DTC B389A set immediately after programming a replacement BCM, the Immobilizer Learn procedure was not properly completed. The Immobilizer Learn procedure needs to be performed again.

5. On the SPS Supported Controllers screen, select IMMO Immobilizer Learn - Setup. On the next screen, select Body Control Module IMMO Learn with Existing Transponder or Remote Key and follow the on-screen instructions. When Immobilizer Learn is complete, press the Unlock button on the keyless entry transmitter to allow the keyless entry transmitter to exit the Immobilizer Learn mode.

NOTE: When performing the Tire Pressure Monitor Sensor Learn during BCM setup, the EL-46079 tire pressure monitor diagnostic tool must be used to activate each tire pressure sensor for vehicles with UJM.

- **For Key Ignition System, begin with the ignition in the RUN position.**
- **For Push Button Start System, begin with the vehicle in vehicle ON power mode.**

6. On the SPS Supported Controllers screen, select K9 Body Control Module - Setup (or K9 Body Control Module - Configuration & Setup) and follow the on-screen instructions.
7. Check the driver information center display for additional messages regarding further calibration instructions. If there are no additional driver information center instructions present, programming is complete.
8. At the end of programming, choose the "Clear DTCs" function on the SPS screen.
9. If ABS, Traction Control and/or Stabilitrak indicators are ON and DTC C0161 is set in the K17 Electronic Brake Control Module after performing BCM programming and setup, do the following:
 1. Disconnect the scan tool from the X84 Data Link Connector.
 2. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft)

away from the vehicle. It may take up to 2 min to power down.

3. Ignition ON, verify DTC C0161 is in history. If not, repeat the above step to make sure the vehicle is in sleep mode.
4. Use the scan tool to clear the DTCs.

Reprogram Control Module

To program an existing K9 Body Control Module, perform the following procedure:

1. Install **EL-49642** SPS programming support tool.

NOTE: **Make sure the vehicle ignition switch state is in appropriate position for the following step.**

- **For Key Ignition System, begin with the ignition in the RUN position.**
- **For Push Button Start System, begin with the vehicle in vehicle ON power mode.**

2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K9 Body Control Module - Programming and follow the on-screen instructions.

NOTE: **When performing the Tire Pressure Monitor Sensor Learn during BCM setup, the EL-46079 tire pressure monitor diagnostic tool must be used to activate each tire pressure sensor for vehicles with UJM.**

4. On the SPS Supported Controllers screen, select K9 Body Control Module - Setup (or K9 Body Control Module - Configuration & Setup) and follow the on-screen instructions.
5. Check the driver information center display for additional messages regarding further calibration instructions. If there are no additional driver information center instructions present, programming is complete.
6. At the end of programming, choose the "Clear DTCs" function on the SPS screen.
7. If ABS, Traction Control and/or Stabilitrak indicators are ON and DTC C0161 is set in the K17 Electronic Brake Control Module after performing BCM programming and setup, do the following:
 1. Disconnect the scan tool from the X84 Data Link Connector.
 2. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from the vehicle. It may take up to 2 min to power down.
 3. Ignition ON, verify DTC C0161 is in history. If not, repeat the above step to make sure the vehicle is in sleep mode.
 4. Use the scan tool to clear the DTCs.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
 - **If the control module cannot be reprogrammed**
 1. Ignition OFF for one minute, ignition ON.
 2. Verify the control module can be reprogrammed.
 - If the control module cannot be reprogrammed, replace the control module.
 - If the control module can be reprogrammed.
 3. All OK.
 - **If the control module can be reprogrammed**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Control Module replacement, programming and setup

CONTROL SOLENOID VALVE AND TRANSMISSION CONTROL MODULE ASSEMBLY PROGRAMMING AND SETUP (CVT)

The following service procedures require either a programming or a setup event be performed for a complete repair.

NOTE: **If replacing both the transmission control module and the transmission assembly, replace the transmission first and then the transmission control module.**

Transmission Control Module (TCM) Replacement

If the TCM is replaced, the following procedures must be performed:

1. TCM Reprogramming. Refer to **Service Programming System (SPS)**.
2. The Transmission Adaptive Pressure Reset - Refer to **Transmission Adaptive Pressure Reset** .

Transmission Control Module (TCM) Reprogramming

NOTE: **Use a scan tool to view and record the Transmission Control Module - End Model Part Number in the original TCM prior to starting the TCM reprogramming procedure.**

1. If the TCM needs to be reprogrammed, refer to **Service Programming System (SPS)**.
2. Perform the Transmission Adaptive Pressure Reset. Refer to **Transmission Adaptive Pressure Reset** .

NOTE: After programming, perform the following to avoid future misdiagnosis:

1. Turn the ignition OFF for 30 seconds.
2. Turn the ignition ON with the engine OFF.
3. Use the scan tool in order to retrieve history DTCs from all modules.
4. Clear all history DTCs.

Transmission Replacement

NOTE: The Read Only Memory (ROM) is part of the control solenoid valve assembly which is part of the transmission assembly, and is not serviced separately.

Perform the Transmission Adaptive Pressure Reset. Refer to Transmission Adaptive Pressure Reset .

ELECTRONIC BRAKE CONTROL MODULE PROGRAMMING AND SETUP

- NOTE:**
- DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.
 - Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.
 - Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.
 - Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
 - During the programming procedure, follow the SPS prompts for the correct ignition switch position.
 - Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to Special Tools.

Replace and Program EBCM or Reprogram EBCM

To program a replacement or an existing EBCM, perform the following procedure:

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Electronic Brake Control Module-Programming and follow the on-screen instructions.
4. On the SPS Supported Controllers screen, select Electronic Brake Control Module-Setup and follow the on-screen instructions.
5. On the SPS Supported Controllers screen, select Electronic Brake Control Module-Configuration and follow the on-screen instructions.
6. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. DO NOT turn the Ignition OFF. Ensure that all ECU, DLC and programming tool connections are secure and the TIS terminal operating software is up to date.
2. Attempt to reprogram the ECU.
3. If the ECU can still not be programmed, turn the Ignition OFF for at least one minute.
4. Turn the Ignition ON, and attempt to reprogram the ECU. The ECU should program.
 - If the ECU still cannot be programmed, replace the ECU.

K20 ENGINE CONTROL MODULE: PROGRAMMING AND SETUP (LC5)

Before Programming The Engine Control Module

The following service procedures require either a programming or a setup event performed for a complete repair.

NOTE: **DO NOT program a control module unless you are directed by a service procedure or you are directed by a service bulletin. Programming a control module at any other time will not permanently correct a customers concern.**

The following criteria must be met before performing the programming or learning procedure:

- Vehicle system voltage
- There is no charging system concern. All charging system concerns must be repaired before programming a control module.
- Battery voltage is between 12-16 V. The battery must be charged before programming the control module if the battery voltage is low.
- A battery charger is NOT connected to the vehicle battery. Incorrect system voltage or voltage fluctuations from a battery charger may cause programming failure or control module damage.
- Turn OFF or disable any of the following systems that may put a load on the vehicle battery:

- Twilight sentinel
- Interior lights
- Daytime running lights
- HVAC systems
- Engine cooling fans, etc.
- The ignition switch is in the proper position. The scan tool prompts you to turn ON the ignition, with the engine OFF. DO NOT change the position of the ignition switch during the programming procedure, unless instructed to do so.
- All of the following tool connections are secure:
 - The connection at the data link connector (DLC)
 - The voltage supply circuits

DO NOT disturb the tool harnesses while programming. If an interruption occurs during the programming procedure, programming failure or control module damage may occur.

ECM Replacement

If the engine control module (ECM) is replaced, the following procedures must be performed:

1. Connect a scan tool to the vehicle and access SPS. Refer to **Service Programming System (SPS)**.

NOTE: **The Prepare Control Module for Removal function can only be performed when communication with the old control module is still possible.**

2. Before removing the old control module, perform the SPS function Prepare Control Module for Removal.
3. Replace the ECM.
4. Perform the SPS function Engine Control Module - Programming and follow the on-screen instructions.
5. Perform the SPS Function Immobilizer Learn. Refer to **Immobilizer System Component Programming**.
6. Clear DTCs after completing the programming procedure.
7. Start and idle engine.
8. Perform the throttle/idle learn. Refer to **Q38 Throttle Body: Throttle/Idle Learn**
9. Perform the crankshaft position system learn. Refer to **Crankshaft Position System Variation Learn**

ECM Reprogramming

If the engine control module (ECM) needs to be reprogrammed, the following procedures must be performed:

1. Connect a scan tool to the vehicle and access SPS. Refer to **Service Programming System (SPS)**.
2. Perform the SPS function Engine Control Module - Programming and follow the on-screen instructions.

Setup for Component Replacement

If any of the following components are replaced or repaired, perform the idle learn procedure. Refer to **Q38 Throttle Body: Throttle/Idle Learn** .

- The throttle body assembly is replaced.
- The throttle body is cleaned.
- The engine control module (ECM) is replaced.
- The idle air control valve (IAC) is replaced.

FX3 only- If any of the following components are replaced or repaired, perform the crankshaft position system variation learn procedure.

Refer to **Crankshaft Position System Variation Learn**

- The engine assembly is replaced
- The engine control module (ECM) is replaced
- The crankshaft is replaced
- The crankshaft position sensor is replaced
- Any engine repairs which disturb the crankshaft to crankshaft position sensor relationship.

K20 ENGINE CONTROL MODULE: PROGRAMMING AND SETUP (LL0)

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to **Special Tools**.

NOTE:

- **DO NOT** program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. **DO NOT** connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.

- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.
- Note the engine oil life remaining percentage.

Replace and Program Control Module

To program a replacement K20 Engine Control Module (ECM), perform the following procedure:

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. Before removing the old control module, perform the SPS function Prepare Control Module for Removal, if available.

NOTE: The Prepare Control Module for Removal function can only be performed when communication with the old control module is still possible.

4. Replace the ECM.
5. Perform the SPS function K20 Engine Control Module - Programming and follow the on-screen instructions.
6. Clear the DTCs after completing the Programming procedure.
7. Perform the SPS function Immobilizer Learn and follow the on-screen instructions. Refer to **Immobilizer System Component Programming**.
8. Perform the SPS function K20 Engine Control Module - Configuration & Setup and follow the on-screen instructions.
9. Clear DTCs after completing the Configuration & Setup procedure.

Reprogram Control Module

To reprogram an existing K20 Engine Control Module, perform the following procedure:

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. Clear DTCs after completing the Programming procedure.

NOTE: If vehicle fails to start during Configuration and Setup, perform the SPS Function Immobilizer Learn and follow the on-screen instructions.

4. Perform the SPS function Engine Control Module - Configuration & Setup and follow the on-screen instructions, if available.
5. Clear DTCs after completing the Configuration & Setup procedure.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following:

1. Ignition ON. Ensure the control module, DLC, and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
 - **If the control module cannot be reprogrammed**
 1. Ignition OFF for one minute, ignition ON.
 2. Verify the control module can be reprogrammed.
 - If the control module cannot be reprogrammed, replace the K20 Engine Control Module.
 - **If the control module can be reprogrammed**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for ECM replacement, programming and setup.

HVAC SYSTEM CONTROL MODULE PROGRAMMING AND SETUP

This device requires no programming or setup.

IMMOBILIZER CONTROL MODULE PROGRAMMING AND SETUP

Replace and Program ECU or Reprogram ECU

This ECU does not require SPS programming or any setup procedures.

INFLATABLE RESTRAINT SENSING AND DIAGNOSTIC MODULE PROGRAMMING AND SETUP

The inflatable restraint sensing and diagnostic module (SDM) must be programmed with the proper calibration software. The module stores and utilizes this information however if it is not properly configured with the correct calibration software, the SDM will not control all of the vehicle features properly.

Ensure that the following conditions exist in order to prepare for SDM programming:

1. The battery is fully charged.
2. The MDI data link connectors are secure.
3. The scan tool is loaded with the most current software version.
4. All disconnected modules and devices are reconnected securely.
5. This entire procedure has been reviewed before proceeding.

Do not reprogram the SDM unless directed by a service procedure or a service bulletin.

NOTE:

- The air bag indicator light may remain ON after the body control module (BCM), or SDM is replaced, and during the programming procedure for the BCM until after the procedure is completed. When installing a new SDM, there may be several DTCs set prior to programming. Once programmed, these DTCs should be in history and can be cleared.
- Failure to complete the following Setup procedure may cause DTC B1001 to be set in the SDM.

The following service procedures require either a programming or a setup event performed for a complete repair:

Sensing and Diagnostic Module Replacement and/or Programming

If the inflatable restraint sensing and diagnostic module needs to be replaced and/or reprogrammed, the following procedures must be performed:

1. Access SPS. Refer to **Service Programming System (SPS)**.
2. Perform the SPS function Inflatable Restraint Sensing and Diagnostic Module Programming and follow the on-screen instructions.
3. Perform the SPS function Inflatable Restraint Sensing and Diagnostic Module Setup and follow the on-screen instructions.
4. Clear DTCs after completing the programming procedure.

If the control module fails to program, proceed as follows:

1. Ensure the DLC and Accessory Power Module connections are good.
2. Inspect the Techline equipment for the latest software version.
3. Attempt to program the SDM. If the SDM still cannot be programmed properly, replace the SDM.

INSTRUMENT CLUSTER PROGRAMMING AND SETUP

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to **Special Tools**.

NOTE:

- **DO NOT** program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is

securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.

- **Stable battery voltage is critical during programming.** Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS programming support tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. **DO NOT** connect a battery charger.
- **Turn OFF or disable systems that may put a load on the vehicles battery** such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete.** Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.

Replace and Program ECU or Reprogram ECU

To program a replacement or an existing ECU, perform the following procedure:

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Instrument Cluster - Programming and follow the on-screen instructions.
4. On the SPS Supported Controllers screen, select Instrument Cluster - Setup and follow the on-screen instructions.
5. On the SPS Supported Controllers screen, select Instrument Cluster - Configuration and follow the on-screen instructions.
6. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. **DO NOT** turn the ignition OFF. Ensure that all ECU, DLC and programming tool connections are secure and the TIS terminal operating software is up to date.
2. Attempt to reprogram the ECU.
3. If the ECU can still not be programmed, turn the ignition OFF for at least one minute.
4. Turn the ignition ON and attempt to reprogram the ECU. The ECU should program.
 - If the ECU still cannot be programmed, replace the ECU.

OBJECT ALARM MODULE PROGRAMMING AND SETUP

The K41R Rear Parking Assist Control Module requires no programming or setup.

PASSENGER PRESENCE SYSTEM PROGRAMMING AND SETUP

When the passenger presence system is replaced or serviced, perform the rezeroing procedure for the passenger presence system. Refer to **Passenger Presence System Rezeroing** for the rezeroing procedure.

POWER STEERING CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT** program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. **DO NOT** connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.

Diagnostic Aids

The internal steering wheel angle sensor does not require a centering often. Centering of the internal steering wheel angle sensor might be required after certain service procedures are performed. Some of these procedures are as follows:

- Power Steering Control module replacement
- Steering column replacement
- Collision or other physical damage to steering or suspension components

Certain steering symptoms can be corrected by performing the steering wheel angle sensor centering procedures such as:

- Poor, or uneven return to center
- Poor, or uneven on center feel

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to **Special Tools**.

Replace and Program Control Module or Reprogram Control Module

This control module does not require SPS programming or any setup procedures.

This control module does not require SPS programming but does require the following setup procedures after a new control module is installed:

To program a replacement or an existing control module, perform the following procedure:

1. Install **EL-49642** SPS Programming Support Tool.
2. Using the steering wheel, align and center the front wheels forward.
3. Apply the parking brake, and set the transmission in Park if equipped with an automatic transmission.
4. Turn ON the ignition, with the engine OFF.
5. Access the Service Programming System (SPS) and follow the on-screen instructions.
6. On the SPS Supported Controllers screen, select Power Steering Control Module - Programming and follow the on-screen instructions.
7. Using a scan tool, select Power Steering Control Module and perform the Configuration/Reset Functions, Steering Wheel Angle Sensor Centering procedure and follow the on-screen instructions.
8. Clear all DTCs after completing the programming and setup procedures.
9. Turn OFF the ignition.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
 - **If the control module cannot be reprogrammed**
 1. Ignition OFF for one minute, ignition ON.
 2. Verify the control module can be reprogrammed.
 - If the control module cannot be reprogrammed, replace the control module.
 - If the control module can be reprogrammed.
 - 3. All OK.
 - **If the control module can be reprogrammed**

3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Control Module replacement, programming and setup.

RADIO PROGRAMMING AND SETUP (2GB, UM7)

NOTE:

- **DO NOT** program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. **DO NOT** connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.

Diagnostic Aids

- During radio programming you may be required to select multiple calibrations dependant upon vehicle equipment. Have the vehicle build/RPO information available during the following procedure to ensure the correct calibrations are selected.
- The XM satellite radio (if equipped) is integrated into the radio. If XM was activated in the previous radio, the replacement radio will require no additional activation steps. Customer subscription information is transferred to the replacement radio when a replacement radio is ordered.

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to **Special Tools**.

Replace and Program Control Module or Reprogram Control Module

To program a replacement or an existing ECU, perform the following procedure:

1. Install **EL-49642** SPS Programming Support Tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select A11 Radio - Programming and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
 - **If the control module cannot be reprogrammed**
 1. Ignition OFF for one minute, ignition ON.
 2. Verify the control module can be reprogrammed.
 - If the control module cannot be reprogrammed, replace the control module.
 - If the control module can be reprogrammed.
 3. All OK.
 - **If the control module can be reprogrammed**
3. All OK.

RADIO PROGRAMMING AND SETUP (UF7, UH7)

NOTE:

- **DO NOT** program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS programming support tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. **DO NOT** connect a battery charger.

- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Diagnostic Aids

- If programming of the control module is being performed at the direction of a bulletin or PI, follow the instructions provided in that document.
- During audio system programming you may be required to select multiple calibrations dependent upon vehicle equipment. Have the vehicle build/RPO information available during the following procedure to ensure the correct calibrations are selected.
- Dependant upon vehicle equipment, the current software level of the module, or the release of updates, USB programming may not be required when replacing/reprogramming the control module. If USB files for the application are not available via SPS, or have not been received from General Motors in another manner of distribution, the USB update process will not need to be performed.
- The length of time for the USB programming to complete will vary depending on the number and size of the files in the update.
- All data will be erased from the USB device BEFORE the calibration is downloaded onto the device. To ensure important information is NOT erased, always verify that NO information is stored on the device BEFORE beginning the calibration download. If required, transfer important files to another storage device BEFORE beginning the calibration download.
- The XM satellite radio (if equipped) is integrated into the radio. If XM was activated in the previous radio, the replacement radio will require no additional activation steps. Customer subscription information is transferred to the replacement radio when a replacement radio is ordered.

Reference Information

Special Tools

- **EL-49642** SPS Programming Support Tool
- USB 2.0 flash drive with a minimum capacity of 4 GB.

For equivalent regional tools, refer to **Special Tools**.

Replace and Program Control Module or Reprogram Control Module

To program a replacement or an existing control module, perform the following procedure:

1. Install the **EL-49642** SPS Programming Support Tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select A11 Radio - Programming, and follow the on-screen

instructions.

4. When programming is complete, access the Service Programming System (SPS) and follow the on-screen instructions.
5. Connect a USB drive to the computer.

NOTE: **If using a pre-configured USB drive supplied by General Motors, proceed to step 8.**

6. On the SPS Supported Controllers screen, select A11 Radio - USB File Transfer, and follow the on-screen instructions.

NOTE:

- **If there are no files available for USB transfer via SPS, proceed to step 12.**
- **All existing files on the USB drive will be erased when the new files are copied.**

7. Upon completion of the file transfer, remove the USB drive from the computer.
8. Ignition ON, radio ON.
9. Connect the USB drive to the USB port in the vehicle.
10. Using the radio controls, select the following: Config>Radio Settings>Software Versions Menu>Update Radio Software. Follow the infotainment display on-screen instructions and select Update when prompted. Programming will take several minutes.
11. When programming is complete, remove the USB device from the vehicle USB port.
12. At the end of programming, choose the "Clear DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
 - **If the control module cannot be reprogrammed**
 1. Ignition OFF for one minute, ignition ON.
 2. Verify the control module can be reprogrammed.
 - If the control module cannot be reprogrammed, replace the control module.
 - If the control module can be reprogrammed.
 3. All OK.
 - **If the control module can be reprogrammed**
3. All OK.

REMOTE CONTROL DOOR LOCK RECEIVER PROGRAMMING AND SETUP

Diagnostic Aids

The remote control door lock receiver only functions as an antenna, receiving the signals sent by the keyless entry transmitter and forwarding them to the body control module (BCM). The keyless entry software is contained wholly within the BCM.

Replace and Program ECU or Reprogram ECU

This ECU does not require SPS programming or any setup procedures.

SERVICE PROGRAMMING SYSTEM (SPS)

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to **Special Tools**.

For step-by-step control module programming instructions, please refer to the techline information system (TIS) terminal.

Review the information below to ensure proper programming protocol.

NOTE:

- **DO NOT program a control module unless you are directed by a service procedure or you are directed by a General Motors service bulletin. Programming a control module at any other time will not permanently correct a customers concern.**
- **It is essential that the TIS terminal, MDI, and/or Scan Tool, is equipped with the latest software before performing service programming.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required, install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.**
- **Some modules will require additional programming/setup events to be performed before or after programming.**
- **Some vehicles may require the use of a CANDi or MDI module for programming.**
- **Review the appropriate service information for these procedures.**
- **DTCs may set during programming. Clear DTCs after programming is complete.**
- **Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Ensure the following conditions are met before programming a control module:

- Vehicle system voltage:
 - There is not a charging system concern. All charging system concerns must be repaired before programming a control module.
 - Battery voltage is greater than 12 volts but less than 16 volts. The battery must be fully charged before programming the control module.
 - Turn OFF or disable any system that may put a load on the vehicles battery, such as the following components:
 - Interior lights
 - Exterior lights including daytime running lights (DRL)-Applying the parking brake, on most vehicles, disables the DRL system
 - Heating, ventilation, and air conditioning (HVAC) systems
 - Engine cooling fans
 - Radio, etc.
- The ignition switch must be in the proper position. SPS prompts you to turn ON the ignition, with the engine OFF. DO NOT change the position of the ignition switch during the programming procedure, unless instructed to do so.
- Make certain all tool connections are secure, including the following components and circuits:
 - Scan Tool
 - The RS-232 communication cable port
 - The connection at the data link connector (DLC)
 - The voltage supply circuits
 - MDI
 - The USB, Ethernet or Wireless communication port
 - The connection at the data link connector (DLC)
- DO NOT disturb the tool harnesses while programming. If an interruption occurs during the programming procedure, programming failure or control module damage may occur.

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. DO NOT turn the ignition OFF. Ensure that all control module and DLC connections are secure and the TIS terminal operating software is up to date.
2. Attempt to reprogram the control module.
3. If the control module can still not be programmed, turn the ignition OFF for at least one minute.
4. Turn the ignition ON and attempt to reprogram the control module. The control module should program.
 - If the control module still cannot be programmed, replace the control module.

After successfully programming the control module, ensure that all post programming procedures are performed; refer to **Control Module References** for the appropriate control module Programming and Setup document for any required procedures.

TELEMATICS COMMUNICATION INTERFACE CONTROL MODULE PROGRAMMING AND SETUP

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to Special Tools.

Each of the following service procedures require programming or setup procedures to be performed on the telematics communication interface control module.

Communication Interface Module Replacement

NOTE:

- It is critical to use the service replacement telematics communication interface control module only in the vehicle for which it was ordered.
- Failure to perform the following procedures will result in a red LED, DTC(s) being set, and limited or incomplete OnStar® services.
- An OnStar® button press to the OnStar® call center is not required to complete the procedure.
- It may take up to 24 hours for OnStar® service to become fully activated after performing the procedures.
- Perform the following procedure only once. Repeat attempts of the procedure may result in a delay of the activation process.
- To fully activate an OnStar® module, both the setup and activation request procedures must be completed on all vehicles with and without an active OnStar® subscription to insure the unit has been setup properly for the vehicle it has been installed into and also to update the OnStar® with the correct unit information.
- To initialize the Turn-by-Turn feature, the vehicle must first be driven in open sky condition at speeds greater than 10 mph (16 kph) or more for a minimum of 5 miles (8 km), and perform at least 2 left and 2 right 90 degree turns coming to complete stops prior to each turn.
- On vehicles up fitted with TTY capabilities, it is necessary to perform a power cycle of the OnStar® Interface Module (OTIM), and toggle the TTY mode after completing the telematics communication interface control module installation and setup procedures.

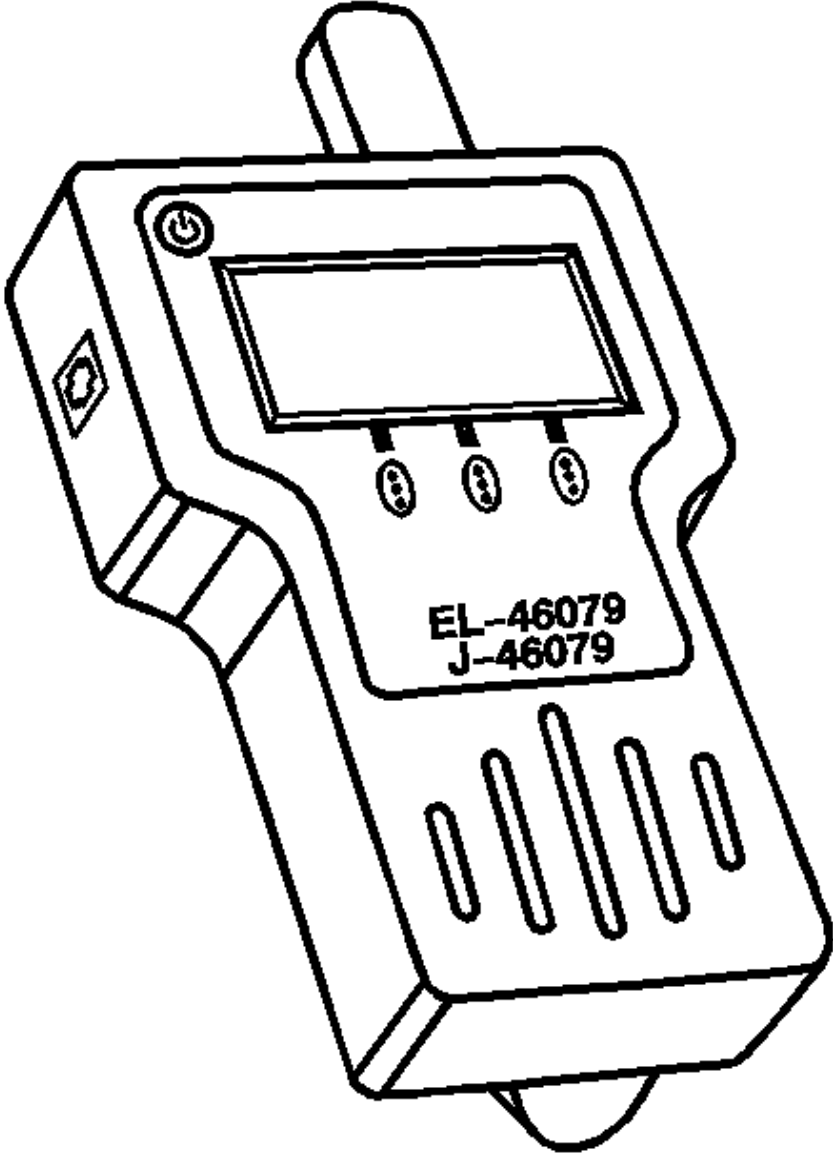
1. Install EL-49642 SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select ONSU Onstar® Module Setup and Service Activation and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.
5. The default language for the new telematics communication interface control module is English. To

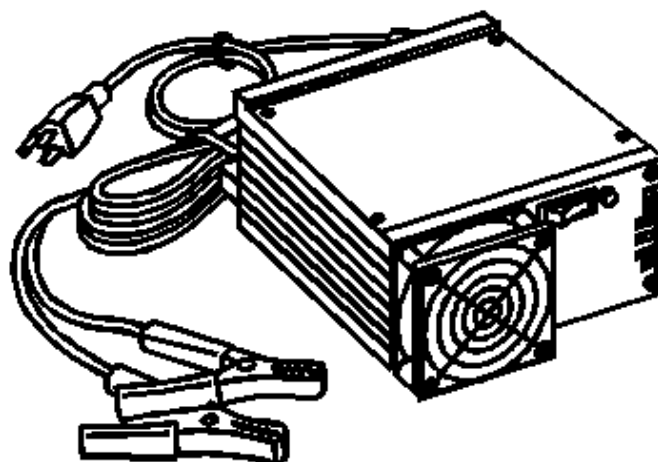
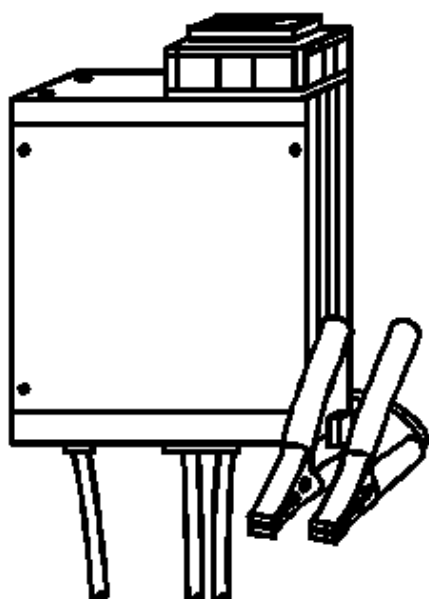
change to an alternate language, access the scan tool.

6. Inform the customer that it may take up to 24 hours for the OnStar® service to become fully activated.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description
	EL 46079 J 46079 Tire Pressure Monitor Diagnostic Tool



EL 49642
EL 50113
Europe- Use
recommended
equivalent
workshop
equipment
SPS
Programming
Support Tool

SUSPENSION

Rear Suspension - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Rear Axle to Body Retaining Bolt	170 N.m	125 lb ft
Strut to Rear Axle Retaining Bolt	60 N.m	44 lb ft
Strut Upper Mounting Nut	20 N.m	15 lb ft
Wheel Hub Spindle Nut	190 N.m	140 lb ft
Wheel Spindle Assembly to Rear Axle Retaining Nut	80 N.m	59 lb ft

REPAIR INSTRUCTIONS

REAR WHEEL BEARING AND HUB REPLACEMENT

Special Tools

DT-50186 Wheel Hub Holding Tool

For equivalent regional tools, refer to **Special Tools**.

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
3. Remove the brake drum. Refer to **Brake Drum Replacement** .
4. Remove the rear wheel speed sensor, if equipped with ABS. Refer to **Rear Wheel Speed Sensor Replacement** .

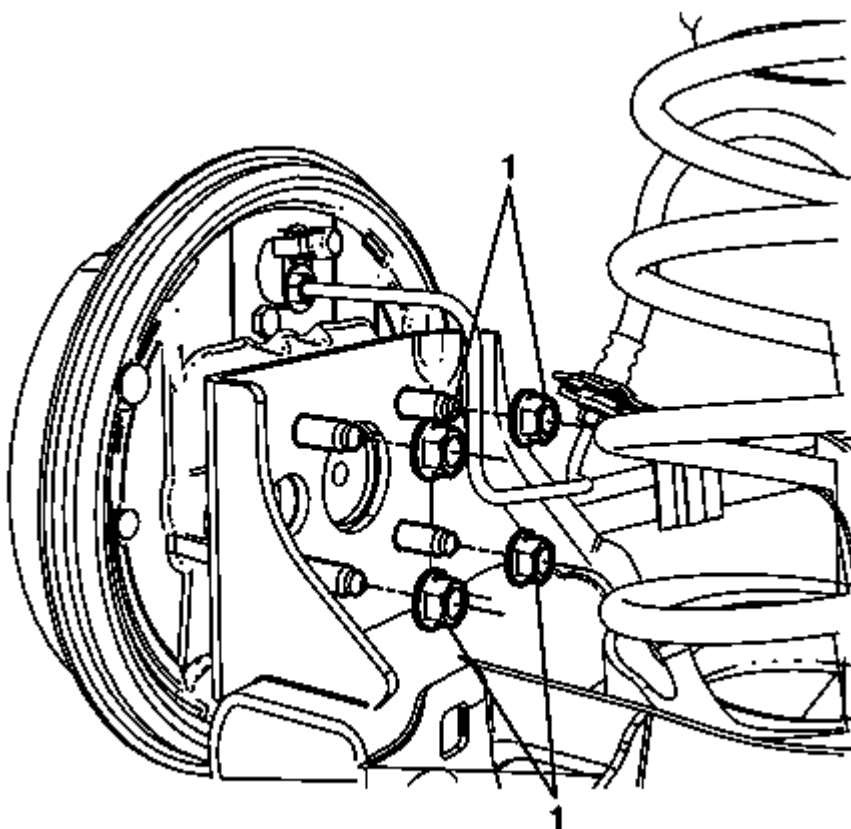


Fig. 1: Wheel Bearing/Hub And Spindle Assembly And Rear Axle Retaining Nuts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the wheel bearing/hub and spindle assembly to rear axle retaining nuts (1).

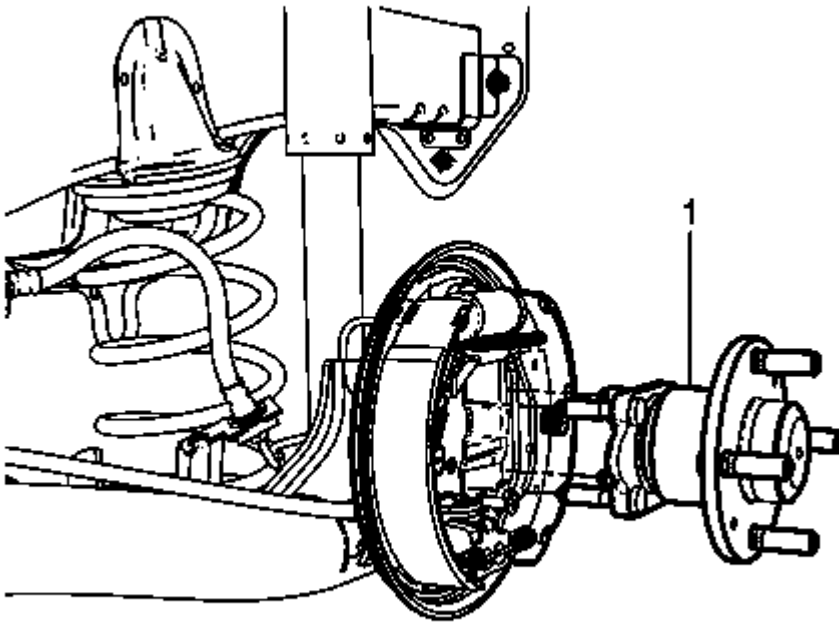


Fig. 2: Wheel Bearing/Hub And Spindle Assembly
Courtesy of GENERAL MOTORS COMPANY

6. Remove the wheel bearing/hub and spindle assembly (1) from the rear axle assembly and the brake backing plate.

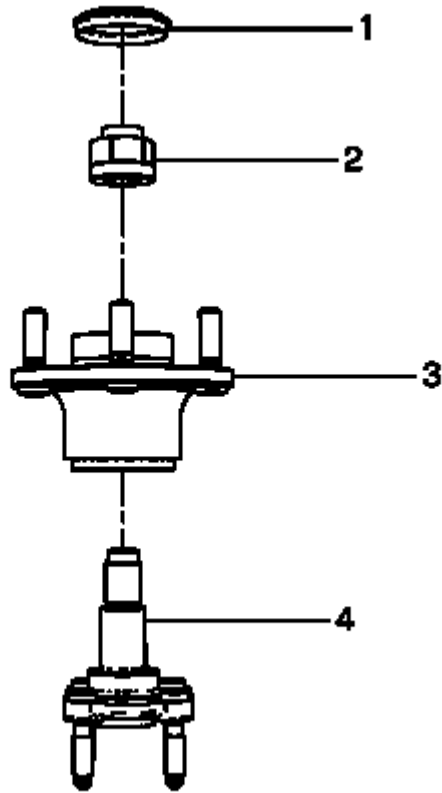


Fig. 3: Wheel Bearing Cap And Wheel Hub/Bearing Assembly
Courtesy of GENERAL MOTORS COMPANY

7. Install the wheel bearing/hub and spindle assembly to the vise.
8. Remove the wheel bearing cap (1).
9. Using the **DT-50186** holding tool, remove the wheel hub spindle nut (2).
10. Remove the wheel hub/bearing assembly (3) from the wheel hub spindle (4).
11. Remove the wheel hub spindle (4) from the vise.

Installation Procedure

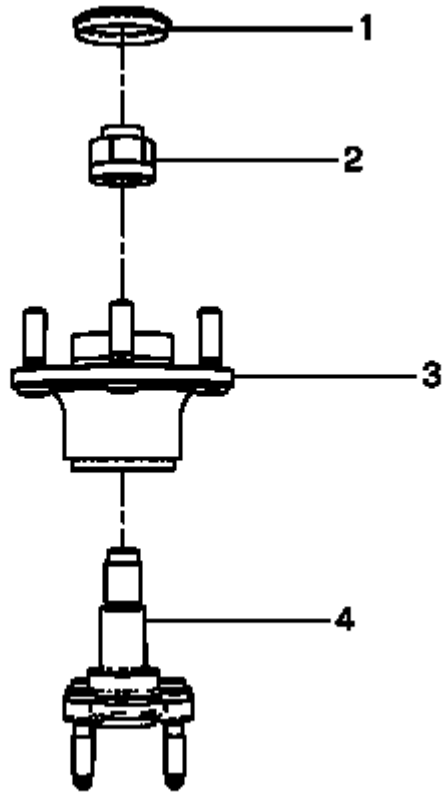


Fig. 4: Wheel Bearing Cap And Wheel Hub/Bearing Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Install the wheel hub spindle (4) to the vise.
2. Install the wheel hub/bearing assembly (3) to the wheel hub spindle (4).

CAUTION: Refer to Fastener Caution .

3. Using the **DT-50186** holding tool, install the wheel hub spindle nut (2) and tighten to 190 N.m (140 lb ft).
4. Install the wheel bearing cap (1) to the wheel hub/bearing and spindle assembly.

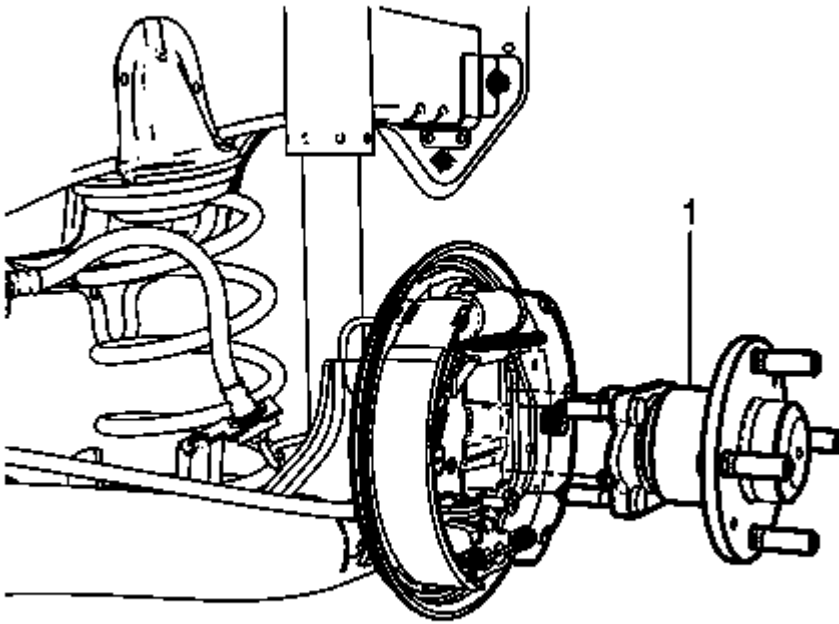


Fig. 5: Wheel Bearing/Hub And Spindle Assembly
Courtesy of GENERAL MOTORS COMPANY

5. Install the wheel bearing/hub and spindle assembly (1) to the brake backing plate and the rear axle assembly.

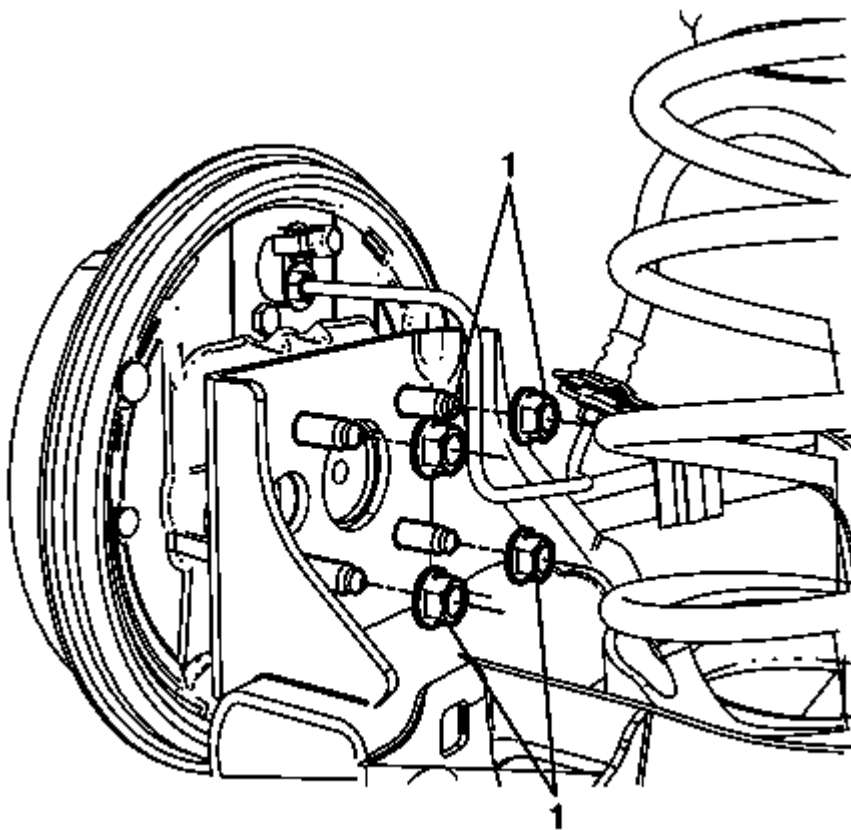


Fig. 6: Wheel Bearing/Hub And Spindle Assembly And Rear Axle Retaining Nuts
Courtesy of GENERAL MOTORS COMPANY

6. Install the wheel bearing/hub and spindle assembly to rear axle retaining nuts (1). Tighten the nuts evenly, in a cross-pattern to 80 N.m (59 lb ft).
7. Install the rear wheel speed sensor, if equipped with ABS. Refer to **Rear Wheel Speed Sensor Replacement** .
8. Install the brake drum. Refer to **Brake Drum Replacement** .
9. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
10. Lower the vehicle.

SHOCK ABSORBER REPLACEMENT

Removal Procedure

1. Apply the park brake completely.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
3. Support the rear tire with a hydraulic jack stand.

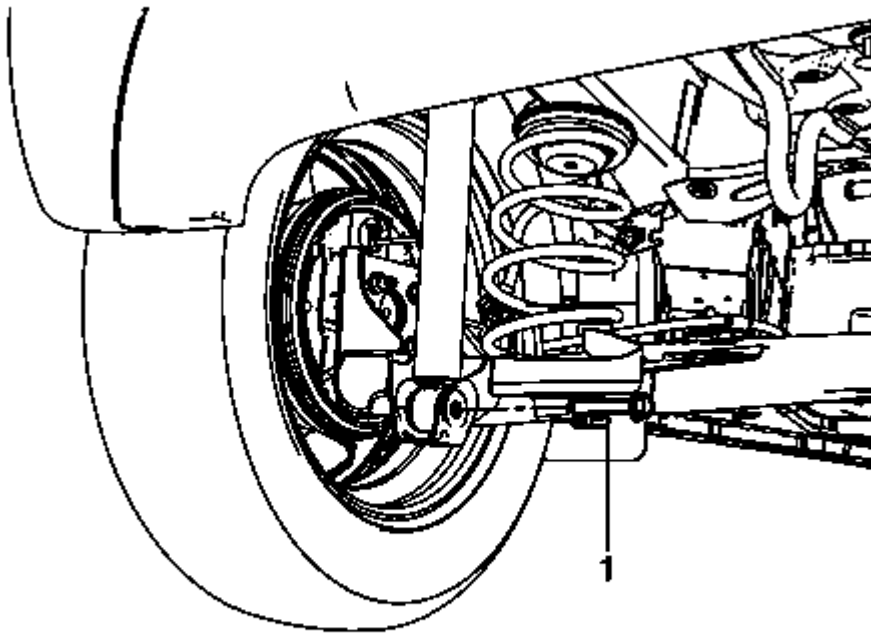


Fig. 7: Shock Absorber Strut To Rear Axle Retaining Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Remove the shock absorber strut to rear axle retaining bolt (1).
5. Remove the jack stand.
6. Lower the vehicle.
7. Remove the rear wheelhouse trim finish panel. Refer to **Rear Wheelhouse Trim Finish Panel Replacement** .

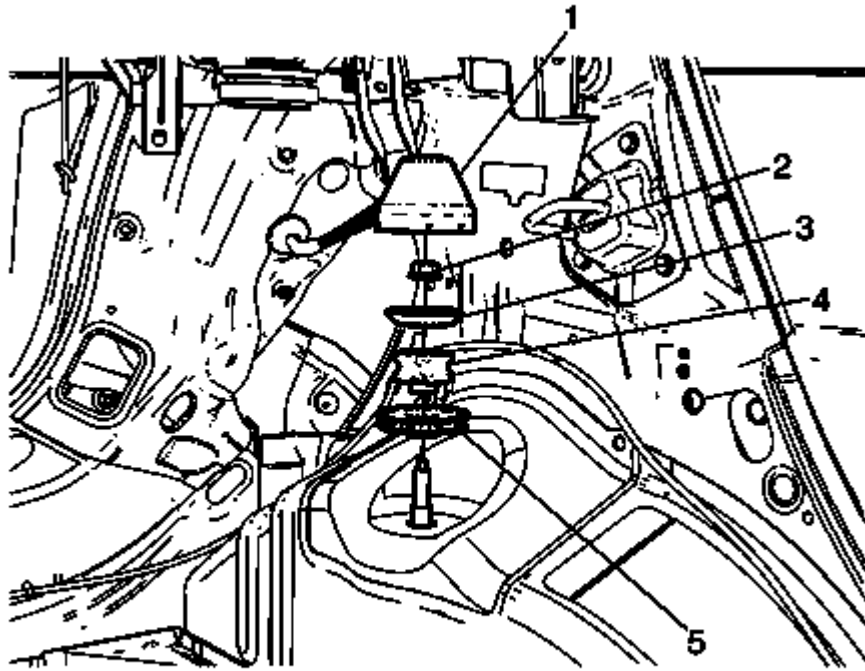


Fig. 8: Upper Mounting Plate And Upper Mount Assembly
Courtesy of GENERAL MOTORS COMPANY

8. Remove the strut upper cap (1) from the shock absorber strut.
9. Remove the strut nut (2) from the shock absorber strut.
10. Remove the upper mounting plate (3), the upper mount assembly (4) and the washer (5) from the shock absorber strut.
11. Remove the shock absorber strut assembly from the vehicle.

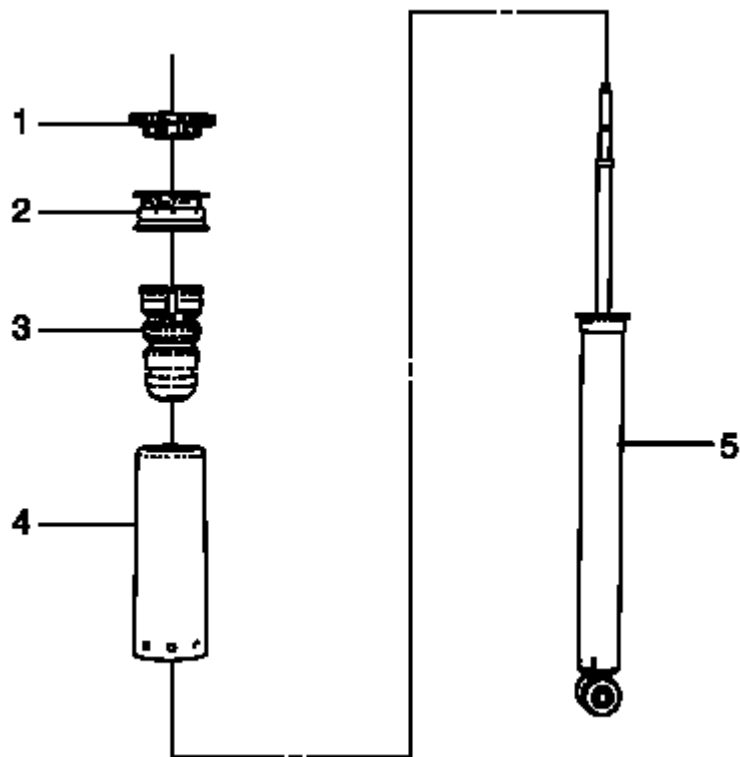


Fig. 9: Lower Mount Assembly And Washer
Courtesy of GENERAL MOTORS COMPANY

12. Remove the lower mount assembly (1), the washer (2), the jounce bumper (3), and the dust shield (4) from the strut (5).

Installation Procedure

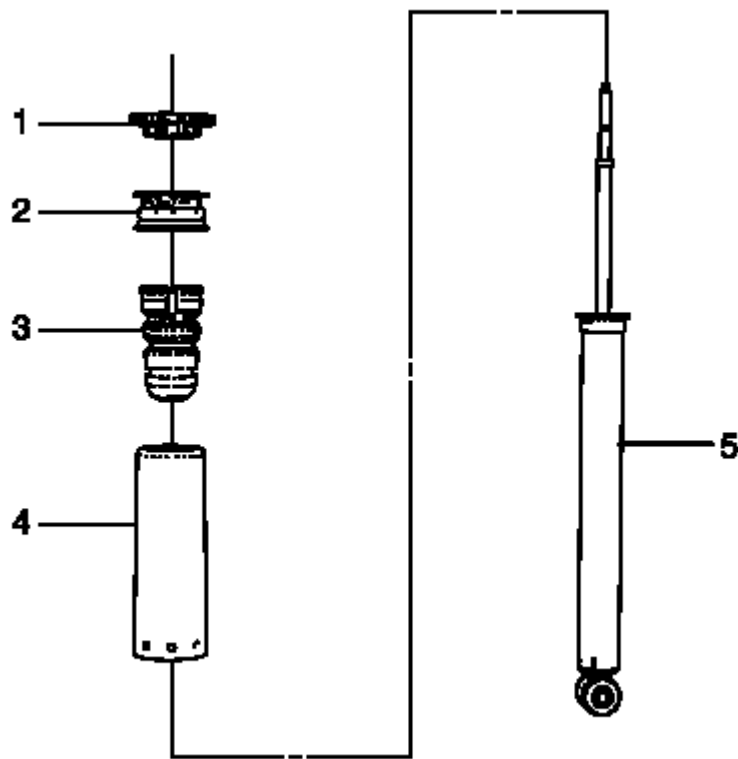


Fig. 10: Lower Mount Assembly And Washer
Courtesy of GENERAL MOTORS COMPANY

1. Install the lower mount assembly (1), the washer (2), the jounce bumper (3), and the dust shield (4) to the strut (5).
2. Position the shock absorber strut assembly to the vehicle.

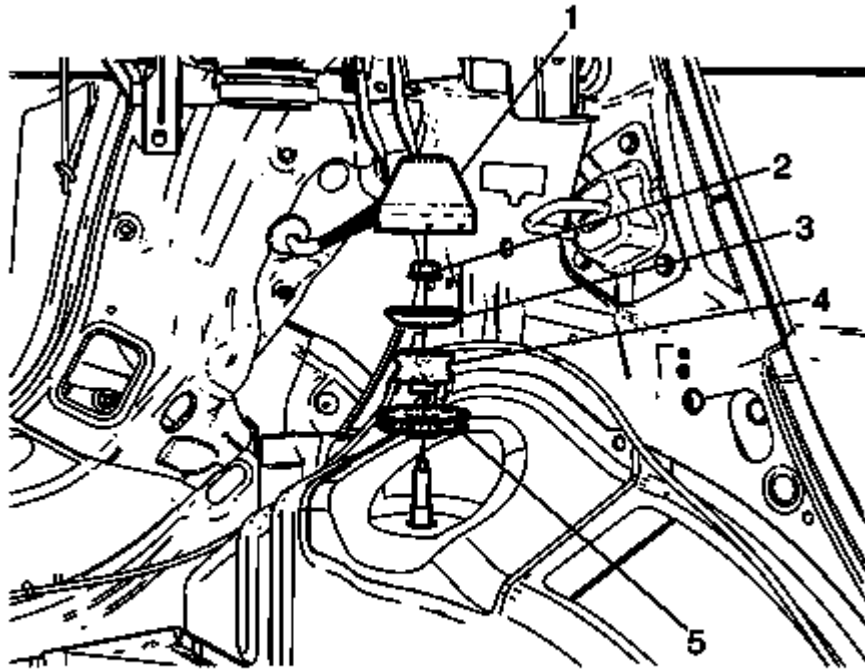


Fig. 11: Upper Mounting Plate And Upper Mount Assembly
Courtesy of GENERAL MOTORS COMPANY

3. Install the upper mounting plate (3), the upper mount assembly (4) and the washer (5) to the shock absorber strut.

CAUTION: Refer to Fastener Caution .

4. Install the strut upper mounting nut (2) to the shock absorber strut and tighten to 20 (15 lb ft).
5. Install the strut upper cap (1) to the shock absorber strut.
6. Install the rear wheelhouse trim finish panel. Refer to **Rear Wheelhouse Trim Finish Panel Replacement** .
7. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
8. Support the rear tire with the hydraulic jack stand.

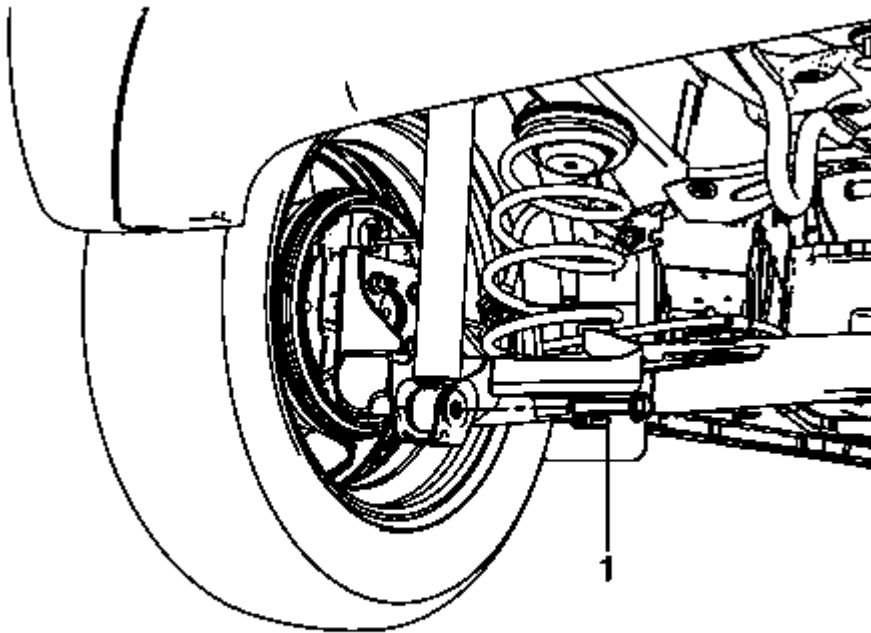


Fig. 12: Shock Absorber Strut To Rear Axle Retaining Bolt
Courtesy of GENERAL MOTORS COMPANY

9. Install the shock absorber strut to rear axle retaining bolt (1) and tighten it by hand.
10. Raise the rear axle to the rear suspension height specification by measuring the vertical distance between the center of wheel and bottom edge of the wheelhouse. Refer to **Trim Height Specifications** .
11. Tighten the shock absorber strut to rear axle retaining bolt (1) and tighten to 60 (44 lb ft).
12. Remove the hydraulic jack stand.
13. Lower the vehicle.

REAR SPRING REPLACEMENT

Removal Procedure

1. Apply the park brake completely.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
3. Support the tire to be replaced with a hydraulic jack stand.
4. Remove the shock absorber strut to rear axle retaining bolt. Refer to **Shock Absorber Replacement**.
5. Lower the hydraulic jack stand.

NOTE: The opposite strut to rear axle retaining bolt must be removed so that the

rear axle can turn down easily.

KEEP supporting the tire with the hydraulic jack stand to prevent the rear brake hose and rear wheel speed sensor harness from being damaged.

6. Support the opposite tire with the hydraulic jack stand.
7. Remove the opposite strut to rear axle retaining bolt. Refer to **Shock Absorber Replacement**.
8. Using the hydraulic jack stand, slowly lower the rear axle until the tension is not applied to the rear brake hose and rear wheel speed sensor harness.

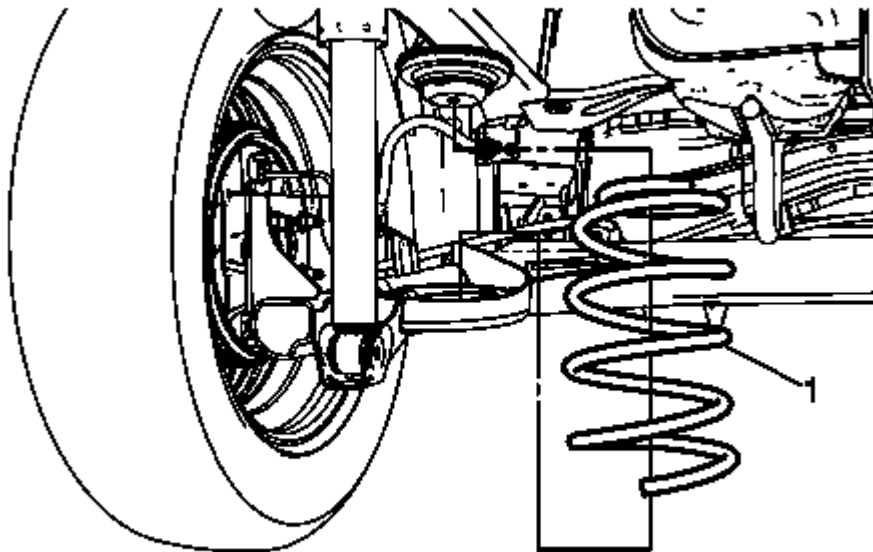


Fig. 13: Spring

Courtesy of GENERAL MOTORS COMPANY

9. With the hydraulic jack stand supported, remove the spring (1) from the vehicle.

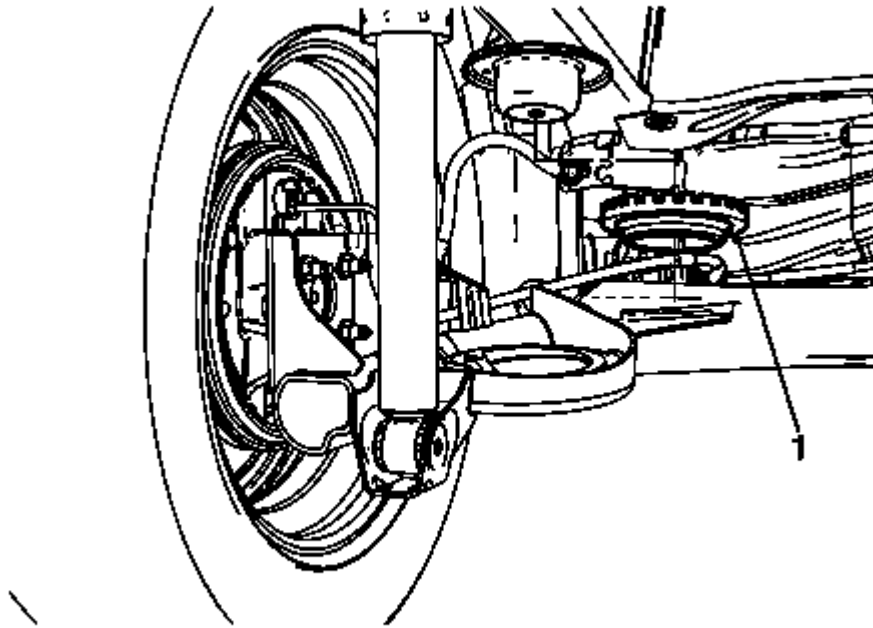


Fig. 14: Spring Upper Insulator

Courtesy of GENERAL MOTORS COMPANY

10. Remove the spring upper insulator (1) from the upper spring seat on the underbody rear side rail.

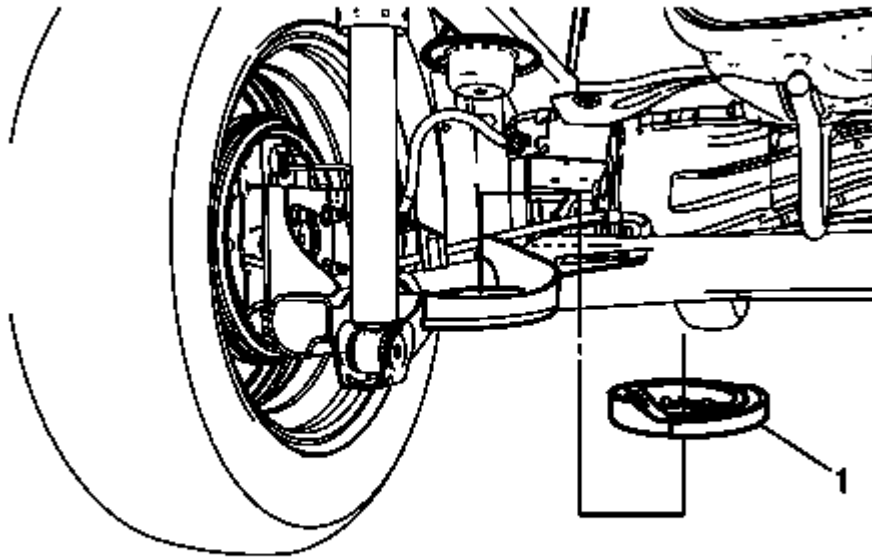


Fig. 15: Spring Lower Insulator
Courtesy of GENERAL MOTORS COMPANY

11. Remove the spring lower insulator (1) from the lower spring seat on the rear axle.

Installation Procedure

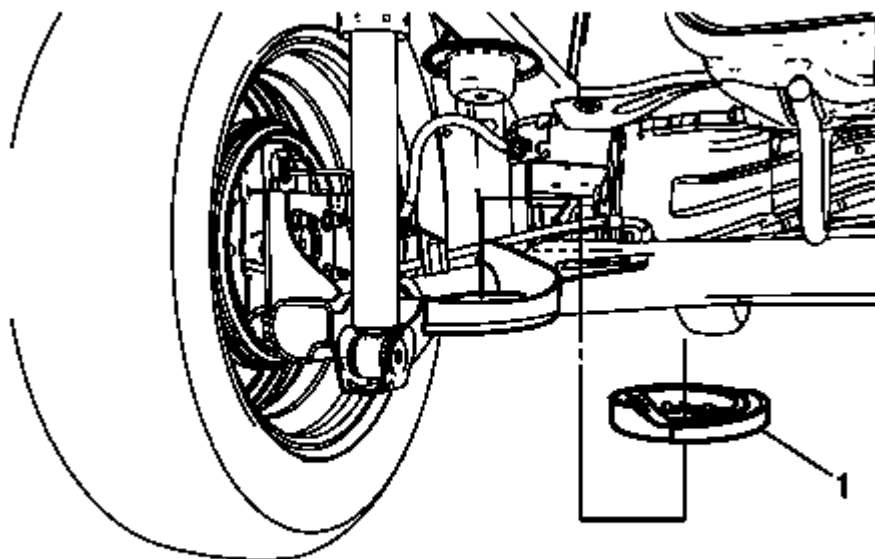


Fig. 16: Spring Lower Insulator

Courtesy of GENERAL MOTORS COMPANY

1. Install the spring lower insulator (1) to the lower spring seat on the rear axle.

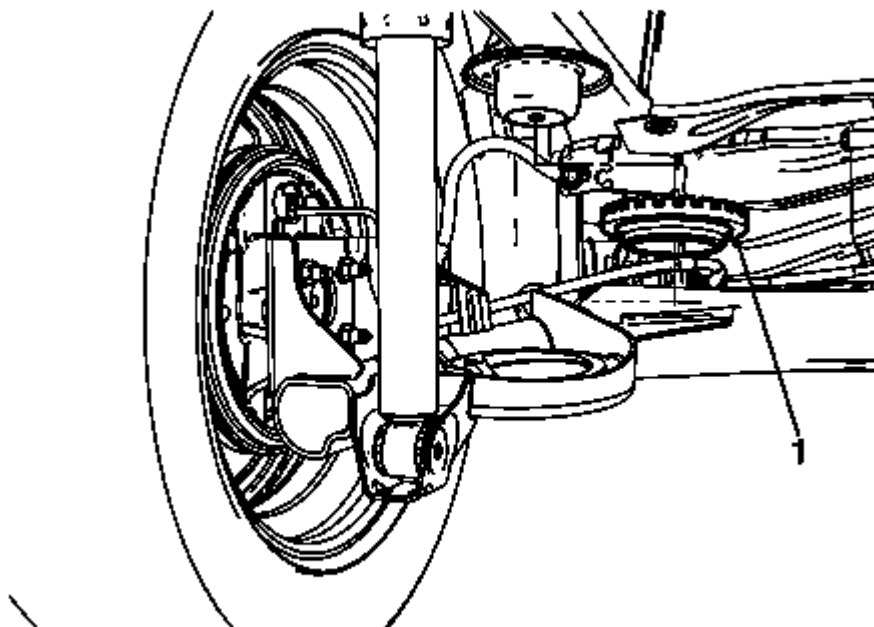


Fig. 17: Spring Upper Insulator

Courtesy of GENERAL MOTORS COMPANY

2. Install the spring upper insulator (1) to the upper spring seat on the underbody rear side rail.

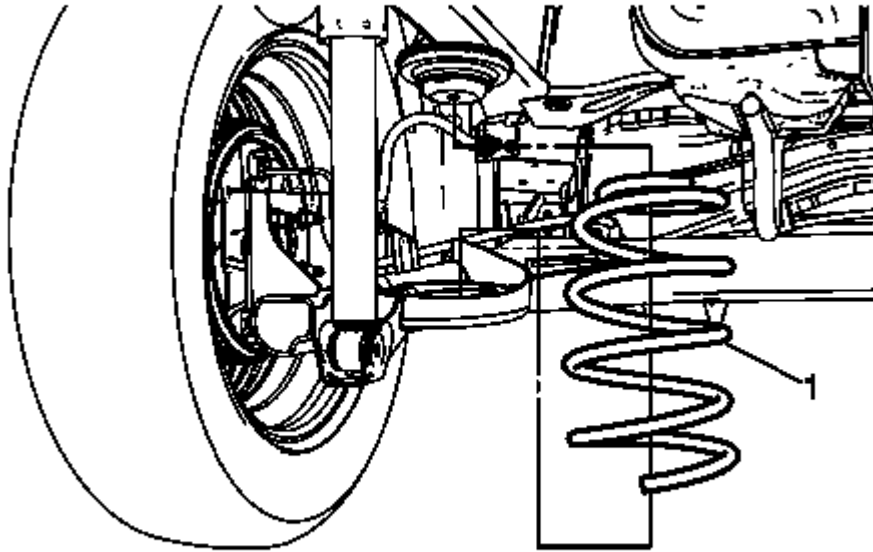


Fig. 18: Spring

Courtesy of GENERAL MOTORS COMPANY

3. Install the spring (1) to the vehicle, making sure the lower coil is seated into the lower spring seat.
4. Raise the hydraulic jack stand in order to compress the rear spring.
5. Install the shock absorber strut to rear axle retaining bolt. Refer to **Shock Absorber Replacement**.
6. Raise the hydraulic jack stand in order to compress the opposite rear spring.
7. Install the opposite shock absorber strut to rear axle retaining bolt. Refer to **Shock Absorber Replacement**.
8. Remove the hydraulic jack stand.
9. Lower the vehicle.

REAR AXLE REPLACEMENT

Special Tools

EN-50187 Rear Axle Supporter

For equivalent regional tools, refer to **Special Tools**.

Removal Procedure

1. Release the park brake lever boot from the floor console and loosen the adjusting nut enough to completely relieve tension on the parking brake cable.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
3. Remove the rear tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** .
4. Disconnect the parking brake cables from the equalizer and remove three parking brake cable clamps for both of the cables. Refer to **Parking Brake Cable Replacement** .
5. Remove both of the rear wheel speed sensors, if equipped with ABS. Refer to **Rear Wheel Speed Sensor Replacement** .
6. Disconnect the rear wheel cylinder pipes from the rear brake hose. Refer to **Rear Brake Hose Replacement** .

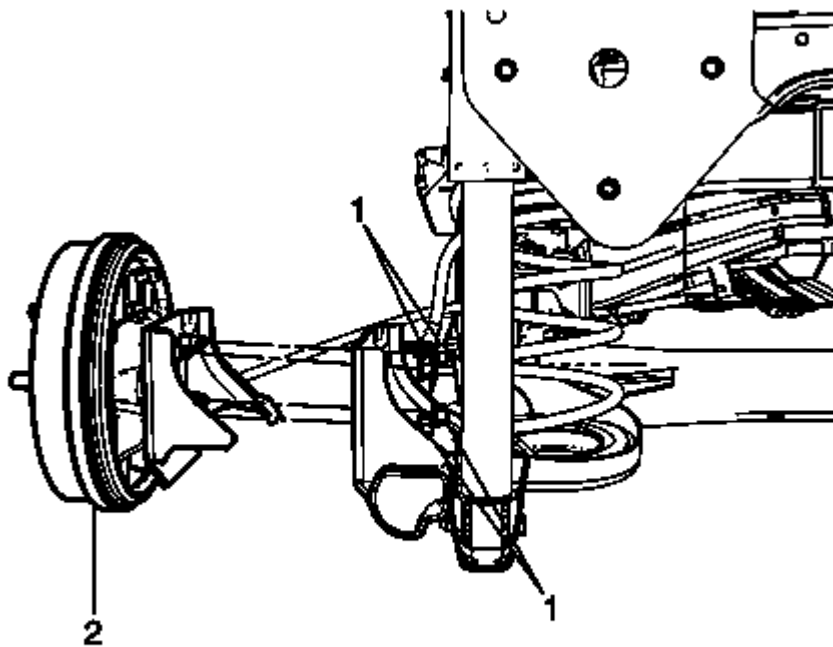


Fig. 19: Rear Axle Retaining Nuts And Backing Plates As An Assembly
Courtesy of GENERAL MOTORS COMPANY

7. Remove the wheel bearing/hub and spindle assembly to rear axle retaining nuts (1) from both sides.
8. Remove the wheel bearing/hubs, the brakes and backing plates as an assembly (2) from the rear axle.

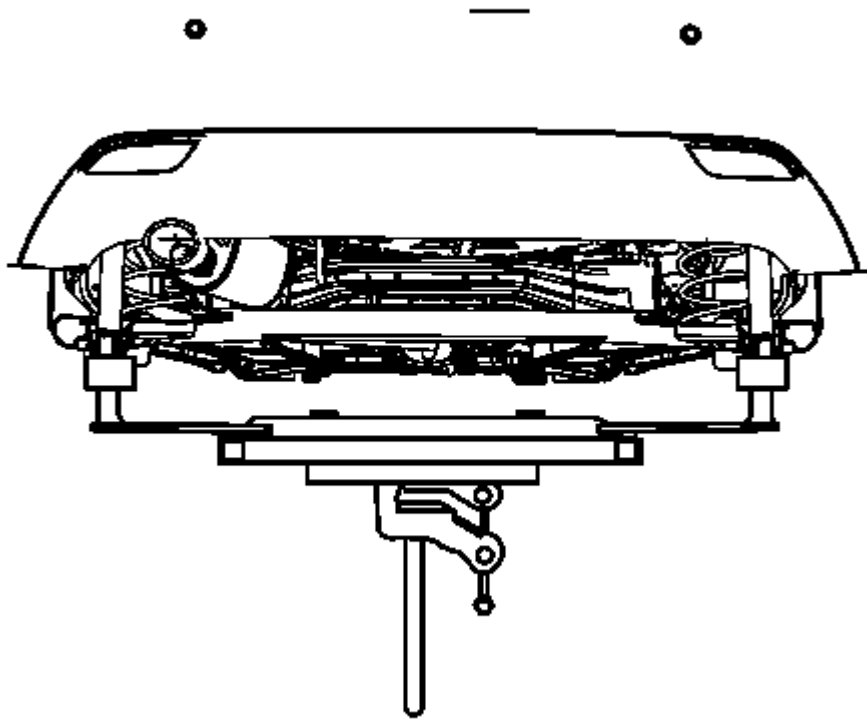


Fig. 20: Hydraulic Jack Stand And DT-50187
Courtesy of GENERAL MOTORS COMPANY

9. Install the **DT-50187** supporter to a hydraulic jack stand and support the rear axle with the two rear adapters of the **DT-50187** supporter.
10. Remove both of the shock absorber strut to rear axle retaining bolts from the rear axle. Refer to **Shock Absorber Replacement**.
11. Lower the hydraulic jack stand and remove the rear springs from the both sides.

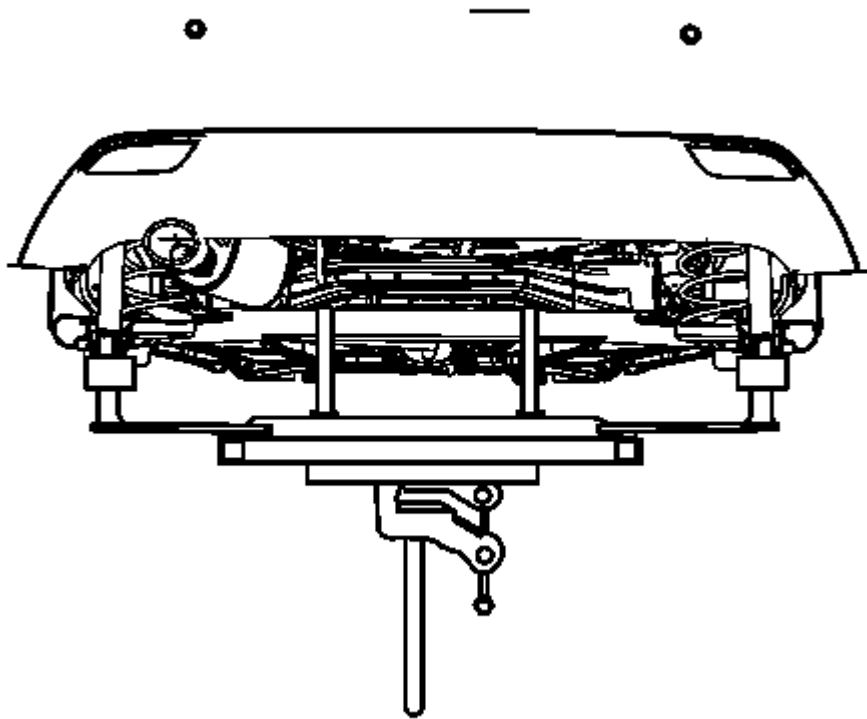


Fig. 21: Hydraulic Jack Stand And DT-50187
Courtesy of GENERAL MOTORS COMPANY

12. Position the hydraulic jack stand with the **DT-50187** supporter to the rear axle and support it with all adapters of the **DT-50187** supporter.

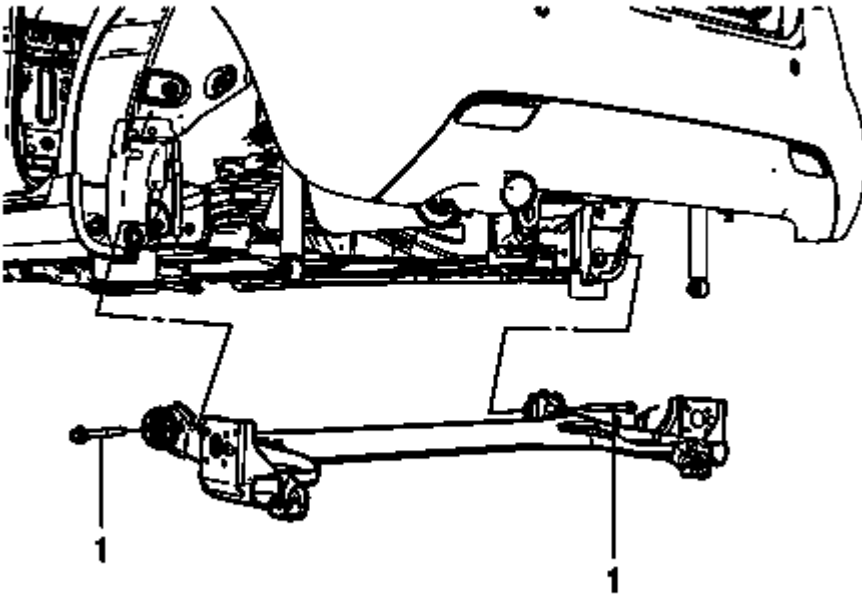


Fig. 22: Body Retaining Bolts

Courtesy of GENERAL MOTORS COMPANY

13. Remove the rear axle to body retaining bolts (1).
14. Slowly lower the hydraulic jack stand to remove the rear axle from the vehicle.
15. Remove the rear coil spring lower insulators from the axle.
16. Remove the rear axle from the hydraulic jack stand with the **DT-50187** supporter.

Installation Procedure

1. Place the rear axle on the hydraulic jack stand with **DT-50187** supporter.
2. Install the rear coil spring lower insulators to the rear axle.

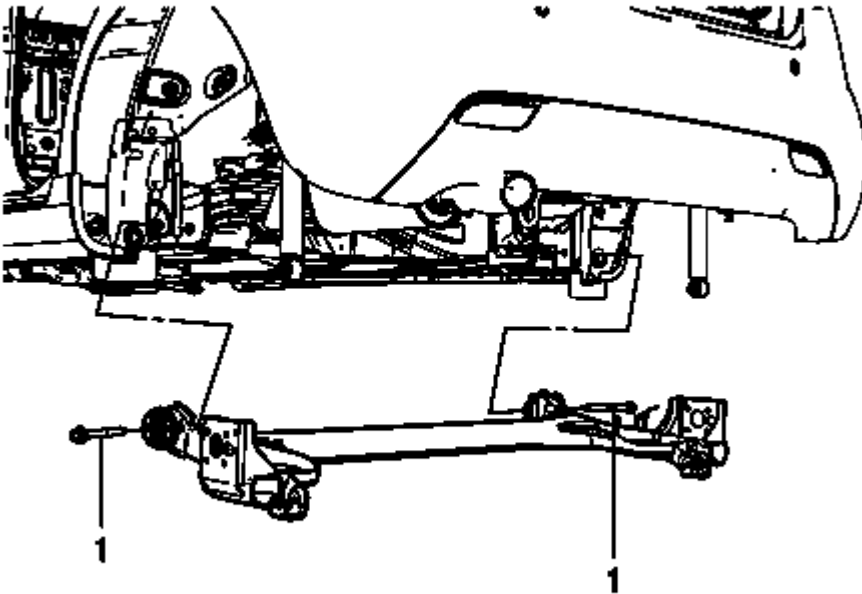


Fig. 23: Body Retaining Bolts

Courtesy of GENERAL MOTORS COMPANY

3. Using the hydraulic jack stand, raise the rear axle to the correct position.
4. Hand tighten all rear axle to body retaining bolts (1).

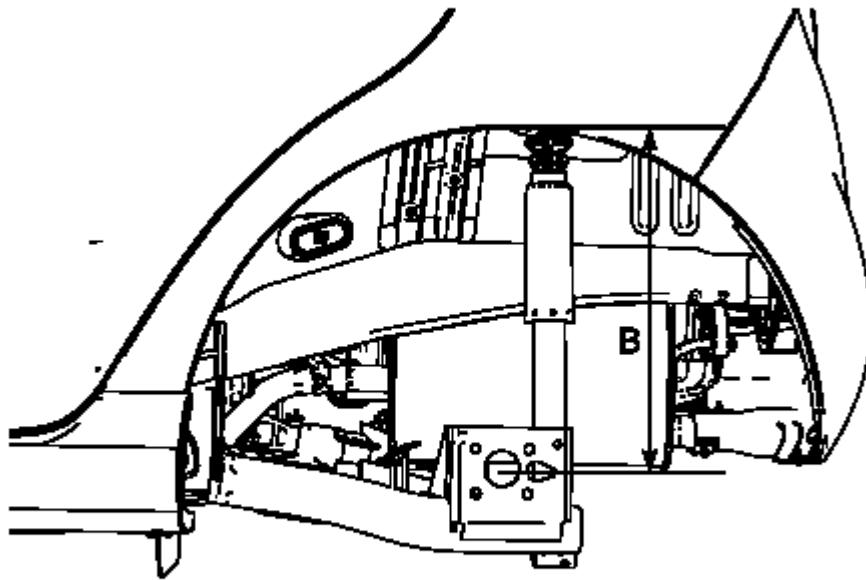


Fig. 24: View Of DT-20187

Courtesy of GENERAL MOTORS COMPANY

NOTE: The rear axle to body retaining bolts must be tightened with the axle at the correct suspension height.

5. Using the two rear adapters of the **DT-50187** supporter and the hydraulic jack stand, raise the rear axle to the proper suspension height specification (B: 357.2 mm, 14.06 in) by measuring the vertical distance between the center of wheel and bottom edge of the wheelhouse.

CAUTION: Refer to Fastener Caution .

6. Tighten completely the axle to body retaining bolts to 170 N.m (125 lb ft).
7. Lower the hydraulic jack stand.
8. Install the rear springs.

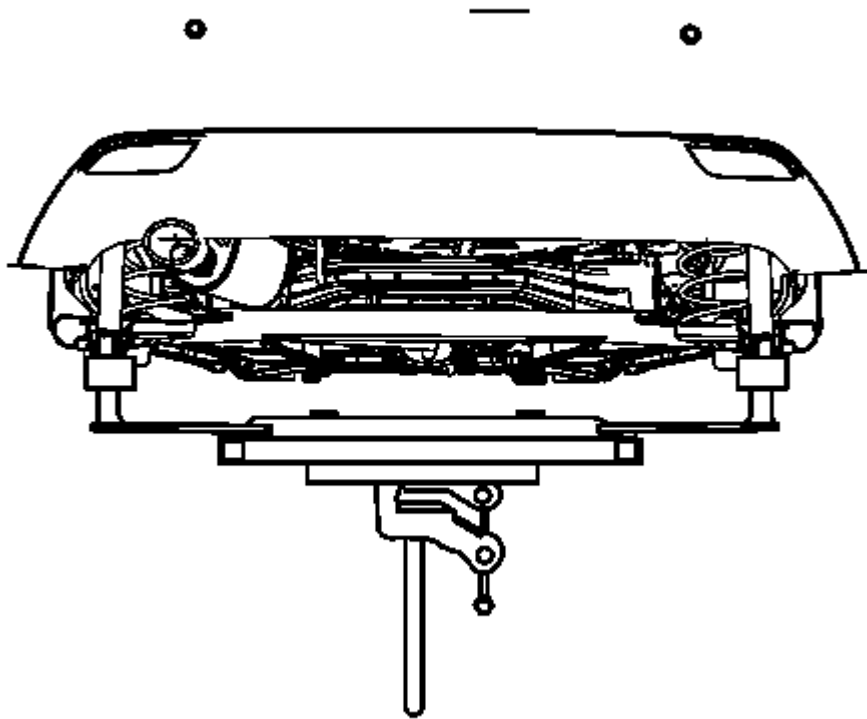


Fig. 25: Hydraulic Jack Stand And DT-50187
Courtesy of GENERAL MOTORS COMPANY

9. Support the rear axle with the two rear adapters of the **DT-50187** supporter, and install the shock absorber strut to rear axle retaining bolts to the rear axle. Refer to **Shock Absorber Replacement**.

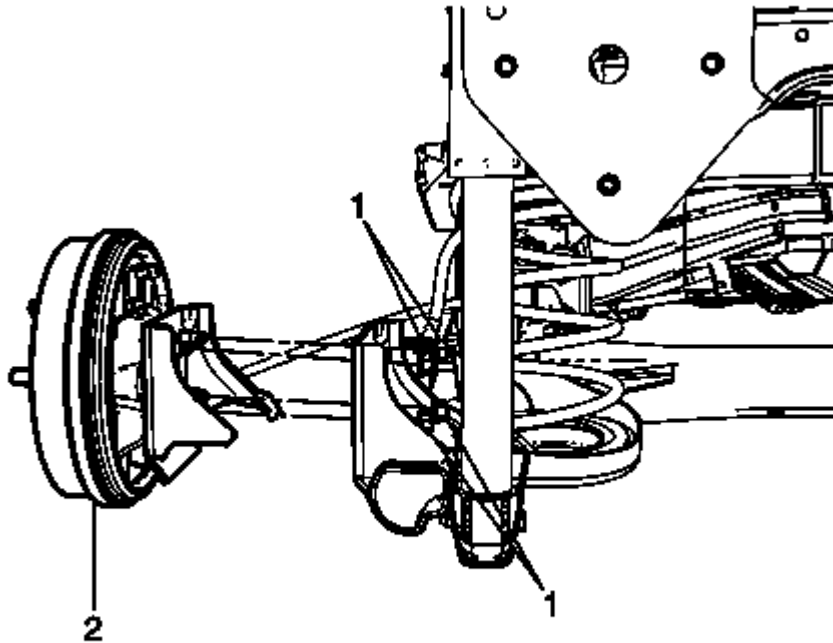


Fig. 26: Rear Axle Retaining Nuts And Backing Plates As An Assembly
Courtesy of GENERAL MOTORS COMPANY

10. Lower the hydraulic jack stand and remove the **DT-50187** supporter.
11. Install the wheel bearing/hubs, the brakes and backing plates as an assembly to the rear axle.
12. Install the wheel bearing/hub and spindle assembly to rear axle retaining nuts (1) to both sides.
13. Install the rear wheel cylinder pipes to the rear brake hose. Refer to **Rear Brake Hose Replacement** .
14. Install both of the rear wheel speed sensors, if equipped with ABS. Refer to **Rear Wheel Speed Sensor Replacement** .
15. Connect the parking brake cables to the equalizer and install three parking brake cable clamps for both of the cables. Refer to **Parking Brake Cable Replacement** .
16. Adjust the park brake cable tension. Refer to **Parking Brake Adjustment** .
17. Install park brake lever boot.
18. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** , **Hydraulic Brake System Bleeding (Pressure)** .
19. Install the rear tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** .
20. Verify the rear wheel alignment. Refer to **Wheel Alignment Specifications** .
21. Lower the vehicle.

WHEEL STUD REPLACEMENT

Special Tools

CH-43631 Ball Joint Remover

For equivalent regional tools, refer to Special Tools.

Removal Procedure

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
2. Remove the tire and wheel assembly. Refer to Tire and Wheel Removal and Installation .
3. Remove the brake drum. Refer to Brake Drum Replacement .
4. Remove the wheel bearing/hub. Refer to Rear Wheel Bearing and Hub Replacement.

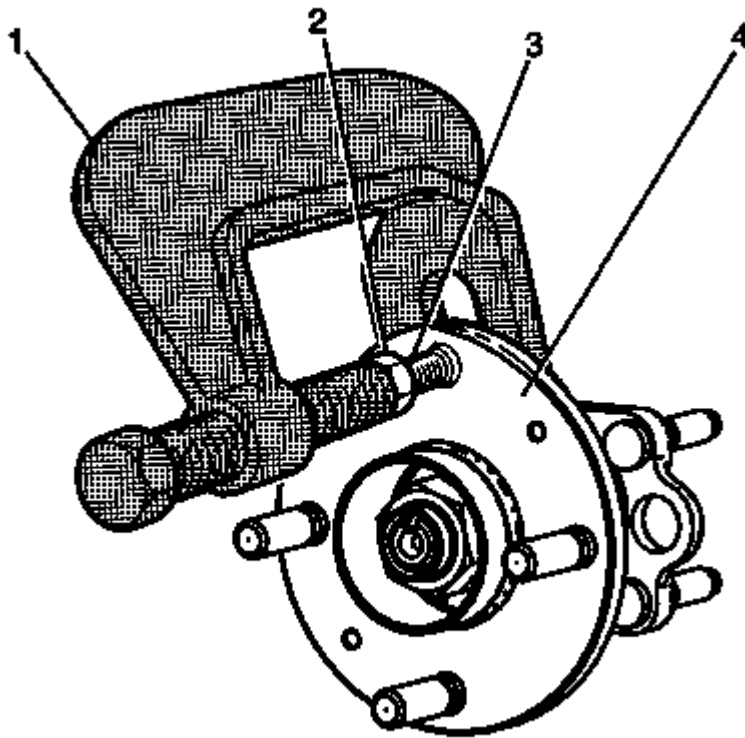


Fig. 27: Wheel Nut And Wheel Stud
Courtesy of GENERAL MOTORS COMPANY

5. Install a wheel nut (2) flush with the end of the wheel stud (3).
6. Using the **CH-43631** remover (1), remove the wheel stud (3) from the wheel hub (4).

Installation Procedure

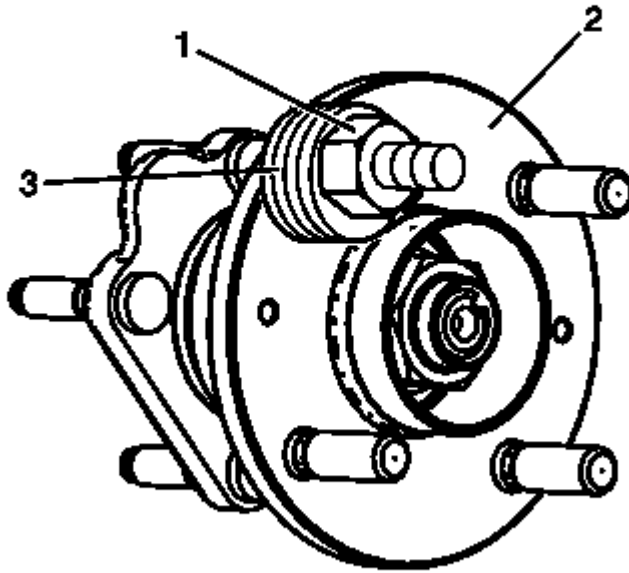


Fig. 28: Washers And Wheel Nut

Courtesy of GENERAL MOTORS COMPANY

1. Install the NEW wheel stud into the wheel bearing/hub (2).
2. Add enough washers (3) in order to draw the stud into the hub.
3. Install and tighten the wheel nut (1) until the head of the wheel stud is fully seated against the back of the bearing hub flange (2).
4. Install the wheel nut (1) and the washers (3).
5. Install the wheel bearing/hub. Refer to **Rear Wheel Bearing and Hub Replacement**.
6. Install the brake drum. Refer to **Brake Drum Replacement** .
7. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
8. Lower the vehicle.

DESCRIPTION AND OPERATION

REAR SUSPENSION DESCRIPTION AND OPERATION

This vehicle has a semi-independent twist-beam rear suspension system consisting of the following components:

- An axle with integral trailing arms

- A V-shaped twisting cross beam
- Two coil springs
- Two standard shock absorbers

Axle Assembly

The axle assembly attaches to the underbody through a rubber bushing and bracket located at the front of each integral trailing arm. The brackets are bolted to the underbody side rails. The axle structure itself maintains the geometrical relationship of the wheels relative to the centerline of the body.

Rear camber and tow are not adjustable. Replace any damaged suspension components as necessary.

Coil Spring

The coil springs support the weight of the vehicle in the rear. Rubber insulators isolate the coil spring at the upper and lower spring seat.

Shock Absorber

The shock absorbers are connected to the rear axle and the vehicle underbody. The shock absorbers are non-adjustable and non-refillable. Service of the shocks requires replacement of the shock assembly.

Wheel Bearing/Hub Assembly

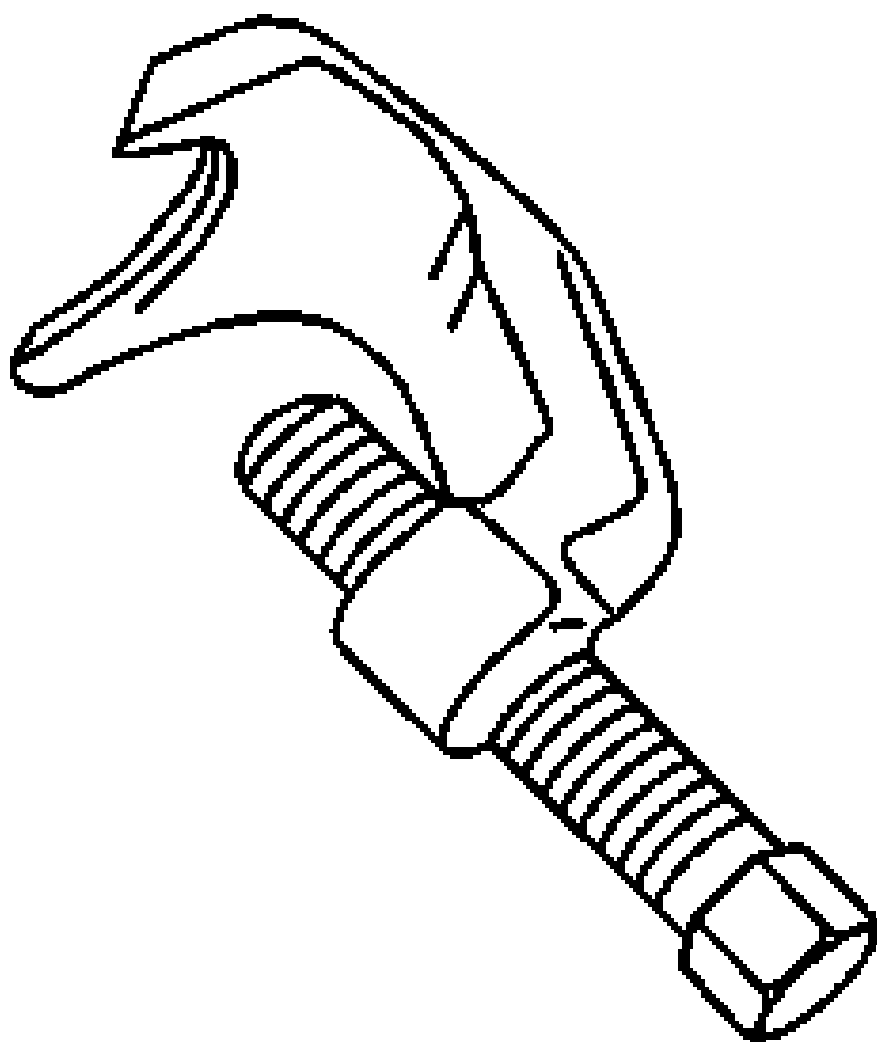
A single hub and bearing assembly is bolted to both ends of the rear axle assembly. The hub and bearing assembly is a sealed unit that eliminates the need for wheel bearing adjustment or periodic maintenance.

Although the rear suspension components are lubricated for life and require no routine lubrication, they should be inspected periodically for damage and wear.

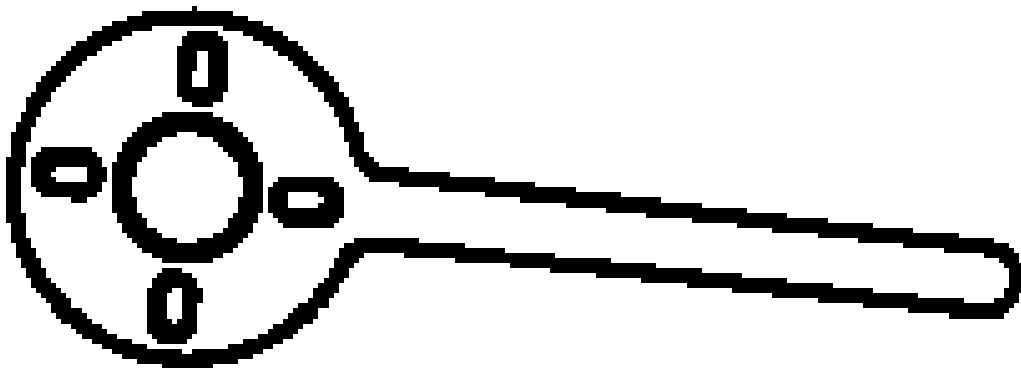
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

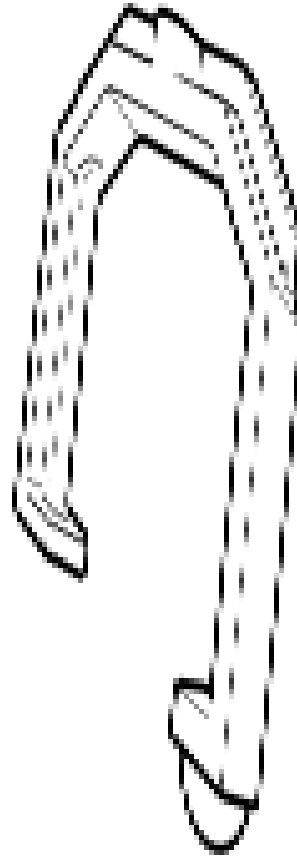
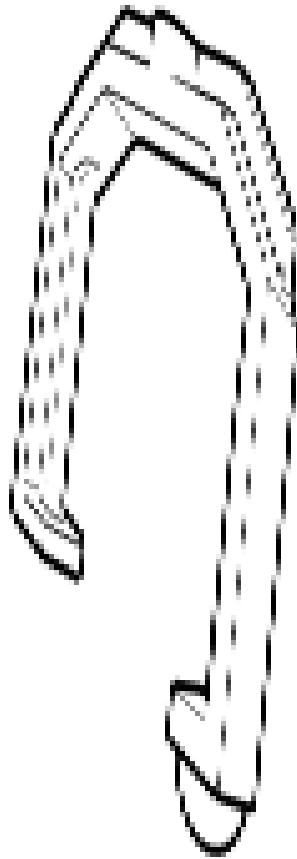
Illustration	Tool Number/ Description



CH-43631
J-43631
Ball Joint
Remover



DT-50186
Wheel Hub
Holding
Tool



DT-50187
Rear Axle
Supporter

RESTRAINTS

Seat Belts - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Front Seat Belt Buckle Bolt	40 N.m	30 lb ft
Front Seat Belt Height Adjuster Bolt	40 N.m	30 lb ft
Front Seat Belt Lower Anchor Bolt	40 N.m	30 lb ft
Front Seat Belt Retractor Bolt	40 N.m	30 lb ft
Front Seat Belt Upper Anchor Bolt	40 N.m	30 lb ft
Rear Center Seat Belt Buckle Bolt	40 N.m	30 lb ft
Rear Seat Belt Buckle Bolt	40 N.m	30 lb ft
Rear Seat Belt Lower Anchor Bolt	40 N.m	30 lb ft
Rear Seat Belt Retractor Bolt	40 N.m	30 lb ft
Rear Seat Belt Upper Anchor Bolt	40 N.m	30 lb ft

SCHEMATIC WIRING DIAGRAMS

SEAT BELT WIRING SCHEMATICS

Driver Switch and Indicator Wiring Schematics

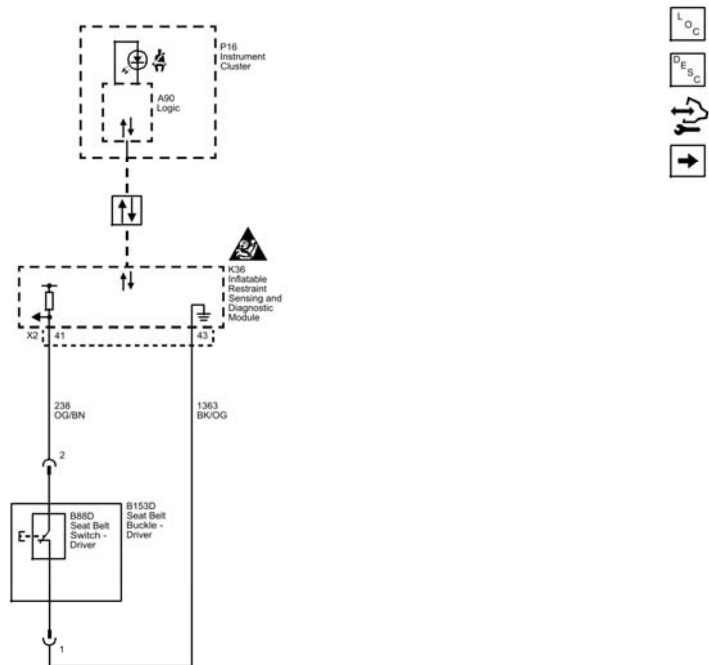


Fig. 1: Driver Switch and Indicator Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Passenger Indicators, Sensors and Switches (AYF) Wiring Schematics

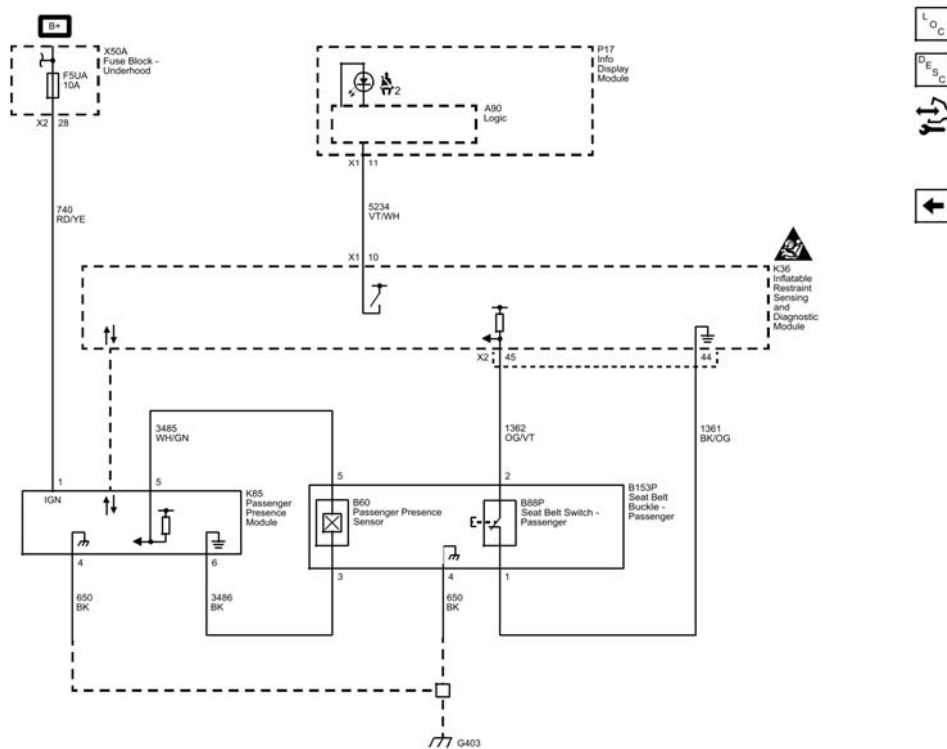


Fig. 2: Passenger Indicators, Sensors and Switches (AYF) Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Passenger Indicators, Sensors and Switches (AY0) Wiring Schematics

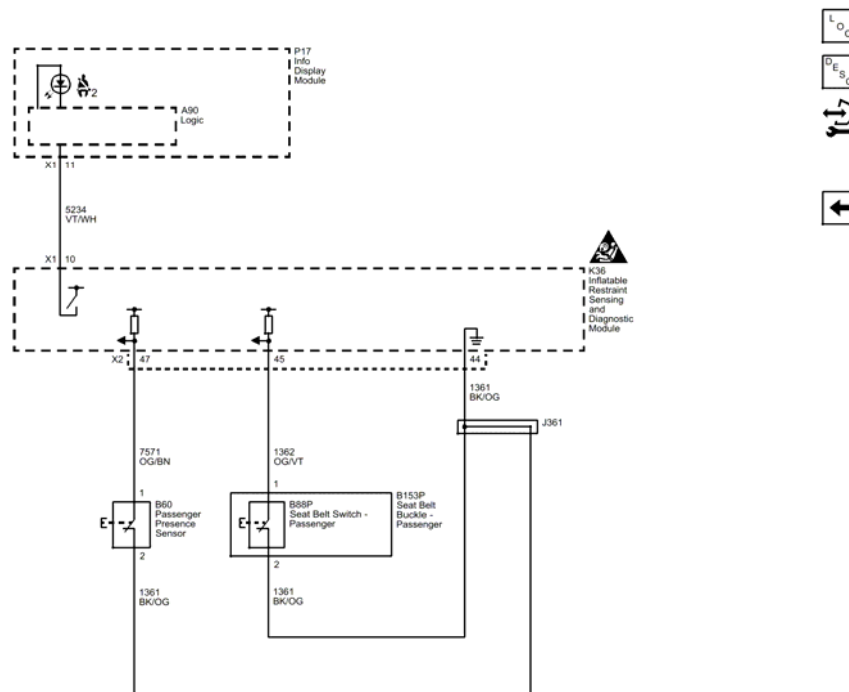


Fig. 3: Passenger Indicators, Sensors and Switches (AY0) Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC B0072 or B0073</u>	DTC B0072 Driver Seat Belt Switch Circuit DTC B0073 Passenger Seat Belt Switch Circuit
<u>DTC B0082</u>	DTC B0082 01 Seat Belt Reminder Sensor Short to Battery DTC B0082 02 Seat Belt Reminder Sensor Short to Ground DTC B0082 04 Seat Belt Reminder Sensor Open Circuit

DTC B0072 OR B0073: SEAT BELT SWITC

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category

DTC Descriptors

DTC B0072

Driver Seat Belt Switch Circuit

DTC B0073

Passenger Seat Belt Switch Circuit

For symptom byte information refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Driver Seat Belt Buckle Signal	B0072 02, B0072 0B	B0072 04, B0072 06, B0072 0C	B0072 04, B0072 06	B0072 01, B0072 05	B0072 08
Driver Seat Belt Buckle Low Reference	-	B0072 04, B0072 06, B0072 0C	B0072 04, B0072 06	-	-
Passenger Seat Belt Buckle Signal	B0073 02, B0073 0B	B0073 04, B0073 06, B0073 0C	B0073 04, B0073 06	B0073 01, B0073 05	B0073 08
Passenger Seat Belt Buckle Low Reference	-	B0073 04, B0073 06, B0073 0C	B0073 04, B0073 06	-	-

Circuit/System Description

The inflatable restraint seat belt buckle switch is within the seat belt buckle and provides an input to the inflatable restraint sensing and diagnostic module (SDM). The inflatable restraint sensing and diagnostic module supplies a low reference circuit and a seat belt buckle signal circuit to determine a buckled or unbuckled condition. The inflatable restraint sensing and diagnostic module monitors the seat belt buckle circuits and if a fault is detected a DTC will be set.

Conditions for Running the DTC

Ignition voltage is between 9-16 V.

Conditions for Setting the DTC

B0072 01 or B0073 01

The seat belt buckle circuit is shorted to voltage.

B0072 02 or B0073 02

The seat belt buckle circuit is shorted to ground.

B0072 04 or B0073 03

The seat belt buckle circuit is open.

B0072 05 or B0073 05

The seat belt buckle circuit is shorted to voltage or open.

B0072 06 or B0073 06

The seat belt buckle circuit is shorted to ground or open.

B0072 08 or B0073 08

The seat belt buckle signal is invalid.

B0072 0B or B0073 0B

The seat belt buckle signal is above threshold.

B0072 0C or B0073 0C

The seat belt buckle signal is below threshold.

Action Taken When the DTC Sets

The inflatable restraint sensing and diagnostic module will store a DTC and illuminate the air bag indicator in the instrument cluster.

Conditions for Clearing the DTC

The condition for setting the DTC no longer exists.

Reference Information

Schematic Reference

Seat Belt Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the appropriate scan tool Seat Belt Status parameter changes between Buckled and Unbuckled when the seat belt is buckled and unbuckled.
 - **If the parameter does not change**

Refer to Circuit/System Testing.

- **If the parameter changes**
3. All OK.

Circuit/System Testing

NOTE: When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected component/connector.

- **B153D Seat Belt Buckle-Driver**
- **B153P Seat Belt Buckle-Passenger**
- **K36 Inflatable Restraint Sensing and Diagnostic Module**

1. Ignition OFF, disconnect the harness connector at the appropriate B153 Seat Belt Buckle. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 ohms between the low reference circuit terminal 1 and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the K36 Inflatable Restraint Sensing and

Diagnostic Module.

2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If less than 5 ohms**
3. Ignition ON.
4. Verify the appropriate scan tool Seat Belt Status parameter is Buckled.
 - **If not Buckled**
 1. Ignition OFF, disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 2. Test for infinite resistance between the signal circuit terminal 2 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If Buckled**
5. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the low reference circuit terminal 1.
6. Verify the appropriate scan tool Seat Belt Status parameter is Unbuckled.
 - **If not Unbuckled**
 1. Ignition OFF, disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If Unbuckled**
7. Test or replace the B153 Seat Belt Buckle.

Component Testing

1. Ignition OFF, disconnect the harness connector at the B153 Seat Belt Buckle.
2. Test for infinite resistance between the signal terminal 2 and the low reference terminal 1.
 - **If less than infinite resistance**

Replace the B153 Seat Belt Buckle.
 - **If infinite resistance**
3. Insert the seat belt into the buckle.
4. Test for less than 5 ohms between the signal terminal 2 and the low reference terminal 1.

- If 5 ohms or greater

Replace the B153 Seat Belt Buckle.

- If less than 5 ohms

5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Front Seat Belt Buckle Replacement**
- **SIR/SRS Wiring Repairs**
- **Control Module References** for inflatable restraint sensing and diagnostic module replacement, programming and setup.

DTC B0082: SEAT BELT REMINDER SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0082 01

Seat Belt Reminder Sensor Short to Battery

DTC B0082 02

Seat Belt Reminder Sensor Short to Ground

DTC B0082 04

Seat Belt Reminder Sensor Open Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Seat Belt Reminder Sensor Signal	B0082 02	B0082 04	B0082 01	-
Seat Belt Reminder Sensor Low	-	B0082 04	-	-

Reference				
-----------	--	--	--	--

Circuit/System Description

The seat belt reminder sensor is within the passenger seat cushion and provides an input to the Inflatable Restraint Sensing and Diagnostic Module (SDM). The Inflatable Restraint Sensing and Diagnostic Module supplies a low reference circuit and a seat belt reminder sensor signal circuit to determine seated or unseated condition of passenger seat.

Conditions for Running the DTC

Ignition voltage is between 9-16 V.

Conditions for Setting the DTC

B0082 01

The Inflatable Restraint Sensing and Diagnostic Module detects a short to voltage in the seat belt reminder sensor signal circuit.

B0082 02

The Inflatable Restraint Sensing and Diagnostic Module detects a short to ground in the seat belt reminder sensor signal circuit

B0082 04

The Inflatable Restraint Sensing and Diagnostic Module detects an open/high resistance in the seat belt reminder sensor signal circuit or the seat belt reminder sensor ground circuit

Action Taken When the DTC Sets

The SIR System is disabled and no deployments are allowed.

Conditions for Clearing the DTC

- The DTC will be current for as long as the fault is present
- When the fault is no longer present, the DTC will be a history DTC
- A history DTC will clear after 50 ignition cycles

Reference Information

Schematic Reference

Seat Belt Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify, with the passenger seat unoccupied, the scan tool Passenger Seat Occupancy Status parameter is Empty Seat.
 - **If not Empty Seat**

Refer to Circuit/System Testing
 - **If Empty Seat**
3. Verify, with the passenger seat occupied, the scan tool Passenger Seat Occupancy Status parameter is Occupied.
 - **If not Occupied**

Refer to Circuit/System Testing
 - **If Occupied**
4. All OK.

Circuit/System Testing

1. Ignition OFF. Disconnect the harness connector at the B60 Passenger Presence Sensor, wait 120 seconds.
2. Test for less than 30 ohms between the low reference circuit terminal 2 and ground.
 - **If 30 ohms or greater**
 1. Ignition OFF, disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.
- If less than 2 ohms, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
- **If less than 30 ohms**
- 3. Ignition ON.
- 4. Test for 4.75-5.25 V between the signal circuit terminal 1 and ground.
 - **If less than 4.75 V**
 1. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If greater than 5.25 V**
 1. Ignition OFF. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module. Ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If between 4.75-5.25 V**
- 5. Replace the B60 Passenger Presence Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Front Seat Cushion Cover and Pad Replacement** for Passenger Presence Sensor replacement
- **Control Module References** for Inflatable Restraint Sensing and Diagnostic Module control module replacement, programming and setup

SYMPTOMS - SEAT BELTS

NOTE: Review the seat belt system description and operation in order to familiarize yourself with the system and how it functions. Refer to **Seat Belt System Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the seat belt system. Refer to **Checking Aftermarket Accessories**.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to the following symptom diagnostic procedure in order to diagnose the symptom:

- **Seat Belt Indicator Malfunction - Driver**
- **Seat Belt Indicator Malfunction - Passenger**

SEAT BELT DOES NOT RETRACT

1. Grab the seat belt webbing and slowly and firmly extract 15-25 mm (5/8-1 in) of webbing from the seat belt.
2. Release the seat belt and allow the webbing to slowly retract back into the retractor.
3. Check to see if the seat belt is released. If the seat belt is not released, repeat steps 1 and 2, two times more.
4. If the retractor does not release after repeating the steps, replace with a new retractor.

SEAT BELT INDICATOR MALFUNCTION - DRIVER

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Driver Seat Belt Switch Signal	1	2	2	-
Driver Seat Belt Switch Low Reference	-	2	-	-
1. Indicator will remain ON with seat belt buckled. 2. Indicator will illuminate only for the bulb check.				

Circuit/System Description

The driver seat belt switch is a 2-wire switch wired to the inflatable restraint sensing and diagnostic module (SDM) using a signal circuit and a low reference circuit. When the seat belt is unbuckled the switch is closed and when the seat belt is buckled the switch is open. The inflatable restraint sensing and diagnostic module sends the status of the driver seat belt via serial data to the instrument cluster. After receiving the message, the instrument cluster controls the illumination of the driver seat belt indicator.

Reference Information

Schematic Reference

Seat Belt Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Seat Belt System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the driver seat belt indicator turns ON and OFF when commanding the instrument cluster all indicators ON and OFF with a scan tool.
 - **If the driver seat belt indicator does not turn ON and OFF as commanded .**

Replace the P16 Instrument Cluster.
 - **If the driver seat belt indicator does turn ON and OFF as commanded**
2. Verify the scan tool Diver Seat Belt Switch parameter changes between Buckled and Unbuckled when buckling and unbuckling the driver seat belt.
 - **If the parameter does not change**

Refer to Circuit/System Testing.
 - **If the parameter changes**
3. All OK.

Circuit/System Testing

NOTE: When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected component/connector.

- **B153D Seat Belt Buckle-Driver**
- **Seat belt switch harness connector**
- **K36 Inflatable Restraint Sensing and Diagnostic Module**
- **Inflatable Restraint Sensing and Diagnostic Module wiring harness connector**

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B153D Seat Belt Buckle-Driver. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 ohms between the low reference circuit terminal 1 and ground.
 - **If 5 ohms or greater**
 1. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 2. Test for less than 2 ohms in each low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If less than 5 ohms**
3. Ignition ON.
4. Verify the scan tool Driver Seat Belt Status parameter is Buckled.
 - **If not Buckled**
 1. Ignition OFF, disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 2. Test for infinite resistance between the seat belt switch signal circuit terminal 2 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If Buckled**
5. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the low reference circuit terminal 1.
6. Verify the scan tool Driver Seat Belt Status parameter is Unbuckled.
 - **If Unbuckled**
 1. Ignition OFF, disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in each circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If Unbuckled**

7. Test or replace the B153D Seat Belt Buckle-Driver.

Component Testing

1. Ignition OFF, disconnect the harness connector at the B153D Seat Belt Buckle-Driver, buckle the driver seat belt.
2. Test for infinite resistance between the signal circuit terminal 2 and the low reference terminal 1.

- **If not infinite resistance**

Replace the B153D Seat Belt Buckle-Driver.

- **If infinite resistance**

3. Unbuckle the driver seat belt.
4. Test for less than 1 ohms between the signal circuit terminal 2 and the low reference terminal 1.

- **If 1 ohms or greater**

Replace the B153D Seat Belt Buckle-Driver.

- **If less than 1 ohms**

5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Front Seat Belt Buckle Replacement**
- **Control Module References** for inflatable restraint sensing and diagnostic module or instrument cluster replacement, programming and setup

SEAT BELT INDICATOR MALFUNCTION - PASSENGER

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Passenger Seat Belt Buckle	1	2	2	-

Signal				
Passenger Seat Belt Buckle Low Reference	-	2	-	-
Passenger Seat Belt Indicator Control	3	3	4	-
1. Indicator will remain ON with Seat Belt Buckled. 2. Indicator will illuminate only for the bulb check. 3. Indicator will not illuminate. 4. Indicator always ON.				

Circuit/System Description

When an individual is sitting in the passenger seat the passenger presence sensor detects the individual. A signal to the Inflatable Restraint Sensing and Diagnostic Module indicates a person is in the passenger seat. The Inflatable Restraint Sensing and Diagnostic Module will turn the passenger seat belt indicator on. The passenger Seat Belt Buckle is a 2-wire switch wired to the Inflatable Restraint Sensing and Diagnostic Module (SDM) using a signal circuit and a low reference circuit. When the seat belt is unbuckled the switch is closed and when the seat belt is buckled the switch is open. The Inflatable Restraint Sensing and Diagnostic Module controls the passenger seat belt indicator via a hard wire to the Info Display Module.

Diagnostic Aids

Objects on the passenger seat can cause the passenger seat belt reminder to be commanded on. Depending on the sensing technology used, a conductive object (computers, MP3 players, cell phones, diagnostic scan tool, wires, a hand, etc.) placed on the passenger seat may cause the Passenger Presence Detection Module to command the passenger air bag indicator ON and/or command the passenger seat belt indicator ON. The fasten seat belt chime will also sound.

Reference Information

Schematic Reference

Seat Belt Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Seat Belt System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**

- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the passenger seat belt indicator turns ON and OFF when performing the Passenger Seat Belt Reminder Indicator On/Off Control Function with a scan tool.
 - **If the passenger seat belt indicator does not turn ON and OFF**

Refer to Seat Belt Indicator Malfunction in Circuit/System Testing.

- **If the passenger seat belt indicator turns ON and OFF**
3. Verify the scan tool Passenger Seat Belt Status parameter changes between Buckled and Unbuckled when buckling and unbuckling the seat belt.
 - **If the parameter does not change between Buckled and Unbuckled when buckling and unbuckling the seat belt**

Refer to Seat Belt Switch Malfunction in Circuit/System Testing.

- **If the parameter changes between Buckled and Unbuckled when buckling and unbuckling the seat belt**
4. All OK.

Circuit/System Testing

Seat Belt Buckle Malfunction

NOTE: When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected component/connector.

- **B153 Seat Belt Buckle**
- **Seat Belt Buckle harness connector**
- **K36 Inflatable Restraint Sensing and Diagnostic Module**
- **Inflatable Restraint Sensing and Diagnostic Module harness connector**

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B153P Seat Belt Buckle-Passenger. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 ohms between the low reference circuit terminal 2 (AY0) or 1 (AYF) and ground.

- **If 5 ohms or greater**
 1. Disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If less than 5 ohms**
- 3. Ignition ON.
- 4. Verify the scan tool Passenger Seat Belt Status parameter is Buckled.
 - **If not Buckled**
 1. Disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 2. Test for infinite resistance between the Seat Belt Buckle signal circuit terminal 1 (AY0) or 2 (AYF) and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If less than 2 ohms, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If Buckled**
- 5. Install a 3 A fused jumper wire between the signal circuit terminal 1 (AY0) or 2 (AYF) and the low reference circuit terminal 2 (AY0) or 1 (AYF).
- 6. Verify the scan tool Passenger Seat Belt Status parameter is Unbuckled.
 - **If not Unbuckled**
 1. Disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 3. Test for less than 2 ohms in each circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If Unbuckled**
- 7. Test or replace the B153P Seat Belt Buckle-Passenger.

Seat Belt Indicator Malfunction

1. Ignition OFF, disconnect the harness connector at the P17 Info Display Module. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 7 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.

- **If less than 10 ohms**
- 3. Connect a test lamp between the control circuit terminal 11 and ground, ignition ON.
- 4. Verify with a scan tool, command the Passenger Seat Belt Reminder Indicator ON and OFF, the test lamp should turn ON and OFF while changing between the commanded states.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1V or greater, repair the short to voltage on the circuit.
 - If less than 1V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 2. Test for infinite resistance between the control circuit terminal 4 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If test lamp turns ON and OFF**
- 5. Replace the P17 Info Display Module.

Component Testing

1. Ignition OFF, disconnect the harness connector at the B153P Seat Belt Buckle-Passenger, buckle the passenger seat belt.
2. Test for infinite resistance between the signal circuit terminal 1 (AY0) or 2 (AYF) and the low reference terminal 2 (AY0) or 1 (AYF).
 - **If not infinite resistance**

Replace the B153P Seat Belt Buckle-Passenger.
 - **If infinite resistance**
3. Unbuckle the passenger seat belt.
4. Test for less than 1 ohms between the signal circuit terminal 1 (AY0) or 2 (AYF) and the low reference terminal 2 (AY0) or 1 (AYF).
 - **If 1 ohms or greater**

Replace the B153P Seat Belt Buckle-Passenger.
 - **If less than 1 ohms**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair

- **Front Seat Belt Buckle Replacement**
- **Information Center Telltale Assembly Replacement** for Info Display Module replacement
- **Control Module References** for Inflatable Restraint Sensing and Diagnostic Module or Instrument Cluster replacement, programming and setup

REPAIR INSTRUCTIONS

REPAIRS AND INSPECTIONS REQUIRED AFTER A COLLISION

WARNING: Restraint systems can be damaged in a collision. To help avoid injury and ensure that all parts in need of replacement are replaced:

- Replace any seat belt system that was in use during the collision serious enough to deploy any automatic restraint device such as air bags and seat belt pretensioners. This not only includes seat belt systems in use by people of adult size, but seat belt systems used to secure child restraints, infant carriers and booster seats, including LATCH system and top tether anchorages.
- Replace any seat belt system that has torn, worn or damaged components. This not only includes adult seat belt systems, but built-in child restraints and LATCH system components, if any.
- Replace any seat belt system if you observe the words "REPLACE" or "CAUTION" or if a yellow tag is visible. Do not replace a seat belt if only the child seat caution label is visible.
- Replace any seat belt system if you are doubtful about its condition. This not only includes adult seat belt systems, but built-in child restraints, LATCH system components and any restraint system used to secure infant carriers, child restraints and booster seats.

Do NOT replace single seat belt system components in vehicles that have been in a collision as described above. Always replace the entire seat belt system with the buckle, guide and retractor assembly, which includes the latch and webbing material.

After a minor collision where no automatic restraint device was deployed, seat belt system replacement may not be necessary, unless some of the parts are torn, worn or damaged.

FRONT SEAT BELT BUCKLE REPLACEMENT

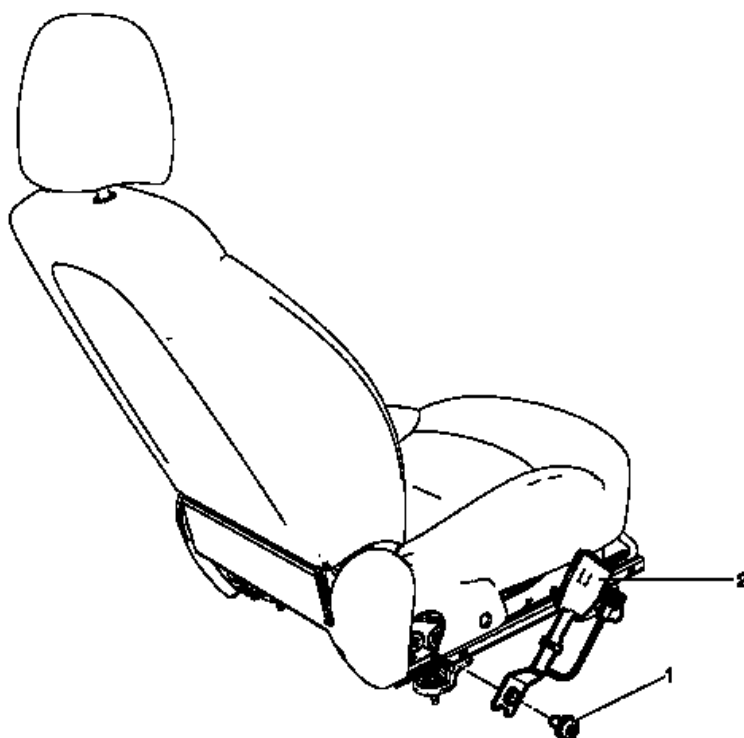


Fig. 4: Front Seat Belt Buckle
 Courtesy of GENERAL MOTORS COMPANY

Front Seat Belt Buckle Replacement

Callout	Component Name
Preliminary Procedure	
Remove the front seat. Refer to <u>Driver or Passenger Seat Removal and Installation</u> .	
1	Front Seat Belt Buckle Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 40 N.m (30 lb ft)
2	Front Seat Belt Buckle Assembly

REAR SEAT BELT BUCKLE REPLACEMENT

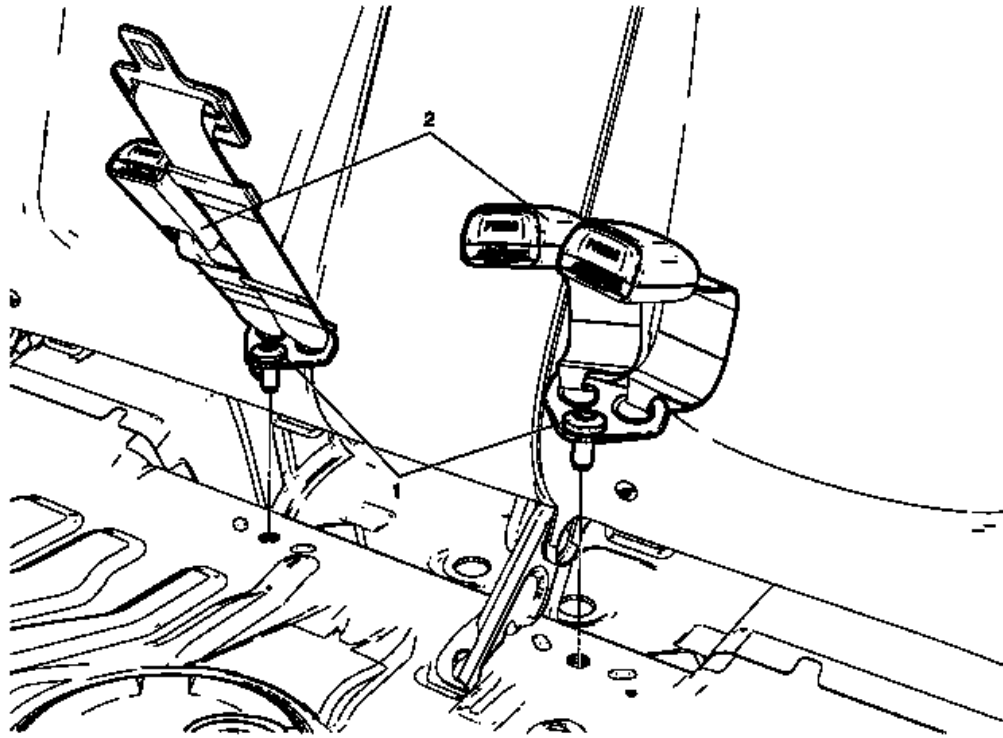


Fig. 5: Front Seat Belt Buckle
 Courtesy of GENERAL MOTORS COMPANY

Rear Seat Belt Buckle Replacement

Callout	Component Name
Preliminary Procedure Remove the rear seat cushion. Refer to <u>Rear Seat Cushion Removal and Installation</u> .	
1	Rear Seat Belt Buckle Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 40 N.m (30 lb ft)
2	Rear Seat Belt Buckle Assembly

REAR SEAT CENTER BELT REPLACEMENT

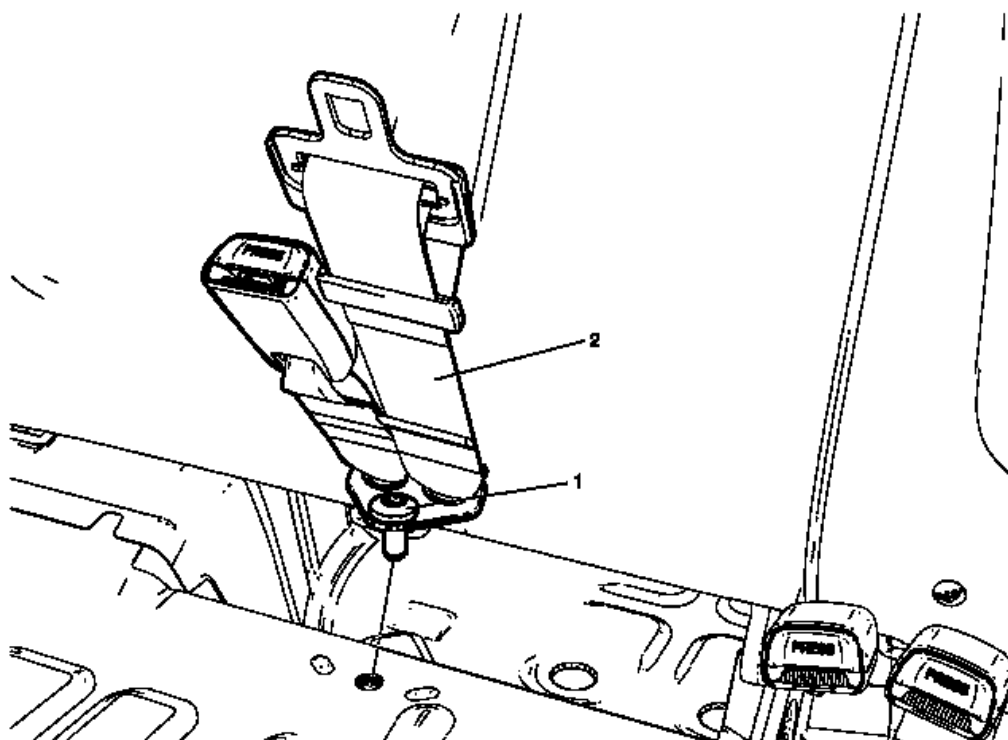


Fig. 6: Rear Seat Center Belt
 Courtesy of GENERAL MOTORS COMPANY

Rear Seat Center Belt Replacement

Callout	Component Name
Preliminary Procedure Remove the rear seat cushion. Refer to <u>Rear Seat Cushion Removal and Installation</u> .	
1	Rear Seat Center Belt Nut CAUTION: Refer to <u>Fastener Caution</u> . Tighten 40 N.m (30 lb ft)
2	Rear Seat Center Belt Assembly

SHOULDER BELT REPLACEMENT - REAR

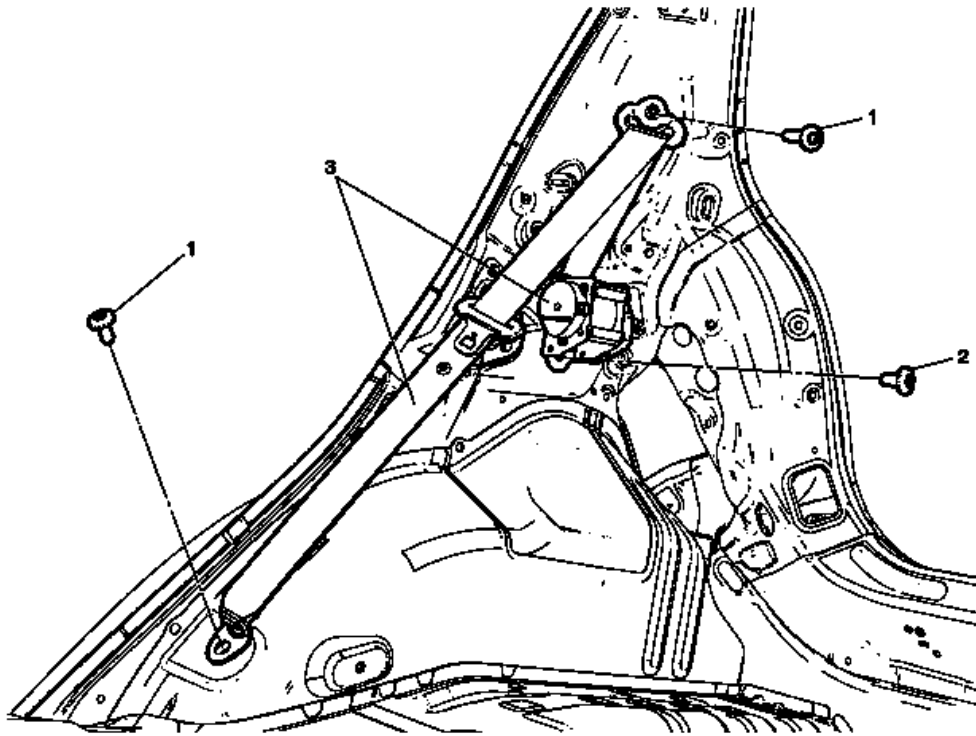


Fig. 7: Rear Seat Belt Assembly
 Courtesy of GENERAL MOTORS COMPANY

Shoulder Belt Replacement - Rear

Callout	Component Name
Preliminary Procedures 1. Remove the rear wheelhouse trim finish. Refer to <u>Rear Wheelhouse Trim Finish Panel Replacement</u> . 2. Remove the quarter window garnish molding. Refer to <u>Quarter Window Garnish Molding Replacement</u> .	
1	Rear Seat Belt Anchor Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 40 N.m (30 lb ft)
2	Rear Seat Belt Retractor Bolt Tighten 40 N.m (30 lb ft)
3	Rear Seat Belt Assembly

FRONT SEAT BELT GUIDE ADJUSTER REPLACEMENT

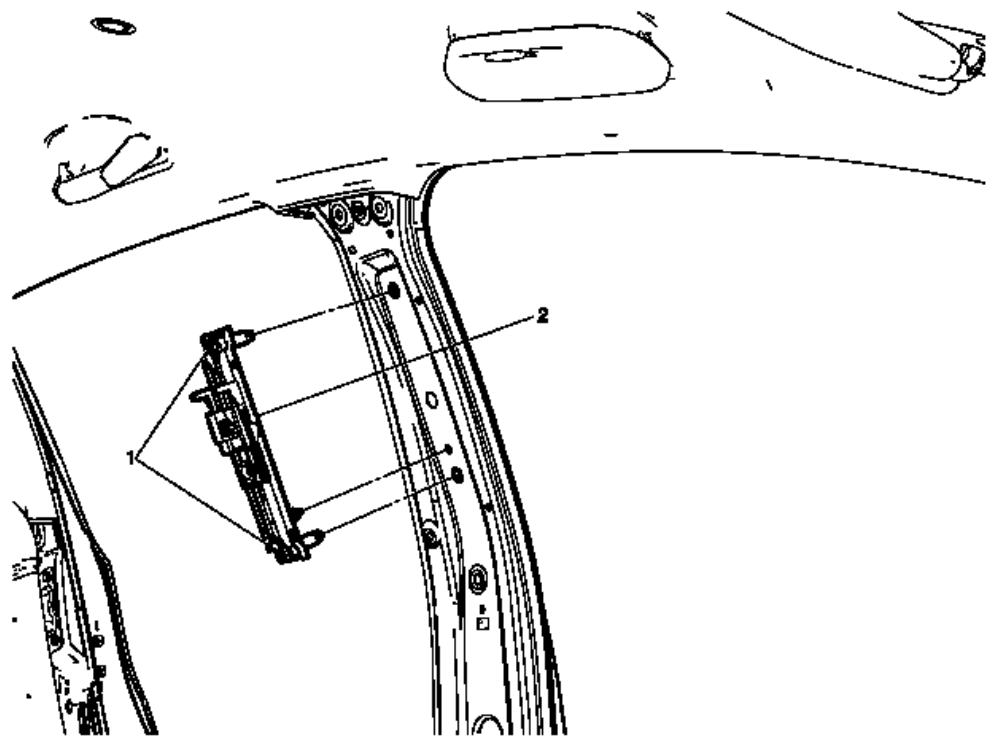


Fig. 8: Front Seat Belt Guide Adjuster
Courtesy of GENERAL MOTORS COMPANY

Front Seat Belt Guide Adjuster Replacement

Callout	Component Name
Preliminary Procedure Remover center pillar upper trim panel. Refer to Center Pillar Upper Trim Panel Replacement .	
1	Front Seat Shoulder Belt Guide Adjuster Bolt (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 40 N.m (30 lb ft)
2	Front Seat Shoulder Belt Guide Adjuster Assembly

DESCRIPTION AND OPERATION

SEAT BELT SYSTEM DESCRIPTION AND OPERATION

Seat Belt with P17 Info Display Module Block Diagram

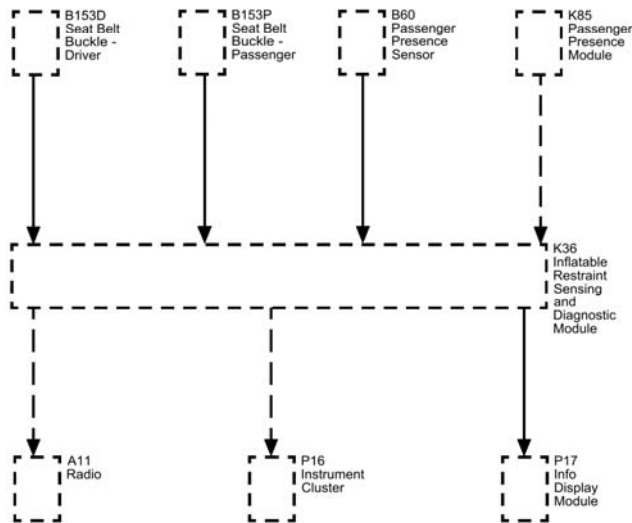


Fig. 9: Seat Belt with P17 Info Display Module Block Diagram
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
HW	Hard-Wired
HW	Hard-Wired
HW	Hard-Wired
HW	Hard-Wired
DA	Serial Data
DA	Serial Data
DA	Serial Data
B153D	B153D Seat Belt Buckle - Driver
B153P	B153P Seat Belt Buckle - Passenger
B60	B60 Passenger Presence Sensor
K36	K36 Inflatable Restraint Sensing and Diagnostic Module
A11	A11 Radio

P16	P16 Instrument Cluster
K85	Passenger Presence Module
P17	P17 Info Display Module

Restraint System

NOTE: If the vehicle has been in a collision, refer to **Repairs and Inspections Required After a Collision**

The vehicle has front and rear seat belts that are the primary means of occupant restraint. Seat belts help to keep the occupants inside the passenger compartment and to gradually reduce the impact forces during the following events:

- Frontal impact type crashes
- Rear impact type crashes
- Side impact type crashes
- Roll-over type crashes

All seat belt retractors have emergency locks. The retractors remain unlocked during normal operation and under normal driving conditions. The retractors remain unlocked during normal conditions in order to allow free movement of the upper body of each occupant. A pendulum locks the seat belt webbing into position. The pendulum causes a locking bar to engage a cog on the spool of the retractor mechanism when the following conditions occur:

- A rapid extraction of the seat belt webbing from the retractor
- An abrupt change in vehicle speed
- An abrupt change in vehicle direction
- Operation of the vehicle on a steep upgrade
- Operation of the vehicle on a downgrade

The seat belts have an automatic locking (cinch) feature. The cinch feature is activated when the seat belt webbing is completely extended from the retractor. The cinch feature prevents the webbing from extending beyond the position from which it is allowed to retract. Use of the cinch feature is recommended for securing a child seat. The cinch feature may be cancelled by allowing the webbing to wind back completely into the retractor. After the cinch feature is cancelled, the webbing is unlocked. After the cinch feature is cancelled, the webbing will extend from the retractor. This vehicle is also equipped with a supplemental inflatable restraint (SIR) system. Refer to **Supplemental Inflatable Restraint System Description and Operation**

Front Seat Belt System

The front seat belt system includes a driver and passenger seat belt retractor pretensioner. Both front seat belt pretensioners includes a seat belt switch in the seat buckle which controls a reminder lamp and a tone alarm.

NOTE: The front passenger seat is equipped with a passenger presence sensor, which detects an occupant. If the passenger presence sensor detects an empty front

passenger seat, then the passenger fasten safety belt indicator will be disabled.

- When the driver seat belt is buckled and the ignition switch is turned ON, the following events will occur:
 - The tone alarm will not operate.
 - The reminder lamp will not operate.
- When the passenger seat belt is buckled with an occupant sitting in the passenger front seat, then the ignition switch is turned ON, the following events will occur:
 - The tone alarm will not operate.
 - The reminder lamp, which is located within the Instrument Panel Multifunction Switch, will not be turned ON.
- When the driver seat belt is not buckled and the ignition switch is in the ON position, the following events will occur:
 - The tone alarm will operate for 4-8 seconds and then go OFF.
 - The fasten safety belt indicator will turn ON for 20 seconds, until the driver seat belt is buckled.
- When the passenger seat belt is not buckled with an occupant sitting in the passenger front seat, then the ignition switch is turned ON, the following events will occur:
 - The tone alarm will operate for 4-8 seconds and then go OFF.
 - The reminder lamp, which is located within the Instrument Panel Multifunction Switch, will be turned ON.

Rear Seat Belt System

The Rear Seat Belt System includes the following components:

- The rear seat belt retractor is located at the wheelhouse panel and attached to the floor panel by the rear seat shoulder belt retractor bracket.
- The rear seat belt buckles and the center seat belt buckle are attached to each seat.

Child Seat Restraint System

WARNING: A child in a rear-facing child restraint can be seriously injured if the right-front passengers air bag inflates. This is because the back of a rear-facing child restraint would be very close to the inflating air bag. NEVER use a rear-facing child restraint in this vehicle. If a forward-facing child restraint is suitable for your child, ALWAYS move the front passenger seat as far back as it will go and then install the child restraint. Be sure the child restraint position does not conflict with any additional requirements provided by the manufacturer. For more information, refer to the vehicle owners manual and the instruction that came with the child restraint.

A child in a rear-facing child restraint can be seriously injured if the right-front passengers air bag inflates. This is because the back of a rear-facing child restraint would be very close to the inflating air bag. NEVER use a rear-facing child restraint in this vehicle. If a forward-facing child restraint is suitable for your child, ALWAYS move the front passenger seat as far back as it will go and then install the child restraint. Be sure the child

restraint position does not conflict with any additional requirements provided by the manufacturer. For more information, refer to the vehicle owners manual and the instruction that came with the child restraint.

The child seat may only be used in a forward facing seating location. The child seat should be installed and secured according to the manufacturer's directions. If the child seat has a top strap, the seat will need to be anchored. Passengers should not be allowed to sit at locations where the seat belts are being used to secure the child seat.

All vehicles are equipped with a dual-mode type retractor with emergency and automatic locking features. The automatic locking feature is for restraint of a child seat. The child seat can be secured by pulling the seat belt all the way out to lock it. Then tighten the seat belt around the child seat.

If a child seat is to be used in the second seat position, a special dealer-installed anchor must be used in order to anchor the child seat top strap. This only applies to the seats designed with the top strap provision and for the vehicles sold in Canada. In order to ensure the correct top strap angle, the child seat is only to be used at the seating position for which the top strap anchor is installed.

Fasten Safety Belt Indicators

There are two fasten safety belt indicators for this vehicle. The driver fasten safety belt reminder is displayed in the instrument cluster and the passenger fasten safety belt reminder is displayed in the Instrument Panel Multifunction Switch. The fasten safety belt indicator may only be ON during RUN. The fasten safety belt indicator illuminates under the following conditions:

- During the bulb check
- The inflatable restraint sensing and diagnostic module (SDM) sends the status of the driver seat belt to the instrument cluster via serial data. The passenger seat belt status is sent to the Instrument Panel Multifunction Switch via a hard wire. If any of the seat belts are unfastened, the instrument cluster will send a message requesting a chime sound to be turned ON after a bulb check.

ACCESSORIES & EQUIPMENT

Seat Hardware, Trim, and Upholstery - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Front Seat Armrest Mounting Bolt	45 N.m	33 lb ft
Front Seat Back Cushion Frame Bolt	45 N.m	33 lb ft
Front Seat Inner Cover Screw	2.5 N.m	22 lb in
Front Seat Mounting Bolt	45 N.m	33 lb ft
Front Seat Outer Cover Screw	2.5 N.m	22 lb in
Rear Seat Back Cushion Bolt	24 N.m	18 lb ft
Rear Seat Back Cushion Latch Bolt	11 N.m	97 lb in
Rear Seat Back Cushion Nut	24 N.m	18 lb ft

REPAIR INSTRUCTIONS

DRIVER OR PASSENGER SEAT REMOVAL AND INSTALLATION

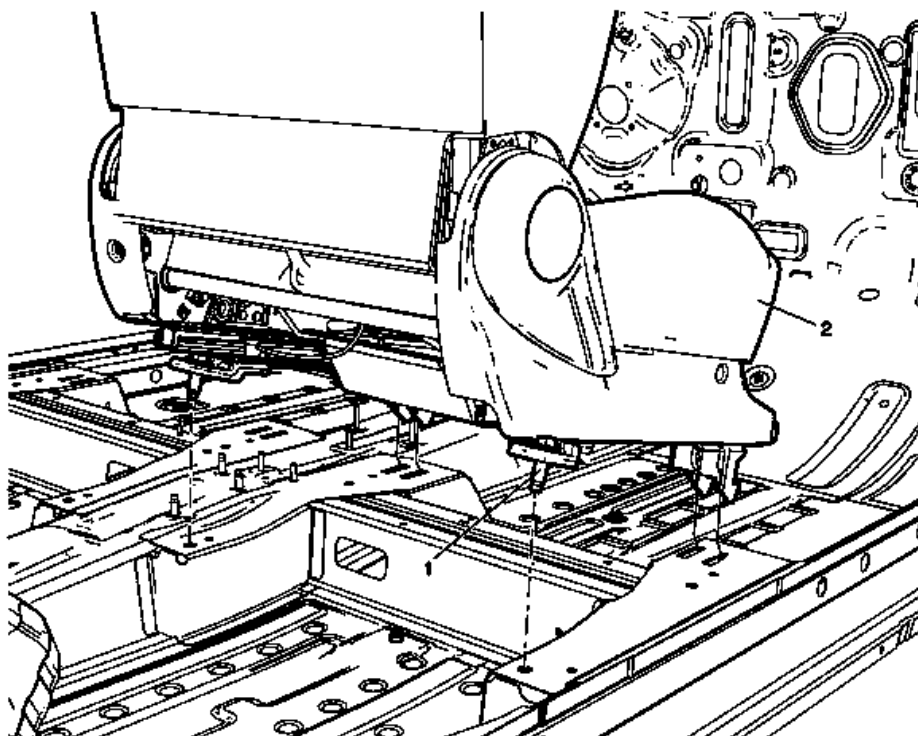


Fig. 1: Seat Assembly

Courtesy of GENERAL MOTORS COMPANY

Driver or Passenger Seat Removal and Installation

Callout	Component Name
1	Front Seat Mounting Bolt (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . TIP: Adjust the seat forward or rearward to access the nuts. Tighten 45 N.m (33 lb ft)
2	Seat Assembly Procedure Disconnect the electrical connectors.

DRIVER OR PASSENGER SEAT ADJUSTER HANDLE KNOB REPLACEMENT

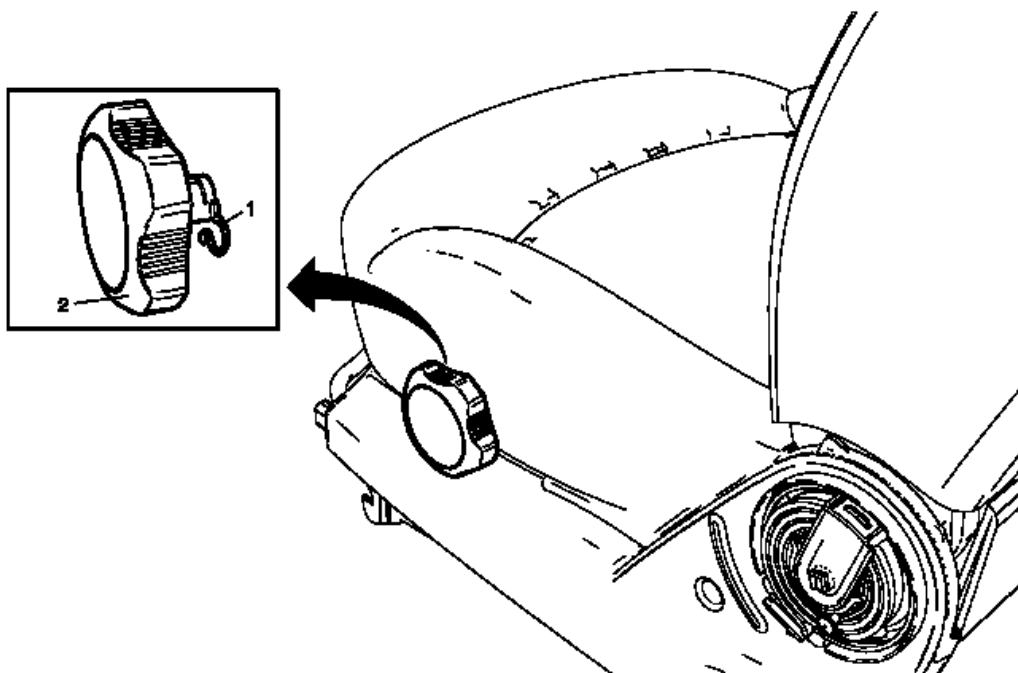


Fig. 2: Front Seat Adjuster Handle Knob

Courtesy of GENERAL MOTORS COMPANY

Driver or Passenger Seat Adjuster Handle Knob Replacement

Callout	Component Name
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1	Front Seat Adjuster Handle Knob Clamp TIP: Use a proper tool to release adjuster handle knob clamp.
2	Front Seat Adjuster Handle Knob

FRONT SEAT ARMREST REPLACEMENT

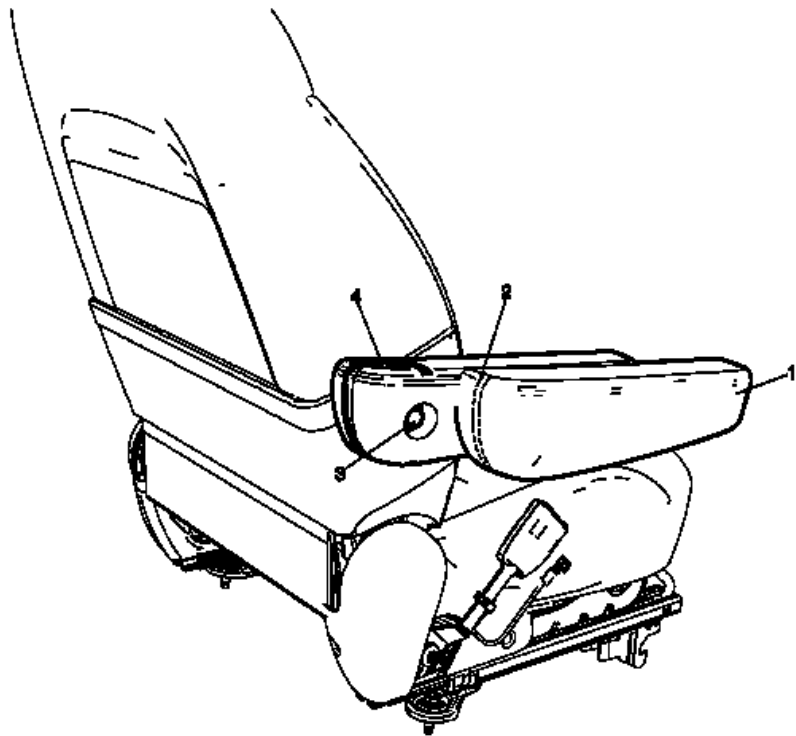


Fig. 3: Front Seat Armrest Assembly
 Courtesy of GENERAL MOTORS COMPANY

Front Seat Armrest Replacement

Callout	Component Name
1	Front Seat Armrest Cover
2	Front Seat Armrest Cover Zipper Procedure Open the zipper to access the front seat armrest mounting bolt.
3	Front Seat Armrest Mounting Bolt (Qty: 1) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 45 N.m (33 lb ft)
4	Front Seat Armrest Assembly

DRIVER OR PASSENGER SEAT HEAD RESTRAINT REPLACEMENT

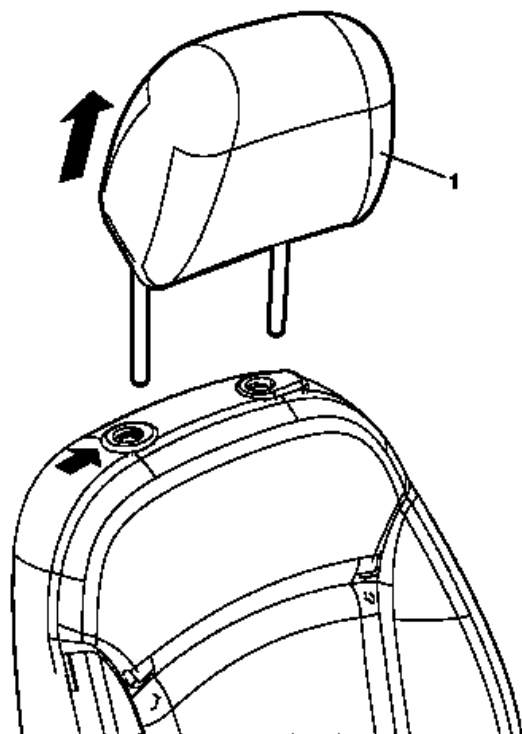


Fig. 4: Front Seat Head Restraint

Courtesy of GENERAL MOTORS COMPANY

Driver or Passenger Seat Head Restraint Replacement

Callout	Component Name
1	Front Seat Head Restraint Procedure 1. Raise the headrest to the full upward position. 2. Depress the flush button on the head restraint guide. 3. Remove the head restraint by pulling up on the restraint.

DRIVER OR PASSENGER SEAT HEAD RESTRAINT GUIDE REPLACEMENT

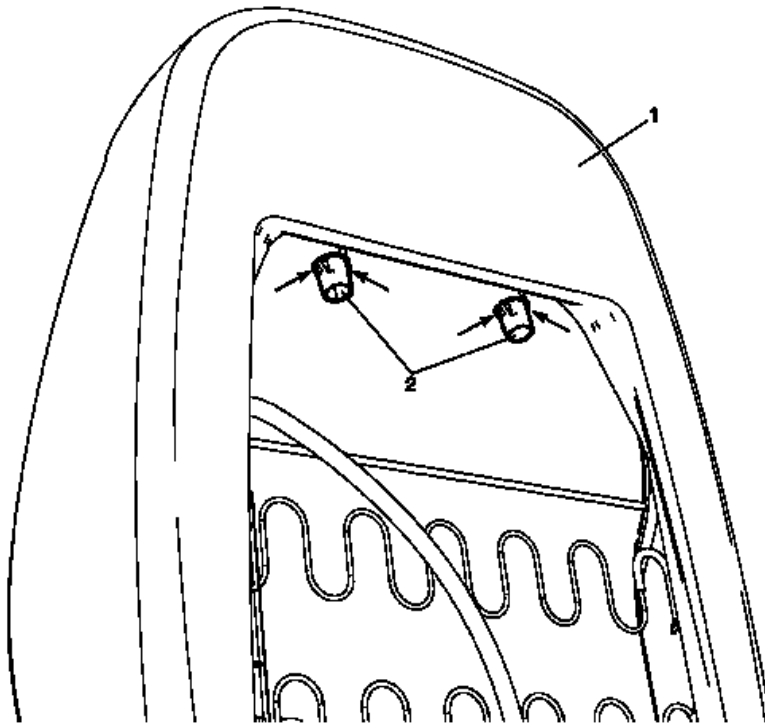


Fig. 5: Driver or Passenger Seat Head Restraint Guide
 Courtesy of GENERAL MOTORS COMPANY

Driver or Passenger Seat Head Restraint Guide Replacement

Callout	Component Name
Preliminary Procedures	
1. Remove the hog rings at the rear part of the front seat back. Refer to <u>Driver or Passenger Seat Back Cushion Cover Replacement</u> .	
2. Remove the front seat back cushion cover and pad to access the head restraint guide.	
1	Front Seat Back Cushion Pad
2	Front Seat Head Restraint Guide

FRONT SEAT CUSHION COVER REPLACEMENT

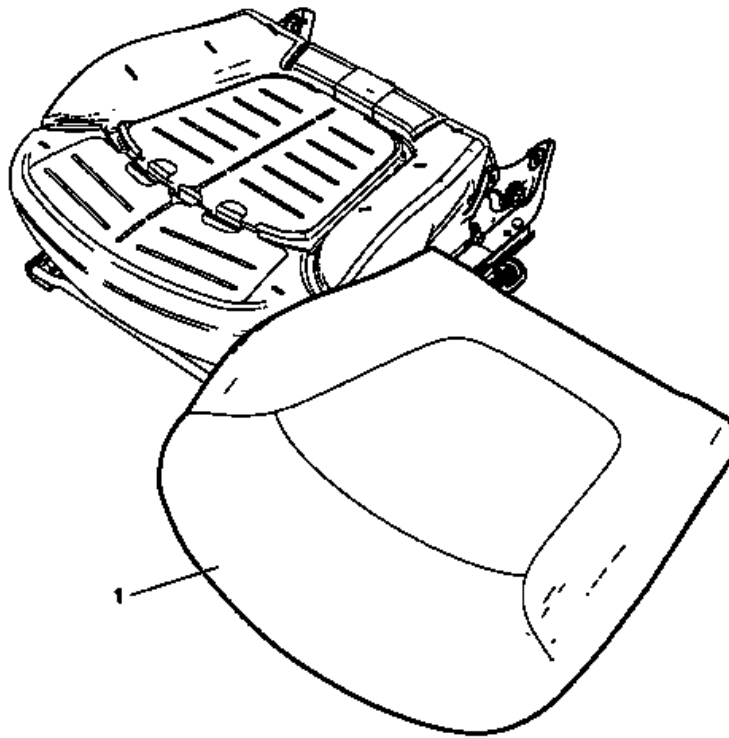


Fig. 6: Front Seat Cushion Cover
 Courtesy of GENERAL MOTORS COMPANY

Front Seat Cushion Cover Replacement

Callout	Component Name
Preliminary Procedure Remove the front seat back cushion frame. Refer to <u>Driver or Passenger Seat Back Cushion Frame Replacement</u> .	
1	Front Seat Cushion Cover Procedure Remove the hog rings and retainers securing the seat cushion cover.

FRONT SEAT CUSHION OUTER TRIM PANEL REPLACEMENT

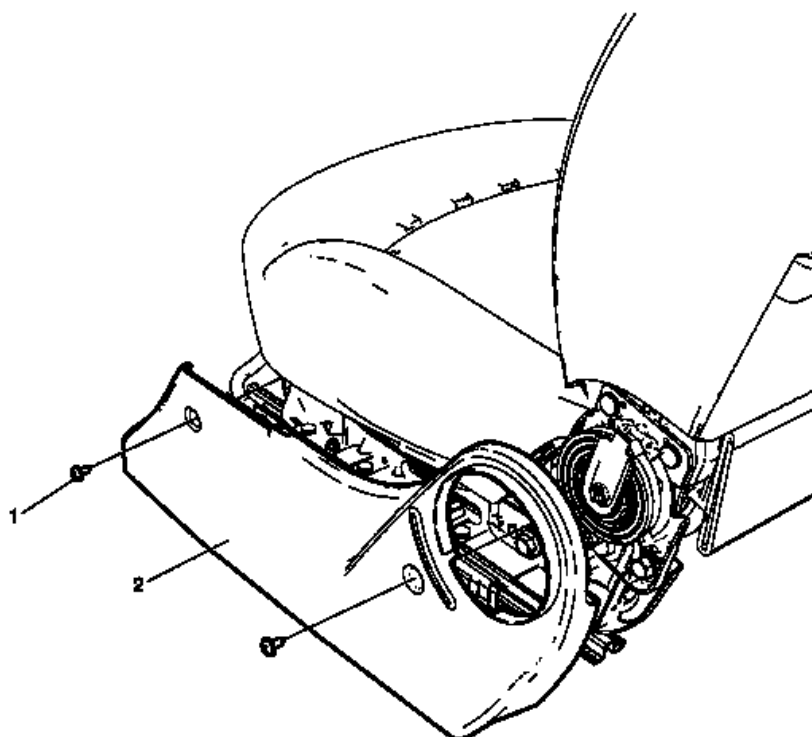


Fig. 7: Front Seat Cushion Outer Trim Panel
 Courtesy of GENERAL MOTORS COMPANY

Front Seat Cushion Outer Trim Panel Replacement

Callout	Component Name
Preliminary Procedure 1. Remove the front seat recliner handle. Refer to <u>Front Seat Back Recliner Handle Replacement</u>. 2. Remove the front seat adjuster handle knob. Refer to <u>Driver or Passenger Seat Adjuster Handle Knob Replacement</u>.	
1	Front Seat Outer Cover Screw (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2.5Y (22 lb in)
2	Front Seat Outer Cover

FRONT SEAT CUSHION INNER TRIM PANEL REPLACEMENT

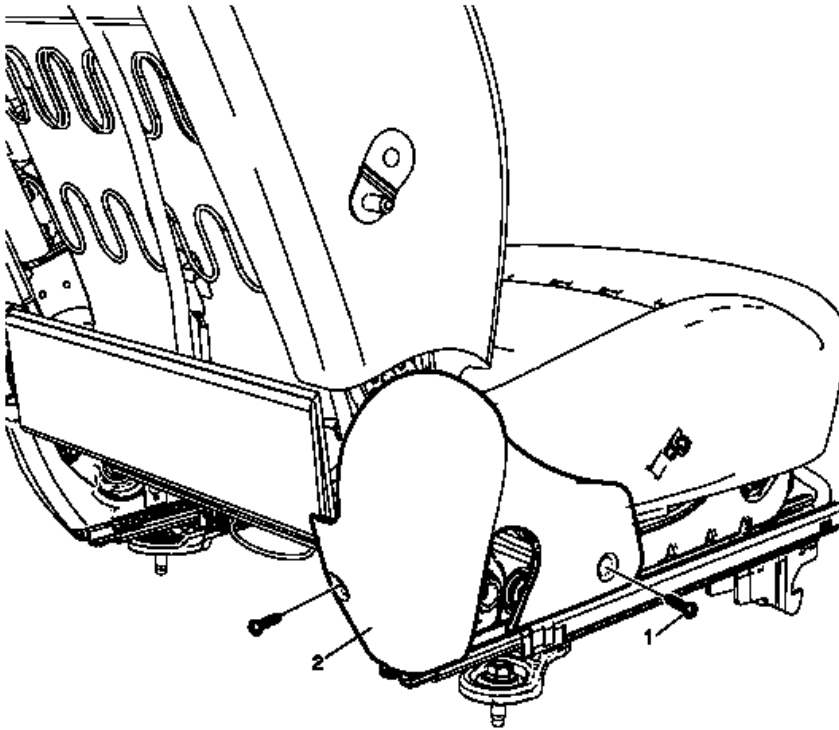


Fig. 8: Front Seat Cushion Inner Trim Panel
 Courtesy of GENERAL MOTORS COMPANY

Front Seat Cushion Inner Trim Panel Replacement

Callout	Component Name
1	Front Seat Inner Cover Screw (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . TIP: Adjust the seat forward or rearward to access the nuts. Tighten 2.5Y (22 lb in)
2	Front Seat Inner Cover

FRONT SEAT CUSHION COVER AND PAD REPLACEMENT

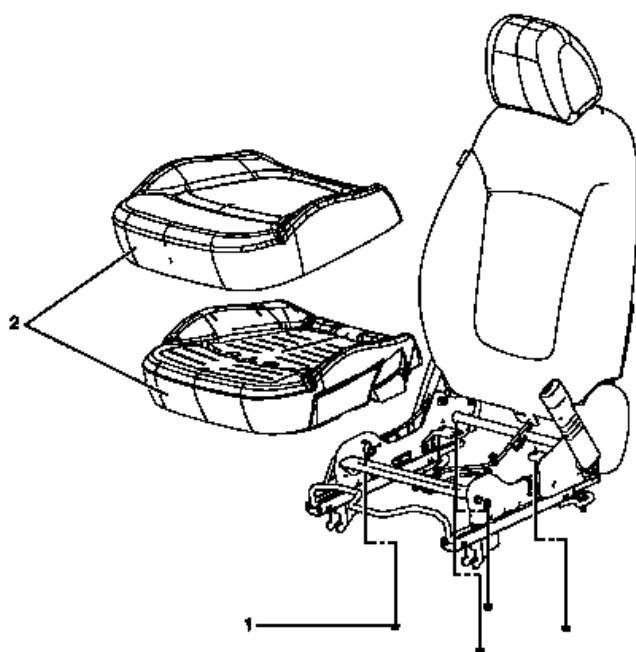


Fig. 9: Front Seat Cushion Cover and Pad
 Courtesy of GENERAL MOTORS COMPANY

Front Seat Cushion Cover and Pad Replacement

Callout	Component Name
Preliminary Procedure Remove the front seat. Refer to <u>Driver or Passenger Seat Removal and Installation.</u>	
1	Front Seat Cushion Nut (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 30.5 (22.5 lb ft)
2	Front Seat Cushion Cover and Pad WARNING: Replace the passenger presence system as a complete assembly to prevent possible injury to the occupant. The bladder, the pressure sensor, the seat cushion, and the control module are assembled and calibrated as a unit. Using only some of the components in the service kit will cause the passenger presence system to operate improperly. Procedure 1. Disconnect the electrical connectors that attach to the seat cushion, if equipped.

2. Remove the seat cushion cover and pad from the seat cushion frame as an assembly.
3. Disengage the j-channel retainers from the seat cushion frame.
4. Remove the hog rings.
5. Pull the cover away from the pad to disengage the hog rings.
6. If working on the passenger seat, re-zero the inflatable restraint passenger presence system whenever the seat cushion or any component of the passenger presence system is removed. Refer to **Passenger Presence System Rezeroing** .

DRIVER OR PASSENGER SEAT CUSHION PAD REPLACEMENT

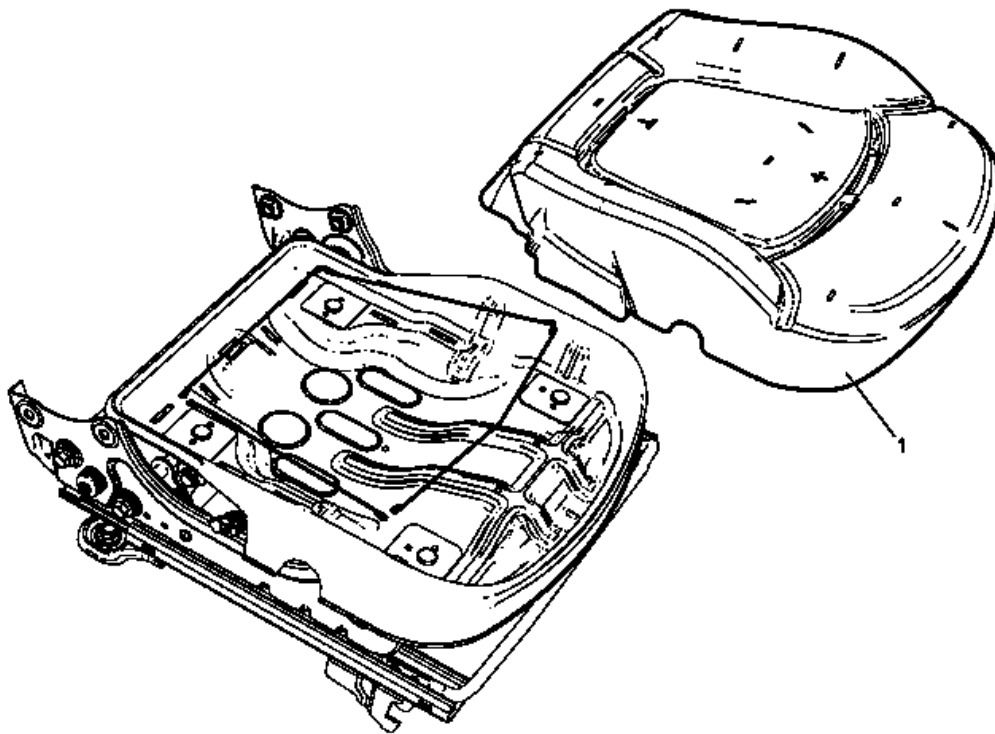


Fig. 10: Driver or Passenger Seat Cushion Pad
 Courtesy of GENERAL MOTORS COMPANY

Driver or Passenger Seat Cushion Pad Replacement

Callout	Component Name
Preliminary Procedure Remove the front seat cushion cover. Refer to <u>Front Seat Cushion Cover Replacement</u> .	
1	Front Seat Cushion Pad Procedure If necessary, remove the seat cushion heating mat. Refer to <u>Driver or Passenger Seat Cushion Heater Replacement</u> .

DRIVER OR PASSENGER SEAT BACK CUSHION COVER REPLACEMENT

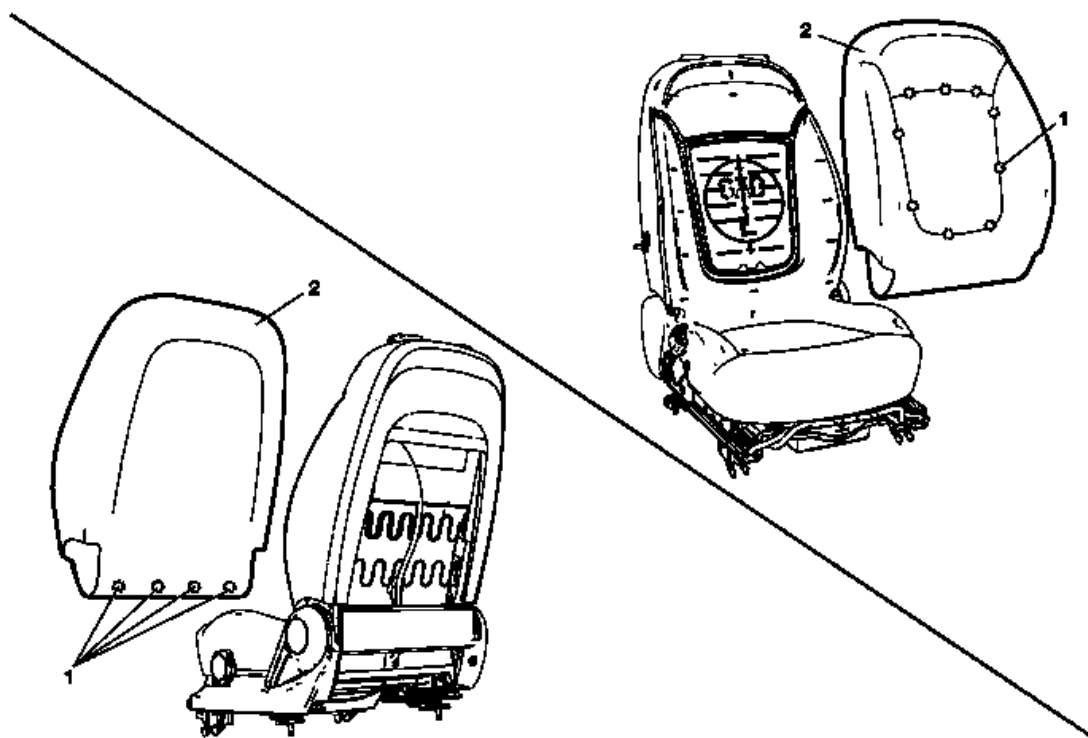


Fig. 11: Driver or Passenger Seat Back Cushion Cover
 Courtesy of GENERAL MOTORS COMPANY

Driver or Passenger Seat Back Cushion Cover Replacement

Callout	Component Name
Preliminary Procedure	
Remove the front seat armrest. Refer to Front Seat Armrest Replacement .	
1	Front Seat Back Cushion Cover Hog Ring (Qty: 13) TIP: Begin at the rear part of the front seat back cushion cover, release the hog rings.
2	Front Seat Back Cushion Cover

FRONT SEAT BACK PAD REPLACEMENT

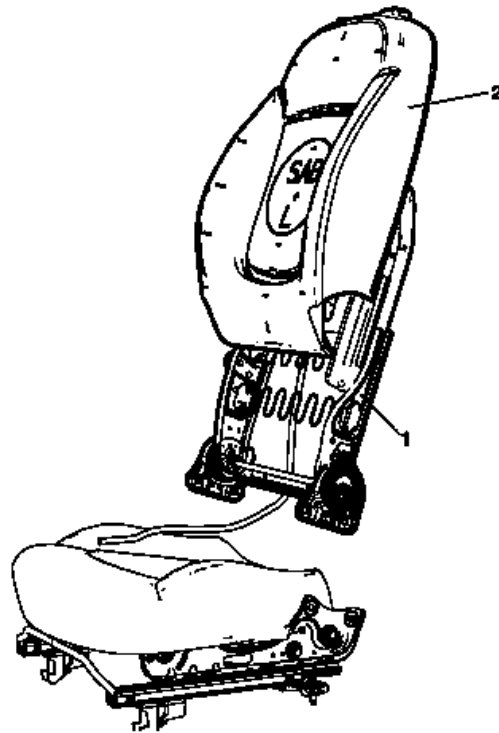


Fig. 12: Front Seat Back Pad
 Courtesy of GENERAL MOTORS COMPANY

Front Seat Back Pad Replacement

Callout	Component Name
Preliminary Procedures	
1. Remove the front seat back cushion cover. Refer to <u>Driver or Passenger Seat Back Cushion Cover Replacement.</u> 2. Remove the front seat back cushion frame. Refer to <u>Driver or Passenger Seat Back Cushion Frame Replacement.</u> 3. Remove the inflatable restraint side impact module as needed. Refer to <u>Front Seat Outboard Seat Back Airbag Replacement .</u>	
1	Front Seat Back Cushion Frame
2	Front Seat Back Cushion Pad Procedure 1. Remove the front seat back cushion frame, then remove the cushion pad. 2. If necessary, remove the front seat back cushion heating mat. Refer to <u>Driver or Passenger Seat Back Cushion Heater Replacement .</u>

DRIVER OR PASSENGER SEAT BACK CUSHION FRAME REPLACEMENT

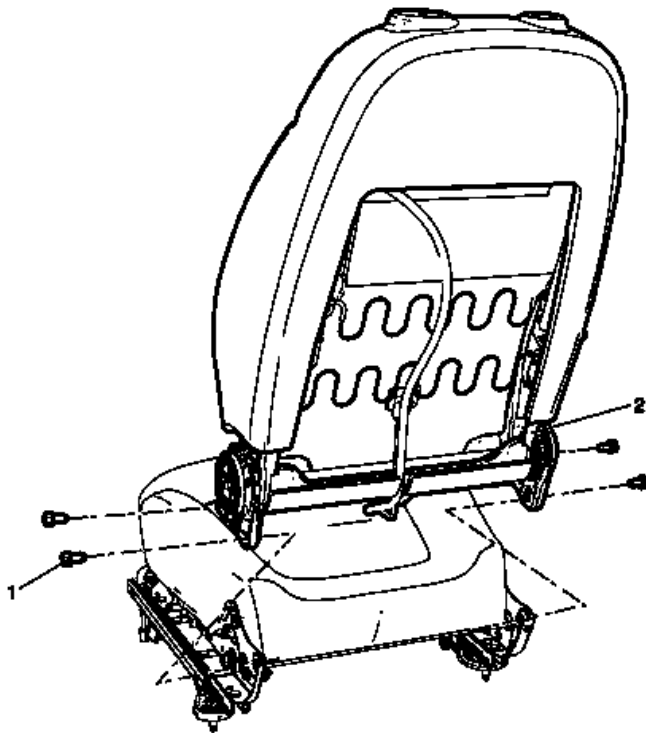


Fig. 13: Driver or Passenger Seat Back Cushion Frame
 Courtesy of GENERAL MOTORS COMPANY

Driver or Passenger Seat Back Cushion Frame Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the front seat. Refer to <u>Driver or Passenger Seat Removal and Installation</u>. 2. Remove the front seat inner trim panel. Refer to <u>Front Seat Cushion Inner Trim Panel Replacement</u>. 3. Remove the front seat outer trim panel. Refer to <u>Front Seat Cushion Outer Trim Panel Replacement</u>.	
1	Front Seat Back Cushion Frame Bolt (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 45 N.m (33 lb ft)
2	Front Seat Back Cushion Frame Procedure

1. Disconnect electrical connectors as needed.
2. Remove the inflatable restraint side impact module. Refer to **Front Seat Outboard Seat Back Airbag Replacement** .
3. If replacing with a new front seat back frame, transfer components as necessary.

FRONT SEAT BACK RECLINER HANDLE REPLACEMENT

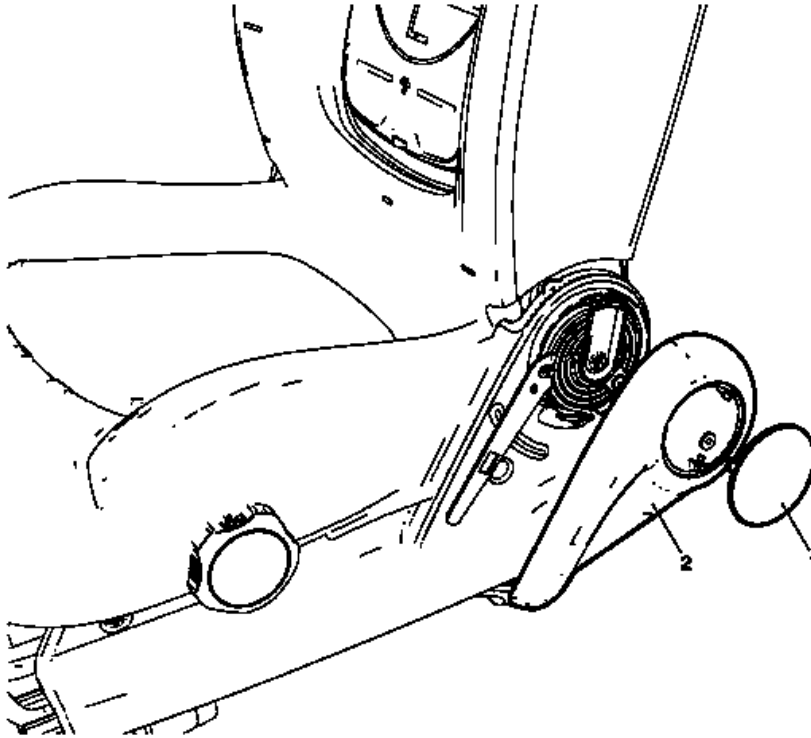


Fig. 14: Front Seat Back Recliner Handle
Courtesy of GENERAL MOTORS COMPANY

Front Seat Back Recliner Handle Replacement

Callout	Component Name
1	Front Seat Recliner Handle Cover Procedure Pull the handle cover away from the seat to remove.
2	Front Seat Recliner Handle Procedure Pull the handle away from the seat to remove.

REAR SEAT HEAD RESTRAINT REPLACEMENT

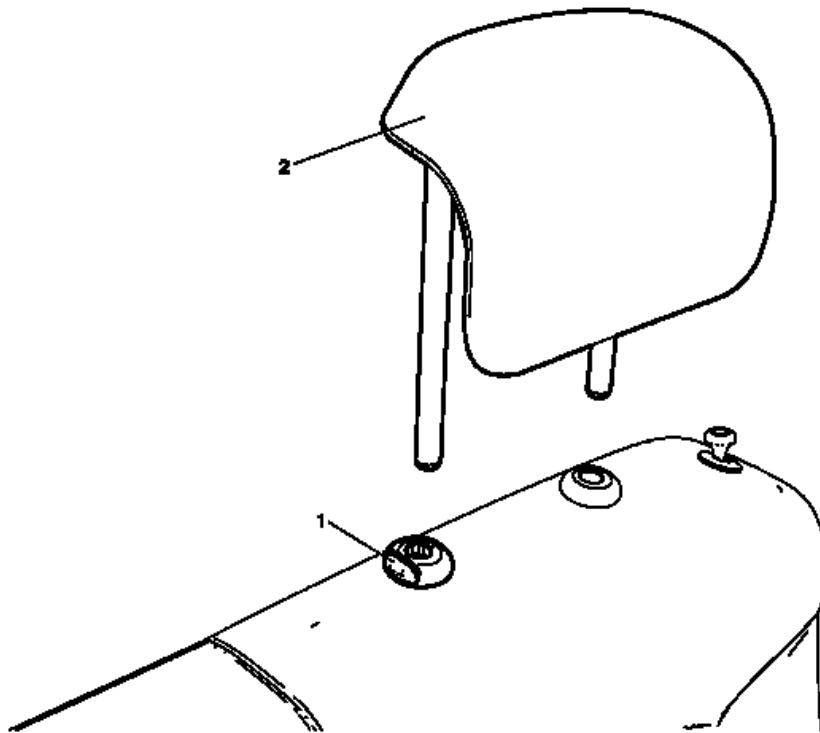


Fig. 15: Rear Seat Head Restraint
Courtesy of GENERAL MOTORS COMPANY

Rear Seat Head Restraint Replacement

Callout	Component Name
1	Rear Seat Head Restraint Flush Button Procedure Push the flush button and remove the head restraint.
2	Rear Seat Head Restraint

REAR SEAT HEAD RESTRAINT GUIDE REPLACEMENT

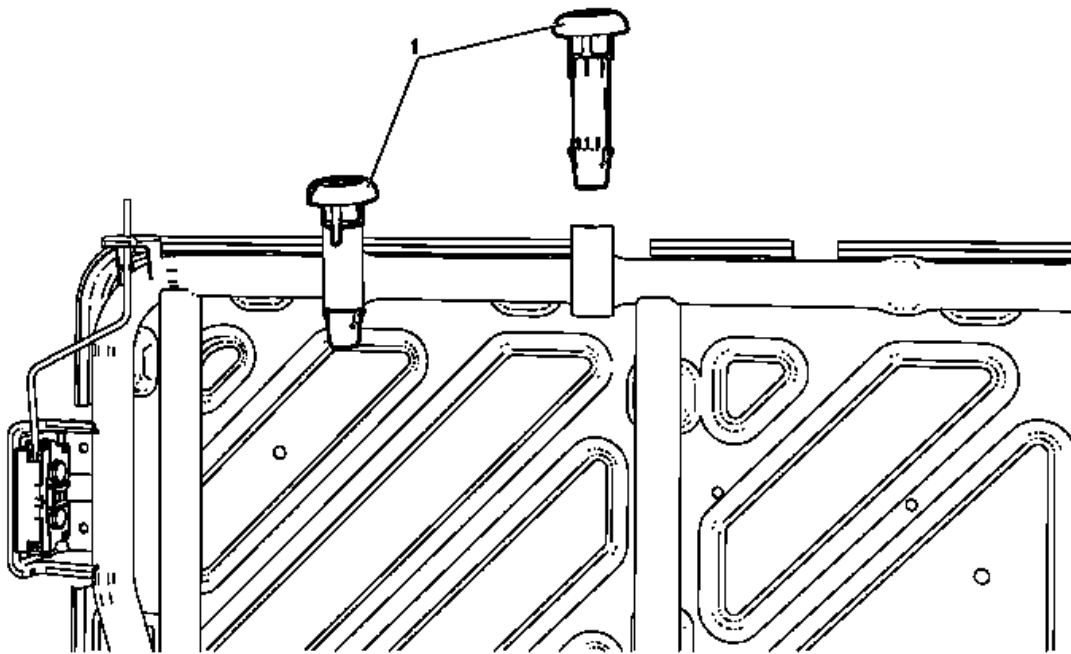


Fig. 16: Rear Seat Head Restraint Guide
 Courtesy of GENERAL MOTORS COMPANY

Rear Seat Head Restraint Guide Replacement

Callout	Component Name
Preliminary Procedure	
Remove rear seat back cushion pad. Refer to <u>Rear Seat Back Cushion Pad Replacement.</u>	
1	Rear Seat Head Restraint Guide Procedure Unclip the rear seat head restraint guide.

REAR SEAT BACK BOLSTER REPLACEMENT

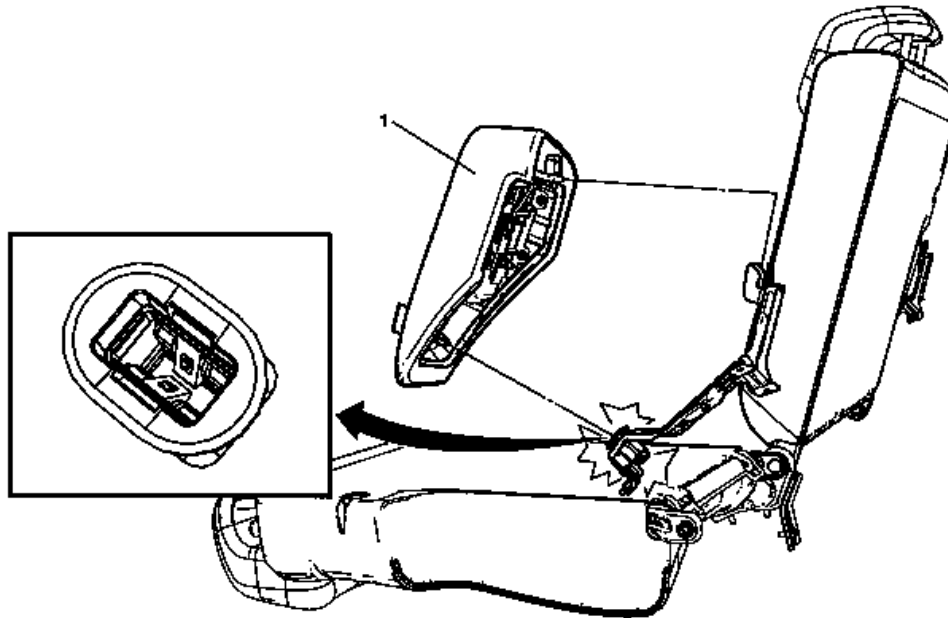


Fig. 17: Rear Seat Back Bolster
 Courtesy of GENERAL MOTORS COMPANY

Rear Seat Back Bolster Replacement

Callout	Component Name
1	Rear Seat Back Cushion Bolster WARNING: Refer to <u>SIR Warning</u> . WARNING: Do not repair or replace the seat stitching or seams in the seat back trim cover with an internal mounted seat side airbag module. Replace the complete seat back trim cover from the OEM. Non-OEM seat stitching may cause improper airbag deployment which could result in personal injury. Procedure 1. Disable the SIR system. Refer to <u>SIR Disabling and Enabling</u> . 2. Fold rear seat back cushion down. 3. Pull the lower seat back cushion bolster forward. NOTE: Use a flat-bladed screwdriver to aid in releasing the retainer from the bolster retaining bar.

4. Pull the seat back cushion bolster up.
5. Disconnect the electrical connector.
6. Remove rear seat back cushion bolster.
7. Remove the rear seat side inflatable module. Refer to **Rear Seat Outboard Seat Back Airbag Replacement** .

REAR SEAT CUSHION HINGE PIVOT REPLACEMENT

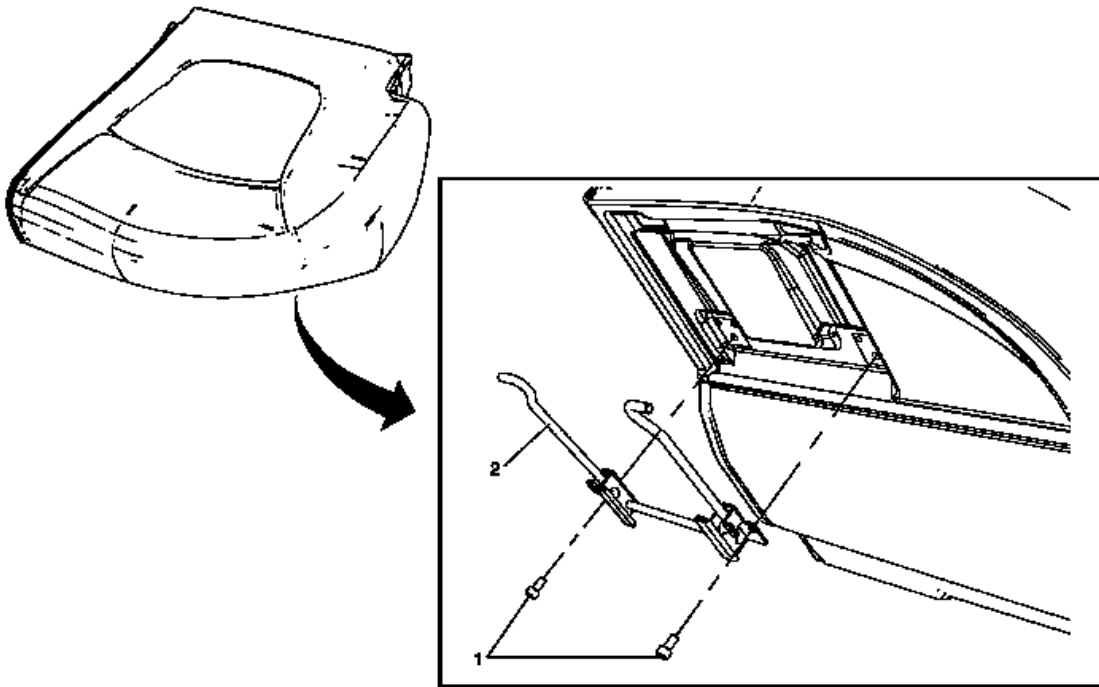


Fig. 18: NO CONTENT
Courtesy of GENERAL MOTORS COMPANY

Rear Seat Cushion Hinge Pivot Replacement

Callout	Component Name
Preliminary Procedure	
Remove the rear seat. Refer to <u>Rear Seat Cushion Removal and Installation</u> .	
1	Rear Seat Cushion Hinge Pivot Bolt (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 30.5 (22.5 lb ft)
2	Rear Seat Cushion Hinge Pivot

REAR SEAT CUSHION REMOVAL AND INSTALLATION

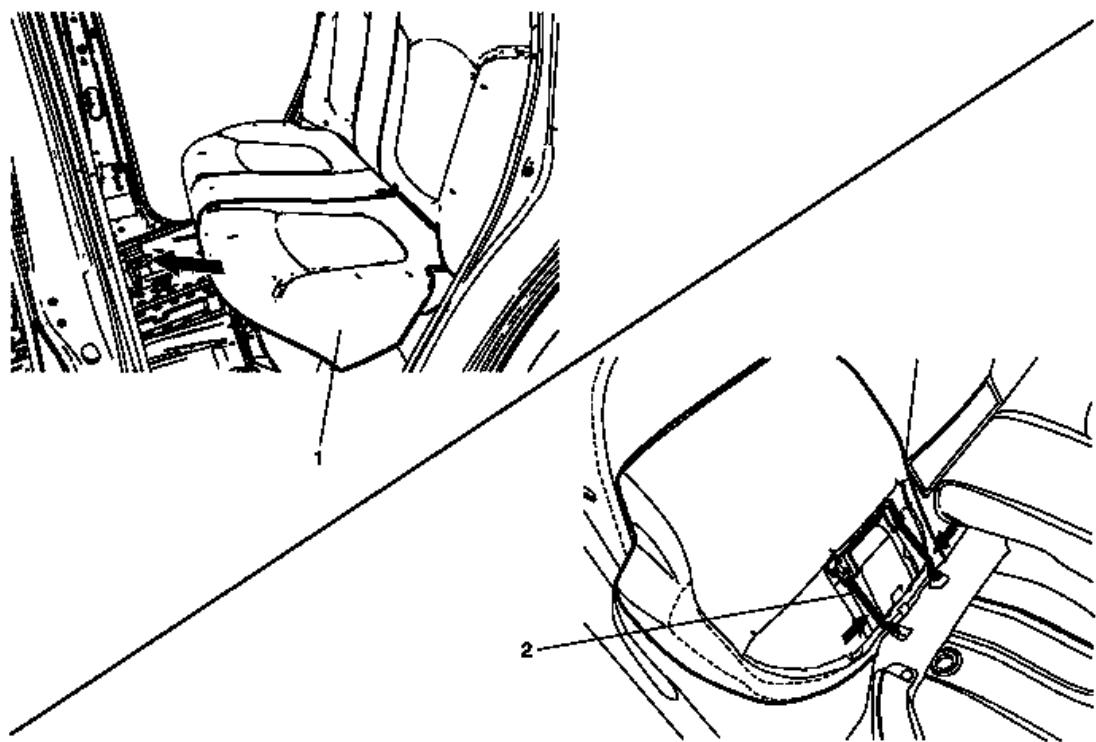


Fig. 19: Rear Seat Cushion
Courtesy of GENERAL MOTORS COMPANY

Rear Seat Cushion Removal and Installation

Callout	Component Name
1	Rear Seat Cushion Procedure Pull up on the front of the seat cushion to disengage the retainers.
2	Rear Seat Cushion Hinge Wire Procedure Reverse the rear seat cushion to disengage the rear seat cushion hinge wire.

REAR SEAT BACK CUSHION LATCH REPLACEMENT

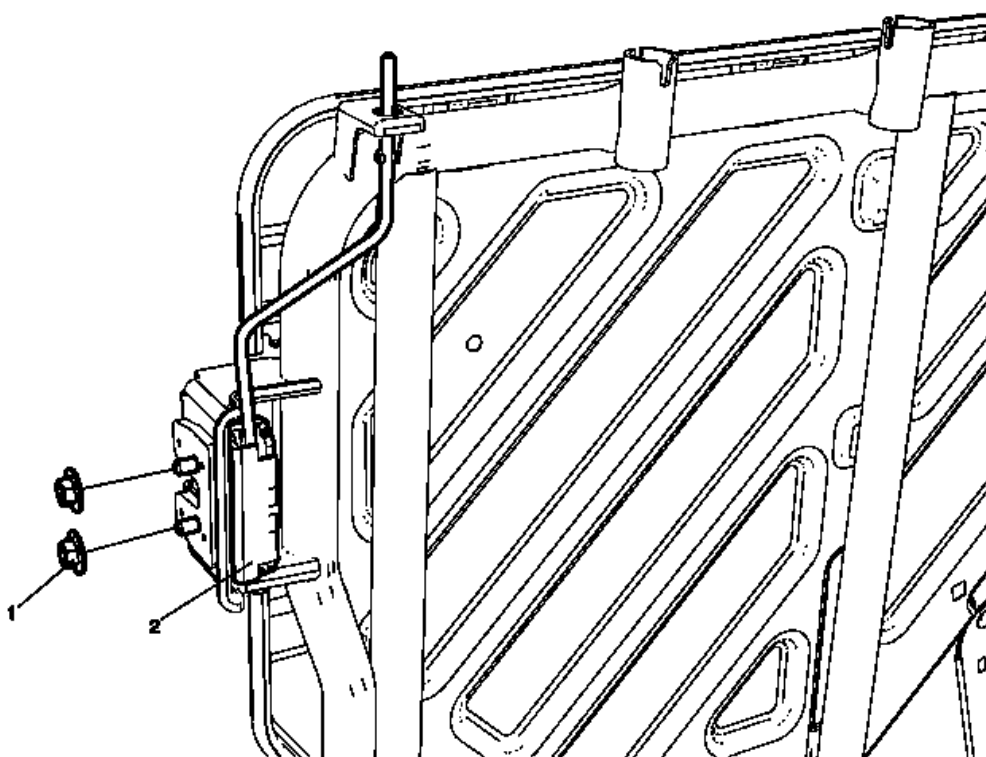


Fig. 20: Rear Seat Back Cushion Latch
 Courtesy of GENERAL MOTORS COMPANY

Rear Seat Back Cushion Latch Replacement

Callout	Component Name
Preliminary Procedure	
Remove rear seat back cushion pad. Refer to <u>Rear Seat Back Cushion Pad Replacement</u> .	
1	Rear Seat Back Cushion Latch Bolt (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 11 N.m (97 lb in)
2	Rear Seat Back Cushion Latch

REAR SEAT BACK CUSHION REMOVAL AND INSTALLATION

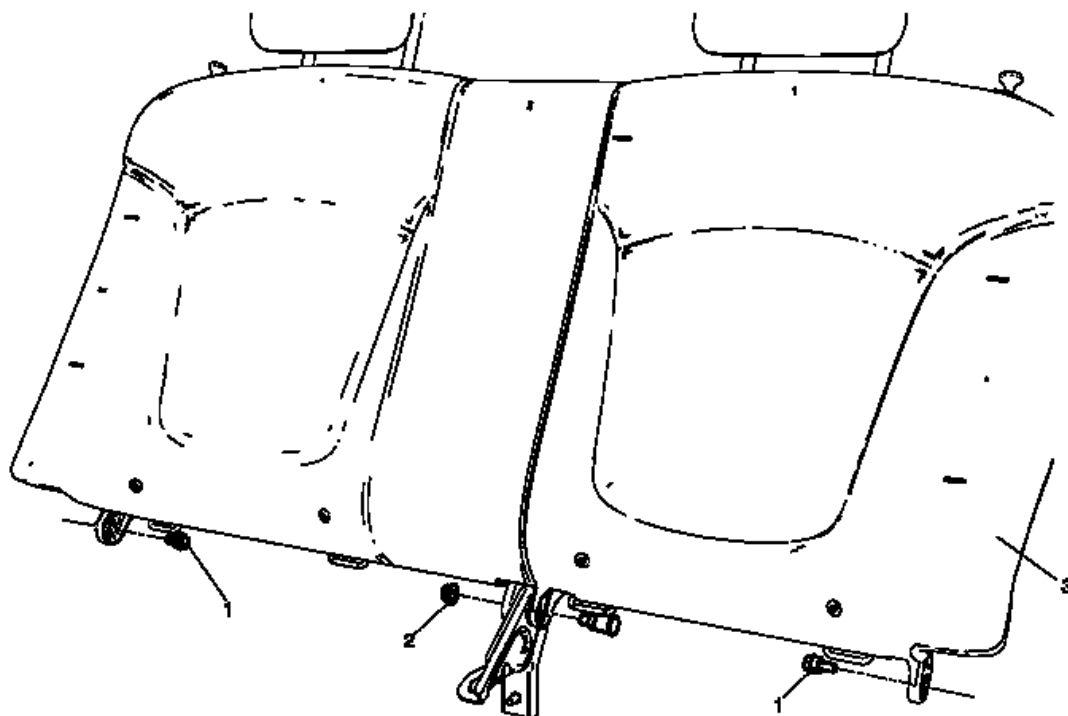


Fig. 21: Rear Seat Back Cushion

Courtesy of GENERAL MOTORS COMPANY

Rear Seat Back Cushion Removal and Installation

Callout	Component Name
Preliminary Procedure	
Remove the rear seat cushion. Refer to <u>Rear Seat Cushion Removal and Installation.</u>	
1	Rear Seat Back Cushion Bolt (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 24 N.m (18 lb ft)
2	Rear Seat Back Cushion Nut (Qty: 1) Tighten 24 N.m (18 lb ft)
3	Rear Seat Back Cushion

REAR SEAT BACK CUSHION PAD REPLACEMENT

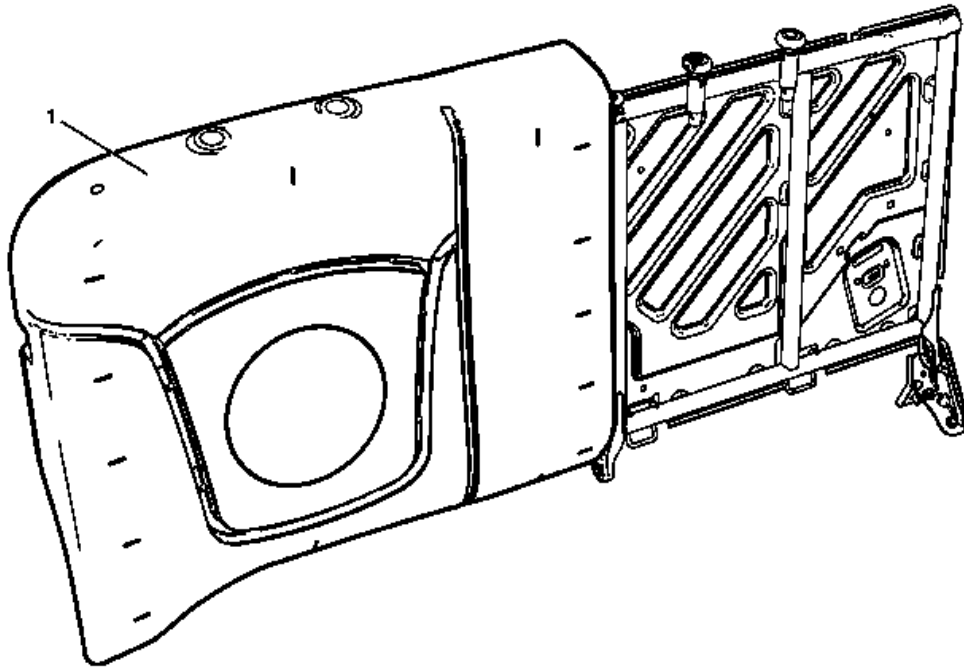


Fig. 22: Rear Seat Back Cushion

Courtesy of GENERAL MOTORS COMPANY

Rear Seat Back Cushion Pad Replacement

Callout	Component Name
Preliminary Procedure	
Remove the rear seat back cushion cover. Refer to <u>Rear Seat Back Cover Replacement</u> .	
1	Rear Seat Back Cushion Pad

REAR SEAT BACK COVER REPLACEMENT

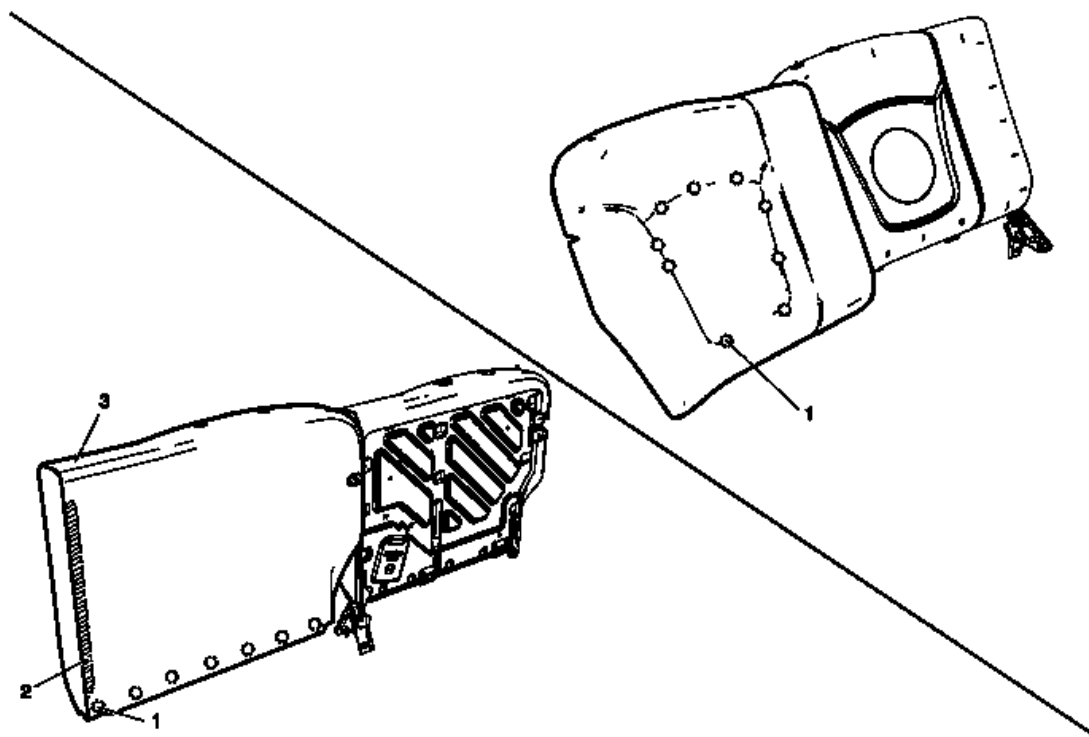


Fig. 23: Rear Seat Back Cover

Courtesy of GENERAL MOTORS COMPANY

Rear Seat Back Cover Replacement

Callout	Component Name
Preliminary Procedure	
Remove the rear seat back cushion. Refer to <u>Rear Seat Cushion Removal and Installation</u> .	
1	Rear Seat Back Cushion Cover Hog Ring (Qty: 16) TIP: Begin at the rear part of the rear seat, release the hog rings.
2	Rear Seat Back Cushion Cover Zipper TIP: Open the zipper to remove the cushion cover.
3	Rear Seat Back Cushion Cover

REAR SEAT BACK CUSHION LATCH RELEASE HANDLE REPLACEMENT

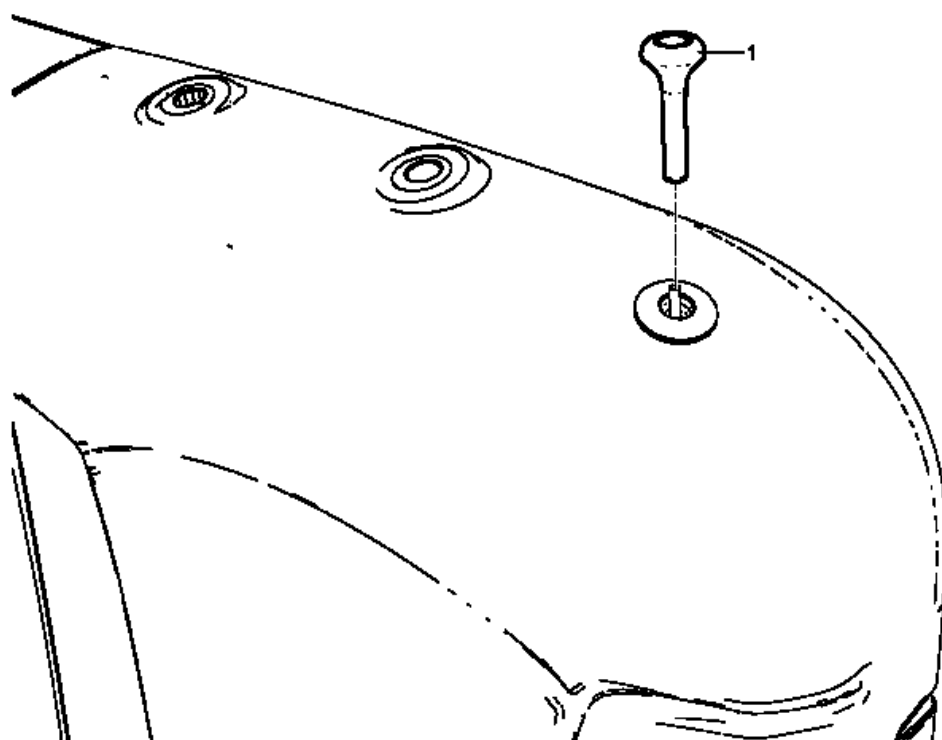


Fig. 24: Rear Seat Back Cushion Latch Release Handle

Courtesy of GENERAL MOTORS COMPANY

Rear Seat Back Cushion Latch Release Handle Replacement

Callout	Component Name
1	Rear Seat Back Cushion Latch Release Handle
	Procedure Turn the release handle clockwise for removal.

DESCRIPTION AND OPERATION

MANUAL SEATS DESCRIPTION

NOTE: Do not attempt to change the designed seat position by altering the designed seat adjuster-to-floor pan anchor provisions or the seat adjuster-to-seat frame anchor provisions. Changing the seat position could affect the performance of the seat system.

This vehicle is equipped with low-backed front seats with separate head restraints and a three-passenger folding rear seat. Split folding rear seat is optional. Seat cushions and seatbacks have formed foam pads, which fit the contours of the full-panel seatback frame assembly and the designed contour of the seat cushion frame. There are no front seat forward or rearward relocation provisions provided at either the seat adjuster-to-seat frame or the seat adjuster-to-floor pan anchor attachments.

ACCESSORIES & EQUIPMENT

Seat Heating and Cooling - Spark

SCHEMATIC WIRING DIAGRAMS

HEATED/COOLED SEAT WIRING SCHEMATICS

Heated Seats (C37)

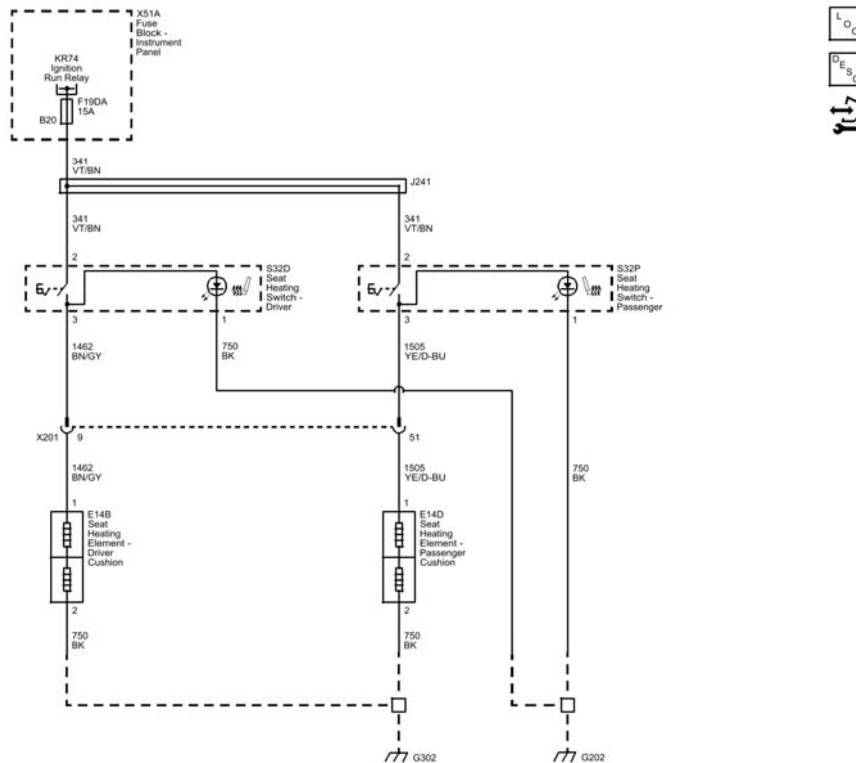


Fig. 1: Heated Seats (C37) Wiring Schematics
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

SYMPTOMS - SEAT HEATING AND COOLING

IMPORTANT: Review the system description in order to familiarize yourself with the system functions. Refer to Heated Seats Description and Operation

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the heated seat system. Refer to

Checking Aftermarket Accessories

- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to **Front Heated Seat Malfunction** in order to diagnose the symptom.

FRONT HEATED SEAT MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition Voltage	1	1	-	-
Heated Seat Element Control	1	1	3	-
Heated Seat Element Ground	-	1	-	-
Heated Seat Switch Ground	-	2	-	-
1. Heated seat is inoperative 2. Heated seat indicator is inoperative 3. Heated seat is always ON				

Circuit/System Description

With the ignition ON, ignition voltage is applied to the driver and passenger seat heating switches through a 15 A fuse located in the instrument panel fuse block. Ground for the seat heating element is supplied from the heating element ground circuit and ground connection G302. Ground is supplied to both the driver and passenger the heated seat switches through the switch ground circuit and the ground connection at G202. This ground circuit is used only for the purpose of illuminating heated seat ON indicator. When a seat heating switch is pressed, ignition voltage is applied through the switch contacts and the control circuit activating the seat heating element.

Reference Information

Schematic Reference

Heated/Cooled Seat Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Heated Seats Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Circuit/System Verification

1. Ignition ON.
2. Verify the appropriate heated seat turns ON and OFF when cycling the S32 Seat Heating Switch ON and OFF.
 - **If the heated seat does not turn ON or OFF**
3. Verify the seat heating switch indicator turns ON and OFF when cycling the S32 Seat Heating Switch ON and OFF.
 - **If the indicator does not turn ON or OFF**

Refer to Circuit/System Testing - Heated Seat Circuit Test

- **If the heated seat turns ON and OFF**

Refer to Circuit/System Testing - Heated Seat Switch Indicator Circuit Test

Circuit/System Testing

Heated Seat Circuit Test

1. Ignition OFF, disconnect the harness connector at the appropriate S32 Seat Heating Switch, ignition ON.
2. Verify a test lamp illuminates between the ignition circuit terminal 2 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
1. Ignition OFF.
2. Test for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, refer to **Power Mode Mismatch** .

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Ignition OFF.
2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance

NOTE: The fuse feeds both the driver and passenger seat heating elements. Test both the driver and passenger seat heating element control circuits.

3. Test for greater than 10 ohms between the control circuit terminal 3 and ground
 - If 10 ohms or less, disconnect the E14 Seat Cushion Heating Element and verify the short is in the circuit or the component.
 - If greater than 10 ohms, replace the S32 Seat Heating Switch.

- **If the test lamp illuminates**

3. Ignition OFF, connect the harness connector at the S32 Seat Heating Switch and disconnect the harness connector at the E14 Seat Cushion Heating Element.
4. Test for less than 10 ohms between the ground circuit terminal 2 and ground.

- **If 10 ohms or greater**

1. Ignition OFF.
2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.

- **If less than 10 ohms**

5. Install a test lamp between the control circuit terminal 1 and ground, ignition ON.
6. Verify the test lamp turns ON and OFF when commanding heated seat ON and OFF using the S32 Seat Heating Switch.

- **If the test lamp remains OFF**

1. Ignition OFF, disconnect the harness connector at the S32 Seat Heating Switch.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the S32 Seat Heating Switch.

- **If the test lamp remains ON**

1. Ignition OFF, disconnect the harness connector at the S32 Seat Heating Switch, ignition ON.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.

- If less than 1 V, test or replace the S32 Seat Heating Switch.
 - **If the test lamp turns ON and OFF**
7. Test or replace the E14 Seat Cushion Heating Element.

Heated Seat Switch Indicator Circuit Test

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the appropriate S32 Seat Heating Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 1 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Test or replace the S32 Seat Heating Switch.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Driver or Passenger Seat Back Cushion Heater Replacement**
- **Driver or Passenger Seat Cushion Heater Replacement**

REPAIR INSTRUCTIONS

DRIVER OR PASSENGER SEAT BACK CUSHION HEATER REPLACEMENT

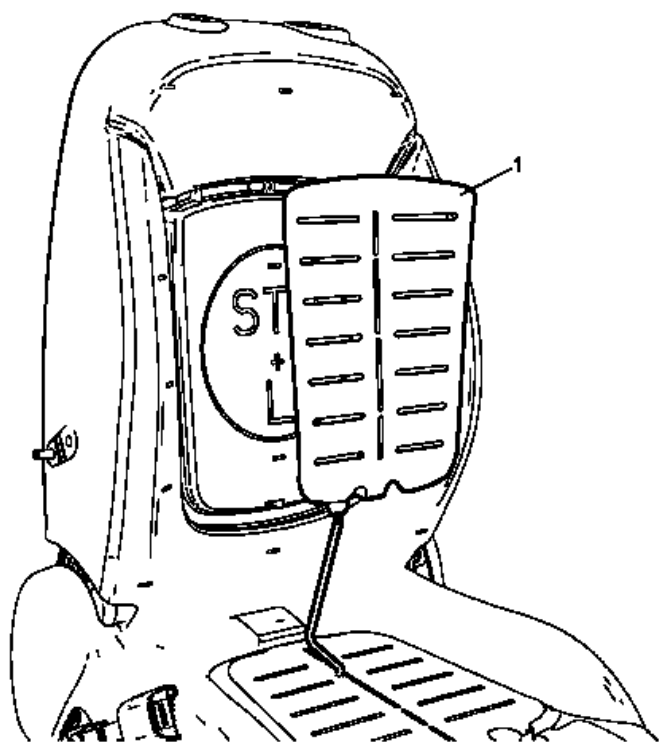


Fig. 2: Driver or Passenger Seat Back Cushion Heater Mat
 Courtesy of GENERAL MOTORS COMPANY

Driver or Passenger Seat Back Cushion Heater Replacement

Callout	Component Name
Preliminary Procedures	
1. Remove the front seat back cushion cover. Refer to <u>Driver or Passenger Seat Back Cushion Cover Replacement</u> .	
2. Disconnect the electric harness connector.	
1	Front Seat Back Cushion Heating Mat

DRIVER OR PASSENGER SEAT CUSHION HEATER REPLACEMENT

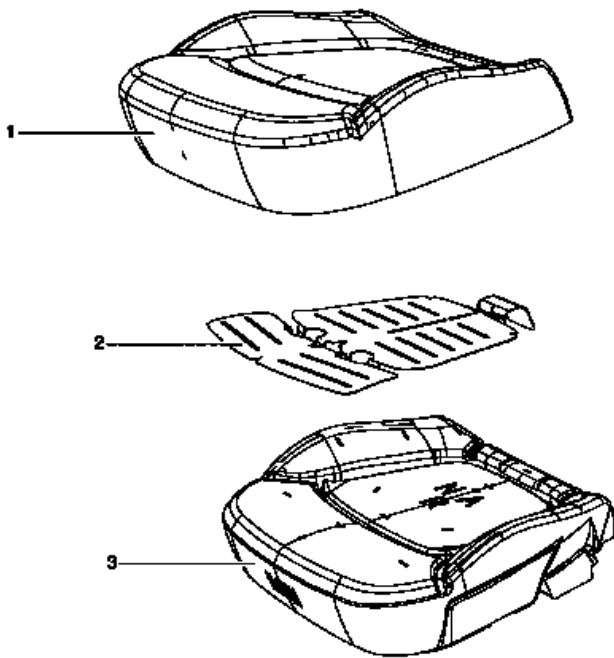


Fig. 3: Driver or Passenger Seat Cushion Heater
 Courtesy of GENERAL MOTORS COMPANY

Driver or Passenger Seat Cushion Heater Replacement

Callout	Component Name
WARNING: Refer to <u>SIR Warning</u> .	
Preliminary Procedures	
1. Remove the driver or passenger seat. Refer to <u>Driver or Passenger Seat Removal and Installation</u> . 2. Remove the front seat cushion cover and pad. Refer to <u>Front Seat Cushion Cover and Pad Replacement</u> .	
1	Front Seat Cushion Cover Procedure Separate the seat cushion from the seat cushion pad by pulling the cover away from the pad.
2	Front Seat Cushion Heater WARNING: Replace the passenger presence system as a complete assembly to prevent possible injury to the occupant. All the components in the service kit are assembled and calibrated as a unit. Using only some of the components in the service kit will cause the passenger presence system to operate improperly.
	Front Seat Cushion Pad

NOTE:

The seat belt presence sensor and heat mat, if equipped, are integral parts of the seat cushion pad.

DESCRIPTION AND OPERATION

HEATED SEATS DESCRIPTION AND OPERATION

The heated seat system consists of the following components:

- Heated seat switch
- Seat cushion heating element

Heated Seat Operation

With the ignition ON, ignition voltage is applied to the driver and passenger heated seat switches through 15 A fuse located in the instrument panel fuse block. Ground for the seat heater element is supplied from the heater element ground circuit and ground connection G302. Ground is supplied to both the driver and passenger the heated seat switches through the switch ground circuit and the ground connection at G202. This ground circuit is used only for the purpose of illuminating heated seat ON indicator. When a heated seat switch is pressed, ignition voltage is applied through the switch contacts and the control circuit activating the seat cushion heater element.

ACCESSORIES & EQUIPMENT

Secondary and Configurable Customer Controls - Spark

SCHEMATIC WIRING DIAGRAMS

STEERING WHEEL SECONDARY/CONFIGURABLE CONTROL WIRING SCHEMATICS

Steering Wheel Secondary/Configurable Control Wiring Schematics

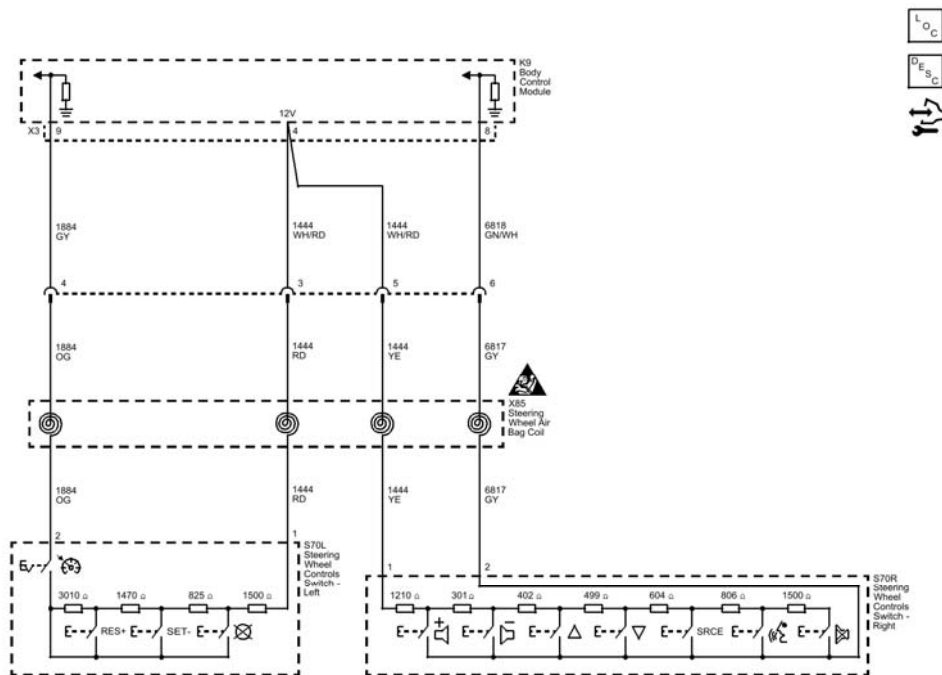


Fig. 1: Steering Wheel Secondary/Configurable Control Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC B1405	DTC B1405 03 Control Module Voltage Reference Output 2 Circuit Low Voltage DTC B1405 07 Control Module Voltage Reference Output 2 Circuit High Voltage

<u>DTC B1529</u>	DTC B1529 03 Control Module Voltage Reference Output 5 Circuit Low Voltage DTC B1529 07 Control Module Voltage Reference Output 5 Circuit High Voltage
<u>DTC B3622</u>	DTC B3622 07 Steering Wheel Controls Signal Circuit High Voltage

DTC B1405: CONTROL MODULE VOLTAGE REFERENCE 2

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B1405 03

Control Module Voltage Reference Output 2 Circuit Low Voltage

DTC B1405 07

Control Module Voltage Reference Output 2 Circuit High Voltage

Diagnostic Fault Information

Electrical DTCs

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
12 V Reference	B1529 03, B1405 03	1	B1529 07	B1529 07
Signal	1	1	B3622 07	-
1. Steering Wheel Controls Inoperative				

Circuit/System Description

The body control module (BCM) monitors the 12V reference circuit to make sure that the voltage stays within the proper range. Damage to components and/or incorrect operation can occur when the voltage is out of range.

Conditions for Running the DTC

- Battery voltage is between 9-16 V.
- The ignition is ON.

Conditions for Setting the DTC

The BCM detects voltage out of range on the 12V reference circuit.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction free ignition cycles have occurred.

Reference Information

Schematic Reference

Steering Wheel Secondary/Configurable Control Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Steering Wheel Controls Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Engine running, accessories OFF, measure and record the battery voltage at the battery terminals.
2. Verify the voltage measured at the battery terminals is between 12.6-15.0 V.
 - **If not between 12.6-15.0 V**

Refer to **Charging System Test** .

- **If between 12.6-15.0 V**

3. Refer to Circuit/System Testing.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S70R Steering Wheel

Controls Switch - Right, ignition ON.

2. Test for B+ between the 12V reference circuit terminal 1 and ground.
 - **If less than B+**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the 12V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the 12V reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If B+**
3. Test for B+ between the 12V reference circuit terminal 1 and signal circuit terminal 2.
 - **If less than B+**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms replace the K9 body control module.
 - **If B+**
4. Ignition OFF, disconnect the X3 harness connector at the K9 Body Control Module.
5. Test for infinite resistance between the S70R Steering Wheel Controls Switch - Right signal circuit terminal 2 and ground.
 - **If less than infinite resistance**

Repair the short to ground on the circuit.
 - **If infinite resistance**
6. Test or replace the S70R Steering Wheel Controls Switch - Right.

Component Testing

1. Ignition OFF, disconnect the harness connector at the S70R Steering Wheel Controls Switch - Right.
2. Test the resistance between the signal terminal 2 and the 12V reference circuit terminal 1 while pressing the appropriate steering wheel controls switch button listed below:
 - **If not the specified value**

Replace the S70R Steering Wheel Controls Switch - Right.
 - **If the specified value**

3. All OK

Function Switch	Minimum Resistance Value	Maximum Resistance Value
Hang Up-Mute	5.0 kohms	5.5 kohms
Telephone Switch	3.6 kohms	4 kohms
Arrow Down	2.2 kohms	2.6 kohms
Arrow Up	1.7 kohms	2 kohms
Volume Down	1.4 kohms	1.6 kohms
Volume Up	1.1 kohms	1.3 kohms
No Switch Pressed	Infinite	Infinite

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Body Control Module replacement, programming and setup

DTC B1529: CONTROL MODULE VOLTAGE REFERENCE OUTPUT 5

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B1529 03

Control Module Voltage Reference Output 5 Circuit Low Voltage

DTC B1529 07

Control Module Voltage Reference Output 5 Circuit High Voltage

Diagnostic Fault Information

Electrical DTCs

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
12 V Reference	B1529 03, B1405 03	1	B1529 07	B1529 07
Signal	1	1	B3622 07	-
1. Steering Wheel Controls Inoperative				

Circuit/System Description

The body control module (BCM) supplies voltage to the steering wheel control switches and monitors the return signal. Each switch state is associated to a set resistance value and when pressed, a specific voltage drop occurs across the resistor unique to the switch. The BCM identifies the switch selection and activates the feature.

Conditions for Running the DTC

- The system voltage is between 9-16 V.
- The ignition is ON.

Conditions for Setting the DTC

B1529 03

- The BCM detects a short to ground in the 12 V reference circuit.
- The above condition is present for greater than 30 seconds.

B1529 07

- The BCM detects a short to voltage in the 12 V reference circuit.
- The above condition is present for greater than 30 seconds.

Action Taken When the DTC Sets

The BCM will ignore switch inputs.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction free ignition cycles have occurred.

Reference Information

Schematic Reference

Steering Wheel Secondary/Configurable Control Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Steering Wheel Controls Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S70R Steering Wheel Controls Switch - Right, ignition ON.
2. Test for B+ between the 12V reference circuit terminal 1 and ground.
 - **If less than B+**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the 12V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the 12V reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If B+**
3. Test for B+ between the 12V reference circuit terminal 1 and signal circuit terminal 2.
 - **If less than B+**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms replace the K9 body control module.
 - **If B+**
4. Ignition OFF, disconnect the X3 harness connector at the K9 Body Control Module.
5. Test for infinite resistance between the S70R Steering Wheel Controls Switch - Right signal circuit terminal 2 and ground.
 - **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

6. Test or replace the S70R Steering Wheel Controls Switch - Right.

Component Testing

1. Ignition OFF, disconnect the harness connector at the S70R Steering Wheel Controls Switch - Right.
2. Test the resistance between the signal terminal 2 and the 12V reference circuit terminal 1 while pressing the appropriate steering wheel controls switch button listed below:

- **If not the specified value**

Replace the S70R Steering Wheel Controls Switch - Right.

- **If the specified value**

3. All OK

Function Switch	Minimum Resistance Value	Maximum Resistance Value
Hang Up-Mute	5.0 kohms	5.5 kohms
Telephone Switch	3.6 kohms	4 kohms
Arrow Down	2.2 kohms	2.6 kohms
Arrow Up	1.7 kohms	2 kohms
Volume Down	1.4 kohms	1.6 kohms
Volume Up	1.1 kohms	1.3 kohms
No Switch Pressed	Infinite	Infinite

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Body Control Module replacement, programming and setup

DTC B3622: STEERING WHEEL CONTROLS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B3622 07

Steering Wheel Controls Signal Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
12 V Reference	B1529 03, B1405 03	1	B1529 07	B1529 07
Signal	1	1	B3622 07	-
1. Steering Wheel Controls Inoperative				

Circuit/System Description

The body control module (BCM) monitors the steering wheel control signal circuit voltage. If the voltage level is too high, damage may result in the system. When a high voltage condition is detected, the BCM will ignore the switch command.

Conditions for Running the DTC

- Battery voltage is between 9-16 V.
- The ignition is ON.

Conditions for Setting the DTC

The BCM detects a short to voltage in the steering wheel control switch signal circuit.

Action Taken When the DTC Sets

The BCM will ignore switch inputs.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction free ignition cycles have occurred.

Reference Information

Schematic Reference

Steering Wheel Secondary/Configurable Control Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Steering Wheel Controls Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S70R Steering Wheel Controls Switch - Right, ignition ON.
2. Test for B+ between the 12V reference circuit terminal 1 and ground.
 - **If less than B+**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the 12V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the 12V reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If B+**
3. Test for B+ between the 12V reference circuit terminal 1 and signal circuit terminal 2.
 - **If less than B+**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms replace the K9 body control module.
 - **If B+**
4. Ignition OFF, disconnect the X3 harness connector at the K9 Body Control Module.
5. Test for infinite resistance between the S70R Steering Wheel Controls Switch - Right signal circuit terminal 2 and ground.
 - **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

6. Test or replace the S70R Steering Wheel Controls Switch - Right.

Component Testing

1. Ignition OFF, disconnect the harness connector at the S70R Steering Wheel Controls Switch - Right.
2. Test the resistance between the signal terminal 2 and the 12V reference circuit terminal 1 while pressing the appropriate steering wheel controls switch button listed below:

- **If not the specified value**

Replace the S70R Steering Wheel Controls Switch - Right.

- **If the specified value**

3. All OK

Function Switch	Minimum Resistance Value	Maximum Resistance Value
Hang Up-Mute	5.0 kohms	5.5 kohms
Telephone Switch	3.6 kohms	4 kohms
Arrow Down	2.2 kohms	2.6 kohms
Arrow Up	1.7 kohms	2 kohms
Volume Down	1.4 kohms	1.6 kohms
Volume Up	1.1 kohms	1.3 kohms
No Switch Pressed	Infinite	Infinite

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for BCM replacement, programming and setup

SYMPTOMS - SECONDARY AND CONFIGURABLE CUSTOMER CONTROLS

NOTE: **The following steps must be completed before using the symptom tables.**

1. Perform the **Diagnostic System Check - Vehicle** before using the symptom tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data link.
2. Review the system description and operation in order to familiarize yourself with the system functions. Refer to **Steering Wheel Controls Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the steering wheel controls. Refer to

Checking Aftermarket Accessories .

- Inspect the easily accessible or visible system components, for obvious damage or conditions, which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections .**

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

Refer to **Steering Wheel Controls Malfunction** in order to diagnose the symptom.

STEERING WHEEL CONTROLS MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
12 V Reference	B1529 03, B1405 03	1	B1529 07	B1529 07
Signal	1	1	B3622 07	-
1. Steering Wheel Controls Inoperative				

Circuit/System Description

The body control module (BCM) supplies voltage to the audio steering wheel control switches and monitors the return signal. Each switch state is associated to a set resistance value and when pressed a specific voltage drop occurs across the resistor unique to the switch. The BCM identifies the switch selection and activates the feature.

Reference Information

Schematic Reference

Steering Wheel Secondary/Configurable Control Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Steering Wheel Controls Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the primary controls of the associated component are functioning properly.
 - **If any of the primary controls do not function properly**

Refer to **Symptoms - Entertainment**

- **If all of the primary controls function properly**
3. Refer to Circuit/System Testing.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S70R Steering Wheel Controls Switch - Right, ignition ON.
2. Test for battery voltage between the reference voltage circuit terminal 1 and ground.
 - **If less than battery voltage**
 1. Ignition OFF, disconnect the harness connector at the K9 body control module.
 2. Test for infinite resistance between the reference voltage circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the reference voltage circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 body control module.
 - **If battery voltage**
3. Test for battery voltage between the reference voltage circuit terminal 1 and signal circuit terminal 2.

- **If less than battery voltage**

1. Ignition OFF, disconnect the harness connector at the K9 body control module.
2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms replace the K9 body control module.

- **If battery voltage**

4. Ignition OFF, disconnect the harness connector at the K9 body control module.
5. Test for infinite resistance between the signal circuit terminal 2 and ground.

- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

6. Test or replace the S70R Steering Wheel Controls Switch - Right.

Component Testing

1. Ignition OFF, disconnect the harness connector at the S70R Steering Wheel Controls Switch - Right.
2. Test the resistance between the signal terminal 2 and the reference voltage terminal 1 while pressing the appropriate steering wheel controls switch button listed below:

- **If not the specified value**

Replace the S70R Steering Wheel Controls Switch - Right.

- **If the specified value**

3. All OK

Function Switch	Minimum Resistance Value	Maximum Resistance Value
Hang Up-Mute	5.0 kohms	5.5 kohms
Telephone Switch	3.6 kohms	4 kohms
Arrow Down	2.2 kohms	2.6 kohms
Arrow Up	1.7 kohms	2 kohms
Volume Down	1.4 kohms	1.6 kohms
Volume Up	1.1 kohms	1.3 kohms
No Switch Pressed	Infinite	Infinite

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for BCM replacement, programming and setup

REPAIR INSTRUCTIONS

STEERING WHEEL CONTROL SWITCH ASSEMBLY REPLACEMENT

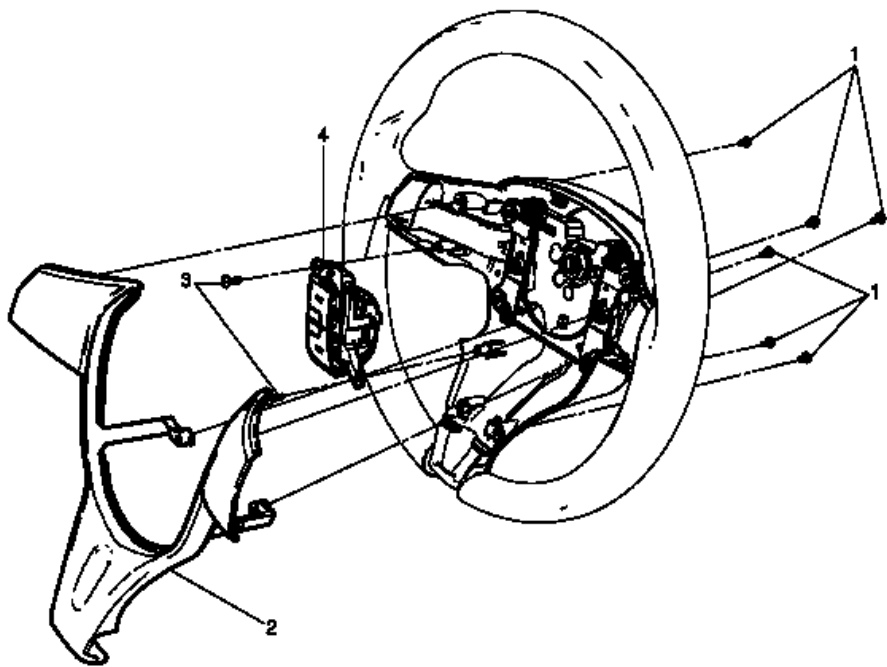


Fig. 2: Steering Wheel Control Switch Assembly
Courtesy of GENERAL MOTORS COMPANY

Steering Wheel Control Switch Assembly Replacement

Callout	Component Name
Preliminary Procedure	
Remove the driver airbag module. Refer to <u>Airbag Steering Wheel Module Replacement</u> .	
1	Steering Wheel Trim Cover Screw (Qty: 6)
2	Steering Wheel Trim Cover
3	Steering Wheel Control Switch Screw (Qty: 2)
4	Steering Wheel Control Switch Assembly
	Procedure 1. Remove the rear object alarm. 2. Disconnect the electrical connector.

DESCRIPTION AND OPERATION

STEERING WHEEL CONTROLS DESCRIPTION AND OPERATION

Steering Wheel Controls Block Diagram

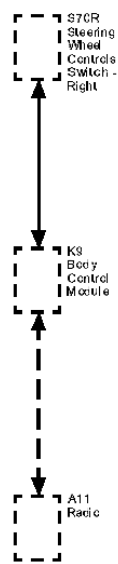


Fig. 3: Steering Wheel Controls Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
DA	Serial Data
HW	Hard-Wired
S70R	S70R Steering Wheel Controls Switch - Right
K9	K9 Body Control Module
A11	A11 Radio

The steering wheel control switches duplicate the function of the primary controls of the associated component, through a network of momentary contact switches and a series of resistors. The body control module (BCM) supplies voltage to the switches and monitors the return signal. When a switch is pressed, a specific voltage drops across the resistor unique to that switch. The BCM identifies the switch selected and sends a serial data message to the component controlled by the switch, activating the feature.

This section is intended to diagnose the circuits between the BCM and the steering wheel control switches. If the primary control for the device is inoperative, refer to the appropriate section for the component the steering wheel control switch is used for.

TRANSMISSION

Shift Lock Control - Spark

SCHEMATIC WIRING DIAGRAMS

SHIFT LOCK CONTROL WIRING SCHEMATICS

Shift Lock Wiring Schematics

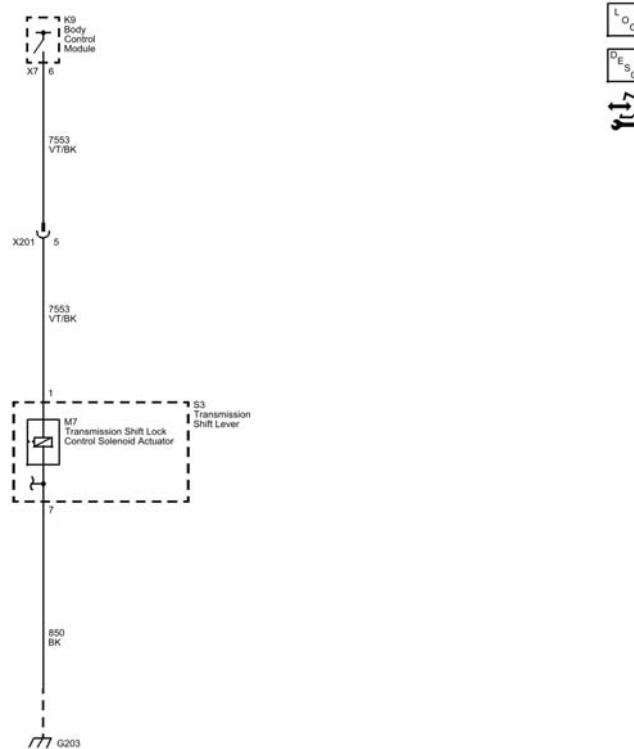


Fig. 1: Shift Lock Wiring Schematic

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC B270A</u>	DTC B270A 01 Park Lock Solenoid Actuator Control Circuit Short to Voltage DTC B270A 02 Park Lock Solenoid Actuator Control Circuit Short to Ground

DTC B270A: PARK LOCK SOLENOID ACTUATOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B270A 01

Park Lock Solenoid Actuator Control Circuit Short to Voltage

DTC B270A 02

Park Lock Solenoid Actuator Control Circuit Short to Ground

DTC B270A 04

Park Lock Solenoid Actuator Control Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	B270A 02	B270A 04	B270A 01	-
Ground	-	B270A 04	-	-

Circuit/System Description

The body control module (BCM) controls the transmission shift lock control solenoid actuator by providing a battery positive voltage to the solenoid when the brake pedal is applied. The BCM monitors the voltage and current flow of the control circuit.

Conditions for Running the DTC

- The ignition switch is in the ON position.
- The brake pedal is applied.
- The transmission is in the PARK position.
- The DTC runs continuously once the above conditions are met.

Conditions for Setting the DTC

B270A 01

The body control module detects a short to voltage in the transmission shift lock control solenoid actuator control circuit for 1 s.

B270A 02

The body control module detects a short to ground in the transmission shift lock control solenoid actuator control circuit for 1 s.

B270A 04

The body control module detects an open in the transmission shift lock control solenoid actuator control circuit for 1 s.

Action Taken When the DTC Sets

The body control module will not attempt to enable the control circuit of the transmission shift lock control solenoid actuator until the next key cycle.

Conditions for Clearing the DTC

- A current DTC B270A will clear when the malfunction is no longer present and the ignition switch is cycled.
- A history DTC will clear after 100 ignition cycles with no current DTC active during the 100 ignition cycles.

Reference Information

Schematic Reference

Shift Lock Control Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic Transmission Shift Lock Control Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Brake Transmission Shift Interlock Solenoid Actuator Command parameter changes from Inactive to Active when the brake pedal is applied.

- **If the parameter does not change**

Refer to **Stop Lamps Malfunction**

- **If the parameter changes**

3. Verify the S3 Transmission Shift Lever moves out of the PARK position when the brake pedal is applied.

- **If the S3 Transmission Shift Lever does not move out of the PARK position**

Refer to Circuit/System Testing.

- **If the S3 Transmission Shift Lever does move out of the PARK position**

All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S3 Transmission Shift Lever. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 7 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Ignition ON, connect a test lamp between the control circuit terminal 1 and the ground circuit terminal 7.
4. Verify the test lamp turns ON and OFF when commanding the Brake Transmission Shift Interlock Solenoid Actuator ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.
- If less than 2 ohms
- 4. Ignition ON.
- 5. Verify a test lamp illuminates between each B+ and ignition circuit terminal at the control module harness connector.
 - If the test lamp does not illuminate, repair the circuit or fuse as necessary.
 - If the test lamp illuminates at each B+ and ignition circuit, replace the K9 Body Control Module.
 - **If the test lamp is always ON**
- 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module, ignition ON.
- 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
- 5. Test or replace the S3 Transmission Shift Lever.

Component Testing

Dynamic Test

1. Install a 10 A fused jumper wire between the control terminal 1 and 12 V. Momentarily install a jumper wire between the ground terminal 7 and ground.
2. Verify the M7 Transmission Shift Lock Control Solenoid Actuator turns on & off/clicks, etc.
 - **If the M7 Transmission Shift Lock Control Solenoid Actuator does not turn on & off/clicks, etc.**

Replace the S3 transmission shift lever.

 - **If the M7 Transmission Shift Lock Control Solenoid Actuator does turn on & off/clicks, etc.**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Transmission Control Replacement**
- **Control Module References** for BCM replacement, programming, and setup

SYMPTOMS - AUTOMATIC TRANSMISSION SHIFT LOCK CONTROL

NOTE: The following steps must be completed before using the symptom tables.

1. Perform the **Diagnostic System Check - Vehicle** before using the Symptom Tables in order to verify that

all of the following are true:

- There are no DTCs set.
- The control modules can communicate via the serial data link.

2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Automatic Transmission Shift Lock Control Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the automatic transmission shift lock control. Refer to **Checking Aftermarket Accessories**.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections**.

Symptom List

Refer to a symptom diagnostic procedure in order to diagnose the symptom:

Transmission Control Lever Malfunction

TRANSMISSION CONTROL LEVER MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	B270A 02	B270A 04	B270A 01	-
Ground	-	B270A 04	-	-

Circuit/System Description

The body control module (BCM) controls the transmission shift lock control solenoid actuator by providing a battery positive voltage to the solenoid when the brake pedal is applied. The BCM monitors the voltage and current flow of the control circuit.

Reference Information

Schematic Reference

Shift Lock Control Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic Transmission Shift Lock Control Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Brake Transmission Shift Interlock Solenoid Actuator Command parameter changes from Inactive to Active when the brake pedal is applied.
 - **If the parameter does not change**

Refer to **Stop Lamps Malfunction**

- **If the parameter changes**
3. Verify the S3 Transmission Shift Lever moves out of the PARK position when the brake pedal is applied.
 - **If the S3 Transmission Shift Lever does not move out of the PARK position**

Refer to Circuit/System Testing.

- **If the S3 Transmission Shift Lever does move out of the PARK position**

All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S3 Transmission Shift Lever. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 ohms between the ground circuit terminal 7 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Ignition ON, connect a test lamp between the control circuit terminal 1 and the ground circuit terminal 7.
4. Verify the test lamp turns ON and OFF when commanding the Brake Transmission Shift Interlock Solenoid Actuator ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms
 4. Ignition ON.
 5. Verify a test lamp illuminates between each B+ and ignition circuit terminal at the control module harness connector.
 - If the test lamp does not illuminate, repair the circuit or fuse as necessary.
 - If the test lamp illuminates at each B+ and ignition circuit, replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
5. Test or replace the S3 Transmission Shift Lever.

Component Testing

Dynamic Test

1. Install a 10 A fused jumper wire between the control terminal 1 and 12 V. Momentarily install a jumper wire between the ground terminal 7 and ground.
2. Verify the M7 Transmission Shift Lock Control Solenoid Actuator turns on & off/clicks, etc.
 - **If the M7 Transmission Shift Lock Control Solenoid Actuator does not turn on & off/clicks,**

etc.

Replace the S3 Transmission Shift Lever.

- **If the M7 Transmission Shift Lock Control Solenoid Actuator does turn on & off/clicks, etc.**

3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Transmission Control Replacement**
- **Control Module References** for BCM replacement, programming, and setup

DESCRIPTION AND OPERATION

AUTOMATIC TRANSMISSION SHIFT LOCK CONTROL DESCRIPTION AND OPERATION

The automatic transmission park lock control system is a safety device that prevents an inadvertent shift out of PARK. The driver must press the brake pedal before moving the park lever out of the PARK position. The system consists of the following components:

- The automatic transmission shift lock control solenoid, is located within the automatic transmission shift lever.
- The body control module, which controls the voltage supply circuit of the park lock control solenoid.
- The engine control module.

The body control module controls the voltage to the automatic transmission shift lock control solenoid. The following conditions must be met before the body control module will supply voltage to the automatic transmission shift lock control solenoid.

- The ignition is in the ON position.
- The engine control module sends an input via serial data to the body control module indicating the transmission is in the PARK position.
- The body control module determines the brake pedal is applied according the brake pedal position.

Since the automatic transmission shift lock control solenoid is permanently grounded, the body control module supplies voltage to the automatic transmission shift lock control solenoid, unlocking the park lever allowing the driver to move the park lever out of the PARK position as the solenoid energizes. When the brake pedal is not applied, the body control module turns the control voltage output of the park lock control solenoid OFF, de-energizing the park lock control solenoid. The de-energized solenoid mechanically locks the park lever in the PARK position.

ACCESSORIES & EQUIPMENT

Squeaks and Rattles - Spark

DIAGNOSTIC INFORMATION AND PROCEDURES

SQUEAKS AND RATTLES

NOTE: Squeaks and rattles are caused by improperly controlled relative motion between vehicle components. There are 4 ways to prevent squeaks and rattles.

- Attach the component that squeaks or rattles securely.
- Separate the components that squeak or rattle to prevent contact.
- Insulate the components that squeak or rattle.
- Insulate low uniform friction surfaces to eliminate stickslip motion.

SYMPTOMS - SQUEAKS AND RATTLES

Rattle Coming From the Side Rail

Checks	Action
Check the brake lines.	• Tap lightly on the brake lines and listen for a rattle. • Install plastic tie straps to secure the brake lines tightly together.

Rattle Under Vehicle at Higher RPM

Checks	Action
Check for heat shield contact with the underbody.	• Raise the vehicle and perform a visual inspection. • Bend the heat shield slightly to gain clearance from the underbody.

Thump From Rear of Vehicle on Bumps

Checks	Action
Check for a properly secured spare tire or tire repair kit in the rear compartment.	• Open the rear compartment and perform a visual inspection of the spare tire or the tire repair kit and the tools. • Tightly secure the spare tire or the tire repair kit and all tools. • Perform a road test to verify that the noise is eliminated.

Glass Knock Coming From the Rear of the Vehicle When Driving Over Bumps

Checks	Action
Check for an out-of-adjustment hatchback latch.	• Test drive the vehicle in order to verify this condition. • Loosen the latch nuts and adjust the latch downward.

Rattle Coming From Door

Checks	Action
Check for rattling electrical connectors inside the door trim panel.	• Tap on the trim panel and listen for a rattle. • Remove the trim panel and wrap foam padding around the connectors as required.

Squeak When Operating Doors

Checks	Action
Check for a lack of lubrication of the door hinge pins.	• Operate the doors and listen for squeaks. • Lubricate the door hinge pins with light oil and coat with lithium grease.

Squeak Coming From Console When Shifting Manual Transmission Condition Occurs In Cold Weather with a Cold Engine

Checks	Action
Check the manual transaxle control lever lower boot.	• Move the control lever between gears and listen for squeaks. • Remove the floor console and replace the lower shift boot or apply talcum powder to the lower shift boot.

Buzz From the Left Side of Instrument Panel

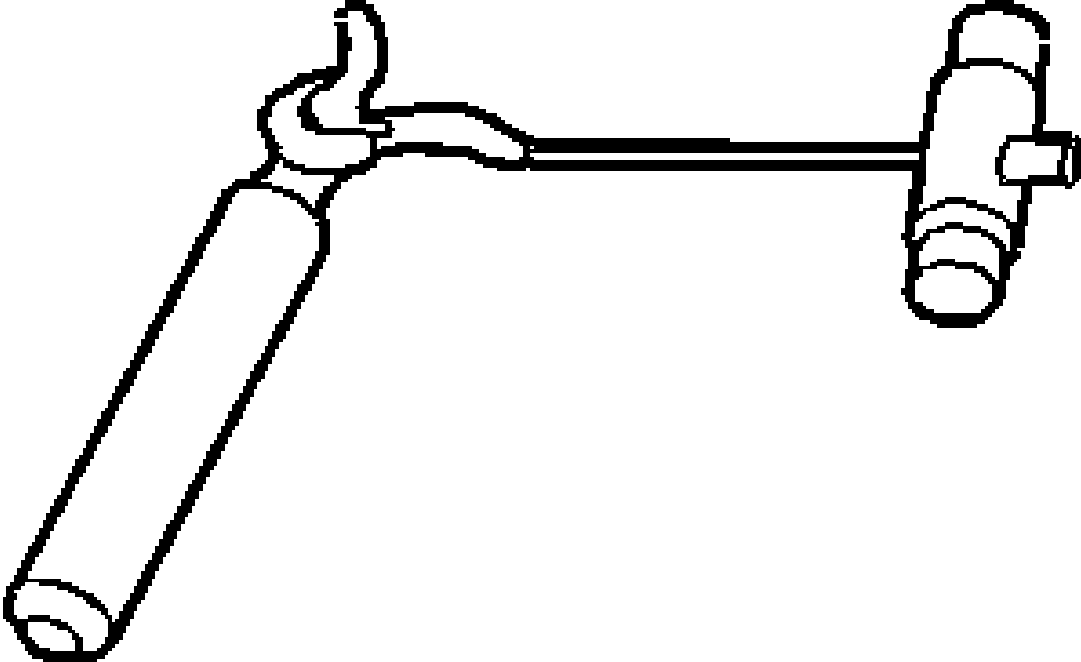
Checks	Action
Check for vibration of the fuse box cover against the instrument panel side trim.	• Tap on the cover with a finger and listen for a buzz. • Apply felt pads to the side trim where the cover makes contact.

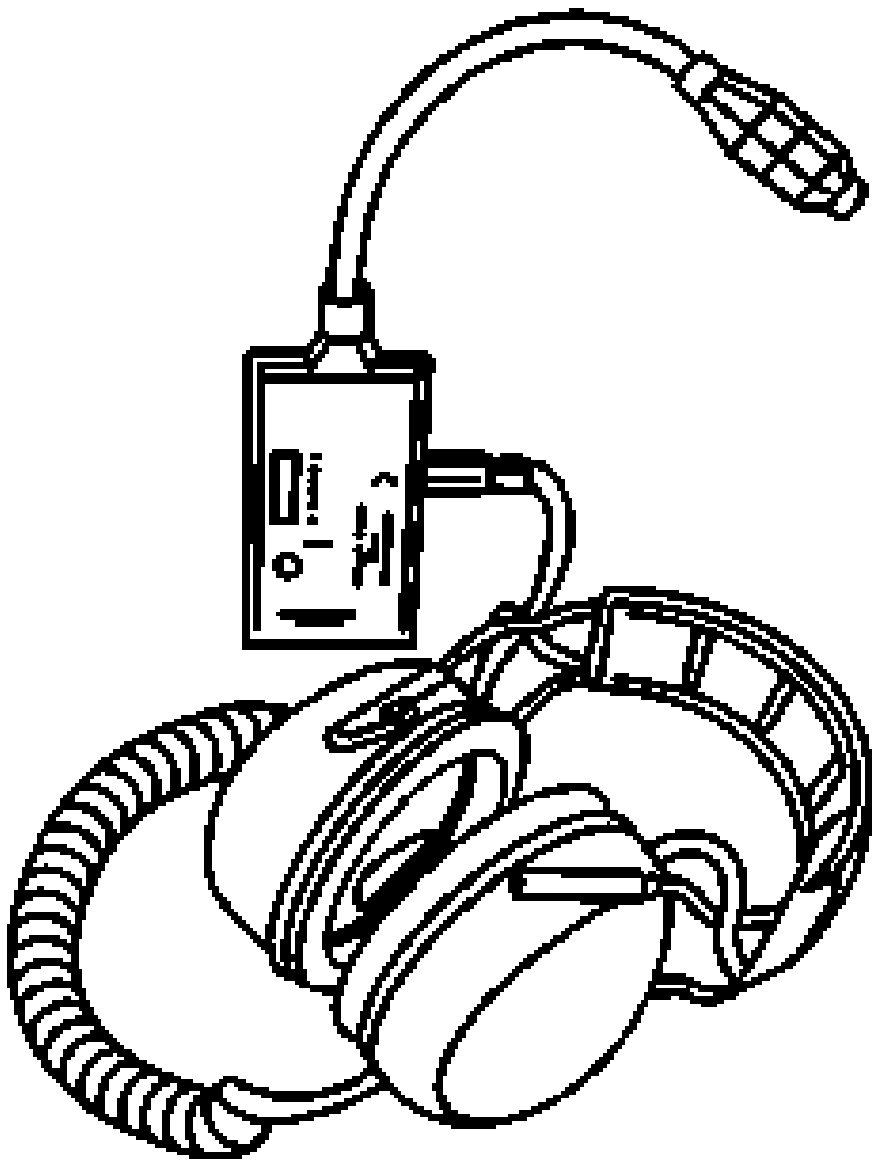
Squeak Coming From Instrument Cluster Trim Plate

Checks	Action
Check for rubbing the cluster trim plate on the instrument panel.	• Test drive the vehicle in order to verify this condition. • Remove the instrument cluster trim plate and install felt tape to the edges.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description
	CH-39570 J-39570 Chassis Ear



GE-41416
J-41416
Ultrasonic
Leak
Detector

ACCESSORIES & EQUIPMENT

Steering Wheel and Column - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Intermediate Steering Shaft Lower Bolt	25	18 lb ft
Intermediate Steering Shaft Upper Bolt	23	17 lb ft
Steering Column Bolt	25	18 lb ft
Steering Column Nut	25	18 lb ft
Steering Wheel Nut	38	28 lb ft
Turn Signal Switch Bracket Screw	3.4	30 lb in

DIAGNOSTIC INFORMATION AND PROCEDURES

SYMPTOMS - STEERING WHEEL AND COLUMN

NOTE: Review the system operation in order to familiarize yourself with the system functions.

Refer to Steering Wheel and Column Description and Operation.

Symptoms List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- High Effort While Tilting Column.
- Lock System Does Not Unlock.
- Lock System Does Not Lock
- Noise in Steering Column.
- Lock System Does Not Lock.

LOCK SYSTEM DOES NOT UNLOCK

Lock System Does Not Unlock

Condition	Action
Check the ignition lock cylinder for damage.	Replace the ignition lock cylinder. Refer to <u>Ignition Lock Cylinder Replacement (Type B)</u> , <u>Ignition Lock Cylinder Replacement (Type A)</u> .

Check the steering column housing for binding or damage.	Remove the steering shaft and clear the steering column housing. Replace the steering column housing as needed.
--	---

HIGH EFFORT WHILE TILTING COLUMN

High Effort While Tilting Column

Condition	Action
The pivot bolt is damaged or misaligned.	If necessary, replace the steering column. Refer to <u>Steering Column Replacement (Electric Power Steering)</u> .

LOCK SYSTEM DOES NOT LOCK

Lock System Does Not Lock

Condition	Action
With the steering wheel in the straight-ahead position, remove the key and rotate the steering wheel 120 degrees to the right.	If the steering column does not lock after 120 degree rotation, remove the trim panels around the ignition lock cylinder and lower the steering column. Refer to <u>Ignition Lock Cylinder Replacement (Type B)</u> , <u>Ignition Lock Cylinder Replacement (Type A)</u> .
Check the lock cylinder for damage.	Replace the ignition lock cylinder. Refer to <u>Ignition Lock Cylinder Replacement (Type B)</u> , <u>Ignition Lock Cylinder Replacement (Type A)</u> .
Check the steering column housing for binding or damage.	Remove the steering shaft and clear the steering column housing. Replace the steering column housing as needed.

NOISE IN STEERING COLUMN

Noise in Steering Column

Step	Action	Yes	No
1	Did you review the Steering Wheel and Column Description and perform the necessary inspections?	Go to Step 2	Go to <u>Steering Column Replacement (Electric Power Steering)</u>
2	Verify that noise is present in the steering column during operation. Is noise present in the steering column during operation?	Go to Step 3	System OK
3	Inspect the steering column mounting features for the following conditions: Steering column mounting fasteners for looseness		

	Steering column mounting features are sheared		
	Are the steering column mounting features loose?	Go to Step 9	Go to Step 4
4	Inspect the SIR/SRS coil for noise. Is the SIR/SRS coil noisy?	Go to Step 10	Go to Step 5
5	Inspect the lock plate retaining ring for correct installation. Is the lock plate retaining ring installed incorrectly?	Go to Step 11	Go to Step 6
6	Inspect the steering column upper and lower bearings for the following conditions: - Damage - Lubrication - Wear - Proper seating		
	Are the bearings in need of repair or replacement?	Go to Step 12	Go to Step 7
7	Does the tilt joint need to be lubricated?	Go to Step 13	Go to Step 8
8	NOTE: This is best evaluated while driving the vehicle, turning the steering and applying the brake pedal. Inspect the intermediate steering shaft for noise. Is the intermediate steering shaft noisy?		
		Go to Step 14	Go to Step 15
9	NOTE: If the steering column mounting is damaged or sheared, the steering column will need to be replaced. Refer to <u>Steering Column Replacement (Electric Power Steering)</u>. Tighten the steering column mounting fastener to specifications. Refer to <u>Fastener Tightening Specifications</u> . Did you complete the repair?	Go to Step 15	-
10	Replace the SIR/SRS coil. Refer to <u>Steering Wheel Airbag Coil Replacement</u> . Did you complete the repair?	Go to Step 15	-
11	Install the lock plate retaining ring correctly. Did you complete the repair?	Go to Step 15	-
12	NOTE: If the steering column upper and/or lower bearings are not serviceable, the steering column will need to be replaced. Refer to <u>Steering Column Replacement (Electric Power Steering)</u>.		-

	Replace the upper and/or lower bearing, if serviceable. Did you complete the repair?	Go to Step 15	
13	Lubricate the tilt joint. Did you complete the repair?	Go to Step 15	-
14	Replace the appropriate intermediate steering shaft component. Refer to <u>Intermediate Steering Shaft Replacement</u> . Did you complete the repair?	Go to Step 15	-
15	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

LOOSENESS IN STEERING COLUMN

Looseness in Steering Column

Step	Action	Yes	No
1	Did you review the Steering Wheel and Column Description and perform the necessary inspections?	Go to Step 2	Go to <u>Steering Column Replacement (Electric Power Steering)</u>
2	Verify that the steering column is loose. Is the steering column loose?	Go to Step 3	System OK
3	Inspect the steering column mounting features for the following conditions. - Steering column mounting fasteners for looseness - Steering column mounting features are sheared Are the steering column mounting features loose?	Go to Step 5	Go to Step 4
4	Inspect the upper and/or lower bearings for looseness. Are any of the bearings worn or loose?	Go to Step 6	Go to Step 7
5	NOTE: If the steering column mounting is damaged or sheared, the steering column will need to be replaced. Refer to <u>Steering Column Replacement (Electric Power Steering)</u>. Tighten the steering column mounting fastener to specifications. Refer to <u>Fastener Tightening Specifications</u> . Did you complete the repair?	Go to Step 7	-
	NOTE: If the steering column mounting is damaged or sheared, the steering column will need to be		

6	replaced. Refer to <u>Steering Column Replacement (Electric Power Steering)</u> . Replace the upper and/or lower bearings, if serviceable. Did you complete the repair	Go to Step 7	-
7	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

REPAIR INSTRUCTIONS

INTERMEDIATE STEERING SHAFT UPPER SEAL REPLACEMENT

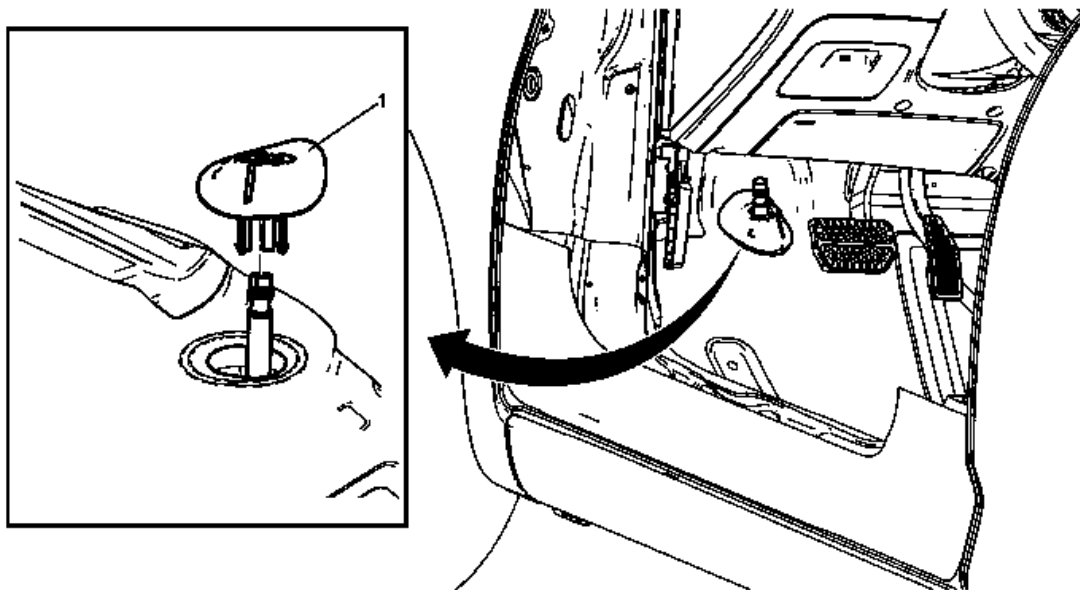


Fig. 1: Intermediate Steering Shaft Upper Seal
Courtesy of GENERAL MOTORS COMPANY

Intermediate Steering Shaft Upper Seal Replacement

Callout	Component Name
Preliminary Procedure Disconnect the intermediate steering shaft from the steering gear. Refer to <u>Intermediate Steering Shaft Replacement</u> .	
	Intermediate Steering Shaft Upper Seal
	Procedure 1. When removing the intermediate steering shaft upper seal, lift up the lip on the upper seal to access and release the retaining tabs securing the upper seal to the lower seal.

1	2. After installing the intermediate steering shaft upper seal, lift up the lip on the upper seal to access and ensure the retaining tabs securing the upper seal to the lower seal are fully engaged. NOTE: Note the orientation of the alignment marking on the seal to help aid in installation.
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INTERMEDIATE STEERING SHAFT LOWER SEAL REPLACEMENT

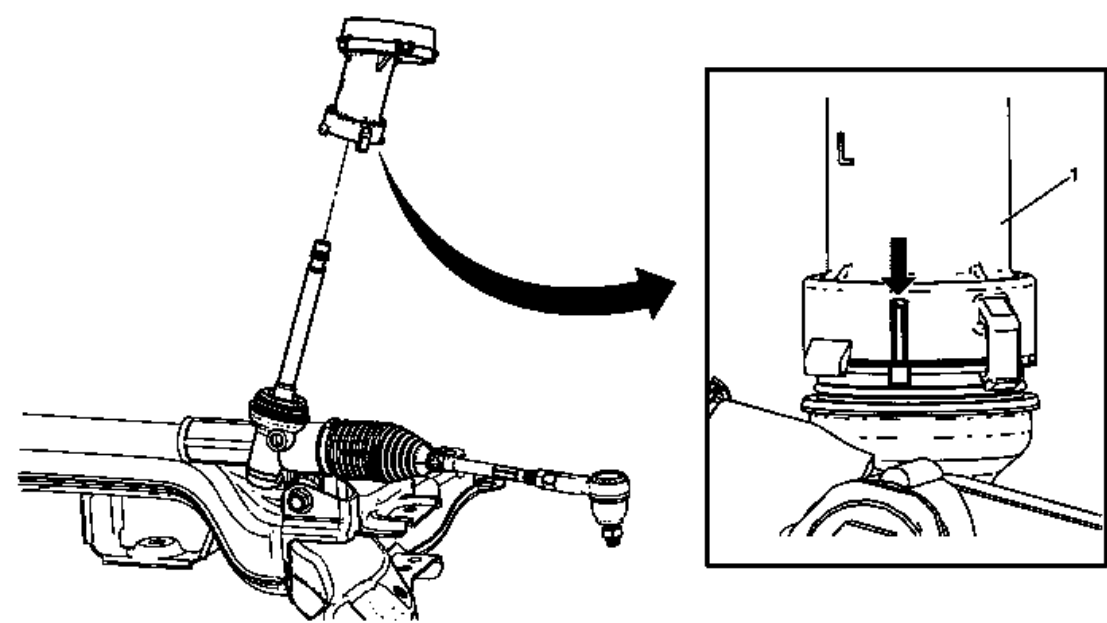


Fig. 2: Intermediate Steering Shaft Lower Seal
Courtesy of GENERAL MOTORS COMPANY

Intermediate Steering Shaft Lower Seal Replacement

Callout	Component Name
Preliminary Procedure	
1. Remove the intermediate steering shaft upper seal. Refer to <u>Intermediate Steering Shaft Upper Seal Replacement</u>. 2. Lower the front suspension frame and steering gear to get an access to remove the intermediate steering shaft lower seal. Refer to <u>Steering Gear Replacement (Electric Power Steering)</u> .	
1	Intermediate Steering Shaft Lower Seal Procedure When installing the intermediate steering shaft lower seal, align the nose of the intermediate steering shaft lower seal to the groove on the power steering gear.

INTERMEDIATE STEERING SHAFT REPLACEMENT

Removal Procedure

1. Turn the steering wheel to the straight forward position and support it from movement.

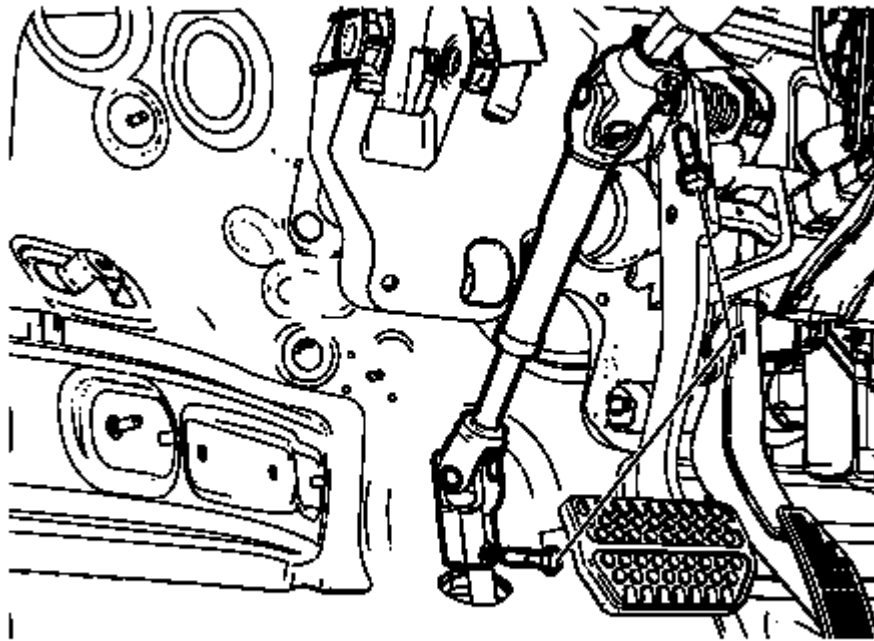


Fig. 3: Intermediate Steering Shaft Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Remove the 2 intermediate steering shaft bolts (1).

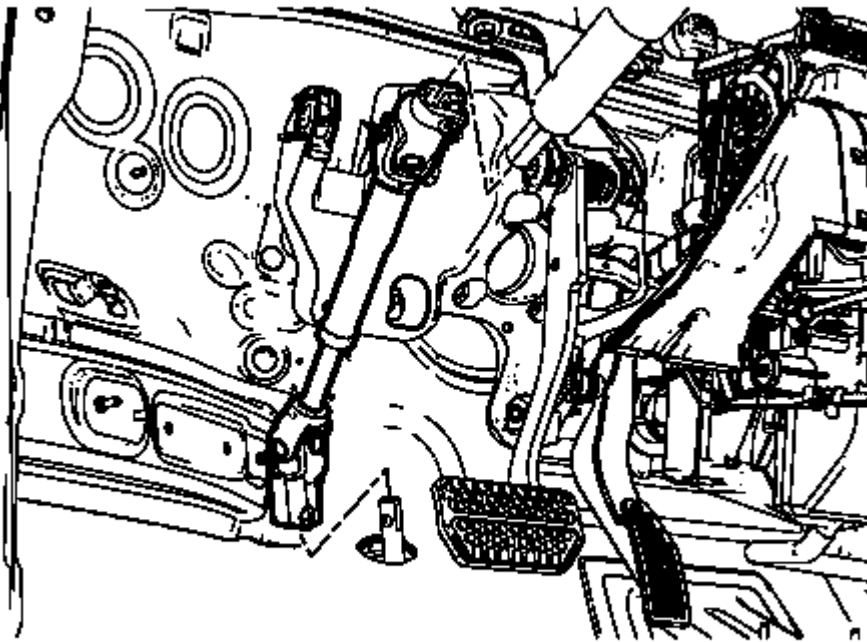


Fig. 4: Intermediate Steering Shaft
Courtesy of GENERAL MOTORS COMPANY

3. Remove the intermediate steering shaft.

Installation Procedure

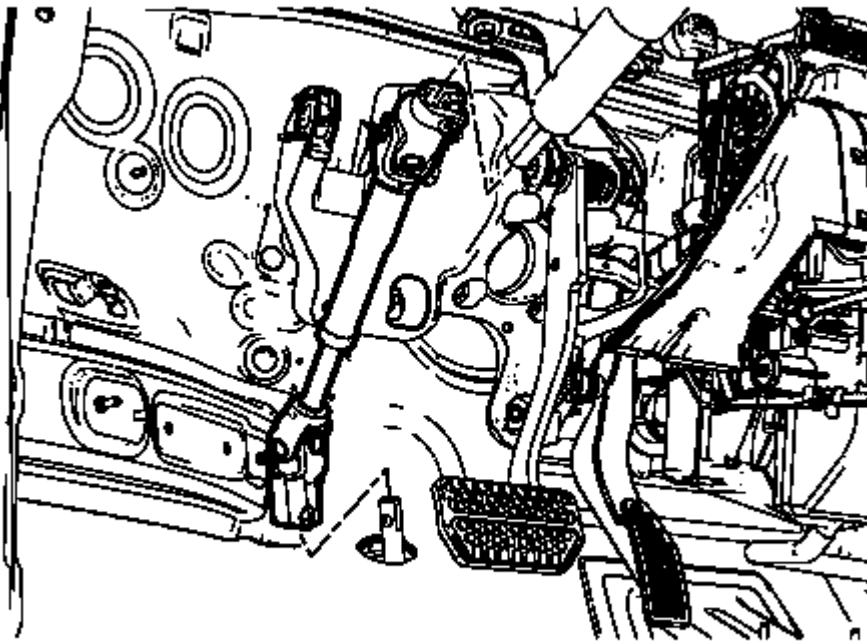


Fig. 5: Intermediate Steering Shaft
Courtesy of GENERAL MOTORS COMPANY

1. Install the intermediate steering shaft.

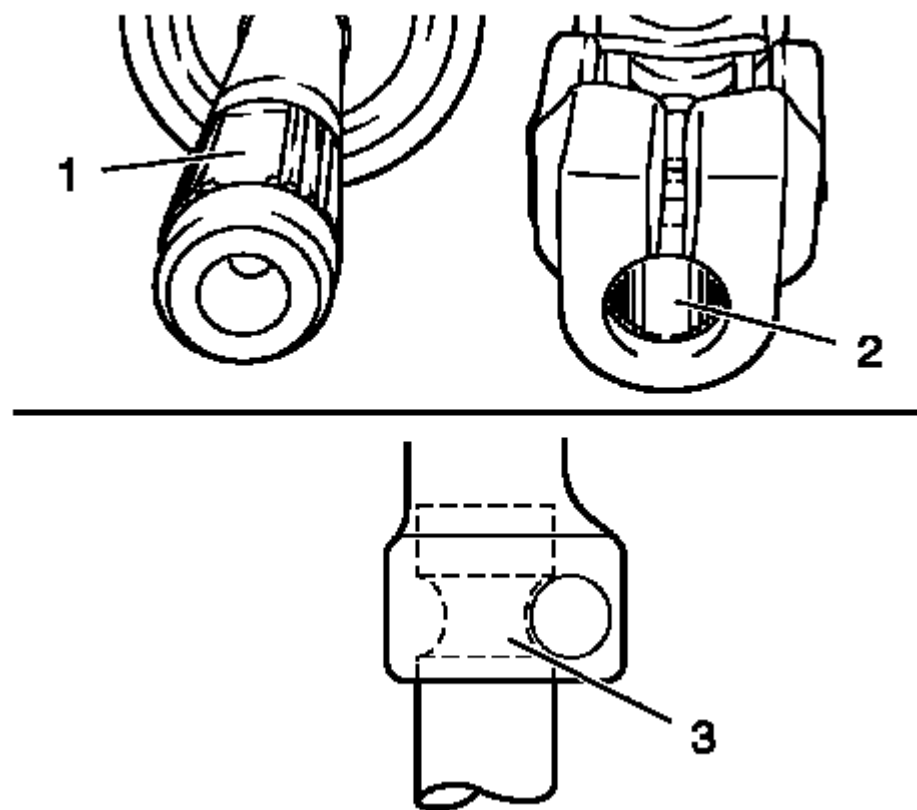


Fig. 6: Universal Joint And Steering Pinion Attachment Points
Courtesy of GENERAL MOTORS COMPANY

NOTE: The recess (2) of the fine toothing in the universal joint have to align precisely with the recess (1) of the fine toothing on the steering pinion. The bore in the universal joint have to align with the groove on the steering pinion (3).

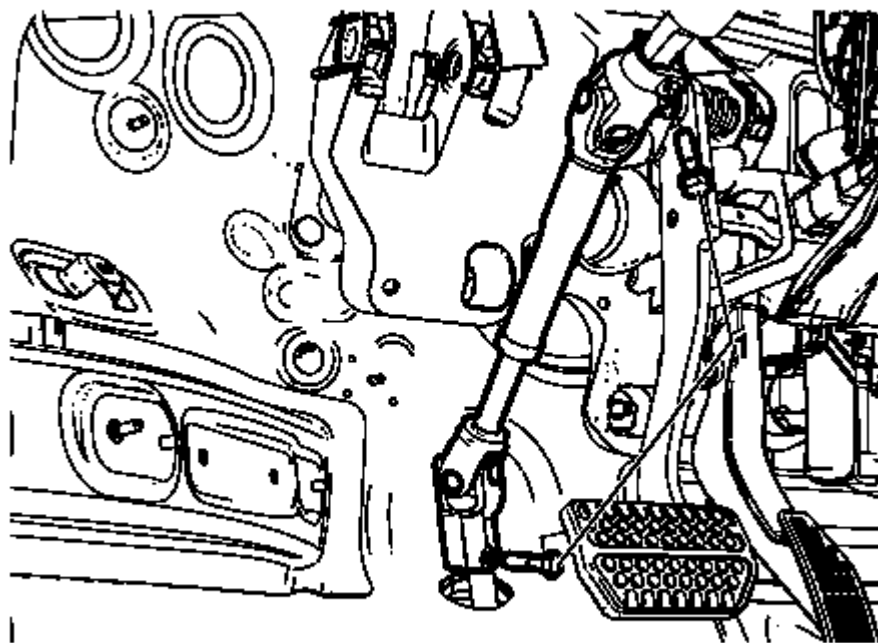


Fig. 7: Intermediate Steering Shaft Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

2. Install the 2 intermediate steering shaft bolts (1) and tighten the intermediate steering shaft bolts to 25 N.m (18 lb ft).

STEERING COLUMN UPPER TRIM COVER REPLACEMENT

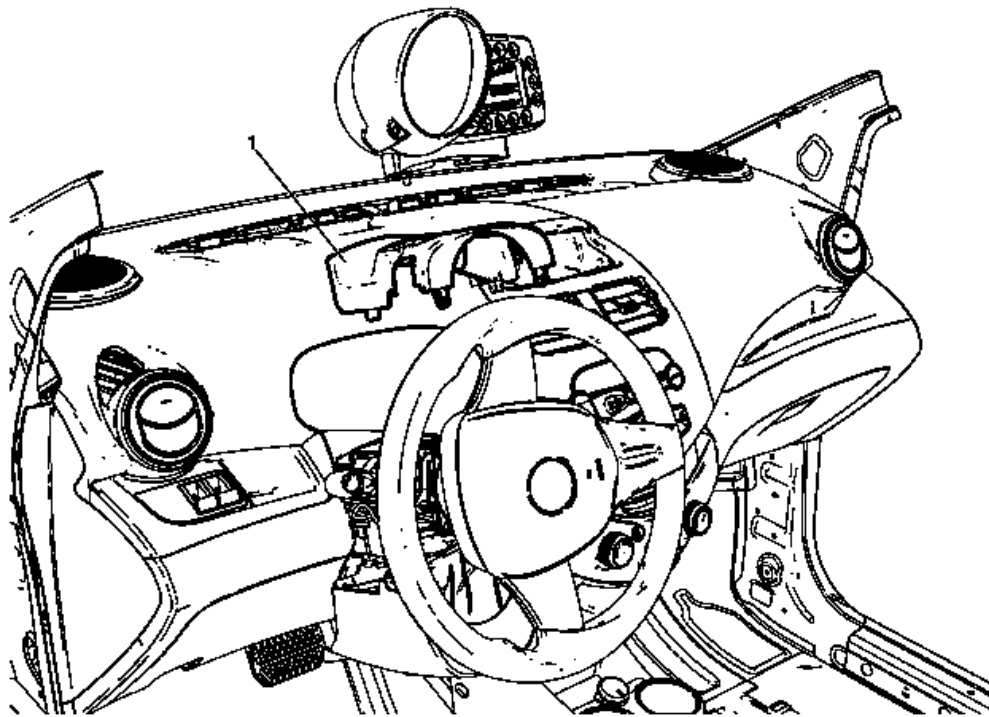


Fig. 8: Steering Column Upper Trim Cover
 Courtesy of GENERAL MOTORS COMPANY

Steering Column Upper Trim Cover Replacement

Callout	Component Name
Preliminary Procedure	
1. Remove the steering column lower cover. Refer to <u>Steering Column Lower Trim Cover Replacement</u> . 2. Remove the cluster. Refer to <u>Instrument Cluster Replacement</u> .	
1	Steering Column Upper Trim Cover Procedure Unclip the steering column upper trim cover from the steering column lower trim cover.

STEERING COLUMN LOWER TRIM COVER REPLACEMENT

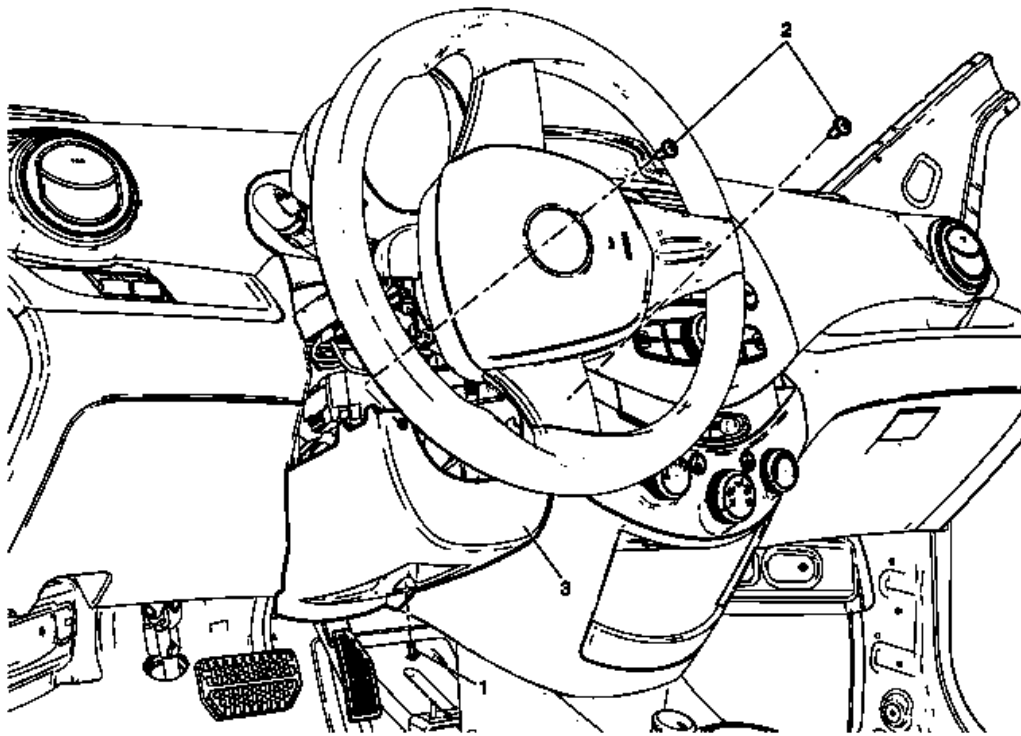


Fig. 9: Steering Column Lower Trim Cover
 Courtesy of GENERAL MOTORS COMPANY

Steering Column Lower Trim Cover Replacement

Callout	Component Name
1	Steering Column Lower Trim Cover Screw (Qty: 1)
2	Steering Column Lower Trim Cover Screw (Qty: 2)
	Procedure
	Turn the steering wheel until the bolts are reachable.
3	Steering Column Lower Trim Cover

TURN SIGNAL SWITCH REPLACEMENT

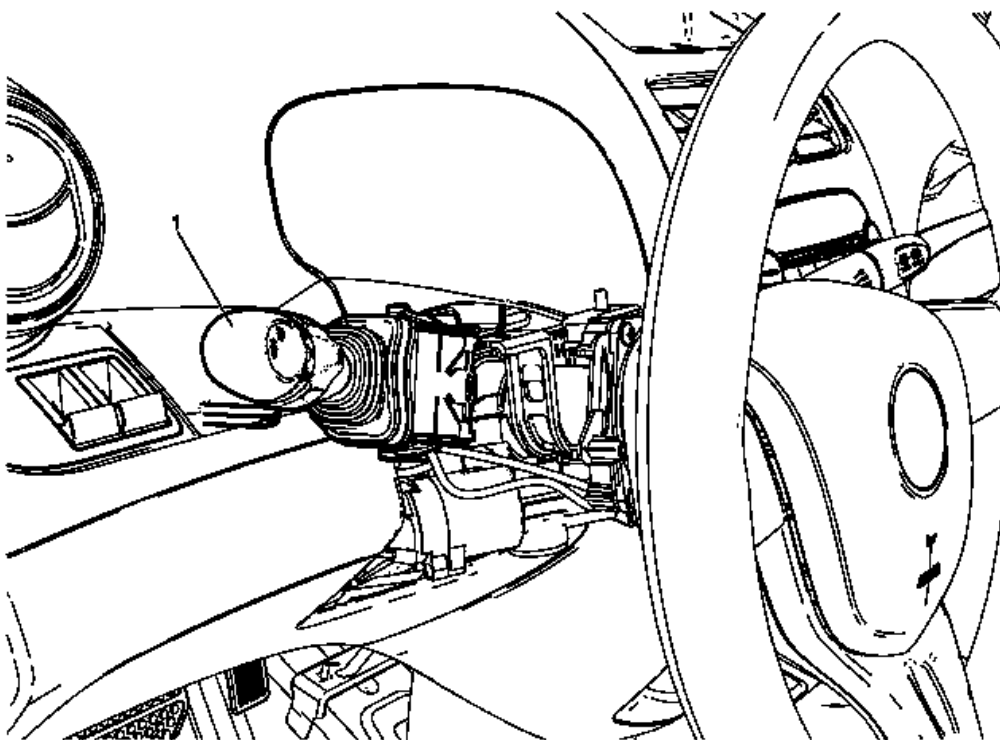


Fig. 10: Turn Signal Switch

Courtesy of GENERAL MOTORS COMPANY

Turn Signal Switch Replacement

Callout	Component Name
Preliminary Procedure	
1. Remove the steering column upper trim cover. Refer to <u>Steering Column Upper Trim Cover Replacement</u>. 2. Remove the steering column lower trim cover. Refer to <u>Steering Column Lower Trim Cover Replacement</u>.	
1	Turn Signal Switch Procedure 1. Disconnect any electrical connectors as needed. 2. Release the plastic retaining tabs to release the turn signal switch from steering wheel inflatable restraint module coil.

TURN SIGNAL SWITCH BRACKET REPLACEMENT

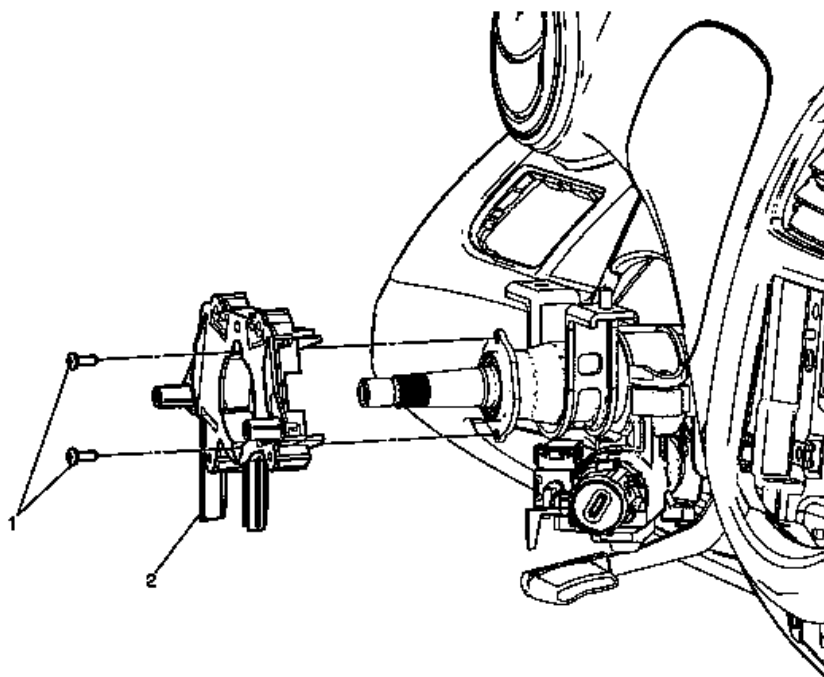


Fig. 11: Turn Signal Switch Bracket
 Courtesy of GENERAL MOTORS COMPANY

Turn Signal Switch Bracket Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the steering wheel airbag coil. Refer to <u>Steering Wheel Airbag Coil Replacement</u> . 2. Remove the turn signal switch. Refer to <u>Turn Signal Switch Replacement</u>. 3. Remove the windshield wiper and washer switch. Refer to <u>Windshield Wiper and Washer Switch Replacement</u> .	
1	Turn Signal Switch Bracket Screw (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 3.4 (30 lb in)
2	Turn Signal Switch Bracket

STEERING WHEEL REPLACEMENT

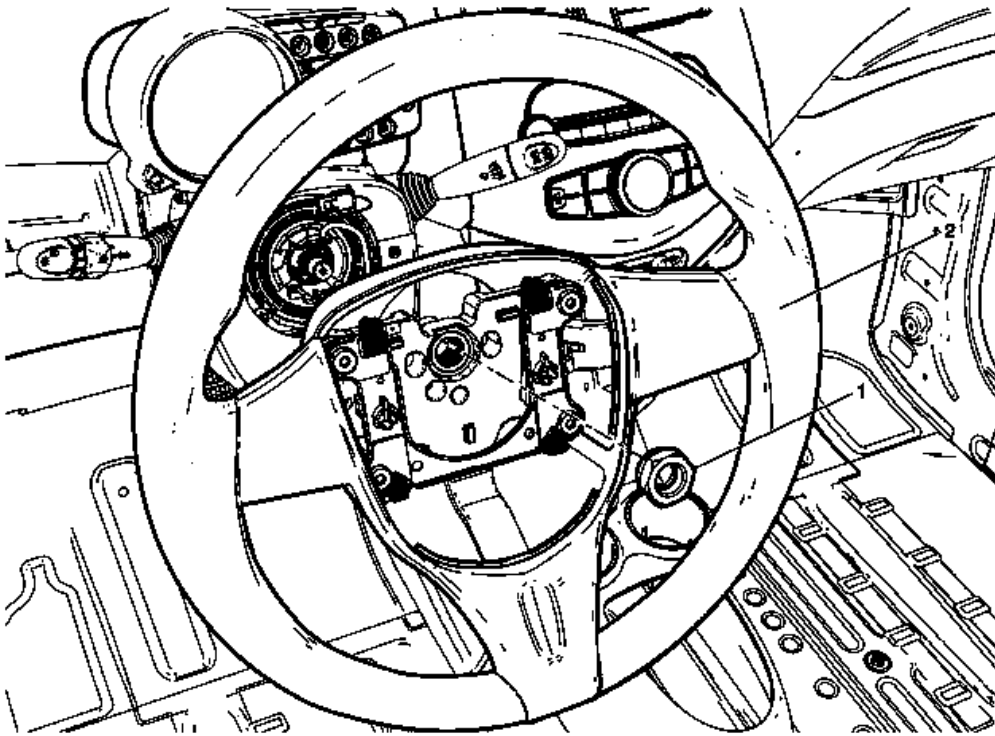


Fig. 12: Steering Wheel

Courtesy of GENERAL MOTORS COMPANY

Steering Wheel Replacement

Callout	Component Name
Preliminary Procedure Remove the inflatable restraint steering wheel module. Refer to <u>Airbag Steering Wheel Module Replacement</u> .	
1	Steering Wheel Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 38 (28 lb ft)
2	Steering Wheel Procedure 1. Disconnect the electrical connectors as needed. 2. Using the CH-50168-A steering wheel puller, remove the steering wheel carefully. Special Tools

STEERING COLUMN REPLACEMENT (ELECTRIC POWER STEERING)

Removal Procedure

1. Disconnect the battery negative cable. Refer to Battery Negative Cable Disconnection and Connection .

CAUTION: With wheels of the vehicle facing straight ahead, secure the steering wheel utilizing steering column anti-rotation pin, steering column lock, or a strap to prevent rotation. Locking of the steering column will prevent damage and a possible malfunction of the SIR system. The steering wheel must be secured in position before disconnecting the following components:

- The steering column
- The intermediate shaft(s)
- The steering gear

After disconnecting these components, do not rotate the steering wheel or move the front tires and wheels. Failure to follow this procedure may cause the SIR coil assembly to become un-centered and cause possible damage to the SIR coil. If you think the SIR coil has become un-centered, refer to your specific SIR coil's centering procedure to re-center SIR Coil.

2. Turn the steering wheel to the straight ahead position and lock it in place.
3. Remove the steering wheel. Refer to Steering Wheel Replacement.
4. Remove the steering column lower trim cover. Refer to Steering Column Lower Trim Cover Replacement.
5. Remove the steering column upper trim cover. Refer to Steering Column Upper Trim Cover Replacement.
6. Remove the turn signal switch bracket. Refer to Turn Signal Switch Bracket Replacement.
7. Disconnect any electrical connectors as necessary.
8. Remove the steering column opening filler. Refer to Steering Column Opening Filler Replacement .
9. Remove the electric power steering module and bracket assembly from the steering column. Refer to Power Steering Control Module Replacement .

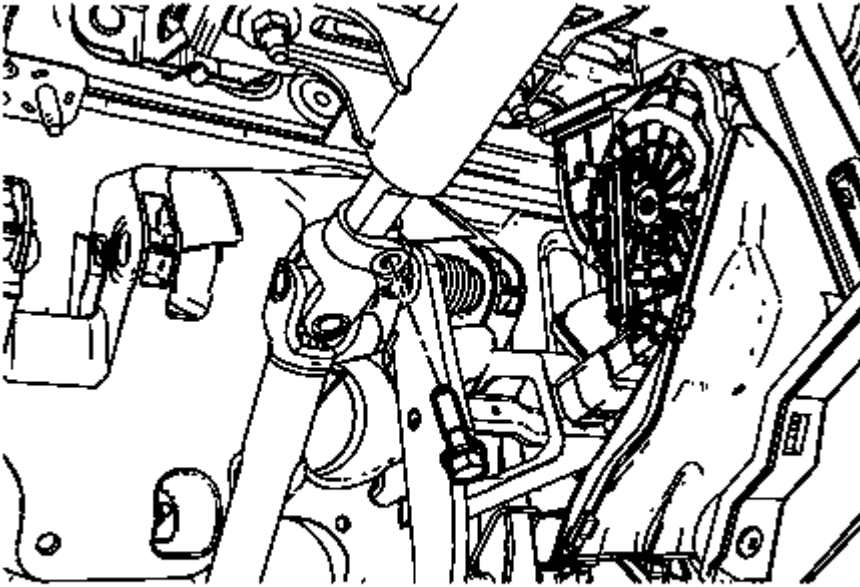


Fig. 13: Intermediate Steering Shaft Upper Bolt
Courtesy of GENERAL MOTORS COMPANY

10. Remove the intermediate steering shaft upper bolt and disconnect the shaft from the steering column. Refer to **Intermediate Steering Shaft Replacement**.

NOTE: Install tie straps between the tilt lever bracket and the base of the steering column to prevent the steering column jacket from pulling apart. The tilt lever **MUST** be in the LOCK (FULL UP) position during the steering column removal and installation to ensure that the tilt lever bracket remains rigid. Also install tie straps around the tilt lever and the steering column jacket to keep the tilt lever in the LOCK position. Do not bend the steering column energy absorbing straps located on the upper steering column mounting bracket.

11. Install tie straps as described above.

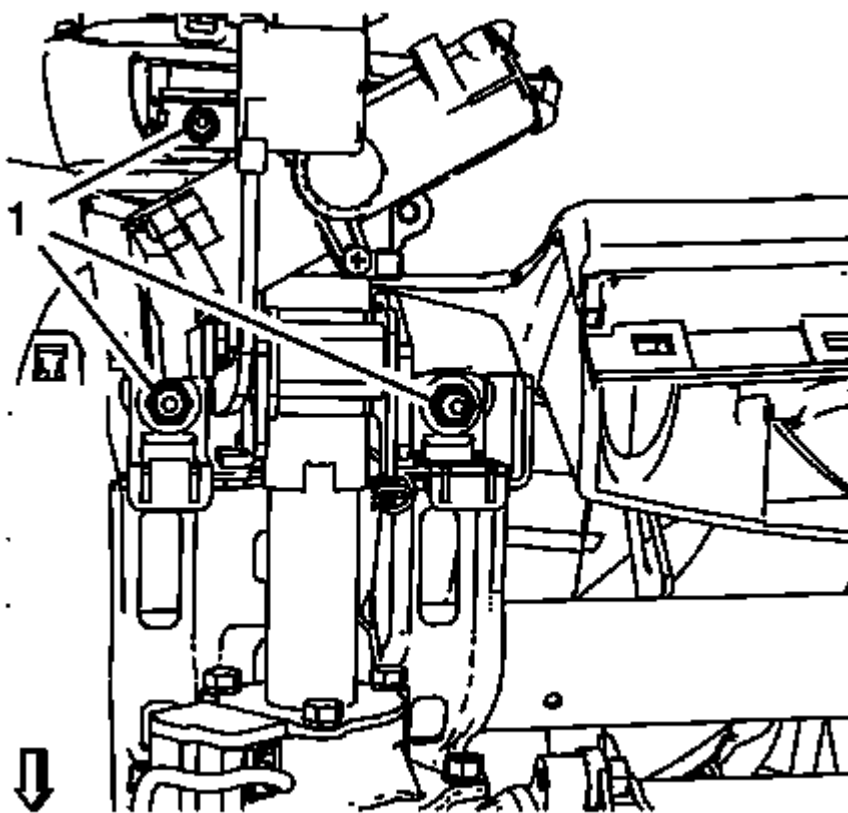


Fig. 14: Steering Column Nuts

Courtesy of GENERAL MOTORS COMPANY

12. Remove and DISCARD the steering column nuts (1).

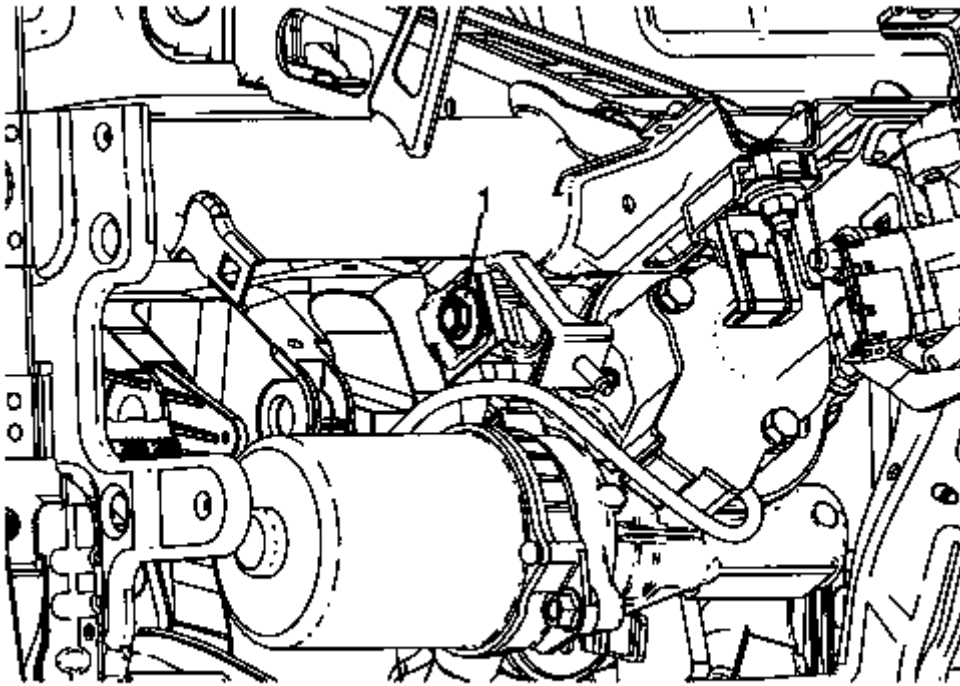


Fig. 15: Steering Column Bolt

Courtesy of GENERAL MOTORS COMPANY

13. Remove the steering column bolt (1).
14. Remove the steering column from the vehicle.

Installation Procedure

1. Install the steering column to the vehicle.

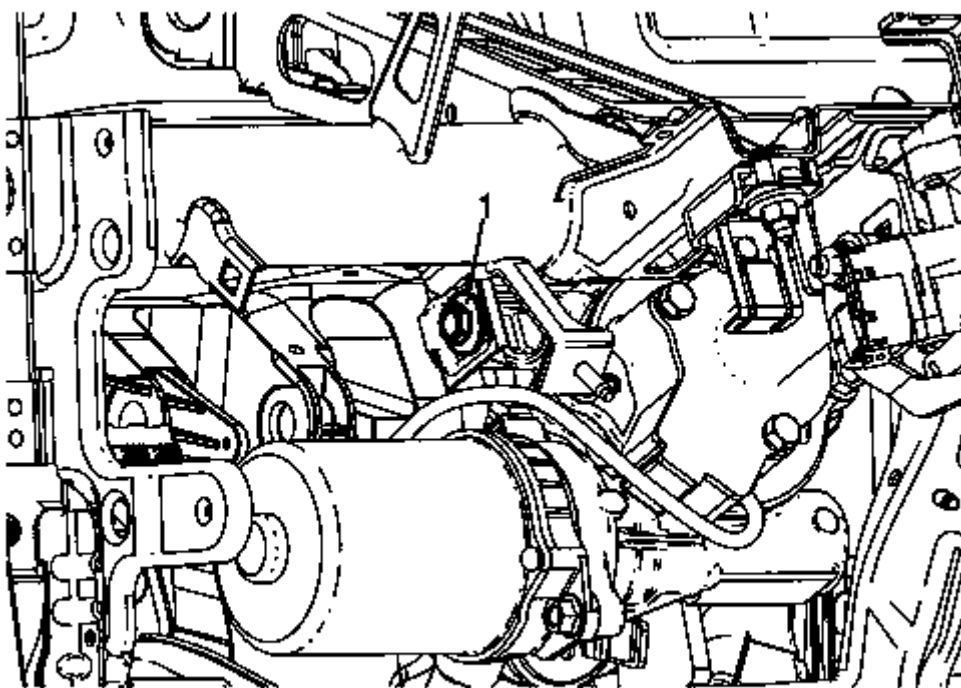


Fig. 16: Steering Column Bolt

Courtesy of GENERAL MOTORS COMPANY

WARNING: In order to ensure the intended function of the steering column in a vehicle during a crash and in order to avoid personal injury to the driver, perform the following:

- Tighten the steering column lower fasteners before you tighten the steering column upper fasteners. Failure to do this can damage the steering column.
- Tighten the steering column fasteners to the specified torque. Overtightening the upper steering column fasteners could affect the steering column collapse.

CAUTION: Refer to Fastener Caution .

NOTE: Start all steering column fasteners by hand before finalizing any torques. Do NOT bend the steering column energy absorbing straps located on the upper steering column mounting bracket during installation.

2. Install the steering column bolt (1) and tighten to 25 (18 lb ft).

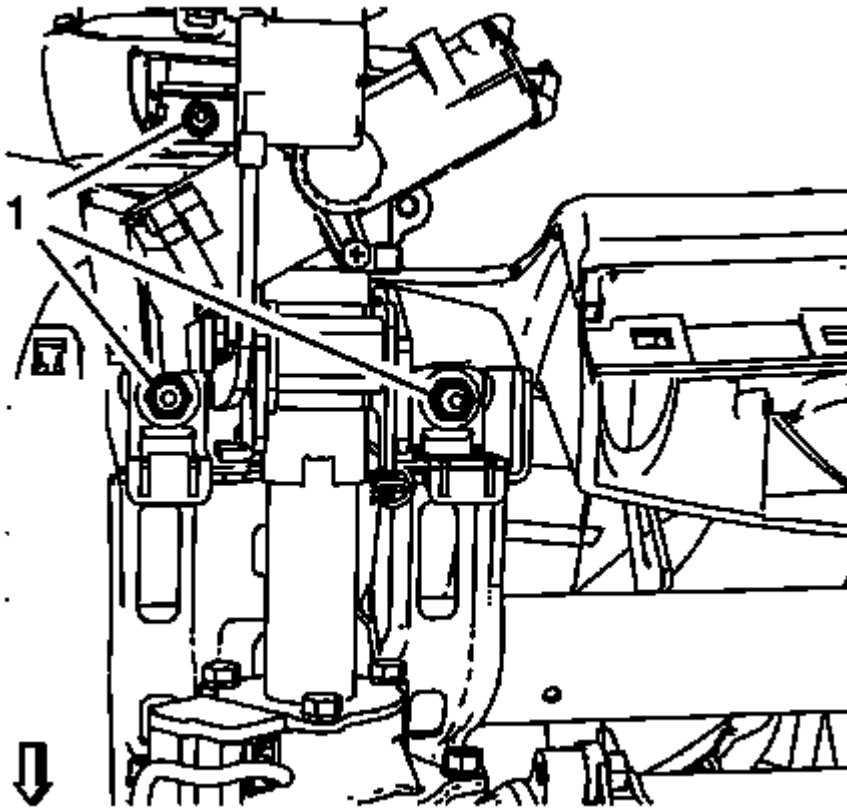


Fig. 17: Steering Column Nuts

Courtesy of GENERAL MOTORS COMPANY

3. Install the NEW steering column nuts (1) and tighten to 25 (18 lb ft).
4. Remove the tie straps.
5. Connect the intermediate steering shaft to the steering column.
6. Install the intermediate steering shaft upper bolt and tighten to 23 (17 lb ft).
7. Install the electric power steering module and bracket assembly to the steering column. Refer to **Power Steering Control Module Replacement** .
8. Install the steering column opening filler. Refer to **Steering Column Opening Filler Replacement** .
9. Connect any electrical connectors as necessary.
10. Install the turn signal switch bracket. Refer to **Turn Signal Switch Bracket Replacement**.
11. Install the steering column upper trim cover. Refer to **Steering Column Upper Trim Cover Replacement**.
12. Install the steering column lower trim cover. Refer to **Steering Column Lower Trim Cover Replacement**.
13. Install the steering wheel. Refer to **Steering Wheel Replacement**.
14. Connect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection** .

15. Calibrate the steering angle sensor. Refer to **Power Steering Control Module Programming and Setup** .

STEERING ANGLE SENSOR REPLACEMENT

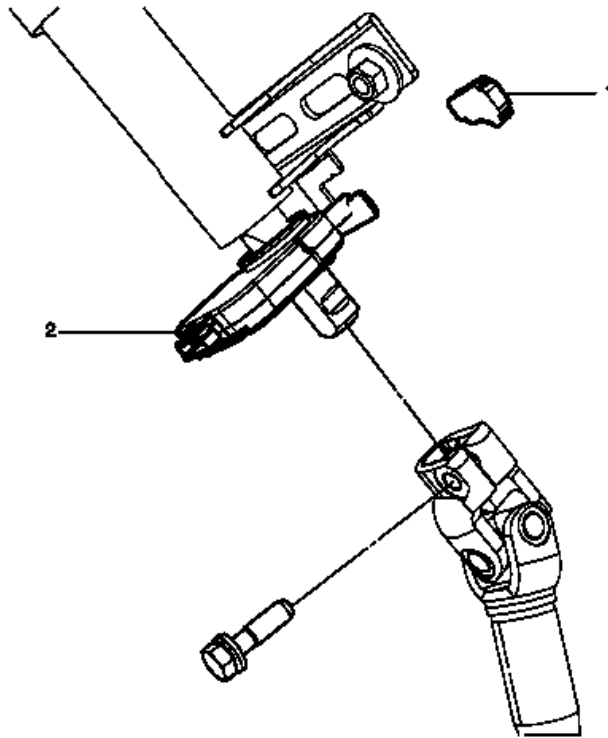


Fig. 18: Steering Angle Sensor
Courtesy of GENERAL MOTORS COMPANY

Steering Angle Sensor Replacement

Callout	Component Name
Preliminary Procedure Remove the intermediate steering shaft upper bolt and disconnect the intermediate steering shaft from the steering column. Refer to <u>Intermediate Steering Shaft Replacement</u> .	
1	Steering Angle Sensor Holder
2	Steering Angle Sensor
Procedure 1. Disconnect the electrical connector. 2. Remove the steering angle sensor from the bracket of steering column. 3. After installation, center the steering angle sensor. Refer to <u>Steering Angle Sensor Centering</u> .	
NOTE:	

	The steering angle sensor should be installed in the correct orientation. If the force is needed on installing check the orientation of sensor. Incorrect installation causes that the sensor can't recognize the steering angle of vehicle normally.
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DESCRIPTION AND OPERATION

STEERING WHEEL AND COLUMN DESCRIPTION AND OPERATION

The steering wheel and column has 4 primary functions:

- Vehicle steering
- Vehicle security
- Driver convenience
- Driver safety

Vehicle Steering

The steering wheel is the first link between the driver and the vehicle. The steering wheel is fastened to a steering shaft within the column. At the lower end of the column, the intermediate shaft connects the column to the steering gear.

The steering column can be adjusted vertically and longitudinally.

Vehicle Security

Theft deterrent components are mounted and designed into the steering column. The following components allow the column to be locked in order to minimize theft:

- The ignition switch
- The steering column lock
- The ignition cylinder
- The theft deterrent immobilizer module, if equipped

Driver Convenience

The steering wheel and column may also have driver controls attached for convenience and comfort. The following controls may be mounted on the steering wheel or column.

- The turn signal switch
- The headlamp dimmer switch
- The wiper/washer switch
- The horn pad
- The redundant radio/entertainment system controls
- The tilt functions

- The telephone system controls

Driver Safety

The steering wheel and column has safety features to protect the driver. The following components may be mounted on or near the steering column:

Energy-Absorbing Steering Column: The energy-absorbing steering column compresses in the event of a front-end collision, which reduces the chance of injury to the driver. The energy-absorbing feature, collapsible steering shaft, and break away mounting features help reduce the injury in the event of an accident.

SIR Coil and Module: For additional information on the operation of the SIR coil and module, refer to **Supplemental Inflatable Restraint System Description and Operation** .

Steering Wheel Angle Sensor: The steering wheel angle sensor is located somewhere along the steering shaft assembly. The sensor measures the position of the steering wheel and the speed at which it is rotated. A signal representing this measurement is provided to the electronic stability control (ESC) in the ABS module.

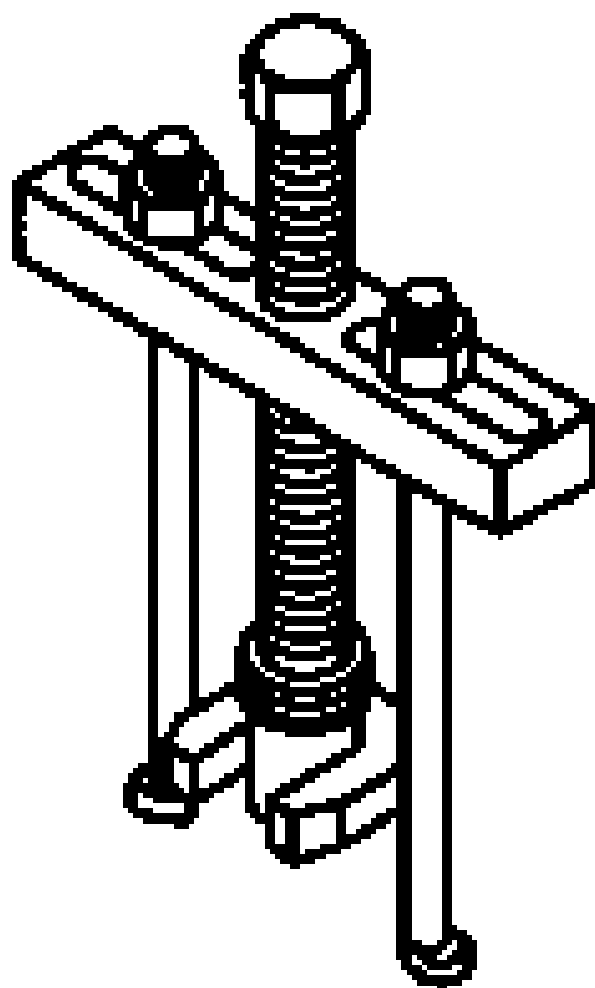
The Theft Deterrent Immobilizer Module: The immobilizer module is mounted in the steering column lock on cars without Passive Entry Passive Start system (PEPS). Refer to **Immobilizer Description and Operation** .

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description
	CH-50168-A Steering Wheel

Puller



RESTRAINTS

Supplemental Inflatable Restraints - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Front End Inflatable Restraint Discriminating Sensor	7.5	66 lb in
Front Seat Belt Anchor Bolt	40	30 lb ft
Front Seat Belt Anchor Plate Tensioner Fastener	40	30 lb ft
Front Seat Belt Retractor Bolt	40	30 lb ft
Front Seat Belt Tensioner Anchor Bolt	5	44 lb in
Inflatable Restraint Instrument Panel Module Bolt	8	71 lb in
Inflatable Restraint Sensing and Diagnostic Module Bolt	10	89 lb in
Inflatable Restraint Side Impact Sensor	7.5	66 lb in
Instrument Panel Inflatable Restraint Lower Module Bolt	10	89 lb in
Instrument Panel Inflatable Restraint Module Bracket Bolt	10	89 lb in
Rear Seat Side Inflatable Restraint Module Replacement	3.5	31 lb in
Roof Side Rail Inflatable Restraint Module Bolt	10	89 lb in
Seat Side Inflatable Restraint Module Nut	10	89 lb in
Steering Wheel Inflatable Restraint Module Coil	1.5	11 lb in

SCHEMATIC WIRING DIAGRAMS

SIR WIRING SCHEMATICS

Power, Ground, Serial Data, and Indicators Wiring Schematics

Fig. 1: Power, Ground, Serial Data, and Indicators Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Front Air Bags, Impact Sensor, and Pretensioners (AY0) Wiring Schematics

Fig. 2: Front Air Bags, Impact Sensor, and Pretensioners (AY0) Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Front Impact Sensors, Retractors, Driver and Passenger Air Bags (AYF) Wiring Schematics

Fig. 3: Front Impact Sensors, Retractors, Driver and Passenger Air Bags (AYF) Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Knee and Rear Seat Air Bags Wiring Schematics

Fig. 4: Knee and Rear Seat Air Bags Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Side Impact Sensors, Seat and Roof Air Bags Wiring Schematics

Fig. 5: Side Impact Sensors, Seat and Roof Air Bags Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

COMPONENT LOCATOR

SIR IDENTIFICATION VIEWS

The SIR Identification Views shown below illustrate the approximate location of all SIR components available for the vehicle. This will assist in determining the appropriate SIR Disabling and Enabling for a given service procedure, refer to **SIR Disabling and Enabling**.

Fig. 6: Identifying SIR Identification Views
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	B59R Front Impact Sensor - Right - Located at the front of the engine compartment, on the right side of the radiator support
2	F101 Passenger Instrument Panel Air Bag - Located at the top right, under the instrument panel
3	F114P Knee Air Bag - Passenger - Located below the glove box in the instrument panel
4	F105R Roof Rail Air Bag - Right - Located in the passenger compartment, along the right roof rail
5	K36 Inflatable Restraint Sensing and Diagnostic Module - Located underneath the center console
6	B63RF Side Impact Sensor - Right Front - Located inside the right front door
7	B60 Passenger Presence Sensor - Located on the passenger front seat underneath the seat bottom trim
8	F109P Seat Belt Anchor Plate Tensioner - Located in the passenger compartment, right side middle, mounted to base of B-pillar
9	F112P Seat Belt Retractor Pretensioner - Passenger - Located in the passenger compartment, right side middle, mounted to base of B-pillar
10	F106P Seat Side Air Bag - Passenger - Located on the seat back of passenger seat
11	B63RM Side Impact Sensor - Right Middle - Located in the passenger compartment, right side under the trim, mounted to base of B-pillar

12	F105R Roof Rail Air Bag - Right - Located in the passenger compartment, along the right roof rail
13	F106RR Seat Side Air Bag - Right Rear - Located on the seat back bolster of the rear passenger seat
14	F106LR Seat Side Air Bag - Left Rear - Located on the seat back bolster of the rear passenger seat
15	F105L Roof Rail Air Bag - Left - Located in the passenger compartment, along the left roof rail
16	B63LM Side Impact Sensor - Left Middle - Located in the passenger compartment, left side under the trim, mounted to base of B-pillar
17	F106D Seat Side Air Bag - Driver - Located on the seat back of driver seat
18	F112D Seat Belt Retractor Pretensioner - Driver - Located in the driver compartment, left side middle, mounted to base of B-pillar
19	F109D Seat Belt Anchor Plate Tensioner - Located in the passenger compartment, left side middle, mounted to base of B-pillar
20	B63LF Side Impact Sensor - Left Front - Located inside the left front door
21	F105L Roof Rail Air Bag - Left - Located in the passenger compartment, along the left roof rail
22	F114D Knee Air Bag - Driver - Located below the steering wheel in the instrument panel
23	F107 Steering Wheel Air Bag - Located on the steering wheel
24	P14 Passenger Air Bag Disable Indicator - Located in the passenger compartment, in the center of the instrument panel
25	C1 Battery - Located In the engine compartment, on the left side, near the underhood fuse block
26	B59L Front Impact Sensor - Left - Located at the front of the engine compartment, on the left side of the radiator support

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC B0012 or B0013</u>	DTC B0012 Driver Steering Wheel Air Bag Deployment Loop Stage 1
	DTC B0013 Driver Steering Wheel Air Bag Deployment Loop Stage 2
	DTC B0014 01 Driver Seat Side Air Bag Deployment Loop Short to Battery DTC B0014 02 Driver Seat Side Air Bag Deployment Loop Short to Ground DTC B0014 04 Driver Seat Side Air Bag Deployment Loop Open

DTC B0014, B0021, B0031, or B0038

DTC B0014 0D Driver Seat Side Air Bag
Deployment Loop High Resistance
DTC B0014 0E Driver Seat Side Air Bag
Deployment Loop Low Resistance
DTC B0021 01 Passenger Seat Side Air Bag
Deployment Loop Short to Battery
DTC B0021 02 Passenger Seat Side Air Bag
Deployment Loop Short to Ground
DTC B0021 04 Passenger Seat Side Air Bag
Deployment Loop Open
DTC B0021 0D Passenger Seat Side Air Bag
Deployment Loop High Resistance
DTC B0021 0E Passenger Seat Side Air Bag
Deployment Loop Low Resistance
DTC B0031 01 Left Rear Seat Side Air Bag
Deployment Loop Short to Battery
DTC B0031 02 Left Rear Seat Side Air Bag
Deployment Loop Short to Ground
DTC B0031 04 Left Rear Seat Side Air Bag
Deployment Loop Open
DTC B0031 0D Left Rear Seat Side Air Bag
Deployment Loop High Resistance
DTC B0031 0E Left Rear Seat Side Air Bag
Deployment Loop Low Resistance
DTC B0038 01 Right Rear Seat Side Air Bag
Deployment Loop Short to Battery
DTC B0038 02 Right Rear Seat Side Air Bag
Deployment Loop Short to Ground
DTC B0038 04 Right Rear Seat Side Air Bag
Deployment Loop Open
DTC B0038 0D Right Rear Seat Side Air Bag
Deployment Loop High Resistance
DTC B0038 0E Right Rear Seat Side Air Bag
Deployment Loop Low Resistance

DTC B0015 01 Driver Seat Belt Retractor
Pretensioner Deployment Loop Short to Battery
DTC B0015 02 Driver Seat Belt Retractor
Pretensioner Deployment Loop Short to Ground
DTC B0015 04 Driver Seat Belt Retractor
Pretensioner Deployment Loop Open
DTC B0015 0D Driver Seat Belt Retractor
Pretensioner Deployment Loop High Resistance
DTC B0015 0E Driver Seat Belt Retractor
Pretensioner Deployment Loop Low Resistance
DTC B001A 01 Driver Seat Belt Anchor
Pretensioner Deployment Loop Short to Battery
DTC B001A 02 Driver Seat Belt Anchor
Pretensioner Deployment Loop Short to Ground

<u>DTC B0015, B001A, B001B, or B0022</u>	DTC B001A 04 Driver Seat Belt Anchor Pretensioner Deployment Loop Open DTC B001A 0D Driver Seat Belt Anchor Pretensioner Deployment Loop High Resistance DTC B001A 0E Driver Seat Belt Anchor Pretensioner Deployment Loop Low Resistance DTC B001B 01 Passenger Seat Belt Anchor Pretensioner Deployment Loop Short to Battery DTC B001B 02 Passenger Seat Belt Anchor Pretensioner Deployment Loop Short to Ground DTC B001B 04 Passenger Seat Belt Anchor Pretensioner Deployment Loop Open DTC B001B 0D Passenger Seat Belt Anchor Pretensioner Deployment Loop High Resistance DTC B001B 0E Passenger Seat Belt Anchor Pretensioner Deployment Loop Low Resistance DTC B0022 01 Passenger Seat Belt Retractor Pretensioner Deployment Loop Short to Battery DTC B0022 02 Passenger Seat Belt Retractor Pretensioner Deployment Loop Short to Ground DTC B0022 04 Passenger Seat Belt Retractor Pretensioner Deployment Loop Open Circuit DTC B0022 0D Passenger Seat Belt Retractor Pretensioner Deployment Loop High Resistance DTC B0022 0E Passenger Seat Belt Retractor Pretensioner Deployment Loop Low Resistance
<u>DTC B0016, B0018, B0023, or B0025</u>	DTC B0016 01 Left Roof Rail Air Bag Deployment Loop Short to Battery DTC B0016 02 Left Roof Rail Air Bag Deployment Loop Short to Ground DTC B0016 04 Left Roof Rail Air Bag Deployment Loop Open DTC B0016 0D Left Roof Rail Air Bag Deployment Loop High Resistance DTC B0016 0E Left Roof Rail Air Bag Deployment Loop Low Resistance DTC B0023 01 Right Roof Rail Air Bag Deployment Loop Short to Battery DTC B0023 02 Right Roof Rail Air Bag Deployment Loop Short to Ground DTC B0023 04 Right Roof Rail Air Bag Deployment Loop Open DTC B0023 0D Right Roof Rail Air Bag Deployment Loop High Resistance DTC B0023 0E Right Roof Rail Air Bag Deployment Loop Low Resistance
	DTC B0017 01 Driver Knee Air Bag Deployment Loop Short to Battery

<u>DTC B0017 or B0024</u>	DTC B0017 02 Driver Knee Air Bag Deployment Loop Short to Ground DTC B0017 04 Driver Knee Air Bag Deployment Loop Open DTC B0017 0D Driver Knee Air Bag Deployment Loop High Resistance DTC B0017 0E Driver Knee Air Bag Deployment Loop Low Resistance DTC B0024 01 Passenger Knee Air Bag Deployment Loop Short to Battery DTC B0024 02 Passenger Knee Air Bag Deployment Loop Short to Ground DTC B0024 04 Passenger Knee Air Bag Deployment Loop Open DTC B0024 0D Passenger Knee Air Bag Deployment Loop High Resistance DTC B0024 0E Passenger Knee Air Bag Deployment Loop Low Resistance
<u>DTC B0019 or B0020</u>	DTC B0019 01 Passenger Instrument Panel Air Bag Deployment Loop Stage 1 Short to Battery DTC B0019 02 Passenger Instrument Panel Air Bag Deployment Loop Stage 1 Short to Ground DTC B0019 04 Passenger Instrument Panel Air Bag Deployment Loop Stage 1 Open DTC B0019 0D Passenger Instrument Panel Air Bag Deployment Loop Stage 1 High Resistance DTC B0019 0E Passenger Instrument Panel Air Bag Deployment Loop Stage 1 Low Resistance DTC B0020 01 Passenger Instrument Panel Air Bag Deployment Loop Stage 2 Short to Battery DTC B0020 02 Passenger Instrument Panel Air Bag Deployment Loop Stage 2 Short to Ground DTC B0020 04 Passenger Instrument Panel Air Bag Deployment Loop Stage 2 Open DTC B0020 0D Passenger Instrument Panel Air Bag Deployment Loop Stage 2 High Resistance DTC B0020 0E Passenger Instrument Panel Air Bag Deployment Loop Stage 2 Low Resistance
<u>DTC B0052</u>	DTC B0052 00 Deployment Commanded DTC B0052 56 Deployment Commanded Too Many Transitions
<u>DTC B0071</u>	DTC B0071 03 Passenger Seat Belt Tension Sensor Circuit Voltage Below Threshold DTC B0071 04 Passenger Seat Belt Tension Sensor Circuit Open DTC B0071 07 Passenger Seat Belt Tension Sensor Circuit Voltage Above Threshold

	DTC B0071 08 Passenger Seat Belt Tension Sensor Circuit Voltage Performance - Signal Invalid
<u>DTC B0074</u>	DTC B0074 0D Passenger Presence Sensor High Resistance DTC B0074 0E Passenger Presence Sensor Low Resistance
<u>DTC B0081 (Inflatable Restraint Sensing and Diagnostic Module)</u>	DTC B0081 00 Passenger Presence Module Malfunction DTC B0081 3A Passenger Presence Module Incorrect Component Installed DTC B0081 71 Passenger Presence Module Invalid Data
<u>DTC B0081 (Passenger Presence System)</u>	DTC B0081 11 Passenger Presence Module High Input DTC B0081 4B Passenger Presence Module Calibration Not Learned DTC B0081 5A Passenger Presence Module Not Plausible
	DTC B0083 01 Left Front Impact Sensor Short to Battery DTC B0083 02 Left Front Impact Sensor Short to Ground DTC B0083 04 Left Front Impact Sensor Open DTC B0083 05 Left Front Impact Sensor High/Voltage Open DTC B0083 0C Left Front Impact Sensor Low Current DTC B0083 39 Left Front Impact Sensor Internal Electronic Failure DTC B0083 3A Left Front Impact Sensor Incorrect Component Installed DTC B0083 71 Left Front Impact Sensor Invalid Serial Data Received DTC B0084 01 Right Front Impact Sensor Short to Battery DTC B0084 02 Right Front Impact Sensor Short to Ground DTC B0084 04 Right Front Impact Sensor Open DTC B0084 05 Right Front Impact Sensor High/Voltage Open DTC B0084 0C Right Front Impact Sensor Low Current DTC B0084 39 Right Front Impact Sensor Internal Electronic Failure DTC B0084 3A Right Front Impact Sensor Incorrect Component Installed DTC B0084 71 Right Front Impact Sensor Invalid

DTC B0083-B0088

Serial Data Received

DTC B0085 01 Left Front Side Impact Sensor Short to Battery

DTC B0085 02 Left Front Side Impact Sensor Short to Ground

DTC B0085 04 Left Front Side Impact Sensor Open

DTC B0085 05 Left Front Side Impact Sensor High/Voltage Open

DTC B0085 0C Left Front Side Impact Sensor Low Current

DTC B0085 39 Left Front Side Impact Sensor Internal Malfunction

DTC B0085 3A Left Front Side Impact Sensor Incorrect Component Installed

DTC B0085 71 Left Front Side Impact Sensor Invalid Serial Data Received

DTC B0086 01 Right Front Side Impact Sensor Short to Battery

DTC B0086 02 Right Front Side Impact Sensor Short to Ground

DTC B0086 04 Right Front Side Impact Sensor Open

DTC B0086 05 Right Front Side Impact Sensor High/Voltage Open

DTC B0086 0C Right Front Side Impact Sensor Low Current

DTC B0086 39 Right Front Side Impact Sensor Internal Malfunction

DTC B0086 3A Right Front Side Impact Sensor Incorrect Component Installed

DTC B0086 71 Right Front Side Impact Sensor Invalid Data

DTC B0087 01 Left Rear Side Impact Sensor Short to Battery

DTC B0087 02 Left Rear Side Impact Sensor Short to Ground

DTC B0087 04 Left Rear Side Impact Sensor Open

DTC B0087 05 Left Rear Side Impact Sensor High/Voltage Open

DTC B0087 0C Left Rear Side Impact Sensor Low Current

DTC B0087 39 Left Rear Side Impact Sensor Internal Malfunction

DTC B0087 3A Left Rear Side Impact Sensor Incorrect Component Installed

DTC B0087 71 Left Rear Side Impact Sensor Invalid Serial Data Received

DTC B0088 01 Right Rear Side Impact Sensor Short

	to Battery DTC B0088 02 Right Rear Side Impact Sensor Short to Ground DTC B0088 04 Right Rear Side Impact Sensor Open DTC B0088 05 Right Rear Side Impact Sensor High/Voltage Open DTC B0088 0C Right Rear Side Impact Sensor Low Current DTC B0088 39 Right Rear Side Impact Sensor Internal Malfunction DTC B0088 3A Right Rear Side Impact Sensor Incorrect Component Installed DTC B0088 71 Right Rear Side Impact Sensor Invalid Data
<u>DTC B0091</u>	DTC B0091 01 Front Impact Sensor Short to Battery DTC B0091 02 Front Impact Sensor Short to Ground DTC B0091 04 Front Impact Sensor Open Circuit DTC B0091 05 Front Impact Sensor High Voltage/Open DTC B0091 0C Front Impact Sensor Low Current DTC B0091 39 Front Impact Sensor Internal Electronic Failure DTC B0091 3A Front Impact Sensor Incorrect Component Installed DTC B0091 71 Front Impact Sensor Invalid Serial Data Received
<u>DTC B1001</u>	DTC B1001 00 Option Configuration
<u>DTC B1019</u>	DTC B1019 00 System Configuration Error

DTC B0012 OR B0013: DRIVER STEERING WHEEL AIR BAG DEPLOYMENT LOOP

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category

DTC Descriptors

DTC B0012

Driver Steering Wheel Air Bag Deployment Loop Stage 1

DTC B0013

Driver Steering Wheel Air Bag Deployment Loop Stage 2

For symptom byte information refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Steering Wheel Air Bag Stage 1 High Control	B0012 02, B0012 0E	B0012 0D	B0012 04, B0012 0D	B0012 01	-
Steering Wheel Air Bag Stage 1 Low Control	B0012 02, B0012 0E	B0012 0D	B0012 04, B0012 0D	B0012 01	-
Steering Wheel Air Bag Stage 2 High Control	B0013 02, B0013 0E	B0013 0D	B0013 04, B0013 0D	B0013 01	-
Steering Wheel Air Bag Stage 2 Low Control	B0013 02, B0013 0E	B0013 0D	B0013 04, B0013 0D	B0013 01	-

Circuit/System Description

During a frontal crash of sufficient force the inflatable restraint sensing and diagnostic module (SDM) will allow current to flow through the deployment loop in order to deploy the steering wheel air bag. The SDM performs continuous diagnostic tests on the deployment loops to check for proper circuit continuity and for shorts to ground or voltage. There are 2 shorting bars used within the steering wheel air bag coil connector which will short together both steering wheel air bag stage 1 high control circuit and steering wheel air bag stage 1 low control circuit and both steering wheel air bag stage 2 high control circuit and steering wheel air bag stage 2 low control circuit when the connector is disconnected. This will help to prevent unwanted deployment of the steering wheel air bag during servicing.

Conditions for Running the DTC

Ignition voltage is between 9-16 V.

Conditions for Setting the DTC

B0012 01 stage 1 or B0013 01 stage 2

The steering wheel air bag deployment loop is shorted to voltage for 2 s.

B0012 02 stage 1 or B0013 02 stage 2

The steering wheel air bag deployment loop is shorted to ground for 2 s.

B0012 04 stage 1 or B0013 04 stage 2

The steering wheel air bag deployment loop is open for 2 s.

B0012 0D stage 1 or B0013 0D stage 2

The steering wheel air bag deployment loop resistance is greater than 4.4 ohms for 2 s.

B0012 0E stage 1 or B0013 0E stage 2

The steering wheel air bag deployment loop resistance is less than 1.7 ohms for 2 s.

Action Taken When the DTC Sets

- The inflatable restraint sensing and diagnostic module requests the instrument cluster to illuminate the AIR BAG indicator.
- The inflatable restraint sensing and diagnostic module will store a DTC, however if an event occurs the system will still attempt deployment.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aid

NOTE: **The following diagnostic aids apply for both current and history DTCs.**

A worn steering wheel air bag coil can cause a repeated history DTC to set. To verify this condition, turn the steering wheel 360 degrees in one direction then back 360 degrees in the other direction, multiple times, while viewing the scan tool Deployment Loop Resistance parameters.

An incorrectly installed connector position assurance (CPA) or incorrectly seated connector can cause a shorting bar to short both control circuits together. Check the connectors and CPAs if a DTC with symptom byte 02 or 0E is set, to ensure the shorting bars are not causing the circuits to be shorted together. Shorting bars are used in the locations listed below:

- Steering wheel air bag assembly
- Steering wheel air bag coil assembly
- Inline harness connectors
- Harness side of the inflatable restraint sensing and diagnostic module connector

Terminal fretting or incorrectly seated connector can cause an open/high resistance condition. Check the circuit terminals for fretting or incorrectly seated connector if a DTC with symptom byte 04 or 0D is set.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-38125-580 Terminal Release Tool Kit

Circuit/System Verification

NOTE:

- **Refer to SIR Service Precautions.**
- **Inspect all terminals for damage or corrosion when disconnecting connectors. Damage or corrosion in the following requires repair or replacement of the affected component/connector.**
 - **Steering wheel air bag**
 - **Steering wheel air bag coil**
 - **Inflatable restraint sensing and diagnostic module**
 - **Air bag wiring harness connector**
 - **Inflatable restraint sensing and diagnostic module wiring harness connector**
- **The connector and connector position assurance (CPA) may seat independent of each other. Both the connector and CPA should seat with an audible and/or tactile click. The CPA isolates the shorting-bars within the connector allowing the deployment circuit to operate properly. Replace any CPA that is damaged or missing.**
- **If the condition is intermittent or cannot be duplicated, disconnect the connectors and add dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087). This procedure will correct the high resistance condition due to terminal fretting corrosion.**

1. Verify the appropriate scan tool Deployment Loop Resistance parameters stay consistently between 2.1-4.0 ohms without any spikes or dropouts while turning the steering wheel 360 degrees in one direction then back 360 degrees in the other direction.

- **If less than 2.1 ohms or greater than 4.0 ohms**

Refer to Circuit/System Testing.

- **If there are spikes or dropouts**

Replace the X85 Steering Wheel Air Bag Coil.

- **If between 2.1-4.0 ohms without any spikes or dropouts**

2. Verify DTC B0012 or B0013 is only set as a history DTC.

- **If the DTC is set as current**

Refer to Circuit/System Testing.

- **If the DTC is set as history**

3. Verify the scan tool Deployment Loop Resistance parameters stay consistently between 2.1-4.0 ohms without any drop outs or spikes while moving the harness near each connector listed below.

- X85 Steering Wheel Air Bag Coil
- F107 Steering Wheel Air Bag
- Any inline harness connector
- K36 Inflatable Restraint Sensing and Diagnostic Module

- **If the reading is erratic while moving the harness, perform the following**

- Inspect each connector terminal for damage or corrosion and repair as necessary.
- Apply dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087) to each connector terminal.
- Ensure each connector and CPA is correctly seated.

- **If between 2.1-4.0 ohms without any spikes or dropouts**

4. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the scan tool and disconnect the appropriate harness connector listed below at the F107 Steering Wheel Air Bag.

- DTC B0012 connector X1
- DTC B0013 connector X2

2. Test for greater than 25 ohms between the control circuit terminal 1 and the control circuit terminal 2 at the harness connector.

- **If 25 ohms or less**

1. Disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

NOTE: Some connectors may be equipped with shorting bars as a safety

component to prevent accidental deployment. When testing on a connector with shorting bars, the shorting bars must be disabled to ensure accurate test results. Insert an appropriate pick from EL-38125-580 and depress the shorting bars above the appropriate terminals. This will lift the shorting bar from the terminal and allow accurate test results. Take care not to damage the connector, shorting bar, or terminal when depressing the shorting bar.

2. Test for infinite resistance between the two control circuits.
 - If less than infinite resistance, repair the short between the two circuits.
 - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If greater than 25 ohms**
3. Ignition ON.
4. Test for less than 11 V between each control circuit terminal listed below and ground:
 - Control circuit terminal 1
 - Control circuit terminal 2
 - **If 11 V or greater**
 1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If less than 11 V**
5. Ignition OFF.
6. Test for greater than 25 ohms between each control circuit terminal listed below and ground:
 - Control circuit terminal 1
 - Control circuit terminal 2
 - **If 25 ohms or less**
 1. Disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

NOTE: **Some connectors may be equipped with shorting bars as a safety component to prevent accidental deployment. When testing on a connector with shorting bars, the shorting bars must be disabled to ensure accurate test results. Insert an appropriate pick from EL-38125-580 and depress the shorting bars above the appropriate terminals. This will lift the shorting bar from the terminal and allow accurate test results. Take care not to damage the connector, shorting bar, or terminal when depressing the shorting bar.**

2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If greater than 25 ohms**
7. Install a 3 A fused jumper wire between the control circuit terminal 1 and the control circuit terminal 2, ignition ON.
 8. Verify the appropriate scan tool Deployment Loop Resistance parameter is consistently less than 2 ohms while turning the steering wheel 360 degrees in one direction then back 360 degrees in the other direction.
 - **If the reading is erratic while turning the steering wheel**

Replace the X85 Steering Wheel Air Bag Coil.

- **If 2 ohms or greater**
1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 2. Test for less than 2 ohms in the X85 Steering Wheel Air Bag Coil and each control circuit end to end.
 - If 2 ohms or greater, replace the X85 Steering Wheel Air Bag Coil or repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If less than 2 ohms**
9. Ignition OFF, connect the harness connector at the F107 Steering Wheel Air Bag, press in the CPA (if equipped) until an audible and/or tactile click is heard.
 10. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
 11. Verify DTC B0012 or B0013 is not set.
 - **If DTC B0012 or B0013 is set**

Replace the F107 Steering Wheel Air Bag.

- **If DTC B0012 or B0013 is not set**
12. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Steering Wheel Airbag Coil Replacement**
- **Airbag Steering Wheel Module Replacement**
- **SIR/SRS Wiring Repairs**
- **Control Module References** for inflatable restraint sensing and diagnostic module replacement, programming and setup

DTC B0014, B0021, B0031, OR B0038: SEAT SIDE AIR BAG DEPLOYMENT LOOP

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0014 01

Driver Seat Side Air Bag Deployment Loop Short to Battery

DTC B0014 02

Driver Seat Side Air Bag Deployment Loop Short to Ground

DTC B0014 04

Driver Seat Side Air Bag Deployment Loop Open

DTC B0014 0D

Driver Seat Side Air Bag Deployment Loop High Resistance

DTC B0014 0E

Driver Seat Side Air Bag Deployment Loop Low Resistance

DTC B0021 01

Passenger Seat Side Air Bag Deployment Loop Short to Battery

DTC B0021 02

Passenger Seat Side Air Bag Deployment Loop Short to Ground

DTC B0021 04

Passenger Seat Side Air Bag Deployment Loop Open

DTC B0021 0D

Passenger Seat Side Air Bag Deployment Loop High Resistance

DTC B0021 0E

Passenger Seat Side Air Bag Deployment Loop Low Resistance

DTC B0031 01

Left Rear Seat Side Air Bag Deployment Loop Short to Battery

DTC B0031 02

Left Rear Seat Side Air Bag Deployment Loop Short to Ground

DTC B0031 04

Left Rear Seat Side Air Bag Deployment Loop Open

DTC B0031 0D

Left Rear Seat Side Air Bag Deployment Loop High Resistance

DTC B0031 0E

Left Rear Seat Side Air Bag Deployment Loop Low Resistance

DTC B0038 01

Right Rear Seat Side Air Bag Deployment Loop Short to Battery

DTC B0038 02

Right Rear Seat Side Air Bag Deployment Loop Short to Ground

DTC B0038 04

Right Rear Seat Side Air Bag Deployment Loop Open

DTC B0038 0D

Right Rear Seat Side Air Bag Deployment Loop High Resistance

DTC B0038 0E

Right Rear Seat Side Air Bag Deployment Loop Low Resistance

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Left Front Seat Side Air Bag High Control	B0014 02, B0014 0E	B0014 0D	B0014 04, B0014 0D	B0014 01	-
Left Front Seat Side Air	B0014 02,		B0014 04,		

Bag Low Control	B0014 0E	B0014 0D	B0014 0D	B0014 01	-
Right Front Seat Side Air Bag High Control	B0021 02, B0021 0E	B0021 0D	B0021 04, B0021 0D	B0021 01	-
Right Front Seat Side Air Bag Low Control	B0021 02, B0021 0E	B0021 0D	B0021 04, B0021 0D	B0021 01	-
Left Rear Seat Side Air Bag High Control	B0031 02, B0031 0E	B0031 0D	B0031 04, B0031 0D	B0031 01	-
Left Rear Seat Side Air Bag Low Control	B0031 02, B0031 0E	B0031 0D	B0031 04, B0031 0D	B0031 01	-
Right Rear Seat Side Air Bag High Control	B0038 02, B0038 0E	B0038 0D	B0038 04, B0038 0D	B0038 01	-
Right Rear Seat Side Air Bag Low Control	B0038 02, B0038 0E	B0038 0D	B0038 04, B0038 0D	B0038 01	-

Circuit/System Description

During a side or frontal crash of sufficient force, the inflatable restraint sensing and diagnostic module (SDM) will allow current to flow through the deployment loop in order to deploy an air bag. There are 2 shorting bars used within the connector that will short the control circuits together when the connector is disconnected. This will help to prevent unwanted deployment of the air bag or retractor pretensioner during servicing.

Conditions for Running the DTC

Ignition voltage is between 9-16 V.

Conditions for Setting the DTC

B0014 01, B0021 01, B0031 01, B0038 01

The air bag control circuit is shorted to voltage for 2 seconds.

B0014 02, B0021 02, B0031 02, B0038 02

The air bag control circuit is shorted to ground for 2 seconds.

B0014 04, B0021 04, B0031 04, B0038 04

The air bag control circuit is open for 2 seconds.

B0014 0D, B0021 0D, B0031 0D, B0038 0D

The air bag deployment loop resistance is greater than 4.2 ohms for 2 seconds.

B0014 0E, B0021 0E, B0031 0E, B0038 0E

The air bag deployment loop resistance is less than 1.4 ohms for 2 seconds.

Action Taken When the DTC Sets

- The inflatable restraint sensing and diagnostic module requests the instrument cluster to illuminate the AIR BAG indicator.
- The inflatable restraint sensing and diagnostic module will store a DTC, however if an event occurs the system will still attempt deployments.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aid

NOTE: **The following diagnostic aids apply for both current and history DTCs.**

An incorrectly installed connector position assurance (CPA) or incorrectly seated connector can cause a shorting bar to short both control circuits together. Check the connectors and CPAs if a DTC with symptom byte 02 or 0E is set, to ensure the shorting bars are not causing the circuits to be shorted together. Shorting bars are used in the locations listed below:

- Front and rear seat side air bags
- Left and right roof rail air bags
- Inline harness connectors
- Harness side of the inflatable restraint sensing and diagnostic module connector

Terminal fretting or incorrectly seated connector can cause an open/high resistance condition. Check the circuit terminals for fretting or incorrectly seated connector if a DTC with symptom byte 04 or 0D is set. DTCs of deployment loops which are in the seat can occur because of stress or damage to the harness due to seat movement. Move the seat to the full extent of travel while using the scan tool to observe deployment type loop parameters.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-38125-580 Terminal Release Tool Kit

Circuit/System Verification

NOTE:

- Refer to **SIR Service Precautions**.
- Inspect all terminals for damage or corrosion when disconnecting connectors. Damage or corrosion in the following requires repair or replacement of the affected component/connector.
 - Seat side air bag
 - Inflatable restraint sensing and diagnostic module
 - All wiring harness connectors
 - Inflatable restraint sensing and diagnostic module wiring harness connector
- The connector and connector position assurance (CPA) may seat independent of each other. Both the connector and CPA should seat with an audible and/or tactile click. The CPA isolates the shorting-bars within the connector allowing the deployment circuit to operate properly.
- If the condition is intermittent or cannot be duplicated, disconnect the connectors and add dielectric grease/lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087). This procedure will correct the high resistance condition due to terminal fretting corrosion.

1. Verify the appropriate scan tool Deployment Loop Resistance parameters stay consistently between 2.1-4.0 ohms without any spikes or dropouts while moving the harness near each connector.
 - F106 Seat Side Air Bag
 - Any inline harness connector
 - K36 Inflatable Restraint Sensing and Diagnostic Module
 - **If less than 2.1 ohms or greater than 4.0 ohms**

Refer to Circuit/System Testing.

- **If there are spikes or dropouts, perform the following:**
 - Inspect each connector terminal and harness for damage or corrosion and repair as necessary.
 - Apply dielectric grease/lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087) to each connector terminal.
 - Ensure each connector and CPA is correctly seated.
- **If between 2.1-4.0 ohms without any spikes or dropouts**

2. All OK

Circuit/System Testing

1. Ignition OFF, scan tool disconnected, disconnect the harness connector at the appropriate F106 Seat Side Air Bag.
2. Test for greater than 25 ohms between the control circuit terminals 1 and 2.

- **If 25 ohms or less**

1. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

NOTE: Some connectors may be equipped with shorting bars as a safety component to prevent accidental deployment. When testing on a connector with shorting bars, the shorting bars must be disabled to ensure accurate test results. Insert an appropriate pick from EL-38125-580 and depress the shorting bars above the appropriate terminals. This will lift the shorting bar from the terminal and allow accurate test results. Take care not to damage the connector, shorting bar, or terminal when depressing the shorting bar.

2. Test for infinite resistance between the 2 control circuits.
 - If less than infinite resistance, repair the short between the 2 circuits.
 - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If greater than 25 ohms**

3. Ignition ON.

4. Test for less than 11 V between each control circuit terminal listed below and ground:

- Control circuit terminal 1
- Control circuit terminal 2

- **If 11 V or greater**

1. Ignition OFF, disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module, ignition ON.

2. Test for less than 1 V between the control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If less than 11 V**

5. Ignition OFF.
6. Test for greater than 25 ohms between each control circuit terminal listed below and ground:
 - Control circuit terminal 1
 - Control circuit terminal 2
 - **If 25 ohms or less**
 1. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If greater than 25 ohms**
7. Install a 3 A fused jumper wire between the control circuit terminals 1 and 2, ignition ON.
8. Verify the appropriate scan tool Deployment Loop Resistance parameter is less than 2 ohms.
 - **If 2 ohms or greater**
 1. Ignition OFF, disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 2. Test for less than 2 ohms in each control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If less than 2 ohms**
9. Ignition OFF, connect the harness connector at the F106 Seat Side Air Bag, press in the CPA (if equipped) until an audible and/or tactile click is heard.
10. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
11. Verify DTC B0014, B0021, B0031, or B0038 is not set.
 - **If DTC B0014, B0021, B0031, or B0038 is set**

Test or replace the F106 Seat Side Air Bag.
 - **If DTC B0014, B0021, B0031, or B0038 is not set**
12. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Front Seat Outboard Seat Back Airbag Replacement**
- **Rear Seat Outboard Seat Back Airbag Replacement**
- **Control Module References** for inflatable restraint sensing and diagnostic module replacement, programming, and setup

DTC B0015, B001A, B001B, OR B0022: SEAT BELT RETRACTOR PRETENSIONER DEPLOYMENT

LOOP/SEAT BELT ANCHOR PRETENSIONER DEPLOYMENT LOOP

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0015 01

Driver Seat Belt Retractor Pretensioner Deployment Loop Short to Battery

DTC B0015 02

Driver Seat Belt Retractor Pretensioner Deployment Loop Short to Ground

DTC B0015 04

Driver Seat Belt Retractor Pretensioner Deployment Loop Open

DTC B0015 0D

Driver Seat Belt Retractor Pretensioner Deployment Loop High Resistance

DTC B0015 0E

Driver Seat Belt Retractor Pretensioner Deployment Loop Low Resistance

DTC B001A 01

Driver Seat Belt Anchor Pretensioner Deployment Loop Short to Battery

DTC B001A 02

Driver Seat Belt Anchor Pretensioner Deployment Loop Short to Ground

DTC B001A 04

Driver Seat Belt Anchor Pretensioner Deployment Loop Open

DTC B001A 0D

Driver Seat Belt Anchor Pretensioner Deployment Loop High Resistance

DTC B001A 0E

Driver Seat Belt Anchor Pretensioner Deployment Loop Low Resistance

DTC B001B 01

Passenger Seat Belt Anchor Pretensioner Deployment Loop Short to Battery

DTC B001B 02

Passenger Seat Belt Anchor Pretensioner Deployment Loop Short to Ground

DTC B001B 04

Passenger Seat Belt Anchor Pretensioner Deployment Loop Open

DTC B001B 0D

Passenger Seat Belt Anchor Pretensioner Deployment Loop High Resistance

DTC B001B 0E

Passenger Seat Belt Anchor Pretensioner Deployment Loop Low Resistance

DTC B0022 01

Passenger Seat Belt Retractor Pretensioner Deployment Loop Short to Battery

DTC B0022 02

Passenger Seat Belt Retractor Pretensioner Deployment Loop Short to Ground

DTC B0022 04

Passenger Seat Belt Retractor Pretensioner Deployment Loop Open Circuit

DTC B0022 0D

Passenger Seat Belt Retractor Pretensioner Deployment Loop High Resistance

DTC B0022 0E

Passenger Seat Belt Retractor Pretensioner Deployment Loop Low Resistance

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Driver Seat Belt Retractor	B0015 02,		B0015 04,		

Pretensioner High Control	B0015 0E	B0015 0D	B0015 0D	B0015 01	-
Driver Seat Belt Retractor Pretensioner Low Control	B0015 02, B0015 0E	B0015 0D	B0015 04, B0015 0D	B0015 01	-
Driver Seat Belt Anchor Pretensioner Low Control	B001A 02, B001A 0E	B001A 0D	B001A 04	B001A 01	-
Driver Seat Belt Anchor Pretensioner High Control	B001A 02, B001A 0E	B001A 0D	B001A 04	B001A 01	-
Passenger Seat Belt Anchor Pretensioner Low Control	B001B 02, B001B 0E	B001B 0D	B001B 04	B001B 01	-
Passenger Seat Belt Anchor Pretensioner High Control	B001B 02, B001B 0E	B001B 0D	B001B 04	B001B 01	-
Passenger Seat Belt Retractor Pretensioner High Control	B0022 02, B0022 0E	B0022 0D	B0022 04, B0022 0D	B0022 01	-
Passenger Seat Belt Retractor Pretensioner Low Control	B0022 02, B0022 0E	B0022 0D	B0022 04, B0022 0D	B0022 01	-

Circuit/System Description

During a side or frontal crash of sufficient force the Inflatable Restraint Sensing and Diagnostic Module will allow current to flow through the deployment loop in order to deploy an air bag or pretensioner. There are 2 shorting bars which will short together control circuits, when the connector is disconnected. This will help to prevent unwanted deployment of the air bag or pretensioner during servicing.

Conditions for Running the DTC

Ignition voltage is between 9-16 V.

Conditions for Setting the DTC

B0015 01, B001A 01, B001B 01, B0022 01

The pretensioner control circuit is shorted to voltage for 2 seconds.

B0015 02, B001A 02, B001B 02, B0022 02

The pretensioner control circuit is shorted to ground for 2 seconds.

B0015 04, B001A 04, B001B 04, B0022 04

The pretensioner control circuit is open for 2 seconds.

B0015 0D, B001A 0D, B001B 0D, B0022 0D

The pretensioner deployment loop resistance is greater than 4.2 ohms for 2 seconds.

B0015 0E, B001A 0E, B001B 0E, B0022 0E

The pretensioner deployment loop resistance is less than 1.4 ohms for 2 seconds.

Action Taken When the DTC Sets

- The Inflatable Restraint Sensing and Diagnostic Module requests the Instrument Cluster to illuminate the AIR BAG indicator.
- The Inflatable Restraint Sensing and Diagnostic Module will store a DTC, however if an event occurs the system will still attempt deployments.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aid

NOTE: **The following diagnostic aids apply for both current and history DTCs.**

An incorrectly installed CPA or incorrectly seated connector can cause a shorting bar to short both control circuits together. Check the connectors and CPAs if a DTC with symptom byte 02 or 0E is set, to ensure the shorting bars are not causing the circuits to be shorted together. Shorting bars are used in the locations listed below:

- Driver and passenger anchor or retractor pretensioners
- Inline connectors - on the side of the harness connector
- Harness side of the inflatable restraint sensing and diagnostic module connector

Terminal fretting or incorrectly seated connectors can cause an open/high resistance condition. Check the circuit terminals for fretting or incorrectly seated connector if a DTC with symptom byte 04 or 0D is set. DTCs of deployment loops which are in the seat can occur because of stress or damage to the harness due to seat movement. Move the seat to the full extend of travel while using the scan tool to observe deployment type loop parameters.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-38125-580 Terminal Release Tool Kit

Circuit/System Verification

NOTE:

- Refer to **SIR Service Precautions**.
- Inspect all terminals for damage or corrosion when disconnecting connectors. Damage or corrosion in the following requires repair or replacement of the affected component/connector.
 - Seat belt retractor pretensioner
 - Seat belt retractor pretensioner wiring harness connector
 - Seat belt anchor pretensioner
 - Seat belt anchor pretensioner wiring harness connector
 - Inflatable Restraint Sensing and Diagnostic Module
 - Inflatable Restraint Sensing and Diagnostic Module wiring harness connector
- The connector and connector position assurance (CPA) may seat independent of each other. Both the connector and CPA should seat with an audible and/or tactile click. The CPA isolates the shorting-bars within the connector allowing the deployment circuit to operate properly.
- If the condition is intermittent or cannot be duplicated, disconnect the connectors and add dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087). This procedure will correct the high resistance condition due to terminal fretting corrosion.

1. Verify the scan tool Deployment Loop Resistance parameters stay consistently between 2.1 and 4.0 ohms without any spikes or dropouts while moving the harness near each connector listed below:
 - F112 Seat Belt Retractor Pretensioner
 - F113 Seat Belt Anchor Pretensioner

- Any inline harness
- K36 Inflatable Restraint Sensing and Diagnostic Module
- **If less than 2.1 or greater than 4.0 ohms**

Refer to Circuit/System Testing.

- **If there are spikes or dropouts, perform the following**
 - Inspect each connector terminal and harness for damage or corrosion and repair as necessary.
 - Apply dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087) to each connector terminal.
 - Ensure each connector and CPA is correctly seated.
- **If within 2.1 and 4.0 ohms without any spikes or dropouts**

2. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the scan tool. It may take up to 2 minutes for all vehicle systems to power down. Disconnect the appropriate harness connector listed below:
 - F112 Seat Belt Retractor Pretensioner
 - F113 Seat Belt Anchor Pretensioner
2. Test for greater than 25 ohms between the appropriate control circuit terminals listed below:
 - F112 Seat Belt Retractor Pretensioner terminals 1 and 2
 - F113 Seat Belt Anchor Pretensioner terminals 1 and 2
 - **If 25 ohms or less**
1. Disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

NOTE: Some connectors may be equipped with shorting bars as a safety component to prevent accidental inflator deployment. When testing on a connector with shorting bars, the shorting bars must be disabled to ensure accurate test results. Insert an appropriate pick from EL-38125-580 and depress the shorting bars above the appropriate terminals. This will lift the shorting bar from the terminal and allow accurate test results. Take care not to damage the connector, shorting bar, or terminal when depressing the shorting bar.

2. Test for infinite resistance between the 2 control circuits.
 - If less than infinite resistance, repair the short between the two circuits.
 - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If greater than 25 ohms**
3. Ignition ON.
4. Test for less than 11 V between the control circuit terminals listed below and ground:

- F112 Seat Belt Retractor Pretensioner terminal 1
 - F112 Seat Belt Retractor Pretensioner terminal 2
 - F113 Seat Belt Anchor Pretensioner terminal 1
 - F113 Seat Belt Anchor Pretensioner terminal 2
 - **If 11 V or greater**
1. Ignition OFF, disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module, ignition ON.
 2. Test for less than 1 V between each control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If less than 11 V**
5. Ignition OFF. It may take up to 2 minutes for all vehicle systems to power down.
 6. Test for greater than 25 ohms between the control circuit terminals listed below and ground:
 - F112 Seat Belt Retractor Pretensioner terminal 1
 - F112 Seat Belt Retractor Pretensioner terminal 2
 - F113 Seat Belt Anchor Pretensioner terminal 1
 - F113 Seat Belt Anchor Pretensioner terminal 2
 - **If 25 ohms or less**
 1. Disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 2. Test for infinite resistance between each control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If greater than 25 ohms**
 7. Install a 3 A fused jumper wire between the appropriate control circuit terminals listed below:
 - F112 Seat Belt Retractor Pretensioner terminals 1 and 2
 - F113 Seat Belt Anchor Pretensioner terminals 1 and 2
 8. Ignition ON.
 9. Verify the scan tool Deployment Loop Resistance parameter is less than 2 ohms.
 - **If 2 ohms or greater**
 1. Ignition OFF.
 2. Disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 3. Test for less than 2 ohms in each control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If less than 2 ohms**
 10. Ignition OFF, connect the harness connector at the F112 Seat Belt Retractor Pretensioner or F113 Seat Belt Anchor Pretensioner, press in the CPA (if equipped) until an audible and/or tactile click is heard.
 11. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.

12. Verify DTC B0015, B001A, B001B, or B0022 is not set.

- **If B0015, B001A, B001B, or B0022 is set**

Replace the appropriate F112 Seat Belt Retractor Pretensioner or F113 Seat Belt Anchor Pretensioner.

- **If DTC B0015, B001A, B001B, or B0022 is not set**

13. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Front Seat Belt Anchor Plate Tensioner Replacement**
- **Driver or Passenger Seat Retractor Side Belt Replacement**
- **SIR/SRS Wiring Repairs**
- **Control Module References** for Inflatable Restraint Sensing and Diagnostic Module replacement, programming and setup

DTC B0016, B0018, B0023, OR B0025: ROOF RAIL AIR BAG DEPLOYMENT LOOP

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0016 01

Left Roof Rail Air Bag Deployment Loop Short to Battery

DTC B0016 02

Left Roof Rail Air Bag Deployment Loop Short to Ground

DTC B0016 04

Left Roof Rail Air Bag Deployment Loop Open

DTC B0016 0D

Left Roof Rail Air Bag Deployment Loop High Resistance

DTC B0016 0E

Left Roof Rail Air Bag Deployment Loop Low Resistance

DTC B0023 01

Right Roof Rail Air Bag Deployment Loop Short to Battery

DTC B0023 02

Right Roof Rail Air Bag Deployment Loop Short to Ground

DTC B0023 04

Right Roof Rail Air Bag Deployment Loop Open

DTC B0023 0D

Right Roof Rail Air Bag Deployment Loop High Resistance

DTC B0023 0E

Right Roof Rail Air Bag Deployment Loop Low Resistance

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Left Roof Rail Air Bag High Control	B0016 02, B0016 0E	B0016 0D	B0016 04, B0016 0D	B0016 01	-
Left Roof Rail Air Bag Low Control	B0016 02, B0016 0E	B0016 0D	B0016 04, B0016 0D	B0016 01	-
Right Roof Rail Air Bag High Control	B0023 02, B0023 0E	B0023 0D	B0023 04, B0023 0D	B0023 01	-
Right Roof Rail Air Bag Low Control	B0023 02, B0023 0E	B0023 0D	B0023 04, B0023 0D	B0023 01	-

Circuit/System Description

During a side or frontal crash of sufficient force the inflatable restraint sensing and diagnostic module (SDM) will allow current to flow through the deployment loop in order to deploy an air bag or pretensioner. There are 2 shorting bars which will short together control circuits, when the connector is disconnected. This will help to prevent unwanted deployment of the air bag or pretensioner during servicing.

Conditions for Running the DTC

Ignition voltage is between 9-16 V.

Conditions for Setting the DTC

B0016 01, B0023 01

The air bag control circuit is shorted to voltage for 2 seconds.

B0016 02, B0023 02

The air bag control circuit is shorted to ground for 2 seconds.

B0016 04, B0023 04

The air bag control circuit is open for 2 seconds.

B0016 0D, B0023 0D

The air bag deployment loop resistance is greater than 4.2 ohms for 2 seconds.

B0016 0E, B0023 0E

The air bag deployment loop resistance is less than 1.4 ohms for 2 seconds.

Action Taken When the DTC Sets

- The inflatable restraint sensing and diagnostic module requests the instrument cluster to illuminate the AIR BAG indicator.
- The inflatable restraint sensing and diagnostic module will store a DTC, however if an event occurs the system will still attempt deployments.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aid

NOTE: **The following diagnostic aids apply for both current and history DTCs.**

An incorrectly installed connector position assurance (CPA) or incorrectly seated connector can cause a shorting bar to short both control circuits together. Check the connectors and CPAs if a DTC with symptom byte 02 or 0E is set, to ensure the shorting bars are not causing the circuits to be shorted together. Shorting bars are used in the locations listed below:

- Left and right roof rail air bags
- Inline harness connectors
- Harness side of the inflatable restraint sensing and diagnostic module connector

Terminal fretting or incorrectly seated connectors can cause an open/high resistance condition. Check the circuit terminals for fretting or incorrectly seated connector if a DTC with symptom byte 04 or 0D is set. DTCs of deployment loops which are in the seat DTC can occur because of stress or damage to the harness due to seat movement. Move the seat to the full extent of travel while using the scan tool to observe deployment type loop parameters.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-38125-580 Terminal Release Tool Kit

Circuit/System Verification

NOTE:

- **Refer to SIR Service Precautions.**
- **Inspect all terminals for damage or corrosion when disconnecting connectors. Damage or corrosion in the following requires repair or replacement of the affected component/connector.**
 - **Roof rail air bag**
 - **Roof rail air bag wiring harness connector**
 - **Inflatable restraint sensing and diagnostic module**
 - **Inflatable restraint sensing and diagnostic module wiring harness**

connector

- The connector and connector position assurance (CPA) may seat independent of each other. Both the connector and CPA should seat with an audible and/or tactile click. The CPA isolates the shorting-bars within the connector allowing the deployment circuit to operate properly.
- If the condition is intermittent or cannot be duplicated, disconnect the connectors and add dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087). This procedure will correct the high resistance condition due to terminal fretting corrosion.

1. Verify the appropriate scan tool Deployment Loop Resistance parameter stays consistently between 2.1 and 4.0 ohms without any spikes or dropouts while moving the harness near each connector listed below:
 - F105L Roof Rail Air Bag - Left
 - F105R Roof Rail Air Bag - Right
 - Any inline harness connector
 - K36 inflatable restraint sensing and diagnostic module
 - **If less than 2.1 or greater than 4.0 ohms**

Refer to Circuit/System Testing.

- **If there are spikes or dropouts, perform the following**
 - Inspect each connector terminal and harness for damage or corrosion and repair as necessary
 - Ensure each connector and CPA is correctly seated.
- **If within 2.1 and 4.0 ohms without any spikes or dropouts**

2. All OK

Circuit/System Testing

1. Ignition OFF. Scan tool disconnected. Disconnect the harness connector at the appropriate F105 Roof Rail Air Bag. It may take up to 2 min for all vehicle systems to power down.
2. Test for greater than 25 ohms between the control circuit terminals 1 and 2.
 - **If 25 ohms or less**
 1. Disconnect the X2 harness connector at the K36 inflatable restraint sensing and diagnostic module.

NOTE: Some connectors may be equipped with shorting bars as a safety component to prevent accidental inflator deployment. When testing on a connector with shorting bars, the shorting bars must be disabled to ensure accurate test results. Insert an appropriate pick from EL-38125-580 and depress the shorting bars above the appropriate terminals. This will lift the shorting bar from the terminal and allow accurate test results. Take care not to damage the connector, shorting bar, or terminal when depressing the shorting bar.

2. Test for infinite resistance between the two control circuits.
 - If less than infinite resistance, repair the short between the two circuits.
 - If infinite resistance, replace the K36 inflatable restraint sensing and diagnostic module.
 - **If greater than 25 ohms**
3. Ignition ON.
4. Test for less than 11 V between the control circuit terminals listed below and ground:
 - Control circuit terminal 1
 - Control circuit terminal 2
 - **If 11 V or greater**
 1. Ignition OFF. Disconnect the X2 harness connector at the K36 inflatable restraint sensing and diagnostic module. Ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K36 inflatable restraint sensing and diagnostic module.
 - **If less than 11 V**
5. Ignition OFF.
6. Test for greater than 25 ohms between the control circuit terminals listed below and ground:
 - Control circuit terminal 1
 - Control circuit terminal 2
 - **If 25 ohms or less**
 1. Disconnect the X2 harness connector at the K36 inflatable restraint sensing and diagnostic module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K36 inflatable restraint sensing and diagnostic module.
 - **If greater than 25 ohms**
7. Ignition OFF. Install a 3 A fused jumper wire between the control circuit terminals 1 and 2. Ignition ON.
8. Verify the scan tool Deployment Loop Resistance parameter is less than 2 ohms.
 - **If 2 ohms or greater**
 1. Ignition OFF. Disconnect the X2 harness connector at the K36 inflatable restraint sensing and diagnostic module.
 2. Test for less than 2 ohms in each control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K36 inflatable restraint sensing and diagnostic module.
 - **If less than 2 ohms**
9. Ignition OFF, connect the harness connector at the F105 Roof Rail Air Bag, press in the CPA (if equipped) until an audible and/or tactile click is heard.
10. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
11. Verify DTC B0016 or B0023 is not set.

- **If DTC B0016 or B0023 is set**

Test or replace the F105 Roof Rail Air Bag.

- **If DTC B0016 or B0023 is not set**

12. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Airbag Roof Side Rail Module Replacement**
- **SIR/SRS Wiring Repairs**
- **Control Module References** for inflatable restraint sensing and diagnostic module replacement, programming and setup

DTC B0017 OR B0024: KNEE AIR BAG DEPLOYMENT LOOP

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0017 01

Driver Knee Air Bag Deployment Loop Short to Battery

DTC B0017 02

Driver Knee Air Bag Deployment Loop Short to Ground

DTC B0017 04

Driver Knee Air Bag Deployment Loop Open

DTC B0017 0D

Driver Knee Air Bag Deployment Loop High Resistance

DTC B0017 0E

Driver Knee Air Bag Deployment Loop Low Resistance

DTC B0024 01

Passenger Knee Air Bag Deployment Loop Short to Battery

DTC B0024 02

Passenger Knee Air Bag Deployment Loop Short to Ground

DTC B0024 04

Passenger Knee Air Bag Deployment Loop Open

DTC B0024 0D

Passenger Knee Air Bag Deployment Loop High Resistance

DTC B0024 0E

Passenger Knee Air Bag Deployment Loop Low Resistance

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Driver Knee Air Bag High Control	B0017 02, B0017 0E	B0017 0D	B0017 04, B0017 0D	B0017 01	-
Driver Knee Air Bag Low Control	B0017 02, B0017 0E	B0017 0D	B0017 04, B0017 0D	B0017 01	-
Passenger Knee Air Bag High Control	B0024 02, B0024 0E	B0024 0D	B0024 04, B0024 0D	B0024 01	-
Passenger Knee Air Bag Low Control	B0024 02, B0024 0E	B0024 0D	B0024 04, B0024 0D	B0024 01	-

Circuit/System Description

During a side or frontal crash of sufficient force the Inflatable Restraint Sensing and Diagnostic Module (SDM) will allow current to flow through the deployment loop in order to deploy an air bag. There are two shorting bars used within the connector that will short together the control circuits, when the connector is disconnected. This will help to prevent unwanted deployment of the air bag or retractor pretensioner during servicing.

Conditions for Running the DTC

Ignition voltage is between 9-16 V.

Conditions for Setting the DTC

B0017 01, B0024 01

The air bag control circuit is shorted to voltage for 2 seconds.

B0017 02, B0024 02

The air bag control circuit is shorted to ground for 2 seconds.

B0017 04, B0024 04

The air bag control circuit is open for 2 seconds.

B0017 0D, B0024 0D

The air bag deployment loop resistance is greater than 4.2 ohms for 2 seconds.

B0017 0E, B0024 0E

The air bag deployment loop resistance is less than 1.4 ohms for 2 seconds.

Action Taken When the DTC Sets

- The Inflatable Restraint Sensing and Diagnostic Module requests the instrument cluster to illuminate the AIR BAG indicator.
- The Inflatable Restraint Sensing and Diagnostic Module will store a DTC, however if an event occurs the system will still attempt deployments.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aid

NOTE: **The following diagnostic aids apply for both current and history DTCs.**

An incorrectly installed connector position assurance (CPA) or incorrectly seated connector can cause a shorting bar to short both control circuits together. Check the connectors and CPAs if a DTC with symptom byte 02 or 0E is set, to ensure the shorting bars are not causing the circuits to be shorted together. Shorting bars are used in the locations listed below:

- Driver and passenger knee air bags
- Inline harness connectors
- Harness side of the inflatable restraint sensing and diagnostic module connector

Terminal fretting or incorrectly seated connector can cause an open/high resistance condition. Check the circuit terminals for fretting or incorrectly seated connector if a DTC with symptom byte 04 or 0D is set.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- Circuit Testing
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs
- Connector Repairs

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-38125-580 Terminal Release Tool Kit

Circuit/System Verification

NOTE:

- Refer to SIR Service Precautions.
- Inspect all terminals for damage or corrosion when disconnecting connectors. Damage or corrosion in the following requires repair or replacement of the affected component/connector.
 - Knee air bag
 - Inflatable restraint sensing and diagnostic module
 - All wiring harness connectors
 - Inflatable restraint sensing and diagnostic module wiring harness connector
- The connector and connector position assurance (CPA) may seat independent of each other. Both the connector and CPA should seat with an audible and/or tactile click. The CPA isolates the shorting-bars within the connector allowing the deployment circuit to operate properly.

- **If the condition is intermittent or cannot be duplicated, disconnect the connectors and add dielectric grease/lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087). This procedure will correct the high resistance condition due to terminal fretting corrosion.**

1. Verify the scan tool Deployment Loop Resistance parameters stay consistently between 2.1 and 4.0 ohms without any spikes or dropouts while moving the harness near each connector listed below:

- F114D Knee Air Bag - Driver
- F114P Knee Air Bag - Passenger
- Any inline harness connector
- K36 Inflatable Restraint Sensing and Diagnostic Module
- **If less than 2.1 or greater than 4.0 ohms**

Refer to Circuit/System Testing.

- **If there are spikes or dropouts, perform the following:**
 - Inspect each connector terminal and harness for damage or corrosion and repair as necessary.
 - Apply dielectric grease/lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087) to each connector terminal
 - Ensure each connector and CPA is correctly seated
 - **If between 2.1 and 4.0 ohms without any spikes or dropouts**

2. All OK

Circuit/System Testing

1. Ignition OFF, disconnect the scan tool and disconnect the harness connector at the appropriate F114 Knee Air Bag.
2. Test for greater than 25 ohms between the control circuit terminals 1 and 2.
 - **If 25 ohms or less**
 1. Disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

NOTE: Some connectors may be equipped with shorting bars as a safety component to prevent accidental inflator deployment. When testing on a connector with shorting bars, the shorting bars must be disabled to ensure accurate test results. Insert an appropriate pick from EL-38125-580 and depress the shorting bars above the appropriate terminals. This will lift the shorting bar from the terminal and allow accurate test results. Take care not to damage the connector, shorting bar, or terminal when depressing the shorting bar.

2. Test for infinite resistance between the 2 control circuits.

- If less than infinite resistance, repair the short between the 2 circuits.
 - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
- **If greater than 25 ohms**
- 3. Ignition ON.
- 4. Test for less than 11 V between the control circuit terminals listed below and ground:
 - Control circuit terminal 1
 - Control circuit terminal 2
 - **If 11 V or greater**
 - 1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module, ignition ON.
 - 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If less than 11 V**
- 5. Ignition OFF.
- 6. Test for greater than 25 ohms between the control circuit terminals listed below and ground:
 - Control circuit terminal 1
 - Control circuit terminal 2
 - **If 25 ohms or less**
 - 1. Disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If greater than 25 ohms**
- 7. Install a 3 A fused jumper wire between the control circuit terminals 1 and 2, ignition ON.
- 8. Verify the scan tool Deployment Loop Resistance parameter is less than 2 ohms.
 - **If 2 ohms or greater**
 - 1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - 2. Test for less than 2 ohms in each control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If less than 2 ohms**
- 9. Ignition OFF, connect the harness connector at the F114 Knee Air Bag, press in the CPA (if equipped) until an audible and/or tactile click is heard.
- 10. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
- 11. Verify DTC B0017 or B0024 is not set.

- **If DTC B0017 or B0024 is set**

Replace the appropriate F114 Knee Air Bag.

- **If DTC B0017 or B0024 is not set**

12. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Instrument Panel Lower Airbag Replacement - Driver Side**
- **Instrument Panel Lower Airbag Replacement - Passenger Side**
- **Control Module References** for K36 Inflatable Restraint Sensing and Diagnostic Module replacement, programming, and setup

DTC B0019 OR B0020: PASSENGER INSTRUMENT PANEL AIR BAG DEPLOYMENT LOOP

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0019 01

Passenger Instrument Panel Air Bag Deployment Loop Stage 1 Short to Battery

DTC B0019 02

Passenger Instrument Panel Air Bag Deployment Loop Stage 1 Short to Ground

DTC B0019 04

Passenger Instrument Panel Air Bag Deployment Loop Stage 1 Open

DTC B0019 0D

Passenger Instrument Panel Air Bag Deployment Loop Stage 1 High Resistance

DTC B0019 0E

Passenger Instrument Panel Air Bag Deployment Loop Stage 1 Low Resistance

DTC B0020 01

Passenger Instrument Panel Air Bag Deployment Loop Stage 2 Short to Battery

DTC B0020 02

Passenger Instrument Panel Air Bag Deployment Loop Stage 2 Short to Ground

DTC B0020 04

Passenger Instrument Panel Air Bag Deployment Loop Stage 2 Open

DTC B0020 0D

Passenger Instrument Panel Air Bag Deployment Loop Stage 2 High Resistance

DTC B0020 0E

Passenger Instrument Panel Air Bag Deployment Loop Stage 2 Low Resistance

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Passenger Instrument Panel Air Bag Stage 1 High Control	B0019 02, B0019 0E	B0019 0D	B0019 04, B0019 0D	B0019 01	-
Passenger Instrument Panel Air Bag Stage 1 Low Control	B0019 02, B0019 0E	B0019 0D	B0019 04, B0019 0D	B0019 01	-
Passenger Instrument Panel Air Bag Stage 2 High Control	B0020 02, B0020 0E	B0020 0D	B0020 04, B0020 0D	B0020 01	-
Passenger Instrument Panel Air Bag Stage 2 Low Control	B0020 02, B0020 0E	B0020 0D	B0020 04, B0020 0D	B0020 01	-

Circuit/System Description

During a side or frontal crash of sufficient force the Inflatable Restraint Sensing and Diagnostic Module (SDM) will allow current to flow through the deployment loop in order to deploy an air bag or pretensioner. There are two shorting bars which will short the control circuits together when the connector is disconnected. This will help to prevent unwanted deployment of the air bag or pretensioner during servicing.

Conditions for Running the DTC

Ignition voltage is between 9-16 V.

Conditions for Setting the DTC

B0019 01, B0020 01

The air bag control circuit is shorted to voltage for 2 seconds.

B0019 02, B0020 02

The air bag control circuit is shorted to ground for 2 seconds.

B0019 04, B0020 04

The air bag control circuit is open for 2 seconds.

B0019 0D, B0020 0D

The air bag deployment loop resistance is greater than 4.2 ohms for 2 seconds.

B0019 0E, B0020 0E

The air bag deployment loop resistance is less than 1.4 ohms for 2 seconds.

Action Taken When the DTC Sets

- The Inflatable Restraint Sensing and Diagnostic Module requests the instrument cluster to illuminate the AIR BAG indicator.
- The Inflatable Restraint Sensing and Diagnostic Module will store a DTC, however if an event occurs the system will still attempt deployments.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aid

NOTE: **The following diagnostic aids apply for both current and history DTCs.**

An incorrectly installed connector position assurance (CPA) or incorrectly seated connector can cause a shorting bar to short both control circuits together. Check the connectors and CPAs if a DTC with symptom byte 02 or 0E is set, to ensure the shorting bars are not causing the circuits to be shorted together. Shorting bars are used in the locations listed below:

- Passenger Instrument Panel Air Bag
- Inline harness connectors
- Harness side of the Inflatable Restraint Sensing and Diagnostic Module connector

Terminal fretting or incorrectly seated connector can cause an open/high resistance condition. Check the circuit terminals for fretting or incorrectly seated connector if a DTC with symptom byte 04 or 0D is set.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-38125-580 Terminal Release Tool Kit

Circuit/System Verification

NOTE:

- Refer to **SIR Service Precautions**.
- Inspect all terminals for damage or corrosion when disconnecting connectors. Damage or corrosion in the following requires repair or replacement of the affected component/connector.
 - Passenger Instrument Panel Air Bag
 - Inflatable Restraint Sensing and Diagnostic Module
 - Passenger Instrument Panel Air Bag wiring harness connector
 - Inflatable Restraint Sensing and Diagnostic Module wiring harness connector
- The connector and connector position assurance (CPA) may seat

independent of each other. Both the connector and CPA should seat with an audible and/or tactile click. The CPA isolates the shorting-bars within the connector allowing the deployment circuit to operate properly.

- If the condition is intermittent or cannot be duplicated, disconnect the connectors and add dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087). This procedure will correct the high resistance condition due to terminal fretting corrosion.

1. Verify the scan tool Deployment Loop Resistance parameters stay consistently between 2.1-4.0 ohms without any spikes or dropouts while moving the harness near each connector listed below:

- F101 Passenger Instrument Panel Air Bag
- Any inline harness connector
- K36 Inflatable Restraint Sensing and Diagnostic Module
- **If less than 2.1 ohms or greater than 4.0 ohms**

Refer to Circuit/System Testing.

- **If there are spikes or dropouts, perform the following**
- Inspect each connector terminal and harness for damage or corrosion and repair as necessary
- Apply dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087) to each connector terminal
- Insure each connector and CPA is correctly seated.
- **If between 2.1-4.0 ohms without any spikes or dropouts**

2. All OK.

Circuit/System Testing

1. Ignition OFF, scan tool disconnected, disconnect the appropriate X1 (DTC B0019) or X2 (DTC B0020) harness connector at the F101 Passenger instrument panel air bag. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for greater than 25 ohms between the appropriate control circuit terminals listed below:
 - F101 Passenger Instrument Panel Air Bag stage 1 control circuit terminal 1 X1 and 2 X1
 - F101 Passenger Instrument Panel Air Bag stage 2 control circuit terminal 1 X2 and 2 X2
 - **If 25 ohms or less**
1. Disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

NOTE: Some connectors may be equipped with shorting bars as a safety component to prevent accidental inflator deployment. When testing on a connector with shorting bars, the shorting bars must be disabled to ensure accurate test results. Insert an appropriate pick from EL-38125-580 and depress the shorting bars above the appropriate terminals. This will lift the shorting bar from the terminal

and allow accurate test results. Take care not to damage the connector, shorting bar, or terminal when depressing the shorting bar.

2. Test for infinite resistance between the two control circuits.
 - If less than infinite resistance, repair the short between the two circuits.
 - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If greater than 25 ohms**

3. Test for less than 11 V between each control circuit terminals listed below and ground:

- F101 Passenger Instrument Panel Air Bag control circuit terminal 1 X1
- F101 Passenger Instrument Panel Air Bag control circuit terminal 2 X1
- F101 Passenger Instrument Panel Air Bag control circuit terminal 1 X2
- F101 Passenger Instrument Panel Air Bag control circuit terminal 2 X2
- **If 11 V or greater**

Repair the short to voltage on the circuit.

- **If less than 11 V**

4. Ignition OFF.

5. Test for greater than 25 ohms between each control circuit terminals listed below and ground:

- F101 Passenger Instrument Panel Air Bag control circuit terminal 1 X1
- F101 Passenger Instrument Panel Air Bag control circuit terminal 2 X1
- F101 Passenger Instrument Panel Air Bag control circuit terminal 1 X2
- F101 Passenger Instrument Panel Air Bag control circuit terminal 2 X2
- **If 25 ohms or less**

Repair the short to ground on the circuit.

- **If greater than 25 ohms**

6. Install a 3 A fused jumper wire between the control circuit terminals listed below:

- F101 Passenger Instrument Panel Air Bag stage 1 control circuit terminal 1 X1 and 2 X1
- F101 Passenger Instrument Panel Air Bag stage 2 control circuit terminal 1 X2 and 2 X2

7. Ignition ON.

8. Verify the scan tool Deployment Loop Resistance parameter is less than 2 ohms.

- **If 2 ohms or greater**

1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
2. Test for less than 2 ohms in each control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If less than 2 ohms**

9. Ignition OFF, connect the harness connector at the F101 Passenger Instrument Panel Air Bag, press in the CPA (if equipped) until an audible and/or tactile click is heard.
10. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
11. Verify DTC B0019 or B0020 is not set.

- **If DTC B0019 or B0020 is set**

Replace the F101 Passenger Instrument Panel Air Bag.

- **If DTC B0019 or B0020 is not set**

12. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Airbag Instrument Panel Module Replacement**
- **SIR/SRS Wiring Repairs**
- **Control Module References** for Inflatable Restraint Sensing and Diagnostic Module control module replacement, programming and setup

DTC B0052: DEPLOYMENT COMMANDED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using the diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0052 00

Deployment Commanded

DTC B0052 56

Deployment Commanded Too Many Transitions

Circuit/System Description

The inflatable restraint sensing and diagnostic module (SDM) senses vehicle impacts and provides deployment signals to the air bags and anchor and/or retractor pretensioners when warranted. The inflatable restraint sensing and diagnostic module sets DTC B0052 after each command for deployment. DTC B0052 will latch and not clear after 3 commanded deployments by the inflatable restraint sensing and diagnostic module. Therefore the

inflatable restraint sensing and diagnostic module has to be replaced.

Conditions for Running the DTC

Ignition voltage is between 9-16 V.

Conditions for Setting the DTC

- The inflatable restraint sensing and diagnostic module detects a frontal impact of sufficient force to warrant deployment of the frontal air bags.
- The inflatable restraint sensing and diagnostic module detects a side impact or rollover (if equipped) of sufficient force to warrant deployment of a seat air bag and/or roof rail air bag.

Action Taken When the DTC Sets

The inflatable restraint sensing and diagnostic module requests the instrument cluster to illuminate the AIR BAG indicator.

Conditions for Clearing the DTC

- DTC B0052 00 is a DTC that may be cleared with a scan tool without replacing the inflatable restraint sensing and diagnostic module. This DTC will not clear if deployment has been commanded more than two times, and the inflatable restraint sensing and diagnostic module would have to be replaced.
- DTC B0052 56 is a latched DTC. The DTC cannot be cleared with the scan tool. Replacement of the inflatable restraint sensing and diagnostic module is required.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that DTC B0052 00 is not set.

- **If DTC B0052 00 is set**

Clear the DTC. If the DTC will not clear, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If DTC B0052 00 is not set**

2. Verify that DTC B0052 56 is not set.

- **If DTC B0052 56 is set**

Replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If DTC B0052 56 is not set**

3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for inflatable restraint sensing and diagnostic module replacement, programming and setup

DTC B0071: PASSENGER SEAT BELT TENSION SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0071 03

Passenger Seat Belt Tension Sensor Circuit Voltage Below Threshold

DTC B0071 04

Passenger Seat Belt Tension Sensor Circuit Open

DTC B0071 07

Passenger Seat Belt Tension Sensor Circuit Voltage Above Threshold

DTC B0071 08

Passenger Seat Belt Tension Sensor Circuit Voltage Performance - Signal Invalid

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Passenger Seat Belt Tension Sensor Signal	B0071 03	-	B0071 04	B0071 07	B0071 08
Passenger Seat Belt Tension Sensor Voltage Reference	B0071 03	-	B0071 03	-	-
Passenger Seat Belt Tension Sensor Low Reference	-	-	B0071 07	-	-

Circuit/System Description

The seat belt tension sensor is a 2-wire sensor mounted inside the passenger seat belt buckle and provides an input to the Passenger Presence Sensor. When an infant car seat is properly restrained on the front passenger seat, the seat belt is tightly secured through the car seat. The seat belt pulls on the tension sensor and changes the voltage signal to the Passenger Presence Sensor. The Passenger Presence Sensor monitors the belt tension sensor signal circuit and if a fault is detected, DTC will be set. When the Passenger Presence Sensor detects this DTC it will send out a serial data message and the Inflatable Restraint Sensing and Diagnostic Module will notify the customer of the enable/disable status by illuminating the OFF indicator on the PASSENGER AIR BAG ON/OFF indicators. The Inflatable Restraint Sensing and Diagnostic Module will then suppress the deployment of the passenger instrument panel air bag and illuminate the AIR BAG indicator.

Conditions for Running the DTC

Ignition voltage is between 9-16 volts.

Conditions for Setting the DTC

- The Passenger Presence Sensor detects the voltage at the passenger seat belt tension sensor signal circuit is less than 0.5 volt or greater than 4.5 volts for 1 second.
- The Passenger Presence Sensor detects the voltage at the passenger seat belt tension sensor voltage reference circuit is less than 4.5 volts or greater than 9.1 volts for 1 second.
- The Passenger Presence Sensor detects the amperage at the passenger seat belt tension sensor low reference circuit is 25 MA or greater for 1 second.

Action Taken When the DTC Sets

- The Passenger Presence Sensor will set a DTC, and then communicate with the Inflatable Restraint Sensing and Diagnostic Module.
- The Inflatable Restraint Sensing and Diagnostic Module will set DTC B0081
- The Inflatable Restraint Sensing and Diagnostic Module disables the passenger instrument panel air bag.
- The Passenger Presence Sensor will illuminate the passenger air bag status OFF indicator.
- The Inflatable Restraint Sensing and Diagnostic Module requests the instrument panel to illuminate the AIR BAG indicator.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aids

Inspect the passenger seat belt tension sensor signal, voltage reference, and low reference circuits carefully for cutting and/or chafing.

Reference Information

Schematic Reference

Seat Belt Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

NOTE: The seat belt buckle replacement with the seat belt tension sensor must be serviced as a complete unit.

When removing connectors, inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected component/connector:

- **Passenger Seat Belt Tension Sensor**
- **Passenger Presence Sensor**
- **Passenger Seat Belt Tension Sensor wiring harness connector**
- **Passenger Presence Sensor wiring harness connector**

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B153P Seat Belt Buckle-Passenger. It may take up to 2 minutes for all vehicle systems to power down.
2. Ignition ON, test for less than 1 V between the passenger seat belt tension sensor signal circuit terminal 5 and ground.
 - **If 1 V or greater**
 1. Ignition OFF, disconnect the harness connector at the K85 Passenger Presence Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the B60 Passenger Presence Sensor.
3. Test for greater than 25 ohms between the passenger seat belt tension sensor signal circuit terminal 5 and ground.
 - **If 25 ohms or less**
 1. Ignition OFF, disconnect the harness connector at the K85 Passenger Presence Module. It may take up to 2 minutes for all vehicle systems to power down.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the B60 Passenger Presence Sensor.
 - **If greater than 25 ohms**
4. Ignition OFF, disconnect the harness connector at the K85 Passenger Presence Module. It may take up to 2 minutes for all vehicle systems to power down.
5. Test for less than 2 ohms between the Passenger Presence Sensor signal circuit terminal 5 and the passenger seat belt tension sensor terminal 5.
 - **If 2 ohms or greater**

Repair the open/high resistance in the circuit

- **If less than 2 ohms**
6. If all circuits test normal, replace the B153P Seat Belt Buckle-Passenger.
 7. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.

8. Verify DTC B0071 does not set.

- **If DTC B0071 is set**

Replace the K85 Passenger Presence Module.

- **If DTC B0071 is not set**

9. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **SIR/SRS Wiring Repairs**
- **Front Seat Belt Buckle Replacement**
- **Control Module References** for Passenger Presence Sensor replacement, setup, and programming

DTC B0074: PASSENGER PRESENCE SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0074 0D

Passenger Presence Sensor High Resistance

DTC B0074 0E

Passenger Presence Sensor Low Resistance

Circuit/System Description

The Passenger Presence Detection Module monitors the sensor status continually. Whenever the sensor mat has an internal malfunction, the Passenger Presence Detection Module will set DTC B0074.

Conditions for Running the DTC

Ignition voltage is between 9-16 V.

Conditions for Setting the DTC

B0074 0D

The Passenger Presence Detection Module has detected a disconnection from the sensor mat.

B0074 0E

The Passenger Presence Detection Module has detected an open circuit.

The Passenger Presence Detection Module has received a fault signal from the sensor mat.

Action Taken When the DTC Sets

The Inflatable Restraint Sensing and Diagnostic Module requests the instrument cluster to illuminate the AIR BAG indicator.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aids

- If either the Inflatable Restraint Sensing and Diagnostic Module or Passenger Presence Sensor were replaced verify that the correct part numbers were used for the vehicle application.
- If this DTC is set as either current or history it may have been caused by an electronic device. If an electronic device (Computers, MP3 Players, Cell Phones, Diagnostic Scan Tool, Power Inverter, etc.) was placed on the passenger seat the Passenger Presence Detection Module may command the passenger air bag indicator to turn on and/or command the passenger seat belt indicator to turn on. Make sure there are no objects on the passenger seat and clear the DTCs. If this DTC resets then perform this diagnostic. If the DTC does not reset there is no further work needed on the passenger presence system.
- If this DTC is set as either current or history it may have been caused by an aftermarket seat heater. The aftermarket seat heater may command the passenger air bag indicator to turn on and/or command the passenger seat belt indicator to turn on. Remove the aftermarket seat heater from the passenger seat and clear the DTCs. If this DTC resets then perform this diagnostic. If the DTC does not reset there is no further work needed on the passenger presence system.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

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Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Connector Repairs**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: This system allows you to service each component separately (module and sensor/sensing mat). Perform a passenger presence system preload test procedure whenever a component is replaced. Refer to **Passenger Presence System Programming and Setup** . Inspect the following component connectors for damage or corrosion. Repair or replace the affected component/connector:

- Passenger Presence Sensor
- Passenger Presence Sensor harness connector
- Passenger Presence Detection Module
- Passenger Presence Detection Module harness connector
- Seat wiring harness to vehicle harness connector

The connector and connector position assurance (CPA) may seat independent of each other. Both the connector and CPA should seat with an audible and/or tactile click.

This system is serviced as a kit (seat foam, module, and/or sensing mat). Perform a Passenger Presence System Preload procedure whenever a component is replaced. Inspect the following component connectors for damage or corrosion. Repair or replace the affected component/connector:

1. Verify that the seat is free of any objects or an aftermarket seat heater.
 - **If objects or an aftermarket seat heater is present**
 1. Remove objects and/or aftermarket seat heater.
 2. Ignition ON, clear the DTC.
 3. Verify that DTC B0074 is not set
 - If the DTC B0074 is set, replace the B60 Passenger Presence Sensor
 - If the DTC B0074 is not set
 4. All OK.
 - **If the seat is empty and does not have an aftermarket seat heater**

2. Verify that DTC B0074 stays current while performing the following:

- Moving the passenger seat forward and backward through its full range of motion.
- Moving the harness near the K85 Passenger Presence Detection Module.
- If applicable, moving the harness near the Passenger Presence Sensor.
- Moving the harness near any seat harness.
- **If DTC B0074 becomes history**

Insure each connector and CPA is correctly seated and inspect each connector terminal for damage or corrosion and repair as necessary.

- **If DTC B0074 stays current**

3. Replace the B60 Passenger Presence Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for B60 Passenger Presence Sensor replacement

DTC B0081: PASSENGER PRESENCE MODULE (INFLATABLE RESTRAINT SENSING AND DIAGNOSTIC MODULE)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0081 00

Passenger Presence Module Malfunction

DTC B0081 3A

Passenger Presence Module Incorrect Component Installed

DTC B0081 71

Passenger Presence Module Invalid Data

Circuit/System Description

When the ignition is turned ON, the inflatable restraint sensing and diagnostic module and the passenger

presence module perform tests to diagnose critical malfunctions. Upon a successful power-up mode the inflatable restraint sensing and diagnostic module will illuminate both PASSENGER AIRBAG ON/OFF indicators. If the inflatable restraint sensing and diagnostic module detects a fault in the passenger presence module, it may disable the passenger instrument panel air bag deployment loop and/or illuminate the AIRBAG indicator.

Conditions for Running the DTC

Ignition voltage is between 9-16 V.

Conditions for Setting the DTC

B0081 00

The inflatable restraint sensing and diagnostic module has received a fault present message from the passenger presence module.

B0081 3A

The inflatable restraint sensing and diagnostic module has received a message from the passenger presence module indicating a vehicle and passenger presence module mismatch.

B0081 71

The inflatable restraint sensing and diagnostic module has received invalid data from the passenger presence module.

Action Taken When the DTC Sets

- The inflatable restraint sensing and diagnostic module requests the instrument cluster to illuminate the AIR BAG indicator.
- The passenger instrument panel air bag deployment loop will be disabled.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aids

If either the inflatable restraint sensing and diagnostic module or passenger presence module were replaced verify that the correct part numbers were used for the vehicle application.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

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Description and Operation

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Electrical Information Reference

- **Circuit Testing**
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- **Connector Repairs**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: Both K36 Inflatable Restraint Sensing and Diagnostic Module and K85 Passenger Presence Module set DTC B0081 but with different symptom bytes. Therefore it is important to identify which module has set the DTC B0081. Use the symptom bytes as a way of identify the correct module to diagnose.

1. Verify that DTC B1001 is not set in the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If DTC B1001 is set in the K36 Inflatable Restraint Sensing and Diagnostic Module**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If DTC B1001 is not set in the K36 Inflatable Restraint Sensing and Diagnostic Module**

2. Verify that DTC B0071, B0074, B0081, B101D, or B101E is not set in the K85 Passenger Presence Module.

- **If any of these DTCs are set in the K85 Passenger Presence Module**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If none of these DTCs are set in the K85 Passenger Presence Module**

3. Verify that DTC B0081 symptom byte 3A or 71 is not set in the K36 Inflatable Restraint Sensing and Diagnostic Module.

NOTE: The K36 Inflatable Restraint Sensing and Diagnostic Module sets a DTC

B0081 3A when an incorrect K85 Passenger Presence Module is installed.

- If DTC B0081 symptom byte 3A or 71 is set in the K36 Inflatable Restraint Sensing and Diagnostic Module

Replace the K85 Passenger Presence Module.

- If DTC B0081 symptom byte 3A or 71 is not set in the K36 Inflatable Restraint Sensing and Diagnostic Module

4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for passenger presence module and inflatable restraint sensing and diagnostic module replacement, programming and setup

DTC B0081: PASSENGER PRESENCE MODULE (PASSENGER PRESENCE SYSTEM)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0081 11

Passenger Presence Module High Input

DTC B0081 4B

Passenger Presence Module Calibration Not Learned

DTC B0081 5A

Passenger Presence Module Not Plausible

Circuit/System Description

When the ignition is turned ON, the inflatable restraint sensing and diagnostic module and the passenger presence module perform tests to diagnose critical malfunctions. Upon a successful power-up mode the inflatable restraint sensing and diagnostic module will illuminate both PASSENGER AIRBAG ON/OFF indicators. If the inflatable restraint sensing and diagnostic module detects a fault in the passenger presence module, it may disable the passenger instrument panel air bag deployment loop, set DTC B0081 and illuminate

the air bag indicator.

Conditions for Running the DTC

Ignition voltage is between 9-16 V.

Conditions for Setting the DTC

Any of the following conditions must exist for 5 s.

B0081 11

The passenger presence module has failed the rezero procedure.

B0081 4B

The passenger presence module is not calibrated.

B0081 5A

The passenger presence module sets this code when the passenger presence module has lost communication with the inflatable restraint sensing and diagnostic module.

Action Taken When the DTC Sets

- The inflatable restraint sensing and diagnostic module requests the instrument cluster to illuminate the AIR BAG indicator.
- The passenger instrument panel air bag deployment loop will be disabled.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aids

- If either the inflatable restraint sensing and diagnostic module or passenger presence module were replaced verify that the correct part numbers were used for the vehicle application.
- If this DTC is set as either current or history it may have been caused by an electronic device. If an electronic device (Computers, MP3 Players, Cell Phones, Diagnostic Scan Tool, Power Inverter, etc.) was placed on the passenger seat the passenger presence module may command the passenger air bag indicator to turn on and/or command the passenger seat belt indicator to turn on. Make sure there are no objects on the passenger seat and clear the DTCs. If this DTC resets then perform this diagnostic. If the DTC does not reset there is no further work needed on the passenger presence system.
- If this DTC is set as either current or history it may have been caused by an aftermarket seat heater. The aftermarket seat heater may command the passenger air bag indicator to turn on and/or command the passenger seat belt indicator to turn on. Remove the aftermarket seat heater from the passenger seat and

clear the DTCs. If this DTC resets then perform this diagnostic. If the DTC does not reset there is no further work needed on the passenger presence system.

Reference Information

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- This system is serviced as a kit (seat foam, module and sensing mat). Perform a passenger presence system rezero procedure whenever a component is replaced. Refer to Passenger Presence System Programming and Setup .
- Both K36 Inflatable Restraint Sensing and Diagnostic Module and K85 Passenger Presence Module set DTC B0081 but with different symptom bytes. Therefore it is important to identify which module has set the DTC B0081. Use the symptom bytes as a way of identify the correct module to diagnose.
- The K36 Inflatable Restraint Sensing and Diagnostic Module sets a B0081 3A when an incorrect K85 Passenger Presence Module is installed.

1. Verify that the seat is free of any objects or an aftermarket seat heater.
 - **If objects and/or an aftermarket seat heater is present**
 1. Remove objects and/or aftermarket seat heater.
 2. Ignition ON, clear the DTC.
 3. Verify that DTC B0081 is not set
 - If the DTC B0081 is set, replace the K85 Passenger Presence Module
 - If the DTC B0081 is not set
 4. All OK.
 - **If the seat is empty and does not have an aftermarket seat heater**
2. Verify that DTC B0081 3A is not set in the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If DTC B0081 3A is set in the K36 Inflatable Restraint Sensing and Diagnostic Module**
Replace the K85 Passenger Presence Module.
 - **If DTC B0081 3A is not set in the K36 Inflatable Restraint Sensing and Diagnostic Module**
3. Verify that DTC B0081 11 or DTC B0081 4B is not set in the K85 Passenger Presence Module.

NOTE: The K36 Inflatable Restraint Sensing and Diagnostic Module sets a redundant B0081 00 DTC when the K85 Passenger Presence Module sets a DTC B0081 11 or B0081 4B.

- If DTC B0081 11 or DTC B0081 4B is set in the K85 Passenger Presence Module

Perform the passenger presence system rezero procedure. Refer to Passenger Presence System Programming and Setup .

- If neither of these DTCs are set in the K85 Passenger Presence Module

4. Verify DTC B0081 5A is not set in the K85 Passenger Presence Module.

- If DTC B0081 5A is set in the K85 Passenger Presence Module

1. Verify the connections at the K36 Inflatable Restraint Sensing and Diagnostic Module and K85 Passenger Presence Module, for terminal corrosion, properly seated connectors, and the connector position assurance is installed.

2. Clear the DTC.

3. Verify DTC B0081 5A does not set in the K85 Passenger Presence Module.

- If DTC B0081 5A sets, replace the K85 Passenger Presence Module.

- If DTC B0081 5A does not set

4. All OK.

- If DTC B0081 5A is not set in the K85 Passenger Presence Module

5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for passenger presence module or inflatable restraint sensing and diagnostic module replacement, programming and setup

DTC B0083-B0088: FRONT/SIDE IMPACT SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptors

DTC B0083 01

Left Front Impact Sensor Short to Battery

DTC B0083 02

Left Front Impact Sensor Short to Ground

DTC B0083 04

Left Front Impact Sensor Open

DTC B0083 05

Left Front Impact Sensor High/Voltage Open

DTC B0083 0C

Left Front Impact Sensor Low Current

DTC B0083 39

Left Front Impact Sensor Internal Electronic Failure

DTC B0083 3A

Left Front Impact Sensor Incorrect Component Installed

DTC B0083 71

Left Front Impact Sensor Invalid Serial Data Received

DTC B0084 01

Right Front Impact Sensor Short to Battery

DTC B0084 02

Right Front Impact Sensor Short to Ground

DTC B0084 04

Right Front Impact Sensor Open

DTC B0084 05

Right Front Impact Sensor High/Voltage Open

DTC B0084 0C

Right Front Impact Sensor Low Current

DTC B0084 39

Right Front Impact Sensor Internal Electronic Failure

DTC B0084 3A

Right Front Impact Sensor Incorrect Component Installed

DTC B0084 71

Right Front Impact Sensor Invalid Serial Data Received

DTC B0085 01

Left Front Side Impact Sensor Short to Battery

DTC B0085 02

Left Front Side Impact Sensor Short to Ground

DTC B0085 04

Left Front Side Impact Sensor Open

DTC B0085 05

Left Front Side Impact Sensor High/Voltage Open

DTC B0085 0C

Left Front Side Impact Sensor Low Current

DTC B0085 39

Left Front Side Impact Sensor Internal Malfunction

DTC B0085 3A

Left Front Side Impact Sensor Incorrect Component Installed

DTC B0085 71

Left Front Side Impact Sensor Invalid Serial Data Received

DTC B0086 01

Right Front Side Impact Sensor Short to Battery

DTC B0086 02

Right Front Side Impact Sensor Short to Ground

DTC B0086 04

Right Front Side Impact Sensor Open

DTC B0086 05

Right Front Side Impact Sensor High/Voltage Open

DTC B0086 0C

Right Front Side Impact Sensor Low Current

DTC B0086 39

Right Front Side Impact Sensor Internal Malfunction

DTC B0086 3A

Right Front Side Impact Sensor Incorrect Component Installed

DTC B0086 71

Right Front Side Impact Sensor Invalid Data

DTC B0087 01

Left Rear Side Impact Sensor Short to Battery

DTC B0087 02

Left Rear Side Impact Sensor Short to Ground

DTC B0087 04

Left Rear Side Impact Sensor Open

DTC B0087 05

Left Rear Side Impact Sensor High/Voltage Open

DTC B0087 0C

Left Rear Side Impact Sensor Low Current

DTC B0087 39

Left Rear Side Impact Sensor Internal Malfunction

DTC B0087 3A

Left Rear Side Impact Sensor Incorrect Component Installed

DTC B0087 71

Left Rear Side Impact Sensor Invalid Serial Data Received

DTC B0088 01

Right Rear Side Impact Sensor Short to Battery

DTC B0088 02

Right Rear Side Impact Sensor Short to Ground

DTC B0088 04

Right Rear Side Impact Sensor Open

DTC B0088 05

Right Rear Side Impact Sensor High/Voltage Open

DTC B0088 0C

Right Rear Side Impact Sensor Low Current

DTC B0088 39

Right Rear Side Impact Sensor Internal Malfunction

DTC B0088 3A

Right Rear Side Impact Sensor Incorrect Component Installed

DTC B0088 71

Right Rear Side Impact Sensor Invalid Data

Diagnostic Fault Information

	Short to	Open/High	Short to	Signal
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Circuit	Ground	Resistance	Voltage	Performance
Left Front Impact Sensor High Signal	B0083 02, B0083 0C	B0083 04, B0083 05	B0083 01	B0083 3A
Left Front Impact Sensor Low Reference	B0083 02, B0083 0C	B0083 04, B0083 05	B0083 01	B0083 3A
Right Front Impact Sensor High Signal	B0084 02, B0084 0C	B0084 04, B0084 05	B0084 01	B0084 3A
Right Front Impact Sensor Low Reference	B0084 02, B0084 0C	B0084 04, B0084 05	B0084 01	B0084 3A
Left Front Side Impact Sensor High Signal	B0085 02, B0085 0C	B0085 04, B0085 05	B0085 01	B0085 39
Left Front Side Impact Low Reference	B0085 02, B0085 0C	B0085 04, B0085 05	B0085 01	B0085 39
Right Front Side Impact Sensor High Signal	B0086 02, B0086 0C	B0086 04, B0086 05	B0086 01	B0086 39
Right Front Side Impact Sensor Low Reference	B0086 02, B0086 0C	B0086 04, B0086 05	B0086 01	B0086 39
Left Rear Side Impact Sensor High Signal	B0087 02, B0087 0C	B0087 04, B0087 05	B0087 01	B0087 39
Left Rear Side Impact Sensor Low Reference	B0087 02, B0087 0C	B0087 04, B0087 05	B0087 01	B0087 39
Right Rear Side Impact Sensor High Signal	B0088 02, B0088 0C	B0088 04, B0088 05	B0088 01	B0088 39
Right Rear Side Impact Sensor Low Reference	B0088 02, B0088 0C	B0088 04, B0088 05	B0088 01	B0088 39

Circuit/System Description

The impact sensors are equipped on vehicles to supplement the Supplemental Inflatable Restraint (SIR) System performance. The impact sensors are electronic and are not part of the deployment loops, but instead provide inputs to the Inflatable Restraint Sensing and Diagnostic Module. The impact sensors can assist in determining the severity of some frontal and side collisions. The Inflatable Restraint Sensing and Diagnostic Module uses the input from the impact sensors to assist in determining the severity of a collision further supporting air bag deployment. If the Inflatable Restraint Sensing and Diagnostic Module determines a deployment is warranted, the Inflatable Restraint Sensing and Diagnostic Module will cause current to flow through the deployment loops deploying the air bags.

Conditions for Running the DTC

Ignition voltage is between 9-16 V.

Conditions for Setting the DTC

Any of the following conditions exist for 10 seconds:

B0083 01, B0084 01, B0085 01, B0086 01, B0087 01, B0088 01

The sensor has been shorted to voltage.

B0083 02, B0084 02, B0085 02, B0086 02, B0087 02, B0088 02

- The sensor has been shorted to ground.
- The sensor current is greater than 23 mA for greater than 5 milliseconds.

B0083 04, B0084 04, B0085 04, B0086 04, B0087 04, B0088 04

- The sensor circuit is open.
- The Inflatable Restraint Sensing and Diagnostic Module has not received a message from the sensor for greater than 375 milliseconds.

B0083 05, B0084 05, B0085 05, B0086 05, B0087 05, B0088 05

- The sensor circuit is open or high resistance.
- The Inflatable Restraint Sensing and Diagnostic Module has not received a message from the sensor for greater than 375 milliseconds.

B0083 0C, B0084 0C, B0085 0C, B0086 0C, B0087 0C, B0088 0C

- The sensor has been shorted to ground.
- The sensor current is greater than 23 mA for greater than 5 milliseconds.

B0083 39, B0084 39, B0085 39, B0086 39, B0087 39, B0088 39

- The Inflatable Restraint Sensing and Diagnostic Module has received a Not OK message from the sensor.
- The Inflatable Restraint Sensing and Diagnostic Module has not received a message.

B0083 3A, B0084 3A, B0085 3A, B0086 3A, B0087 3A, B0088 3A

- The Inflatable Restraint Sensing and Diagnostic Module has received identification message from the sensor, which does not match the identification stored in the Inflatable Restraint Sensing and Diagnostic Module memory.
- The Inflatable Restraint Sensing and Diagnostic Module has reset the sensor twice without detecting the correct identification message.

B0083 71, B0084 71, B0085 71, B0086 71, B0087 71, B0088 71

The Inflatable Restraint Sensing and Diagnostic Module has received invalid serial data from the sensor.

Action Taken When the DTC Sets

The Inflatable Restraint Sensing and Diagnostic Module requests the instrument panel cluster to illuminate the AIR BAG indicator.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.
- An ignition cycle is required for the DTC to go from current to history.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- Circuit Testing
- Testing for Intermittent Conditions and Poor Connections
- Connector Repairs
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- Refer to SIR Service Precautions.
- Inspect all terminals for damage or corrosion when disconnecting connectors. Damage or corrosion in the following requires repair or replacement of the affected component/connector.
 - Impact sensor
 - Inflatable Restraint Sensing and Diagnostic Module
 - Impact sensor wiring harness connector
 - Inflatable Restraint Sensing and Diagnostic Module wiring harness connector
- The connector and connector position assurance (CPA) may seat independent of each other. Both the connector and CPA should seat with

an audible and/or tactile click. The CPA isolates the shorting-bars within the connector allowing the deployment circuit to operate properly. Replace any CPA that is damaged or missing.

- **If the condition is intermittent or cannot be duplicated, disconnect the connectors and add dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087). This procedure will correct the high resistance condition due to terminal fretting corrosion.**

1. Verify that DTC B0083-B0088 symptom byte 3A, 39, or 71 is not set as current.

- **If DTC B0083-B0088 symptom byte 3A, 39 or 71 is set as current**

Replace the appropriate B59 or B63 Impact Sensor.

- **If DTC B0083-B0088 symptom byte 3A, 39 or 71 is not set as current**

2. Verify that DTC B0083-B0088 symptom byte 01, 02, 04, or 05 is not set as current.

- **If DTC B0083-B0088 symptom byte 01, 02, 04, or 05 is set as current**

Refer to Circuit/System Testing.

- **If DTC B0083-B0088 symptom byte 01, 02, 04, 05 is not set as current**

3. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the appropriate B59 or B63 Impact Sensor, wait 120 seconds.

2. Test for less than 10 ohms between the low reference circuit terminal 2 and ground.

- **If 10 ohms or greater**

1. Ignition OFF, disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

2. Test for less than 2 ohms in the low reference circuit end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If less than 10 ohms**

3. Test for greater than 50k ohms between the signal circuit terminal 1 and ground.

- **If 50k ohms or less**

1. Disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If greater than 50k ohms**

4. Ignition ON, test for less than 1 V between the signal circuit terminal 1 and ground.

- **If greater than 1 V**

1. Disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
2. Ignition ON, test for less than 1 V between the signal circuit and ground.
 - If greater than 1 V, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If less than 1 V**

5. Disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
6. Test for less than 2 ohms between the B59 or B63 Impact Sensor signal circuit end to end from the impact sensor terminal 1 and the appropriate K36 Inflatable Restraint Sensing and Diagnostic Module terminal listed below:
 - B63LF Side Impact Sensor - Left Front - Terminal 19 X2
 - B59L Front Impact Sensor - Left - Terminal 23 X2
 - B63RF Side Impact Sensor - Right Front - Terminal 22 X2
 - B59R Front Impact Sensor - Right - Terminal 26 X2
 - B63LR Side Impact Sensor - Left Rear - Terminal 27 X2
 - B63RR Side Impact Sensor - Right Rear - Terminal 30 X2
- **If 2 ohms or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 ohms**

7. Ignition OFF, connect all harness connectors, press in the CPA (if equipped) until an audible and/or tactile click is heard.
8. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
9. Verify the DTC does not set.
 - **If the DTC sets**

Replace the B59 or B63 Impact Sensor.

- **If the DTC does not set**

10. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Airbag Front End Sensor Replacement - Right Side**
- **Airbag Front End Sensor Replacement - Left Side**
- **Airbag Side Impact Center Pillar Sensor Replacement**
- **Airbag Side Impact Sensor Replacement - Front Side Door**
- **Control Module References** for Inflatable Restraint Sensing and Diagnostic Module replacement,

programming and setup

DTC B0091: FRONT IMPACT SENSO

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0091 01

Front Impact Sensor Short to Battery

DTC B0091 02

Front Impact Sensor Short to Ground

DTC B0091 04

Front Impact Sensor Open Circuit

DTC B0091 05

Front Impact Sensor High Voltage/Open

DTC B0091 0C

Front Impact Sensor Low Current

DTC B0091 39

Front Impact Sensor Internal Electronic Failure

DTC B0091 3A

Front Impact Sensor Incorrect Component Installed

DTC B0091 71

Front Impact Sensor Invalid Serial Data Received

Diagnostic Fault Information

	Short to	High		Short to	Signal
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Circuit	Ground	Resistance	Open	Voltage	Performance
Front Impact Sensor High Signal	B0091 02	B0091 04	B0091 0C, B0091 04	B0091 01, B0091 05	B0091 39, B0091 71
Front Impact Sensor Low Reference	B0091 02	B0091 04	B0091 0C, B0091 04	B0091 01	B0091 39, B0091 71

Circuit/System Description

The impact sensors are equipped on vehicles to supplement the Supplemental Inflatable Restraint (SIR) System performance. The impact sensors are electronic and are not part of the deployment loops, but instead provide inputs to the Inflatable Restraint Sensing and Diagnostic Module. The impact sensors can assist in determining the severity of some frontal and side collisions. The Inflatable Restraint Sensing and Diagnostic Module uses the input from the impact sensors to assist in determining the severity of a collision further supporting air bag deployment. If the Inflatable Restraint Sensing and Diagnostic Module determines a deployment is warranted, the Inflatable Restraint Sensing and Diagnostic Module will cause current to flow through the deployment loops deploying the appropriate air bags. The Front impact sensor and side impact sensors utilize a bidirectional 2-wire circuit. The sensors modulate current on the interface to send identification, state of health, and deployment commands to the inflatable restraint sensing and diagnostic module. The Inflatable Restraint Sensing and Diagnostic Module serves as a power source and a ground for the sensors. When the ignition is turned ON and input power from the Inflatable Restraint Sensing and Diagnostic Module is first detected, the sensors respond by performing internal diagnostics and sending an identification to the Inflatable Restraint Sensing and Diagnostic Module. The Inflatable Restraint Sensing and Diagnostic Module considers the identification to be valid if the response time is less than 5 seconds. The sensors continually communicate status messages to the Inflatable Restraint Sensing and Diagnostic Module, which determines if a fault is present in the sensor circuit. When a fault is detected, the Inflatable Restraint Sensing and Diagnostic Module may reset the sensors up to 2 times by removing and reapplying power to it. If the fault is still present, the Inflatable Restraint Sensing and Diagnostic Module will set a DTC.

Conditions for Running the DTC

Ignition voltage is between 9-16 V.

Conditions for Setting the DTC

B0091 01

The Inflatable Restraint Sensing and Diagnostic Module has detected the Front impact sensor has been shorted to voltage

B0091 02

- The Inflatable Restraint Sensing and Diagnostic Module has detected the Front impact sensor has been shorted to ground.
- The Front impact sensor current is greater than 23 mA for greater than 5 milliseconds.

B0091 04

- The Inflatable Restraint Sensing and Diagnostic Module has detected an open/high resistance in the Front impact sensor.
- The Inflatable Restraint Sensing and Diagnostic Module has not received a message from the Front impact sensor for greater than 375 milliseconds.

B0091 05 and B0091 0C

- The Inflatable Restraint Sensing and Diagnostic Module has detected the Front impact sensor has been shorted to voltage.
- The Inflatable Restraint Sensing and Diagnostic Module has detected an open/high resistance in the Front impact sensor.
- The Inflatable Restraint Sensing and Diagnostic Module has not received a message from the Front impact sensor for greater than 375 milliseconds.

B0091 39

- The Inflatable Restraint Sensing and Diagnostic Module has received a Not OK (NOK) message from the Front impact sensor.
- The Inflatable Restraint Sensing and Diagnostic Module has not received a message.

B0091 3A

- The Inflatable Restraint Sensing and Diagnostic Module has received identification message from the Front impact sensor which does not match the identification stored in the Inflatable Restraint Sensing and Diagnostic Module memory.
- The Inflatable Restraint Sensing and Diagnostic Module has reset the Front impact sensor twice without detecting the correct identification message.

B0091 71

The Inflatable Restraint Sensing and Diagnostic Module has received invalid serial data from the Front impact sensor.

Action Taken When the DTC Sets

- The Inflatable Restraint Sensing and Diagnostic Module requests the instrument panel cluster to illuminate the AIR BAG indicator.
- The SIR system is disabled and no deployments are allowed.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. For DTC B0091 39, B0091 3A and B0091 71, replace the B59 Front Impact Sensor.
2. For DTC B0091 01, B0091 02, B0091 04, B0091 05 and B0091 0C, perform the Circuit/System Testing.

Circuit/System Testing

1. Ignition OFF.
2. Disconnect the harness connector at the B59 Front Impact Sensor, wait 120 seconds.
3. Test for less than 10 ohms between the low reference circuit terminal 2 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If less than 10 ohms**
4. Test for greater than 50k ohms between the signal circuit terminal 1 and ground.
 - **If 50k ohms or less**
 1. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If greater than 50k ohms**
5. Disconnect the X2 harness connector at the Inflatable Restraint Sensing and Diagnostic Module.
6. Test for less than 2 ohms between the B59 Front Impact Sensor signal circuit terminal 1 and the Inflatable Restraint Sensing and Diagnostic Module terminal 23 X2.
 - **If 2 ohms or greater**
7. Repair the open/high resistance in the circuit.
 - **If less than 2 ohms**
8. Replace the B59 Front Impact Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Front End Inflatable Restraint Discriminating Sensor Replacement (With AY0)**
- **Control Module References** for Inflatable Restraint Sensing and Diagnostic Module replacement, programming and setup

DTC B1001: OPTION CONFIGURATION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category

DTC Descriptor

DTC B1001 00

Option Configuration

Circuit/System Description

The inflatable restraint sensing and diagnostic module stores a primary data key, which is a 4-digit number. When the ignition is turned ON, the inflatable restraint sensing and diagnostic module compares this information to the information stored in the body control module (BCM) via serial data. If there is a mismatch between the information stored in the inflatable restraint sensing and diagnostic module and body control module, DTC B1001 will set.

Conditions for Running the DTC

System voltage is between 9-16 V.

Conditions for Setting the DTC

The 4-digit Primary Data Key stored in the inflatable restraint sensing and diagnostic module does not match the 4 digits stored in the body control module.

Action Taken When the DTC Sets

- The inflatable restraint sensing and diagnostic module requests the instrument cluster to illuminate the AIR BAG indicator.
- The inflatable restraint sensing and diagnostic module disables all deployments.

Conditions for Clearing the DTC

The last 4-digit Primary Data Key in the inflatable restraint sensing and diagnostic module matches the last 4 digits stored in the Body Control Module.

Diagnostic Aids

- This DTC is an indication that an incorrect inflatable restraint sensing and diagnostic module is installed in the vehicle, or that the inflatable restraint sensing and diagnostic module and/or the body control module was replaced without reprogramming the body control module with the new information.
- If the inflatable restraint sensing and diagnostic module was previously programmed and DTC B1001 is now set, the setup portion of program was not completed. Proceed to the inflatable restraint sensing and diagnostic module setup portion of the **Inflatable Restraint Sensing and Diagnostic Module Programming and Setup**

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the scan tool K36 Inflatable Restraint Sensing and Diagnostic Module Primary Key Status parameter is Valid.

- **If the K36 Inflatable Restraint Sensing and Diagnostic Module Primary Key Status parameter is Invalid**

Perform the K36 Inflatable Restraint Sensing and Diagnostic Module setup. Refer to **Inflatable Restraint Sensing and Diagnostic Module Programming and Setup** .

- **If the K36 Inflatable Restraint Sensing and Diagnostic Module Primary Key Status parameter is Valid**

2. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **SIR/SRS Wiring Repairs**
- **Control Module References** for inflatable restraint sensing and diagnostic module replacement, programming and setup

DTC B1019: SYSTEM CONFIGURATION ERROR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B1019 00

System Configuration Error

Circuit/System Description

The inflatable restraint sensing and diagnostic module monitors the number of safety components installed on the vehicle. When the ignition is turned ON, the inflatable restraint sensing and diagnostic module evaluates the number of safety components installed and compares it to the number of components the inflatable restraint sensing and diagnostic module expects to see on the vehicle with its current calibration. If there is a mismatch between detected components and the components programmed with the inflatable restraint sensing and

diagnostic module calibration, DTC B1019 will set. The components (if equipped) that the inflatable restraint sensing and diagnostic module will detect include inflatable restraint deployment loops, impact sensors, passenger presence system components, seat position sensors, disable switches, and seat belt switches.

Conditions for Running the DTC

Ignition voltage is between 9-16 V.

Conditions for Setting the DTC

The setup for the inflatable restraint sensing and diagnostic module has not been completed and the inflatable restraint sensing and diagnostic module does not detect the passenger presence system (if equipped), the correct number of sensors, or deployment loops, that is expected with this calibration.

Action Taken When the DTC Sets

- The inflatable restraint sensing and diagnostic module requests the instrument cluster to illuminate the AIR BAG warning indicator.
- The DTC must be cleared before running the setup inflatable restraint sensing and diagnostic module.
- Air bag indicator will continue to flash until inflatable restraint sensing and diagnostic module setup procedure is complete.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aids

The inflatable restraint sensing and diagnostic module scan tool deployment loop, impact sensor, and passenger presence (if equipped) data will match what the inflatable restraint sensing and diagnostic module has been programmed to expect to see on the vehicle. B1019 DTC will set if a deployment loop or impact sensor is added or removed from the system, or if the passenger presence is not detected.

DTC B1019 will set when an open/high resistance DTC sets for a deployment loop or impact sensor. This causes mismatch between the learned and actual components connected to the inflatable restraint sensing and diagnostic module.

DTC B1019 can set with no other DTCs if an unused deployment loop or impact sensor circuit is shorted to ground. This causes a mismatch between the learned and actual components connected to the inflatable restraint sensing and diagnostic module.

Reference Information

Schematic Reference

- **Seat Belt Schematics**

- **SIR Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- **Seat Belt System Description and Operation**
- **Supplemental Inflatable Restraint System Description and Operation**

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Connector Repairs**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: DTC B1019 can set after the inflatable restraint sensing and diagnostic module has been replaced and/or reprogrammed before the setup procedure is completed. The setup procedure cannot be completed if DTC B1019 is set as current or history. If a short or open is detected in a deployment circuit prior to the setup procedure being performed, the inflatable restraint sensing and diagnostic module will set DTC B1019.

1. Ignition ON.
2. Verify no other K36 Inflatable Restraint Sensing and Diagnostic Module DTCs are set.
 - **If other K36 Inflatable Restraint Sensing and Diagnostic Module DTCs are set**

Diagnose those DTCs first. Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**
 - **If no other K36 Inflatable Restraint Sensing and Diagnostic Module DTCs are set**
3. Verify the enabled impact sensors identified in the scan tool data list match the number of actual impact sensors installed on the vehicle.
 - **If the number of enabled impact sensors do not match**
 1. Verify the correct K36 Inflatable Restraint Sensing and Diagnostic Module calibration file is loaded in the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - If the K36 Inflatable Restraint Sensing and Diagnostic Module calibration file is correct and

the vehicle contains an incorrect number of sensors, identify which sensors are missing to make the vehicle match the K36 Inflatable Restraint Sensing and Diagnostic Module impact sensor calibration scan tool data list.

- If the calibration file is incorrect
- 2. Reprogram the K36 Inflatable Restraint Sensing and Diagnostic Module. Refer to **Inflatable Restraint Sensing and Diagnostic Module Programming and Setup**
 - **If the number of enabled impact sensors match**
- 4. Verify the enabled deployment loops identified in the scan tool data list match the deployment loops installed on the vehicle.
 - **If the number of enabled deployment loops do not match**
 1. Verify the correct K36 Inflatable Restraint Sensing and Diagnostic Module calibration file is loaded in the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - If the K36 Inflatable Restraint Sensing and Diagnostic Module calibration file is correct and the vehicle contains an incorrect number of loops, identify which deployment loops are missing to make the vehicle match the K36 Inflatable Restraint Sensing and Diagnostic Module impact sensor calibration scan tool data list.
 - If the calibration file is incorrect
 2. Program the K36 Inflatable Restraint Sensing and Diagnostic Module. Refer to **Inflatable Restraint Sensing and Diagnostic Module Programming and Setup**
 - **If the number of enabled deployment loops match**
- 5. Verify a passenger presence system is equipped on the vehicle.
 - **If a passenger presence system is not equipped on the vehicle**

Replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

 - **If a passenger presence system is equipped on the vehicle**
- 6. Verify the scan tool Passenger Presence System Enable Status parameter is Enabled.
 - **If the Passenger Presence System Enable Status parameter is not Enabled**

Refer to **Inflatable Restraint Sensing and Diagnostic Module Programming and Setup**

 - **If the Passenger Presence System parameter is Enabled**
- 7. Verify the scan tool Passenger Presence System Learn Status parameter is Learned.
 - **If the Passenger Presence System Learn Status parameter is not Learned**
 1. Verify the scan tool can communicate with the passenger presence system.
 - If the scan tool will not communicate with the passenger presence system, refer to **Scan Tool Does Not Communicate with Low Speed GMLAN Device**
 - If the scan tool communicates
 2. Ignition OFF, disconnect the scan tool. It may take up to 2 min for all vehicle systems to power down. Ignition ON.
 3. Verify DTC B1019 is not set as current.
 - If the DTC is set as current, refer to **Inflatable Restraint Sensing and Diagnostic Module**

Programming and Setup

- If the DTC is not set as current
- 4. All OK.
 - **If the Passenger Presence System Learn status is Learned**
- 8. Replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **SIR/SRS Wiring Repairs**
- **Control Module References** for inflatable restraint sensing and diagnostic module replacement, programming and setup

PASSENGER PRESENCE SYSTEM REZEROING

Introduction

The inflatable restraints passenger presence system (PPS) is a calibrated system that requires rezeroing anytime the seat cushion trim attachments have been removed or the PPS has been replaced. The procedures below are designed to assist in the rezeroing of the PPS. Before you start, read these procedures carefully and completely. For further information regarding the PPS refer to **Supplemental Inflatable Restraint System Description and Operation**.

NOTE: **The following procedures must be followed:**

1. Read this procedure carefully and completely.
2. The PPS will not function properly if the PPS rezeroing procedure is not performed.
3. Perform the **Diagnostic Repair Verification** after successfully completing the rezeroing procedure to ensure the system is functioning properly.

Passenger Presence System (PPS) Rezeroing Procedure

NOTE: **Before rezeroing the PPS, the front passenger seat must be completely empty of all items. The presence of any items on the front passenger seat will affect the calibration and operation of the PPS. The passenger seat must be between 0°C to 45°C (32°F to 113°F).**

1. Empty the front outboard passenger seat.
2. Verify that all SIR and PPS components, connectors, and connector position assurances (CPAs) are properly connected and mounted.
3. Install a scan tool.
4. Turn ON the ignition, with the engine OFF.

NOTE: DTC B0081 4B may be set prior to rezeroing the system if the system was replaced with a service kit. All other SIR and PPS DTCs must be cleared before rezeroing the PPS. The presence of current or history DTCs will prevent the PPS from rezeroing and may set additional DTCs.

5. Use the scan tool in order to clear the SIR and PPS DTCs.
6. With a scan tool, request the Passenger Presence Sensor Learn procedure.
7. Initiate the Passenger Presence Sensor Learn procedure. The PPS will illuminate both PASSENGER AIR BAG ON and OFF indicators until this procedure has been completed.
8. When the Passenger Presence Sensor Learn procedure has been successfully completed, the PPS will display the current system status.
9. If the Passenger Presence Sensor Learn procedure was unsuccessful, repeat this procedure. Due to the communication status between the SDM and the PPS module, this procedure may have to be repeated until a successful rezero attempt has been achieved.
10. After the PPS has been successfully rezeroed, perform the **Diagnostic Repair Verification** .

SYMPTOMS - SIR

NOTE: Complete the following steps before using the symptom tables:

1. Perform **Diagnostic System Check - Vehicle** before using the symptom tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The inflatable restraint sensing and diagnostic module (SDM) can communicate via the serial data link.
2. Review the SIR system description and operation in order to familiarize yourself with the system functions. Refer to **Supplemental Inflatable Restraint System Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the SIR system. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to **Airbag Indicator Malfunction (Driver)**, **Airbag Indicator Malfunction (Passenger)** in order to diagnose the symptom.

AIRBAG INDICATOR MALFUNCTION (DRIVER)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

When the ignition is turned ON the driver air bag indicator will illuminate, and then turn OFF after the bulb check is complete. The inflatable restraint sensing and diagnostic module (SDM) performs diagnostic tests on the SIR system during the bulb check. If any malfunction exists the inflatable restraint sensing and diagnostic module will request the instrument cluster to illuminate the air bag indicator steady, via serial data. If a preexisting malfunction exists, the air bag indicator will illuminate steady immediately after the ignition is turned ON. If the ignition 1 voltage is outside of the normal operating voltage range of 9-16 V, the inflatable restraint sensing and diagnostic module will command the instrument cluster to illuminate the air bag indicator ON, even with no DTCs present, and then disable all deployment loops.

Diagnostic Aids

- A DTC B1370 may set if the ignition 1 circuit is outside the 9-16 V range.
- A flashing driver air bag indicator is displayed if the inflatable restraint sensing and diagnostic module was programmed but did not fully complete the programming. For a flashing driver airbag indicator, refer to **Inflatable Restraint Sensing and Diagnostic Module Programming and Setup** .

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Connector Repairs**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the air bag indicator turns ON and OFF when commanding the All Indicators ON and OFF with a scan tool.

- **If the air bag indicator does not turn ON or OFF**

Replace the P16 Instrument Cluster.

- **If the air bag indicator does turn ON or OFF**

2. Replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **SIR/SRS Wiring Repairs**
- **Control Module References** for instrument cluster or inflatable restraint sensing and diagnostic module replacement, programming and setup

AIRBAG INDICATOR MALFUNCTION (PASSENGER)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Passenger Air Bag OFF Indicator Control	2	2*	4	-
Passenger Air Bag ON Indicator Control	3	3*	5	-
Passenger Air Bag Disable Indicator Ground	-	1	1	-
1. Both indicators always OFF 2. The OFF indicator will not illuminate 3. The ON indicator will not illuminate 4. The OFF indicator always ON 5. The ON indicator always ON				

* High resistance may cause the appropriate indicator to illuminate less bright than normal

Circuit/System Description

The passenger air bag ON/OFF indicators are used to notify the driver when the passenger presence system has enabled or disabled the passenger instrument panel air bag. When the ignition is turned ON, the ignition voltage is supplied to the passenger presence module. When the Inflatable Restraint Sensing and Diagnostic Module (SDM) receives the appropriate serial data message from the passenger presence module the SDM will then provide voltage to the appropriate indicator.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **The passenger air bag ON and OFF indicators may not operate as expected if there are supplemental inflatable restraint (SIR) DTCs. Repair all SIR DTCs before proceeding with this diagnostic.**

1. Ignition ON.
2. Verify the passenger air bag ON indicator turns ON and OFF when commanding the Passenger Air Bag ON Indicator ON and OFF with a scan tool.
 - **If the air bag ON indicator does not turn ON or OFF**

Refer to Circuit/System Testing.

- **If the air bag ON indicator turns ON or OFF**

3. Verify the passenger air bag OFF indicator turns ON and OFF when commanding the Passenger Air Bag OFF Indicator ON and OFF with a scan tool.

- **If the air bag OFF indicator does not turn ON or OFF**

Refer to Circuit/System Testing.

- **If the air bag OFF indicator turns ON or OFF**

4. All OK.

Circuit/System Testing

NOTE: When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected.

- **P17 Info Display Module**
- **P17 Info Display Module wiring harness.**

1. Ignition OFF, disconnect the harness connector at the P17 Info Display Module.

2. Test for less than 10 ohms between the ground circuit terminal 7 and ground.

- **If 10 ohms or greater**

1. Ignition OFF.

2. Test for less than 2 ohms in the ground circuit end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, repair the open/high resistance in the ground connection.

- **If less than 10 ohms**

3. Ignition ON, command the passenger air bag OFF indicator OFF with a scan tool.

4. Test for less than 11 V between the control circuit terminal 6 and ground.

- **If 11 V or greater**

1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module, ignition ON.

2. Test for less than 1 V between the control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.

- If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If less than 11 V**

5. Command the passenger air bag OFF indicator ON with a scan tool.

6. Test for greater than 4 V between the control circuit terminal 6 and ground.

- **If 4 V or less**

1. Disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic

Module.

2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If greater than 4 V**
7. Command the passenger air bag ON indicator OFF with a scan tool.
8. Test for less than 11 V between the control circuit terminal 5 and ground.
 - **If 11 V or greater**
 1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If less than 11 V**
9. Command the passenger air bag ON indicator ON with a scan tool.
10. Test for greater than 4 V between the control circuit terminal 5 and ground.
 - **If 4 V or less**
 1. Disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If greater than 4 V**
11. Test or replace the P17 Info Display Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Instrument Panel Airbag Arming Status Display Replacement** for P17 Info Display Module replacement
- **Control Module References** for Inflatable Restraint Sensing and Diagnostic Module replacement, programming and setup

SIR DISABLING AND ENABLING

SIR component location affects how a vehicle should be serviced. There are parts of the SIR system installed in various locations around a vehicle. To find the location of the SIR components refer to **Supplemental Inflatable Restraint System Description and Operation**.

There are several reasons for disabling the SIR system, such as repairs to the SIR system or servicing a component near or attached to an SIR component. There are several ways to disable the SIR system depending on what type of service is being performed. The following information covers the proper procedures for disabling/enabling the SIR system.

Condition	Action
If the vehicle was involved in an accident with an air bag deployment.	Disconnect the negative battery cable(s) *. Refer to <u>Repairs and Inspections Required After a Collision</u> .
When performing SIR diagnostics.	Follow the appropriate SIR service manual diagnostic procedure(s) *
When moving, removing or replacing an SIR component or a component attached to an SIR component. (Anytime you remove fasteners.)	Disconnect the negative battery cable(s) *
If the vehicle is suspected of having shorted electrical wires.	Disconnect the negative battery cable(s) *
When performing electrical diagnosis on components other than the SIR system.	Remove the SIR/Airbag fuse(s) when indicated by the diagnostic procedure to disable the SIR system
* DTCs will be lost when the negative battery cable is disconnected.	

SIR Service Precautions

WARNING: When performing service on or near the SIR components or the SIR wiring, the SIR system must be disabled. Failure to observe the correct procedure could cause deployment of the SIR components. Serious injury can occur. Failure to observe the correct procedure could also result in unnecessary SIR system repairs.

The Inflatable Restraint Sensing and Diagnostic Module (SDM) maintains a reserved energy supply. The reserved energy supply provides deployment power for the air bags if the Inflatable Restraint Sensing and Diagnostic Module loses battery power during a collision. Deployment power is available for as much as 2 minutes after disconnecting the vehicle power. Waiting 2 minutes before working on the system after disabling the SIR system prevents deployment of the air bags from the reserved energy supply.

General Service Instructions

The following are general service instructions which must be followed in order to properly repair the vehicle and return it to its original integrity:

- Do not expose air bags to temperatures above 65°C (149°F).

- Verify the correct replacement part number. Do not substitute a component from a different vehicle.
- Use only original GM replacement parts available from your authorized GM dealer. Do not use salvaged parts for repairs to the SIR system.

Discard any of the following components if it has been dropped from a height of 92 cm (3 feet) or greater:

- Inflatable Restraint Sensing and Diagnostic Module (SDM)
- Any air bag
- Driver steering wheel air bag coil
- Any impact sensor
- Seat belt anchor and/or retractor pretensioners
- Passenger presence module and/or occupant sensor

Disabling Procedure - Air Bag Fuse

1. Turn the steering wheel so that the vehicles wheels are pointing straight ahead.
2. Place the ignition in the OFF position.

WARNING: The SDM may have more than one fused power input. To ensure there is no unwanted SIR deployment, personal injury, or unnecessary SIR system repairs, remove all fuses supplying power to the SDM. With all SDM fuses removed and the ignition switch in the ON position, the AIR BAG warning indicator illuminates. This is normal operation, and does not indicate a SIR system malfunction.

3. Locate and remove the fuse(s) supplying power to the Inflatable Restraint Sensing and Diagnostic Module. Refer to **SIR Schematics**, or **Electrical Center Identification Views** .
4. Wait 2 minutes before working on the system.

Enabling Procedure - Air Bag Fuse

1. Place the ignition in the OFF position.
2. Install the fuse(s) supplying power to the Inflatable Restraint Sensing and Diagnostic Module. Refer to **SIR Schematics**, or **Electrical Center Identification Views** .
3. Turn the ignition switch to the ON position. The AIR BAG indicator will illuminate or flash then turn OFF.
4. Perform the Diagnostic System Check - Vehicle if the AIR BAG warning indicator does not operate as described. Refer to **Diagnostic System Check - Vehicle** .

Disabling Procedure - Negative Battery Cable

1. Turn the steering wheel so that the vehicles wheels are pointing straight ahead.
2. Place the ignition in the OFF position.

3. Disconnect the negative battery cable from the battery. Refer to **Battery Negative Cable Disconnection and Connection** .
4. Wait 2 minutes before working on system.

Enabling Procedure - Negative Battery Cable

1. Place the ignition in the OFF position.
2. Connect the negative battery cable to the battery. Refer to **Battery Negative Cable Disconnection and Connection** .
3. Turn the ignition switch to the ON position. The AIR BAG indicator will illuminate or flash then turn OFF.
4. Perform the Diagnostic System Check - Vehicle if the AIR BAG warning indicator does not operate as described. Refer to **Diagnostic System Check - Vehicle** .

REPAIR INSTRUCTIONS

SIR SERVICE PRECAUTIONS

General Service Instructions

WARNING: When performing service on or near the SIR components or the SIR wiring, the SIR system must be disabled. Refer to SIR Disabling and Enabling. Failure to observe the correct procedure could cause deployment of the SIR components, personal injury, or unnecessary SIR system repairs.

NOTE: The Inflatable Restraint Sensing and Diagnostic Module (SDM) maintains a reserved energy supply. The reserved energy supply provides deployment power for the SIR air bags. Deployment power may be available for up to 2 minutes after disconnecting the vehicle power. Disabling the SIR system prevents deployment of the SIR air bags from the reserved energy supply.

NOTE: The following are general service instructions which must be followed in order to properly repair the vehicle and return it to its original integrity:

- Do not expose air bags to temperatures above 85 °C (185 °F)
- Verify the correct replacement part number. Do not substitute a component from a different vehicle
- Use only original GM replacement parts available from your authorized GM dealer. Do not use salvaged parts for repairs to the SIR system

NOTE: Discard any of the following components if it has been dropped from a height of 80 cm (15.75 in) or greater:

- Inflatable Restraint Sensing and Diagnostic Module

- Passenger instrument panel air bag
- Driver steering wheel air bag
- Driver steering wheel air bag coil
- Roof rail air bags
- Front and /or side impact sensors
- Seat belt anchor and/or retractor pretensioners
- Front seat side air bag
- Knee air bag

FRONT END INFLATABLE RESTRAINT DISCRIMINATING SENSOR REPLACEMENT (WITH AY0)

Fig. 7: NO CONTENT
Courtesy of GENERAL MOTORS COMPANY

Front End Inflatable Restraint Discriminating Sensor Replacement (With AY0)

Callout	Component Name
WARNING: Refer to <u>SIR Warning</u> .	
WARNING: Following the deployment of a side impact air bag, inspect the following parts for damage. Replace these parts if necessary:	

- The seat cushion frame
- The seat recliner, if equipped
- The seat adjuster
- The seat back frame

Failure to do so may cause future personal injury.

Preliminary Procedure Disable the SIR system. Refer to **SIR Disabling and Enabling**.

1	Inflatable Restraint Front End Sensor Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 7.5 (66 lb in)
2	Inflatable Restraint Front End Sensor Assembly Procedure 1. Disconnect electrical connector. 2. Loosen the bolt and slide the sensor out of the keyhole slot. NOTE: The bolt is integral to the sensor assembly, DO NOT remove separately.

AIRBAG FRONT END SENSOR REPLACEMENT - RIGHT SIDE

Fig. 8: Airbag Front End Sensor - Right Side
 Courtesy of GENERAL MOTORS COMPANY

Airbag Front End Sensor Replacement - Right Side

Callout	Component Name
WARNING: Do not strike or jolt the inflatable restraint front end sensor. Before applying power to the front end sensor make sure that it is securely fastened. Failure to observe the correct installation procedure could cause SIR deployment, personal injury, or unnecessary SIR system repairs. WARNING: Refer to <u>SIR Warning</u> . Preliminary Procedures 1. Disable the supplemental inflatable restraint (SIR) system. Refer to <u>SIR Disabling and Enabling</u>. 2. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> .	
	Supplemental Inflatable Restraint Front End Discriminating Sensor Bolt (Qty: 1) CAUTION: Refer to <u>Fastener Caution</u> . Procedure 1. Loosen the bolts and slide the sensors out of the keyhole slots. 2. The bolts are integral to the sensor assembly and DO NOT remove separately.

1	NOTE: Integral sensor assembly bolt uses Left Hand threads. Use counterclockwise rotation to loosen fastener at TORX® tip end. If accessing at pan head end of the fastener, use clockwise rotation to loosen bolt. Tighten 7.5 (66 lb in)
2	Supplemental Inflatable Restraint Front End Discriminating Sensor Assembly Procedure 1. Remove connector position assurance (CPA) retainer. 2. Disconnect electrical connector.

AIRBAG FRONT END SENSOR REPLACEMENT - LEFT SIDE

Fig. 9: Airbag Front End Sensor - Left Side
Courtesy of GENERAL MOTORS COMPANY

Airbag Front End Sensor Replacement - Left Side

Callout	Component Name
WARNING: Do not strike or jolt the inflatable restraint front end sensor. Before applying power to the front end sensor make sure that it is securely fastened. Failure to observe the correct installation procedure	

could cause SIR deployment, personal injury, or unnecessary SIR system repairs.

WARNING:

Refer to SIR Warning .

Preliminary Procedures

1. Disable the supplemental inflatable restraint (SIR) system. Refer to SIR Disabling and Enabling.
2. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .

1	Supplemental Inflatable Restraint Front End Discriminating Sensor Bolt (Qty: 1) CAUTION: Refer to <u>Fastener Caution</u> . Procedure 1. Loosen the bolts and slide the sensors out of the keyhole slots. 2. The bolts are integral to the sensor assembly and DO NOT remove separately. NOTE: Integral sensor assembly bolt uses Left Hand threads. Use counterclockwise rotation to loosen fastener at TORX® tip end. If accessing at pan head end of the fastener, use clockwise rotation to loosen bolt. Tighten 7.5 (66 lb in)
2	Supplemental Inflatable Restraint Front End Discriminating Sensor Assembly Procedure 1. Remove connector position assurance (CPA) retainer. 2. Disconnect electrical connector.

AIRBAG SENSING AND DIAGNOSTIC MODULE REPLACEMENT

Fig. 10: Airbag Sensing and Diagnostic Module
 Courtesy of GENERAL MOTORS COMPANY

Airbag Sensing and Diagnostic Module Replacement

Callout	Component Name
Preliminary Procedures 1. Disable the supplemental inflatable restraint (SIR) system. Refer to <u>SIR Disabling and Enabling</u>. 2. Remove the instrument panel lower trim panel. Refer to <u>Front Floor Console Replacement</u>. 3. Disconnect the electrical connector.	
1	Inflatable Restraint Sensing and Diagnostic Module Nut (Qty: 3) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 10 N.m (89 lb in)

AIRBAG STEERING WHEEL MODULE REPLACEMENT

Removal Procedure

WARNING: When carrying a live inflator module, make sure the bag opening is pointed away from you. This minimizes the chance of injury in the case of an accidental deployment. Never carry the inflator module by the wires.

Never carry the inflator module by the connector on the underside of the module.

Make sure that the bag and trim cover are facing up whenever you place a live inflator module on any surface. This is necessary to provide a free space for the bag to expand in the unlikely event of accidental deployment.

Never rest the steering column assembly on the steering wheel with the inflator module face down, and the column vertical. This may result in personal injury.

WARNING: Refer to SIR Warning .

Fig. 11: Insert Suitable Tools To Openings On Both Sides Of Steering Wheel
Courtesy of GENERAL MOTORS COMPANY

1. Disable the supplemental inflatable restraint (SIR) system. Refer to SIR Disabling and Enabling.
2. Insert suitable tools (2) to the openings (1) on both sides of the steering wheel.
3. Release the springs in direction of the arrows by pushing the tool horizontally.
4. Disconnect the electrical connectors.

Installation Procedure

Fig. 12: Steering Wheel Module

Courtesy of GENERAL MOTORS COMPANY

1. Connect the electrical connectors.
2. Align the steering wheel module fasteners to the steering column fastener holes.
3. Push the steering wheel module (1) firmly into the steering column in order to engage the fasteners.
4. Enable the SIR system. Refer to **SIR Disabling and Enabling**.
5. After replacing the module, fully deploy the old module before disposal.

STEERING WHEEL AIRBAG COIL REPLACEMENT

Fig. 13: Steering Wheel Airbag Coil
Courtesy of GENERAL MOTORS COMPANY

Steering Wheel Airbag Coil Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the steering column upper trim cover. Refer to <u>Steering Column Lower Trim Cover Replacement</u> . 2. Remove the steering column lower trim cover. Refer to <u>Steering Column Upper Trim Cover Replacement</u> . 3. Remove the steering wheel. Refer to <u>Steering Wheel Replacement</u> .	
1	Steering Wheel Inflatable Restraint Module Coil Screw Bolt (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 1.5 N.m (13 lb in)
2	Steering Wheel Inflatable Restraint Module Coil Assembly Procedure Disconnect any electrical connectors as needed.

- Do not remove the centering tab from a new steering wheel inflatable restraint module coil until it has been installed or re-centering will be required.
- If re-centering of the steering wheel inflatable restraint module coil is needed then refer to **Steering Wheel Airbag Coil Replacement**.

AIRBAG STEERING WHEEL MODULE COIL CENTERING

CAUTION: The new SIR coil assembly will be centered. Improper alignment of the SIR coil assembly may damage the unit, causing an inflatable restraint malfunction.

1. Verify that the wheels on the vehicle are straight ahead before centering the supplemental inflatable restraint (SIR) steering wheel module coil.
2. Turn the lobe of the clock spring clockwise until the coil ribbon stops. Do not force.
3. Turn the lobe of the clock spring counterclockwise approximately 3 turns to the neutral position.

Fig. 14: Airbag Steering Wheel Module Coil Centering
Courtesy of GENERAL MOTORS COMPANY

4. Properly align until the arrows face each other. This indicates the CENTER position.

AIRBAG INSTRUMENT PANEL MODULE REPLACEMENT

Removal Procedure

WARNING: When carrying a live inflator module, make sure the bag opening is pointed away from you. This minimizes the chance of injury in the case of an accidental deployment. Never carry the inflator module by the wires. Never carry the inflator module by the connector on the underside of the module.

Make sure that the bag and trim cover are facing up whenever you place a live inflator module on any surface. This is necessary to provide a free space for the bag to expand in the unlikely event of accidental deployment.

Never rest the steering column assembly on the steering wheel with the inflator module face down, and the column vertical. This may result in personal injury.

WARNING: Refer to **SIR Warning** .

1. Disable the SIR system. Refer to **SIR Disabling and Enabling**.
2. Remove the instrument panel assembly. Refer to **Instrument Panel Assembly Replacement** .
3. Remove the windshield defroster nozzle. Refer to **Windshield Defroster Nozzle Replacement** .
4. Remove the instrument panel outer air outlet duct. Refer to **Instrument Panel Outer Air Outlet Duct Replacement** .

Fig. 15: Instrument Panel Inflatable Restraint Module Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the instrument panel inflatable restraint module bolts (1).

Fig. 16: Airbag Module Chute And Hooks
Courtesy of GENERAL MOTORS COMPANY

6. If the airbag module should be removed in order to replace the instrument panel with new one follow the step 6-7. If the airbag module should be removed in order to replace the passenger airbag module with new one follow the step 8-10. Cut one side of the airbag module chute (1) partly to release the hooks (2) of module from the chute.

WARNING: Never install the passenger airbag module into the instrument panel assembly that airbag module chute is cut. This may cause incorrect deployment when the passenger airbag is deployed.

7. Remove the passenger airbag module from the instrument panel after releasing the hooks of uncut side from the passenger airbag module chute.

Fig. 17: Straightening Hooks

Courtesy of GENERAL MOTORS COMPANY

NOTE: **Hooks on I/P compartment side can be released more easily from the chute because these hooks are shorter than the opposite hooks.**

8. Roughly straighten the hooks (1) of side that is close to I/P compartment by using the plier.

Fig. 18: Pushing Chute Out Of Hook Using Flat Tip Screw Driver
Courtesy of GENERAL MOTORS COMPANY

9. One by one release straightened hooks from the hole of chute by pushing the chute out of hook using the flat tip screw driver (1) or similar tool.

Fig. 19: Passenger Airbag Module

Courtesy of GENERAL MOTORS COMPANY

10. Remove the passenger airbag module (1) from the instrument panel releasing the hooks of opposite side from the hole of chute.

Installation Procedure

Fig. 20: Existing Passenger Airbag Module
Courtesy of GENERAL MOTORS COMPANY

WARNING: Never install the passenger airbag module into the instrument panel assembly that airbag module chute is cut. This may cause incorrect deployment when the passenger airbag is deployed.

1. Position new or existing passenger airbag module (1) to the chute (2) on new or existing instrument panel.

CAUTION: Make sure that the passenger airbag is installed into the chute completely.

2. Push the passenger airbag module (1) into the chute (2) until the hooks of airbag module is inserted in the holes of chute completely.

Fig. 21: Instrument Panel Inflatable Restraint Module Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

3. Install the passenger airbag module bolts (1) and tighten to 10 (89 lb in).
4. Install the instrument panel outer air outlet duct. Refer to **Instrument Panel Outer Air Outlet Duct Replacement** .
5. Install the windshield defroster nozzle. Refer to **Windshield Defroster Nozzle Replacement** .
6. Install the instrument panel assembly. Refer to **Instrument Panel Assembly Replacement** .
7. Enable the SIR system. Refer to **SIR Disabling and Enabling**.
8. After replacing the module, fully deploy the old module before disposal.

INSTRUMENT PANEL LOWER AIRBAG REPLACEMENT - DRIVER SIDE

Fig. 22: Instrument Panel Lower Airbag - Driver Side
 Courtesy of GENERAL MOTORS COMPANY

Instrument Panel Lower Airbag Replacement - Driver Side

Callout	Component Name
WARNING: Refer to <u>SIR Warning</u> .	
Preliminary Procedures 1. Disable the SIR system. Refer to <u>SIR Disabling and Enabling</u>. 2. Remove the steering column opening filler. Refer to <u>Steering Column Opening Filler Replacement</u> .	
1	Inflatable Restraint Instrument Panel Lower Module Bolt (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 10 (89 lb in)
2	Inflatable Restraint Instrument Panel Lower Module Procedure 1. Disconnect the electrical connector.

- | | |
|--|---|
| | 2. For proper handling and scrapping, refer to <u>Inflatable Restraint Module Handling and Scrapping</u> . |
|--|---|

INSTRUMENT PANEL LOWER AIRBAG REPLACEMENT - PASSENGER SIDE

Fig. 23: Instrument Panel Lower Airbag - Passenger Side
Courtesy of GENERAL MOTORS COMPANY

Instrument Panel Lower Airbag Replacement - Passenger Side

Callout	Component Name
WARNING: Refer to <u>SIR Warning</u> .	
Preliminary Procedures 1. Disable the SIR system. Refer to <u>SIR Disabling and Enabling</u> . 2. Remove the instrument panel compartment. Refer to <u>Instrument Panel Compartment Replacement</u> .	
1	Inflatable Restraint Instrument Panel Lower Module Screw (Qty: 3)
2	Inflatable Restraint Instrument Panel Lower Module Bolt (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> .

	Tighten 10 (89 lb in)
3	Inflatable Restraint Instrument Panel Lower Module Procedure 1. Disconnect the electrical connector. 2. For proper handling and scrapping, refer to <u>Inflatable Restraint Module Handling and Scrapping</u>.

AIRBAG FRONT PASSENGER PRESENCE SENSOR REPLACEMENT

Fig. 24: Airbag Front Passenger Presence Sensor
Courtesy of GENERAL MOTORS COMPANY

Airbag Front Passenger Presence Sensor Replacement

Callout	Component Name
WARNING: Refer to <u>SIR Warning</u> . WARNING: Replace the passenger presence system as a complete assembly to prevent possible injury to the occupant. All the components in the service kit are assembled and calibrated as a unit. Using only some of the components in the service kit will cause the passenger presence system to operate improperly.	

Preliminary Procedures

- 1. Disable the supplemental inflatable restraint (SIR) system. Refer to **SIR Disabling and Enabling**.
- 2. Remove the seat cushion cover from the passenger seat. Refer to **Front Seat Cushion Cover and Pad Replacement** .

	Inflatable Restraint Front Passenger Presence Module
1	Procedure 1. The inflatable restraint passenger presence module must be replaced as a service kit that also includes the seat cushion heating mat, pad and passenger presence sensor. 2. Re-zero the inflatable restraint passenger presence system whenever the seat cushion or any component of the passenger presence system is removed. Refer to <u>Passenger Presence System Rezeroing</u>.

FRONT SEAT OUTBOARD SEAT BACK AIRBAG REPLACEMENT

Fig. 25: Front Seat Outboard Seat Back Airbag
Courtesy of GENERAL MOTORS COMPANY

Front Seat Outboard Seat Back Airbag Replacement

Callout	Component Name
WARNING: Refer to <u>SIR Warning</u> .	

WARNING:

Following the deployment of a side impact air bag, inspect the following parts for damage. Replace these parts if necessary:

- The seat cushion frame
- The seat recliner, if equipped
- The seat adjuster
- The seat back frame

Failure to do so may cause future personal injury.

Preliminary Procedures

1. Disable the SIR system. Refer to **SIR Disabling and Enabling**.
2. Remove the front seatback cushion cover. Refer to **Driver or Passenger Seat Back Cushion Cover Replacement**.

1	Front Seat Side Inflatable Restraint Module Nut (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 4 N.m (36 lb in)
2	Front Seat Side Inflatable Restraint Module Assembly TIP: Disconnect the electrical connector.

REAR SEAT OUTBOARD SEAT BACK AIRBAG REPLACEMENT

Fig. 26: Rear Seat Outboard Seat Back Airbag
 Courtesy of GENERAL MOTORS COMPANY

Rear Seat Outboard Seat Back Airbag Replacement

Callout	Component Name
Preliminary Procedure 1. Disable the SIR system, if equipped. Refer to <u>SIR Disabling and Enabling</u>. 2. Remove the rear seat back cushion bolster. Refer to <u>Rear Seat Back Bolster Replacement</u>.	
1	Rear Seat Side Inflatable Restraint Module Bolt (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 3.5 (31 lb in)
2	Rear Seat Side Inflatable Restraint Module Procedure 1. Remove the connector position assurance (CPA) from the module electrical connector. 2. Disconnect the electrical connector.

AIRBAG SIDE IMPACT CENTER PILLAR SENSOR REPLACEMENT

Fig. 27: AirbRear Seat Outboard Seat Back Airbag Side Impact Sensor - Center Pillar
Courtesy of GENERAL MOTORS COMPANY

Airbag Side Impact Center Pillar Sensor Replacement

Callout	Component Name
WARNING: Refer to <u>SIR Warning</u> . WARNING: Refer to <u>SIR Inflator Module Handling and Storage Warning</u> . WARNING: Following the deployment of a side impact air bag, inspect the following parts for damage. Replace these parts if necessary: • The seat cushion frame • The seat recliner, if equipped • The seat adjuster • The seat back frame Failure to do so may cause future personal injury. Preliminary Procedure	

1. Disable the SIR system. Refer to <u>SIR Disabling and Enabling</u> 2. Remove center pillar lower garnish molding. Refer to <u>Center Pillar Lower Trim Panel Replacement</u> .	
1	Inflatable Restraint Side Impact Sensor Screw CAUTION: Refer to <u>Fastener Caution</u> . Tighten 7.5 (66 lb in)
2	Inflatable Restraint Side Impact Sensor Assembly Procedure 1. Disconnect electrical connector. 2. Loosen the bolts and slide the sensor out of the keyhole slots. TIP: The bolt is integral to the sensor assembly, DO NOT remove separately.

AIRBAG SIDE IMPACT SENSOR REPLACEMENT - FRONT SIDE DOOR

Fig. 28: Inflatable Restraint Front Side Door Side Impact Sensor
Courtesy of GENERAL MOTORS COMPANY

Airbag Side Impact Sensor Replacement - Front Side Door

Callout	Component Name
WARNING: Refer to <u>SIR Warning</u> . WARNING: Refer to <u>SIR Inflator Module Handling and Storage Warning</u> . WARNING: Following the deployment of a side impact air bag, inspect the following parts for damage. Replace these parts if necessary: • The seat cushion frame • The seat recliner, if equipped • The seat adjuster • The seat back frame Failure to do so may cause future personal injury. Preliminary Procedure 1. Disable the SIR system. Refer to <u>SIR Disabling and Enabling</u>. 2. Remove front side door trim panel. Refer to <u>Front Side Door Trim Panel Replacement</u> . 3. For access to sensor detach the water deflector partly from front of door.	
1	Inflatable Restraint Side Impact Sensor Nut CAUTION: Refer to <u>Fastener Caution</u> . Tighten 7.5 (66 lb in)
2	Inflatable Restraint Side Impact Sensor Assembly Procedure 1. Remove the sensor out of the door panel. 2. Disconnect electrical connector.

INSTRUMENT PANEL AIRBAG ARMING STATUS DISPLAY REPLACEMENT

Fig. 29: Instrument Panel Airbag Arming Status Display
 Courtesy of GENERAL MOTORS COMPANY

Instrument Panel Airbag Arming Status Display Replacement

Callout	Component Name
Preliminary Procedure Remove the instrument panel center molding. Refer to <u>Instrument Panel Center Molding Replacement</u> .	
1	Inflatable Restraint Instrument Panel Module Indicator Procedure 1. Remove the indicator from the instrument panel releasing the tab of the indicator. 2. Disconnect the electrical connectors.

AIRBAG ROOF SIDE RAIL MODULE REPLACEMENT

Fig. 30: Airbag Roof Side Rail Module
Courtesy of GENERAL MOTORS COMPANY

Airbag Roof Side Rail Module Replacement

Callout	Component Name
WARNING: In order to prevent SIR deployment, personal injury, or unnecessary SIR system repairs, do not strike the door or the door pillar in the area of the side impact sensor (SIS). Turn OFF the ignition and remove the key when performing service in the area of the SIS. WARNING: When performing service on or near the SIR components or the SIR wiring, the SIR system must be disabled. Refer to SIR Disabling and Enabling. Failure to observe the correct procedure could cause deployment of the SIR components, personal injury, or unnecessary SIR system repairs. Preliminary Procedures 1. Disable the SIR system. Refer to <u>SIR Disabling and Enabling</u>. 2. Remove the headliner. Refer to <u>Headlining Trim Panel Replacement</u> .	
1	Inflatable Restraint Roof Rail Bolt (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> .

	Tighten 10 N.m (89 lb in)
2	Inflatable Restraint Roof Rail Module Assembly TIP: Disconnect the electrical connector.

FRONT SEAT BELT ANCHOR PLATE TENSIONER REPLACEMENT

Fig. 31: Front Seat Belt Anchor Plate Tensioner
Courtesy of GENERAL MOTORS COMPANY

Front Seat Belt Anchor Plate Tensioner Replacement

Callout	Component Name
WARNING: Refer to <u>SIR Seatbelt Pretensioner Handling Warning</u> .	
Preliminary Procedures 1. Remove the center pillar lower trim panel. Refer to <u>Center Pillar Lower Trim Panel Replacement</u> . 2. Remove the rear side door sill trim plate. Refer to <u>Rear Side Door Sill Trim Plate Replacement</u> .	
1	Front Seat Belt Tensioner Cover Procedure Lower the seat belt tensioner cover.
	Front Seat Belt Tensioner Anchor Bolt

2	CAUTION: Refer to <u>Fastener Caution</u> Tighten 5 (44 lb in)
3	Front Seat Belt Anchor Plate Tensioner Fastener Procedure To access the tool hold the floor panel carpet that covers the tensioner. Tighten 40 (30 lb ft)
4	Front Seat Belt Anchor Plate Tensioner Procedure Disconnect the electrical connector.

DRIVER OR PASSENGER SEAT RETRACTOR SIDE BELT REPLACEMENT

Fig. 32: Driver or Passenger Seat Retractor Side Belt
Courtesy of GENERAL MOTORS COMPANY

Driver or Passenger Seat Retractor Side Belt Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the center pillar upper trim panel. Refer to <u>Center Pillar Upper Trim Panel Replacement</u> .	

2. Remove the center pillar lower trim panel. Refer to <u>Center Pillar Lower Trim Panel Replacement</u> .	
1	Front Seat Belt Upper Anchor Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 40 (30 lb ft)
2	Front Seat Belt Lower Anchor Bolt Procedure 1. Lower the seat belt tensioner cover for bolt removal. 2. Remove the anchor bolt. Tighten 40 (30 lb ft)
3	Front Seat Belt Retractor Bolt Tighten 40 (30 lb ft)
4	Front Seat Belt Assembly Procedure 1. Disconnect the pretensioner connector from the retractor. 2. Remove the retractor from the body panel.

REPAIRS AND INSPECTIONS REQUIRED AFTER A COLLISION

Accident With or Without Air Bag Deployment - Component Inspections

WARNING: Proper operation of the Supplemental Inflatable Restraint (SIR) sensing system requires that any repairs to the vehicle structure return the vehicle structure to the original production configuration. Not properly repairing the vehicle structure could cause non-deployment of the air bag(s) in a frontal collision or deployment of the air bag(s) for conditions less severe than intended.

After any collision, inspect the following components as indicated. If you detect any damage, replace the component. If you detect any damage to the mounting points or mounting hardware, repair the component or replace the hardware as needed.

- The steering column-Inspect the steering column for bending, twisting, buckling or any type of damage.
- The instrument panel knee bolsters and mounting points-Inspect the knee bolsters for bending, twisting, buckling, or any other type of damage.
- The instrument panel brackets, braces, etc.-Inspect for bending, twisting, buckling, or any other type of damage.
- The seat belts-Perform the seat belt operational and functional checks. Refer to **Repairs and Inspections Required After a Collision** .
- The instrument panel cross car beam-Inspect for bending, twisting, buckling, or any other type of damage.
- The instrument panel mounting points and brackets-Inspect for bending, twisting, buckling, or any other type of damage.
- The seats and seat mounting points-Inspect for bending, twisting, buckling, or any other type of damage.
- The roof and headliner mounting points.
- The brake pedal --Inspect the brake pedal for bending, twisting, buckling or any type of damage.

Accident With Frontal Air Bag Deployment - Component Replacement and Inspections

After a collision involving air bag deployment, replace the following components.

- Driver Steering Wheel Air Bag
- Passenger instrument panel air bag, if deployed
- Inflatable Restraint Sensing and Diagnostic Module (SDM), if the Inflatable Restraint Sensing and Diagnostic Module has set DTC B0052 and will not clear
- Front and/or Side Impact Sensors
- Driver/Passenger Seat Side Air Bag, if deployed
- Seat back cover if Side Seat Air Bag is deployed
- Driver/Passenger Seat Belt Anchor and/or Retractor Pretensioners

Perform additional inspections on the following components.

- Steering wheel air bag coil and the coil wiring pigtail-Inspect for melting, scorching, or other damage due to excessive heat.
- Mounting points or mounting hardware for the passenger instrument panel air bag, steering wheel air bag, Inflatable Restraint Sensing and Diagnostic Module, seat side air bag (if deployed) and seat belt anchor and/or retractor pretensioners-Inspect for any damage and repair or replace each component as needed.

Accident With Side Seat Air Bag Deployment - Component Replacement and Inspections

After a collision involving driver/passenger side seat air bag deployment, replace the following components.

- Left/right side impact sensors on the side of the impact.
- Left/right roof rail air bag on the side of the impact.
- Inflatable Restraint Sensing and Diagnostic Module (SDM), if the Inflatable Restraint Sensing and

Diagnostic Module has set DTC B0052 and will not clear.

- Inflatable Restraint Seat Belt Anchor and/or Retractor Pretensioner.
- Driver or passenger seat back cushion cover replacement.

WARNING: Do not repair or replace the seat stitching or seams in the seat back trim cover with an internal mounted seat side airbag module. Replace the complete seat back trim cover from the OEM. Non-OEM seat stitching may cause improper airbag deployment which could result in personal injury.

Perform additional inspections on the following components.

- Mounting points or mounting hardware for the side impact sensors, and driver/passenger side seat air bags on the side of impact-Inspect for any damage and repair or replace each component as needed.
- Mounting points, mounting hardware, headliner and trim pieces for the left/right roof rail air bag on the side of impact-Inspect for any damage and repair or replace each component as needed.
- Mounting points or mounting hardware for the Inflatable Restraint Sensing and Diagnostic Module and seat belt anchor and/or retractor pretensioners-Inspect for any damage and repair or replace each component as needed.
- The seat cushion frame
- The seat recliner and cover, if equipped
- The seat adjuster
- The seat back frame
- Door trim assembly
- Impacted seat cushion side covers and switches

Accident With Seat Belt Pretensioner Deployment Only - Component Replacement and Inspections

After a collision involving driver/passenger Seat Belt Retractor or Anchor Pretensioner deployment, replace the following components.

- Driver and Passenger Inflatable restraint seat belt anchor pretensioner and/or retractor pretensioner
- Inflatable Restraint Sensing and Diagnostic Module (SDM), if the Inflatable Restraint Sensing and Diagnostic Module has set DTC B0052 and will not clear

Perform additional inspections for any damage and repair or replace each component as needed on the following components.

- Mounting points or mounting hardware for the Inflatable Restraint Sensing and Diagnostic Module
- Mounting points or mounting hardware for the Seat Belt Anchor Pretensioners
- Mounting points or mounting hardware for the Seat Belt Retractor Pretensioners

Impact Sensor Replacement Guidelines

The impact sensor replacement policy requires replacing sensors in the area of the accident damage. The area of

accident damage is defined as the portion of the vehicle which is crushed, bent, or damaged due to a collision. An example of this would be a moderate collision where the front of the vehicle impacts a object. If the vehicle has an impact sensor mounted forward of the radiator, it must be replaced.

- Replace the impact sensor whether or not the air bags have deployed.
- Replace the impact sensor even if it appears to be undamaged.

Impact sensor damage which is not visible, such as slight bending of the mounting bracket or cuts in the wire insulation, can cause improper operation of the SIR system. Do not try to determine whether the impact sensor is undamaged, replace the impact sensor. Also, if you follow a diagnostic trouble code (DTC) procedure and a malfunctioning impact sensor is indicated, replace the impact sensor.

INFLATABLE RESTRAINT MODULE HANDLING AND SCRAPPING

Special Tools

- **EL-38826** SIR Deployment Harness
- **EL-39401-B** SIR Deployment Fixture

For equivalent regional tools, refer to **Special Tools**.

Live and Undeployed Air Bag

WARNING: Refer to SIR Inflator Module Handling and Storage Warning .

Take special care when handling or storing an undeployed air bag. An air bag deployment produces a rapid generation of gas. This may cause the air bag, or an object in front of the air bag, to project through the air in the event of an unlikely deployment.

Dual Stage Air Bags

Dual stage air bags have two deployment stages. If stage 1 was used to deploy a dual stage air bag, stage 2 may still be active. Therefore, a deployed dual stage air bag must be treated as an active air bag. If disposal of a dual stage air bag is required, both deployment loops must be energized to deploy the air bag.

Scrapping Procedure

During the course of a vehicle's useful life, certain situations may arise which will require the disposal of a live and undeployed air bag. Do NOT dispose a live and undeployed air bag through normal disposal channels until the air bag has been deployed.

Do not deploy the air bag in the following situations:

- After replacement of an air bag under warranty-the air bag may need to be returned undeployed to the manufacturer.

- If the vehicle is the subject of a product liability claim, related to the SIR system and is subject to a preliminary investigation - do NOT alter the SIR system in any manner.
- If the vehicle is involved in a campaign affecting the air bags - follow the instructions in the campaign service bulletin for proper SIR handling procedures.

Deployment Procedures

NOTE: **Some countries, states or localities may not allow service deployment of air bags without special permission or training. Local laws regarding deploying and scrapping of air bags/devices with pyrotechnics must be followed.**

You can deploy the air bag either inside or outside of the vehicle. The method used depends upon the final disposition of the vehicle. Review the following procedures in order to determine which will work best in a given situation:

Deployment Outside Vehicle - Steering Wheel Air Bag, Instrument Panel Air Bag, and Roof Rail Air Bag

Deploy the air bag outside of the vehicle when the vehicle will be returned to service. Situations that require deployment outside of the vehicle include the following:

- Using the SIR diagnostics, you determine that the air bag is malfunctioning.
- The air bag is cosmetically damaged, scratched, or ripped.
- The air bag pigtail is damaged.
- The air bag connector is damaged.
- The air bag connector terminals are damaged.

Deployment and disposal of a malfunctioning air bag is subject to any required retention period.

WARNING: Refer to SIR Inflator Module Disposal Warning .

1. Turn OFF the ignition.

WARNING: Refer to SIR Inflator Module Handling and Storage Warning .

2. Remove the air bag.

Fig. 33: Identifying Clearance For Deployment Of Inflator Module
Courtesy of GENERAL MOTORS COMPANY

3. Clear a space on the ground about 1.85 m (6 ft) in diameter for deployment of the air bag or deployment fixture. If possible, use a paved, outdoor location free of activity. Otherwise, use a space free of activity on the shop floor. Ensure you have sufficient ventilation.
4. Clear the area of loose or flammable objects.

NOTE: **Dual stage deployments are only used in steering wheel and instrument panel air bags. If stage 1 was used to deploy a dual stage air bag, stage 2 may still be active. If disposal of a dual stage air bag is required, both deployment loops must be energized to deploy the air bag.**

5. If you are deploying a steering wheel air bag, place the air bag in the center of the space with the vinyl trim cover facing up and away from the surface.

Fig. 34: Identifying I/P Module Components
Courtesy of GENERAL MOTORS COMPANY

6. When deploying an instrument panel air bag, perform the following instructions:
 1. Place the **EL-39401-B** fixture in the center of the cleared area.
 2. Fill the deployment fixture with water or sand.
 3. Using the proper nuts and bolts, mount the instrument panel air bag (1) to the deployment fixture (2), with the vinyl trim facing up.
 4. Securely tighten all fasteners that hold the instrument panel air bag (1) to the deployment fixture (2).

Fig. 35: Identifying Fasteners Holding Side Impact Module To Deployment Fixture
Courtesy of GENERAL MOTORS COMPANY

7. When deploying a roof rail air bag, perform the following instructions:
 1. Place the **EL-39401-B** fixture (3) in the center of the cleared area.
 2. Fill the deployment fixture with water or sand to provide sufficient stabilization of fixture during deployment.
 3. Adjust and secure the fixture arms (4) to the deployment fixture (3), using the proper nuts and bolts.
 4. Attach the roof rail air bag in the deployment fixture and securely tighten all fasteners.

Fig. 36: Identifying SIR Deployment Harness & Adapter
Courtesy of GENERAL MOTORS COMPANY

8. Inspect the **EL-38826** harness and the appropriate pigtail adapter (2) for damage. Replace as needed.
9. Short the 2 SIR deployment harness leads (1) together using one banana plug seated into the other.
10. Connect the appropriate pigtail adapter (2) to the SIR deployment harness (1).

Fig. 37: Extending SIR Deployment Harness & Adapter
Courtesy of GENERAL MOTORS COMPANY

11. Extend the SIR deployment harness and adapter to the full length from the deployment fixture or area.

Fig. 38: Identifying Inflator Module, SIR Deployment Harness & Adapter
Courtesy of GENERAL MOTORS COMPANY

NOTE: On a dual stage air bag, both connectors must be attached to the deployment harness adapter. This will ensure that both stage 1 and stage 2 of the deployment loops are energized, regardless of the deployment state.

12. Connect the air bag (1) to the adapter (2) on the SIR deployment harness (3).

NOTE:

- The rapid expansion of gas involved with deploying an air bag is very loud. Notify all the people in the immediate area that you intend to deploy the air bag.
- When the air bag deploys, the deployment fixture may jump about 30 cm (1 ft) vertically. This is a normal reaction of the air bag due to the force of the rapid expansion of gas inside the air bag.

- If you are deploying a dual stage air bag with stage 1 already deployed, the fixture may not move and the noise may have been reduced.

13. Clear the area of people.

Fig. 39: Separating Banana Plugs

Courtesy of GENERAL MOTORS COMPANY

14. Separate the 2 banana plugs on the SIR deployment harness that were shorted together earlier in the procedure.

Fig. 40: Connecting SIR Deployment Harness Wires To Power Source
Courtesy of GENERAL MOTORS COMPANY

15. Place a 12 V minimum/2A minimum power source, such as a vehicle battery, near the shorted end of the harness.
16. Connect the SIR deployment harness wires to the power source. Deployment of the air bag will occur when contact is made.

Fig. 41: View Of Deployment Harness Leads
Courtesy of GENERAL MOTORS COMPANY

17. Disconnect the SIR deployment harness from the power source after the air bag deploys.
18. If the air bag did not deploy, disconnect the adapter and discontinue the procedure and contact the Technical Assistance Group.

If deployment was successful, proceed to the following steps.

WARNING: Refer to SIR Deployed Inflator Modules Are Hot Warning .

19. Seat one banana plug into the other in order to short the deployment harness leads.
20. Put on a pair of shop gloves.

21. Disconnect the pigtail adapter from the air bag as soon as possible.
22. Inspect the pigtail adapter and the SIR deployment harness. Replace as needed.
23. Dispose of the deployed air bag through normal refuse channels.
24. Wash your hands with a mild soap.

Deployment Inside Vehicle - Vehicle Scrapping Procedure

Deploy the air bags inside of the vehicle when destroying the vehicle or when salvaging the vehicle for parts. This includes, but is not limited to, the following situations:

- The vehicle has completed all useful life.
- Irreparable damage occurred to the vehicle in a non-deployment type accident.
- Irreparable damage occurred to the vehicle during a theft.
- The vehicle is being salvaged for parts to be used on a vehicle with a different VIN, as opposed to rebuilding as the same VIN.

WARNING: Refer to SIR Inflatable Module Deployment Outside Vehicle Warning .

1. Lower the driver and passenger windows.
2. Turn the ignition switch to the OFF position and remove the ignition key.
3. Check that all air bags which will be deployed are mounted securely.
4. Remove all loose objects from the front seats.

Fig. 42: Identifying I/P Module Connector To Vehicle Harness Connector (LH Side I/P)
Courtesy of GENERAL MOTORS COMPANY

WARNING: A deployed dual stage inflator module will look the same whether one or both stages were used. Always assume a deployed dual stage inflator module has an active stage 2. Improper handling or servicing can activate the inflator module and cause personal injury.

5. Disconnect the steering wheel air bag yellow connector (1) from vehicle harness yellow connector (3).

Fig. 43: Stripping SIR Wires

Courtesy of GENERAL MOTORS COMPANY

NOTE: If the vehicle is equipped with dual stage air bags the steering wheel air

bag and instrument panel air bag will each have 4 wires. Refer to Component Connector End Views for determining high and low circuits.

6. Cut the yellow harness connector out of the vehicle, leaving at least 16 cm (6 in) of wire at the connector.
7. Strip 13 mm (0.5 in) of insulation from each of the connector wire leads.

Fig. 44: Fabricating 20 Ft. Deployment Harness
Courtesy of GENERAL MOTORS COMPANY

8. Cut two 6.1 m (20 ft) deployment wires from a 0.8 mm (18 gauge) or thicker multi-strand wire. Use these wires to fabricate the driver deployment harness.
9. Strip 13 mm (0.5 in) of insulation from both ends of the wires.
10. Twist together one end from each of the wires in order to short the wires. Deployment wires shall remain shorted, and not connected to a power source until you are ready to deploy the air bag.

Fig. 45: Twisting Connector Wire Leads (High Circuits) To Deployment Harness Wire
Courtesy of GENERAL MOTORS COMPANY

11. Twist together the 2 connector wire leads from the high circuits from both stages of the steering wheel air bag, to one set of deployment wires. Refer to **Component Connector End Views** in order to determine the correct circuits.
12. Inspect that the 3-wire connection is secure.
13. Secure and insulate the 3-wire connection to the deployment harness using electrical tape.

Fig. 46: Twisting Connector Wire Leads (Low Circuits) To Deployment Harness Wire
Courtesy of GENERAL MOTORS COMPANY

14. Twist together the 2 connector wire leads from the low circuits from both stages of the steering wheel air bag, to one set of deployment wires. Refer to **Component Connector End Views** in order to determine the correct circuits.
15. Inspect that the 3-wire connection is secure.
16. Secure and insulate the 3-wire connection to the deployment harness using electrical tape.
17. Connect the deployment harness to the connector on the steering wheel air bag.
18. Route the deployment harness out of the driver side of the vehicle.
19. Disconnect the yellow left roof rail harness connector from the vehicle harness connector.
20. Cut the harness connector out of the vehicle, leaving at least 16 cm (6 in) of wire at the connector.
21. Strip 13 mm (0.5 in) of insulation from each of the connector wire leads.
22. Cut two 6.1 m (20 ft) deployment wires from a 0.8 mm (18 gauge) or thicker multi-strand wire. These wires will be used to fabricate the roof rail air bag deployment harness.
23. Strip 13 mm (0.5 in) of insulation from both ends of the wires.

24. Twist together one end from each of the wires in order to short the wires.
25. Twist together one connector wire lead to one deployment wire.
26. Secure and insulate the connection using electrical tape.
27. Twist together and tape the remaining connector wire lead to the remaining deployment wire.
28. Connect the deployment harness to the yellow connector of the roof rail air bag.
29. Route the deployment harness out of the driver side of the vehicle.

Fig. 47: Identifying I/P Module Connector To Vehicle Harness Connector
Courtesy of GENERAL MOTORS COMPANY

30. Disconnect the instrument panel air bag yellow harness connector (1) from the vehicle harness connector (2).

NOTE: **If the vehicle is equipped with dual stage air bags the steering wheel air bag and instrument panel air bag will each have 4 wires. Refer to Component Connector End Views for determining high and low circuits.**

31. Cut the yellow harness connector out of the vehicle, leaving at least 16 cm (6 in) of wire at the connector.
32. Strip 13 mm (0.5 in) of insulation from each of the connector wire leads.
33. Cut two 6.1 m (20 ft) deployment wires from a 0.8 mm (18 gauge) or thicker multi-strand wire. These wires will be used to fabricate the passenger deployment harness.
34. Strip 13 mm (0.5 in) of insulation from both ends of the wires.
35. Twist together one end from each of the wires in order to short the wires.
36. Twist together the 2 connector wire leads from the high circuits from both stages of the instrument panel air bag to one set of deployment wires. Refer to **Component Connector End Views** in order to determine the correct circuits.
37. Inspect that the 3-wire connection is secure.
38. Secure and insulate the 3-wire connection to the deployment harness using electrical tape.
39. Twist together the 2 connector wire leads from the low circuits from both stages of the instrument panel air bag to one set of deployment wires. Refer to **Component Connector End Views** in order to determine the correct circuits.
40. Inspect that the 3-wire connection is secure.
41. Secure and insulate the 3-wire connection to the deployment harness using electrical tape.
42. Connect the deployment harness to the instrument panel air bag in-line connector.
43. Route the deployment harness out of the passenger side of the vehicle.
44. Disconnect the yellow harness connector to the right roof rail air bag from the vehicle harness connector.
45. Cut the harness connector out of the vehicle, leaving at least 16 cm (6 in) of wire at the connector.
46. Strip 13 mm (0.5 in) of insulation from each of the connector wire leads.
47. Cut two 6.1 m (20 ft) deployment wires from a 0.8 mm (18 gauge) or thicker multi-strand wire. These wires will be used to fabricate the roof rail air bag deployment harness.
48. Strip 13 mm (0.5 in) of insulation from both ends of the wires.
49. Twist together one end from each of the wires in order to short the wires.
50. Twist together one connector wire lead to one deployment wire.
51. Secure and insulate the connection using electrical tape.
52. Twist together and tape the remaining connector wire lead to the remaining deployment wire.
53. Connect the deployment harness to the roof rail air bag yellow connector.
54. Route the deployment harness out of the passenger side of the vehicle.
55. Completely cover the windshield and the front door window openings with a drop cloth.
56. Stretch to the full length all of the deployment harness wires on the right side of the vehicle.
57. Deploy each deployment loop one at a time.
58. Place a power source, 12 V minimum/2A minimum, such as a vehicle battery, near the shorted end of the harnesses.
59. Separate one set of wires and touch the wire ends to the power source in order to deploy the selected air bag.
60. Disconnect the deployment harness from the power source and twist the wire ends together.
61. Continue the same process with the remaining deployment harnesses.

62. Disconnect all harnesses from the vehicle.
63. Discard the harnesses.
64. Scrap the vehicle in the same manner as a non-SIR equipped vehicle.
65. If one or all of the air bags did not deploy, remove the undeployed air bags from the vehicle.

PRETENSIONER HANDLING AND SCRAPPING

Scrapping Procedure

During the course of a vehicle's useful life, certain situations may arise which will necessitate the disposal of a live (undeployed) pretensioner. The following information covers the proper procedures for the disposing of a live (undeployed) pretensioner. Deploy the pretensioner before disposal. Do not dispose of a live (undeployed) pretensioner through normal disposal channels until the pretensioner has been deployed. The following information covers the proper procedures for the disposing of a live (undeployed) pretensioner.

- After replacement of a pretensioner under warranty. The pretensioner may need to be returned undeployed to the original manufacturer of pretensioner.
- If the vehicle is the subject of a Product Liability report related to the SIR system and is subject to a Preliminary Investigation (GM-1241). Do not alter the SIR system in any manner.
- If the vehicle is involved in a campaign affecting the pretensioners. Follow the instructions in the Campaign Service Bulletin for proper SIR handling procedures.

Deployment Procedures

NOTE: **Some countries, states or localities may not allow service deployment of air bags without special permission or training. Local laws regarding deploying and scrapping of air bags/devices with pyrotechnics must be followed.**

The pretensioner can be deployed inside or outside of the vehicle. The method used depends upon the final disposition of the vehicle. Review the following procedures in order to determine which will work best in a given situation.

Deployment Inside the Vehicle

Refer to **Inflatable Restraint Module Handling and Scrapping** for deploying the pretensioner inside vehicle under Vehicle Scrapping Procedure.

Deployment Outside Vehicle for Seat Belt Pretensioners

Deploy the seat belt pretensioners outside of the vehicle when the vehicle will be returned to service. Situations that require deployment outside of the vehicle include the following:

- Using the SIR diagnostics, you determine that the seat belt pretensioner is malfunctioning.
- The pretensioner pigtail (if equipped) is damaged.
- The pretensioner connector is damaged.

- The pretensioner connector terminal is damaged.

Deployment and disposal of a malfunctioning seat belt pretensioner is subject to any required retention period.

WARNING: In order to prevent accidental deployment of the pretensioner which could cause personal injury, do not dispose of an undeployed pretensioner as normal shop waste. The undeployed pretensioner contains substances that could cause severe illness or personal injury if the sealed container is damaged during disposal. Use the following deployment procedures to safely dispose of an undeployed pretensioner. Failure to dispose of a pretensioner as instructed may be a violation of federal, state, or local laws.

WARNING: When you are deploying a pretensioner for disposal, perform the deployment procedures in the order listed. Failure to follow the procedures in the order listed may result in personal injury.

Special Tools

- **EL-39401-B** SIR Deployment Fixture
- **EL-38826** SIR Deployment Harness

Fig. 48: Proper Pretensioner Carrying
Courtesy of GENERAL MOTORS COMPANY

1. Turn the ignition switch to the OFF position.
2. Remove the ignition key.
3. Put on safety glasses.
4. Remove the seat belt pretensioner from the vehicle.
5. When carrying a pretensioner to the deployment area keep the open end of pretensioner pointed away from the body.

Fig. 49: Pretensioner Deployment Area
Courtesy of GENERAL MOTORS COMPANY

6. Clear a space on the ground about 1.85 M (6 ft) in diameter for deployment of the pretensioner. If possible, use a paved, outdoor location free of activity. Otherwise, use a space free of activity on the shop floor. Make sure you have sufficient ventilation.
7. Make sure no loose or flammable objects are in the area.
8. Place the **EL-39401-B** SIR deployment fixture in the center of the cleared area.
9. Fill the fixture plastic reservoir with water or sand.

Fig. 50: Mounting Pretensioner In SIR Deployment Fixture
Courtesy of GENERAL MOTORS COMPANY

10. Mount the pretensioner (1) in the SIR deployment fixture (3) with the open end facing up using the following mounting method.
 1. Adjust and secure the EL-39401-B arms (4) to the deployment fixture (3).
 2. To mount, use the proper size bolt (2) and nut (5) with washers in order to secure the pretensioner (1) to the deployment fixture brackets (4).
 3. Securely tighten all fasteners prior to deployment.

Fig. 51: Identifying SIR Deployment Harness & Adapter
Courtesy of GENERAL MOTORS COMPANY

11. Inspect the **EL-38826** SIR deployment harness and the appropriate pigtail adapter for damage. Replace as needed.
12. Short the 2 SIR deployment harness (1) leads together using one banana plug seated into the other.
13. Connect the appropriate pigtail adapter (2) to the SIR deployment harness (1).

Fig. 52: Extending SIR Deployment Harness & Adapter
Courtesy of GENERAL MOTORS COMPANY

14. Extend the SIR deployment harness and adapter to full length from the deployment fixture.

Fig. 53: Connecting Pretensioner To Adapter
Courtesy of GENERAL MOTORS COMPANY

15. Connect the pretensioner (1) to the adapter (2) on the deployment harness (3).

NOTE: **The rapid gas expansion involved with deploying a pretensioner is very loud. Notify all the people in the immediate area that you intend to deploy the seat belt pretensioner.**

16. Clear the area of people.

Fig. 54: Separating Banana Plugs
Courtesy of GENERAL MOTORS COMPANY

WARNING: When you are deploying a pretensioner for disposal, perform the deployment procedures in the order listed. Failure to follow the procedures in the order listed may result in personal injury.

17. Separate the 2 banana plugs on the SIR deployment harness.

Fig. 55: Deploying Pretensioner

Courtesy of GENERAL MOTORS COMPANY

NOTE: When the seat belt pretensioner deploys, the deployment fixture may jump about 30 cm (1 ft) vertically. This is a normal reaction of the seat belt pretensioner due to the force of the rapid expansion of gas inside the pretensioner.

18. Place a 12 V minimum/2 A minimum power source (i.e., vehicle battery) near the shorted end of the harness.
19. Connect the SIR deployment harness wires to the power source. Pretensioner deployment will occur when contact is made.
20. Disconnect the SIR deployment harness from the power source after the pretensioner deploys.

Fig. 56: View Of Deployment Harness Leads
Courtesy of GENERAL MOTORS COMPANY

21. Seat one banana plug into the other in order to short the deployment harness leads.
22. If the pretensioner did not deploy, disconnect the adapter and discontinue the procedure. Contact the Technical Assistance Group. Otherwise, proceed to the following steps.
23. Put on a pair of shop gloves.
24. Disconnect the pigtail adapter from the pretensioner as soon as possible.
25. Inspect the pigtail adapter and the SIR deployment harness. Replace as needed.
26. Dispose of the deployed pretensioner through normal refuse channels.
27. Wash hands with a mild soap.

DESCRIPTION AND OPERATION

SUPPLEMENTAL INFLATABLE RESTRAINT SYSTEM DESCRIPTION AND OPERATION

SIR System Overview

The supplemental inflatable restraint (SIR) system supplements the protection offered by the seat belts. The SIR system contains an inflatable restraint sensing and diagnostic module (SDM), air bags, seat belt pretensioners (anchor and retractor), and impact sensors. The SDM determines the severity of a collision with the assistance of impact sensors located at strategic points on the vehicle. When the SDM detects a collision, the SDM will process the information provided by the sensors to further support air bag or pretensioner deployment. The SDM will deploy the air bags and pretensioners if it detects a collision of sufficient force. If the force of the impact is not sufficient to warrant air bag deployment, the SDM may still deploy the seat belt pretensioners. The SDM contains a sensing device that converts vehicle velocity changes to an electrical signal. The SDM compares these signals to values stored in memory. If the signals exceed a stored value, the SDM will determine the severity of the impact and either cause current to flow through the frontal deployment loops deploying the frontal air bags and pretensioners, or it will deploy the pretensioners only. The SDM continuously monitors the deployment loops for malfunctions and illuminates the SIR system AIR BAG indicator if a fault is detected. The SDM performs continuous diagnostic monitoring of the SIR system electrical components. Upon detection of a circuit malfunction, the SDM will set a DTC and inform the driver by illuminating the SIR system AIR BAG indicator. The steering column and knee bolsters are designed to absorb energy and compress during frontal collisions in order to limit leg movement and decrease the chance of injury to the driver and passenger.

SIR System AIR BAG Indicator

The SIR system AIR BAG indicator, located in the instrument cluster, is used to notify the driver of SIR system malfunctions and to verify that the inflatable restraint sensing and diagnostic module (SDM) is communicating with the instrument cluster. When the ignition is turned ON, the SDM is supplied with ignition positive voltage. The instrument cluster will momentarily turn on the SIR system AIR BAG indicator. While the indicator is on, the SDM conducts tests on all SIR system components and circuits. If no malfunctions are detected the SDM will communicate with the instrument cluster through the serial data circuit and command the SIR system AIR BAG indicator OFF. The SDM provides continuous monitoring of the air bag circuits by conducting a sequence of checks. If a malfunction is detected the SDM will store a diagnostic trouble code (DTC) and command the instrument cluster to illuminate the SIR system AIR BAG indicator via serial data. The presence of a SIR system malfunction could result in non-deployment of the air bags or deployment in conditions less severe than intended. The SIR system AIR BAG indicator will remain ON until the malfunction has been repaired.

Inflatable Restraint Sensing and Diagnostic Module (SDM)

The inflatable restraint sensing and diagnostic module (SDM) is a microprocessor and the control center for the supplemental inflatable restraint (SIR) system. The SDM contains internal sensors along with external impact sensors, mounted at strategic locations on the vehicle. In the event of a collision, the SDM compares the signals from the internal and external impact sensors to a value stored in memory. When the generated signals exceed the stored value, the SDM will cause current to flow through the appropriate deployment loops to deploy the air bags. The SDM records the SIR system status when a deployment occurs and illuminates the SIR system AIR BAG indicator located in the instrument cluster. The SDM performs continuous diagnostic monitoring of the SIR system electrical components and circuitry when the ignition is turned ON. If the SDM detects a malfunction, a DTC will be stored and the SDM will request the instrument cluster to illuminate the SIR system AIR BAG indicator, notifying the driver that a malfunction exists. In the event that ignition positive voltage is lost during a collision, the SDM maintains a 23-volt loop reserve for deployment of the air bags. It is important

when disabling the SIR system for servicing or rescue operations to allow the 23-volt loop reserve to dissipate, which could take up to 1 minute.

Air Bags

This vehicle contains 10 air bags. The 10 air bags are located in the steering wheel (dual inflators), instrument panel (passenger side) (dual inflators), driver side (B-pillar), passenger side (B-pillar), driver side (C-pillar), passenger side (C-pillar), driver side knee, passenger side knee, left roof rail, and right roof rail. To view the locations of the air bags refer to **SIR Identification Views**. Air bags contain a housing, inflatable air bag, two initiating devices (if dual air bags), canister of gas generating material and, in some cases, stored compressed gas. The deployment loops supply current to deploy the air bags. The driver steering wheel and passenger instrument panel air bags have two stages of deployment, which varies the amount of restraint to the occupant according to the collision severity. For moderate frontal collisions the air bags deploy at less than full deployment which consists of stage 1 of the air bag. For more severe frontal collisions a full deployment is initiated which consists of stage 1 and stage 2 of the air bag. The current passing through the air bags ignites the material in the canister producing a rapid generation of gas and in some cases, the release of compressed gas. The gas produced from this reaction rapidly inflates the air bag. Once the air bag is inflated it quickly deflates through the air bag vent holes and/or the bag fabric. A shorting bar (if equipped) is located in the connector.

Seat Belt Pretensioners (Anchor and Retractor)

The seat belt pretensioners (driver and passenger) consist of a housing, seat belt retractor (located in the B-pillar), seat belt anchor (located on the floor), seat belt webbing, an initiator, and a canister of gas generating materials. To view the locations of the seat belt pretensioners refer to **SIR Identification Views**. The initiator is part of the seat belt pretensioner deployment loop. When the vehicle is involved in a collision of sufficient force, the SDM causes current to flow through the seat belt deployment loops to the initiator. Current passing through the initiator ignites the material in the canister producing a rapid generation of gas. The gas produced from this reaction deploys the seat belt pretensioners which removes all of the slack in the seat belts. Depending on the severity of the collision, the seat belt pretensioners may deploy without the frontal air bags deploying, or they will deploy immediately before the frontal air bags deploy. A shorting bar (if equipped) is located in the connector.

Impact Sensors

This vehicle contains 6 impact sensors. There are 6 impact sensors which are located in the front of the vehicle (2, left and right), in the front doors (2, left and right), and on the B-pillar (2, left and right). To view the locations of the impact sensors refer to **SIR Identification Views**. The impact sensors contain a sensing device which monitors vehicle acceleration and velocity changes to detect side collisions that are severe enough to warrant air bag deployment. The impact sensors are not part of the deployment loop, but instead provide input to the SDM. The SDM contains a microprocessor that performs calculations using the measured accelerations and compares these calculations to a value stored in memory. When the generated calculations exceed the stored value, the SDM will cause current to flow through the deployment loops deploying the appropriate air bags.

Passenger Presence Detection System and Passenger Air Bag Indicator

NOTE: **The passenger presence system is a calibrated unit. When replacing the assembly all parts in the service kit must remain together. Do not mix any of the**

old parts with the new parts. After repairing or replacing the passenger presence system, the Preload test must be performed in order to function properly.

The passenger presence system is used to monitor the weight of an occupant in the front passenger seat and communicate the status to the inflatable restraint sensing and diagnostic module (SDM) whether to enable or suppress the deployment of the passenger instrument panel air bag. The passenger presence system consist of an passenger presence module, silicone filled sensor pad, passenger seat belt tension sensor, wiring harness, and PASSENGER AIR BAG ON/OFF indicators. The silicone filled sensor pad is located under the passenger seat foam cushion and is connected by a hose clamped to the passenger presence module. The weight of the occupant sitting in the front passenger seat is measured as a pressure change within the bladder by the passenger presence module. If the pressure from the occupants weight is less than a specified value, the passenger presence module will send a suppress signal to the inflatable restraint sensing and diagnostic module to disable the passenger instrument panel air bag. If the pressure from the occupants weight is higher than a specified value, the passenger presence module will send an enable signal to the inflatable restraint sensing and diagnostic module to enable the passenger instrument panel air bag. The inflatable restraint sensing and diagnostic module will notify the customer of the enable/disable status by turning ON one of the PASSENGER AIR BAG ON/OFF. The passenger presence system monitors itself for faults and will displays diagnostic trouble codes (DTCs) on the scan tool. When a fault is detected, the passenger presence module sends out a message to the inflatable restraint sensing and diagnostic module. The inflatable restraint sensing and diagnostic module responds by sending a command message to the instrument cluster to illuminate the SIR system AIR BAG indicator.

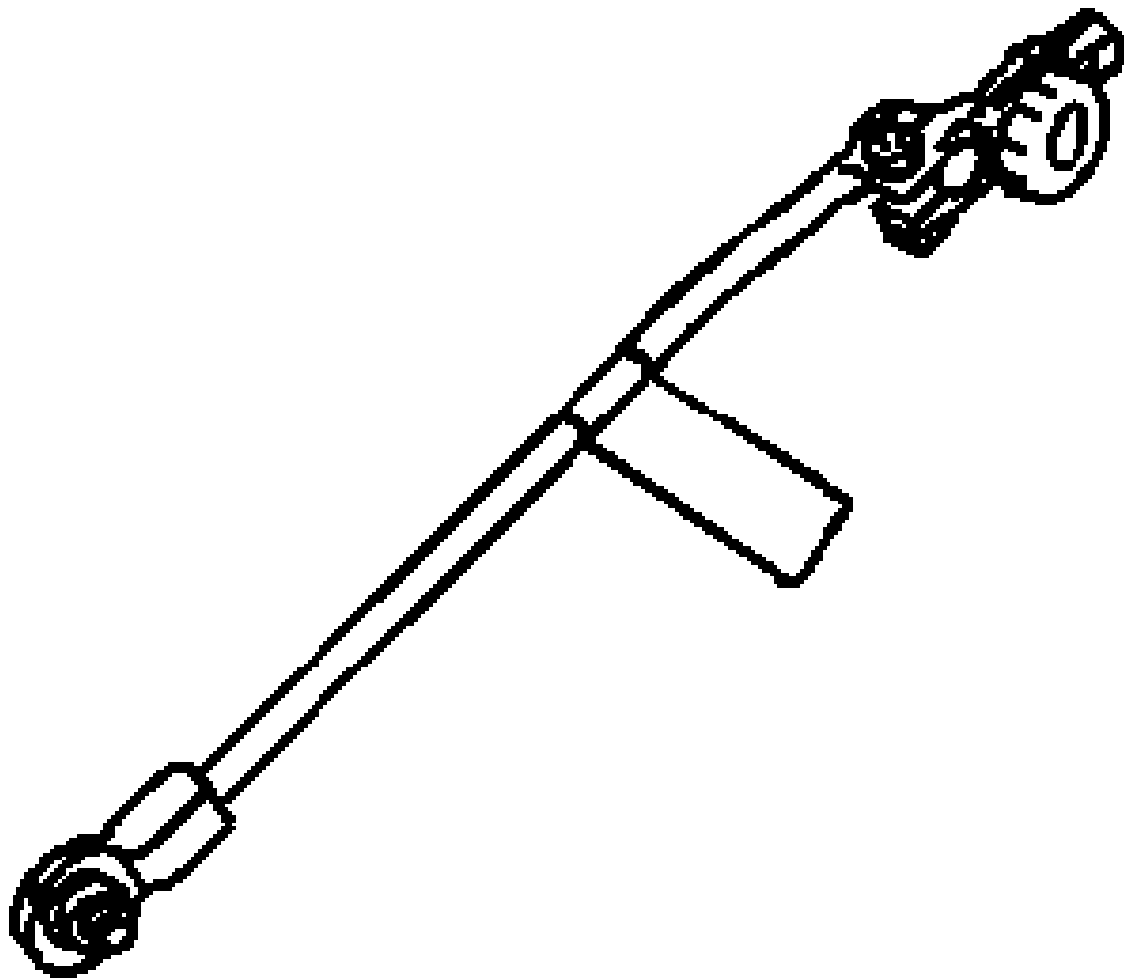
Seat Belt Indicators

The seat belt indicators are controlled through the inflatable restraint sensing and diagnostic module (SDM). For further information on seat belt indicators refer to **Seat Belt System Description and Operation** .

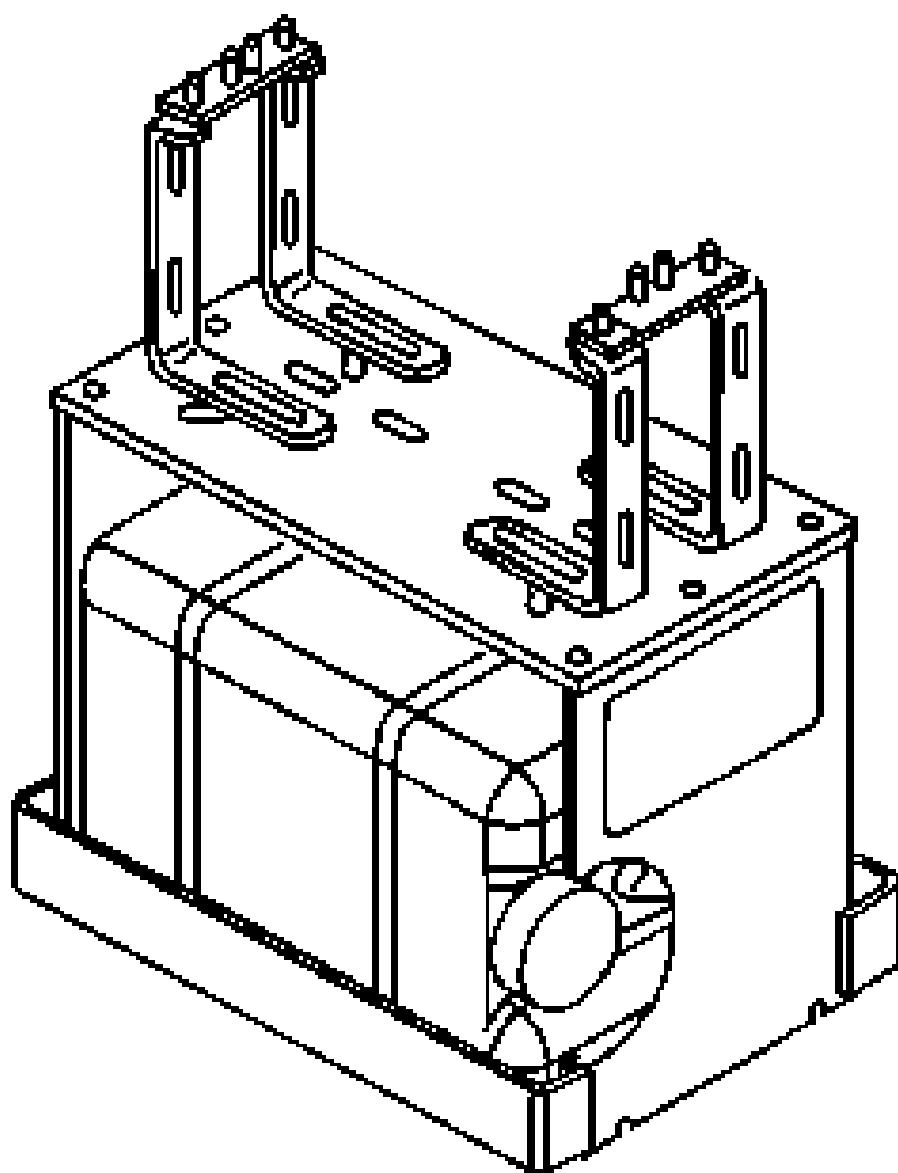
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description



EL 38826
J 38826
KM 799-3
SIR
Deployment
Harness



EL 39401-
B
J 39401-B
SIR
Deployment
Fixture

SUSPENSION

Suspension General Diagnosis - Spark

SPECIFICATIONS

TRIM HEIGHT SPECIFICATIONS

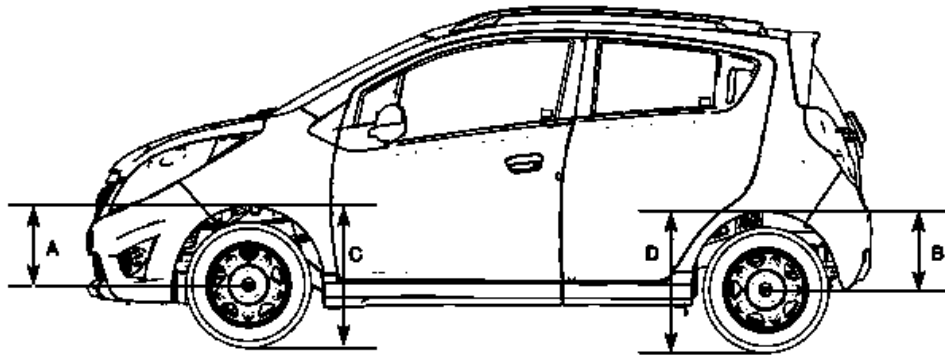


Fig. 1: View Of Trim Height Specifications
Courtesy of GENERAL MOTORS COMPANY

Transmission	Suspension Height mm (in)		Trim Height mm (in) (155/70 R14)	
	Front Suspension Height 'A'	Rear Suspension Height 'B'	Front Trim Height 'C'	Rear Trim Height 'D'
Manual T/M	358.1 mm (14.10 in)	357.2 mm (14.06 in)	625.4 mm (24.62 in)	631.9 mm (24.88 in)
Automatic T/M	358.1 mm (14.10 in)	357.2 mm (14.06 in)	625.0 mm (24.60 in)	631.8 mm (24.87 in)

All measurements are for reference only and intended to be a guide. (Nominal curb weight)

DIAGNOSTIC INFORMATION AND PROCEDURES

SYMPTOMS - SUSPENSION GENERAL DIAGNOSIS

NOTE: The following step must be completed before using the symptom tables.

Review the system description and operation in order to familiarize yourself with the system functions. Refer to the appropriate description and operation:

- Front Suspension Description and Operation

- **Rear Suspension Description and Operation**
- **Tires and Wheels Description and Operation**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of any of the suspension subsystems.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect for correct tire size and inflation pressure.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Ride Diagnosis**
- **Vehicle Leads/Pulls**
- **Body Leans or Sways in Corners**
- **Suspension Bottoms**
- **Torque Steer**
- **Memory Steer**
- **Noise Diagnosis - Front Suspension**
- **Noise Diagnosis - Rear Suspension**

RIDE DIAGNOSIS

Ride Diagnosis

Step	Action	Yes	No
1	Did you review the General Description and perform the necessary inspections?	Go to Step 2	Go to <u>Symptoms - Suspension General Diagnosis</u>
2	NOTE: Verify the vehicle suspension package RPO. Verify that the ride is too soft or too hard. Does the vehicle ride normally?	System OK	Go to Step 3
3	Inspect the tire inflation and adjust to specifications. Refer to <u>Tire Inflation Description</u> . Did you adjust the tire pressure?	Go to Step 6	Go to Step 4
4	Inspect the vehicle trim height. Refer to <u>Trim Height Inspection</u> . Did you find and correct the condition?	Go to Step 6	Go to Step 5
	Inspect the following suspension components for wear or damage:		

5	- Shock absorbers-Refer to <u>Suspension Strut and Shock Absorber Testing - On Vehicle.</u> - Springs		-
	Did you find and correct the condition?	Go to Step 6	
6	Drive the vehicle in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

VEHICLE LEADS/PULLS

Vehicle Leads/Pulls

Step	Action	Yes	No
DEFINITION: At a constant highway speed on a typical straight road, lead/pull is the amount of effort required at the steering wheel to maintain the vehicle straight path.			
1	Did you review the General Description and perform the visual/physical inspections?	Go to Step 2	Go to <u>Symptoms - Suspension General Diagnosis</u>
2	Road test the vehicle in order to verify the complaint. Does the vehicle operate normally?	System OK	Go to Step 3
3	Inspect the tire/wheel assemblies for the following conditions: - Correct tire pressure-Refer to the tire placard. - Correct tire size-Refer to the tire placard. - Abnormal tire wear or damage		
	Did you find and correct the condition?	Go to Step 9	Go to Step 4
4	Perform the <u>Radial Tire Lead/Pull Correction</u> . Did you find and correct the condition?	Go to Step 9	Go to Step 5
5	Inspect and correct/adjust the suspension and steering systems for the following conditions: - Vehicle trim height-Refer to <u>Trim Height Specifications.</u> - Excessively worn, loose, or damaged components		
	Did you find and correct the condition?	Go to Step 9	Go to Step 6
6	Inspect the brake system for brake drag. With the vehicle suspended on a hoist, brake drag can be identified by rotating each wheel several times and		

	observing whether more force is needed to rotate the left wheel or the right wheel. Did you find and correct the condition?	Go to Step 9	Go to Step 7
7	Inspect the wheel alignment and adjust as necessary. Refer to <u>Wheel Alignment Measurement</u> . Did you correct the condition?	Go to Step 9	Go to Step 8
8	Inspect the steering gear for unequal effort. The vehicle must be suspended on a hoist, the engine running, and the transmission in PARK or NEUTRAL. Grasp the tire assembly and manually simulate a turn from the left of center and the right of center observing whether more force is needed to turn to the left or to the right. If this condition exists replace the steering gear. Did you correct the condition?	System OK	Go to Step 3
9	Operate the vehicle in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

BODY LEANS OR SWAYS IN CORNERS

Body Leans or Sways in Corners

Step	Action	Yes	No
1	Did you review the General Description and perform the necessary inspections?	Go to Step 2	Go to <u>Symptoms - Suspension General Diagnosis</u>
2	Verify the vehicle leans or sways in corners. Does the vehicle operate normally?	System OK	Go to Step 3
3	Inspect the following components for wear or damage: • Front coil springs • Rear coil springs Are the components worn or damaged?	Go to Step 5	Go to Step 4
4	1. Inspect the stabilizer shaft link for wear or damage. 2. Replace as necessary. Did you find and correct the condition?	Go to Step 6	Go to Step 2
5	Replace the springs as necessary. Did you complete the repair?	Go to Step 6	-
6	Operate the vehicle in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

SUSPENSION BOTTOMS

Suspension Bottoms

Step	Action	Yes	No
DEFINITION: A loud bang or thump that can usually be felt and/or heard when the vehicle is driven over bumps. This condition is commonly noticed when the vehicle trim height is too low.			
1	Did you review the General Description and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Suspension General Diagnosis
2	Verify that the suspension bottoms. Does the vehicle operate normally?	System OK	Go to Step 3
3	Inspect for vehicle overloading and correct the overloading condition as necessary. Did you find and correct the condition?	Go to Step 6	Go to Step 4
4	Inspect the following components: - Inspect the shock absorbers. Refer to <u>Suspension Strut and Shock Absorber Testing - On Vehicle.</u> - Inspect for damaged coil springs and torsion bar, and replace as necessary. Did you find and correct the condition?	Go to Step 6	Go to Step 5
5	Inspect the vehicle trim height. Refer to <u>Trim Height Inspection.</u> Did you complete the trim height inspection procedure?	Go to Step 6	-
6	Operate the vehicle in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

TORQUE STEER

Torque Steer

Step	Action	Yes	No
DEFINITION: On a dry, smooth, flat road, the vehicle has a left or right steering force only during acceleration.			
1	Did you review the General Description and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Suspension General Diagnosis
	- Drive the vehicle on a straight, smooth, flat road. - Press the accelerator and determine if any additional steering input is required to maintain a straight ahead direction.		

2	3. Repeat this test with the vehicle traveling in the opposite direction in order to eliminate crosswind effects. Lead/pull caused by unlevel roads and crosswinds are considered normal. Does the vehicle exhibit torque steer when the accelerator is pressed?	Go to Step 3	System OK
3	1. Drive the vehicle on a straight, smooth, flat road at 64-97 km/h (40-60 mph). 2. Remove your foot from the accelerator. 3. Shift the transmission into NEUTRAL in order to allow the vehicle to coast. 4. Is any additional steering input required to maintain a straight ahead direction? 5. Repeat this test with the vehicle traveling in the opposite direction in order to eliminate crosswind effects. Lead/pull caused by unlevel roads and crosswinds are considered normal. Does the vehicle direction change when the steering wheel is momentarily released?	Go to <u>Vehicle Leads/Pulls</u>	Go to Step 4
4	Inspect the front suspension and powertrain mounts for worn or damaged components and repair as necessary. Did you find and correct the condition?	Go to Step 6	Go to Step 5
5	Inspect the vehicle trim height. Refer to <u>Trim Height Inspection</u>. Did you find and correct the condition?	Go to Step 6	-
6	Operate the vehicle in order to verify the repair. Did you correct the condition?	System OK	-

MEMORY STEER

Memory Steer

Step	Action	Yes	No
DEFINITION: A lead or pull in the direction the driver previously turned the vehicle. Additionally, after turning in the opposite direction, the vehicle will want to lead or pull in that direction.			
1	Did you review the General Description and perform the necessary inspections?	Go to Step 2	Go to <u>Symptoms - Suspension General Diagnosis</u>
2	Verify that memory steer is present. Does the system operate normally?	System OK	Go to Step 3

3	1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Lubricate the tie rod ends and the ball joints if applicable. 3. Inspect the suspension system for worn or damaged components. 4. Repair as necessary.		
	Did you find and correct the condition?	Go to Step 7	Go to Step 4
4	Inspect for binding strut bearings. 1. Disconnect the strut from the steering knuckle. 2. If the strut is abnormally difficult to rotate, repair or replace the upper bearing mount.		
	Did you find and complete the repair?	Go to Step 7	Go to Step 5
5	Inspect for binding in the lower ball joints. If the joint is binding, replace the joint. Did you find and complete the repair?	Go to Step 7	Go to Step 6
6	Inspect the wheel alignment and adjust as necessary. Refer to <u>Wheel Alignment Measurement</u> . Did you complete the wheel alignment?	Go to Step 7	-
7	Operate the vehicle in order to verify the repair. Did you correct the condition?	System OK	-

NOISE DIAGNOSIS - FRONT SUSPENSION

Noise Diagnosis - Front Suspension

Step	Action	Yes	No
DEFINITION: Any noise emitted from the front of the vehicle that is induced by VEHICLE SPEED or DRIVING TERRAIN as related to the front suspension.			
1	Did you review the General Description and perform the necessary Inspections?	Go to Step 2	Go to <u>Symptoms - Suspension General Diagnosis</u>
2	Attempt to duplicate the condition. Road test the vehicle. Did you duplicate the condition?	Go to Step 3	System OK
3	Is the noise reactive to vehicle load or speed?	Go to Step 4	Go to Step 7
	Inspect the tires for the following condition: • Proper tire inflation and adjust as necessary- Refer to <u>Tire Inflation Description</u> . • Unusual tire wear-Refer to <u>Tire Diagnosis</u> -		

4	<u>Irregular or Premature Wear</u> . Inspect the wheel nuts for looseness and tighten as necessary. Refer to <u>Fastener Tightening Specifications</u> . Did you find and correct the condition?	Go to Step 14	Go to Step 5
5	Inspect the front wheel bearings. Refer to <u>Wheel Bearings Diagnosis</u>. Did you find and correct the condition?	Go to Step 14	Go to Step 6
6	Inspect for front axle or transaxle noises. Refer to <u>Symptoms - Automatic Transmission</u> , or <u>Symptoms - Manual Transmission</u> . Did you find and correct the condition?	Go to Step 14	Go to Step 7
7	Bounce the front of the vehicle in order to duplicate the noise. Did you duplicate the noise?	Go to Step 8	Go to Step 9
8	1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Inspect the front suspension components for looseness. Refer to <u>Fastener Tightening Specifications</u> . 3. Inspect the front suspension components for damage and repair as necessary. Did you find and correct the condition?	Go to Step 14	Go to Step 9
9	1. Install the CH-39570 chassis ear or equivalent. 2. Bounce the front of the vehicle, using CH-39570 chassis ear or equivalent in order to locate the source of the noise. If necessary road test the vehicle. 3. Repair or replace any damaged components as necessary. Did you find and correct the condition?	Go to Step 14	Go to Step 10
10	Inspect the ball joints and steering components for the following conditions: - Lack of lubrication where applicable - Looseness in the ball joints - Looseness in the tie rods Did you find and correct the condition?	Go to Step 14	Go to Step 11

11	Inspect for damaged shock absorbers. Refer to <u>Suspension Strut and Shock Absorber Testing - On Vehicle</u> . Did you find and correct the condition?	Go to Step 14	Go to Step 12
12	Inspect the front stabilizer shaft and stabilizer shaft links for damage and repair as necessary. Refer to <u>Stabilizer Shaft Replacement</u> , or <u>Stabilizer Shaft Link Replacement</u> . Did you find and correct the condition?	Go to Step 14	Go to Step 13
13	Inspect for control arm damage and repair as necessary. Refer to <u>Lower Control Arm Replacement</u> . Did you find and correct the condition?	Go to Step 14	-
14	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

NOISE DIAGNOSIS - REAR SUSPENSION

Noise Diagnosis - Rear Suspension

Step	Action	Yes	No
DEFINITION: Any noise emitted from the rear of the vehicle that is induced by VEHICLE SPEED or DRIVING TERRAIN as related to the rear suspension.			
1	Did you review the General Description and perform the necessary inspections?	Go to Step 2	Go to <u>Symptoms - Suspension General Diagnosis</u>
2	Attempt to duplicate the condition. Road test the vehicle. Did you duplicate the condition?	Go to Step 3	System OK
3	Is the noise reactive to vehicle load or speed?	Go to Step 4	Go to Step 6
4	Perform the following inspections: - Inspect and adjust the tire inflation. Refer to <u>Tire Inflation Description</u> . - Inspect for unusual tire wear. Refer to <u>Tire Diagnosis - Irregular or Premature Wear</u> . - Inspect the wheel nuts for looseness. Refer to <u>Fastener Tightening Specifications</u> . Did you find and correct the condition?	Go to Step 10	Go to Step 5
5	Inspect the rear wheel bearings. Refer to <u>Wheel Bearings Diagnosis</u> . Did you find and correct the condition?	Go to Step 10	Go to Step 6
6	Bounce the rear of the vehicle in order to duplicate the noise.		

	Did you duplicate the noise?	Go to Step 7	Go to Step 9
7	1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Inspect the rear suspension components for looseness. Refer to <u>Fastener Tightening Specifications</u> . 3. Inspect the rear suspension components for damage and repair as necessary.		
	Did you find and correct the condition?	Go to Step 10	Go to Step 8
8	Inspect the rear shock absorber. Refer to <u>Suspension Strut and Shock Absorber Testing - On Vehicle</u> . Did you find and correct the condition?	Go to Step 10	Go to Step 9
9	1. Install the CH-39570 chassis ear or equivalent. 2. Bounce the rear of the vehicle, using CH-39570 chassis ear or equivalent, in order to locate the source of the noise. If necessary, road test the vehicle. 3. Repair or replace any defect component as necessary.		
	Did you find and correct the condition?	Go to Step 10	System OK
10	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

SUSPENSION STRUT AND SHOCK ABSORBER TESTING - ON VEHICLE

Suspension Strut and Shock Absorber Testing - On Vehicle

Step	Action	Yes	No
1	Did you review the General Description and perform the necessary inspections?	Go to Step 2	Go to <u>Symptoms - Suspension General Diagnosis</u>
2	Verify that the customer concern is present. Does the vehicle operate normally?	System OK	Go to Step 3
3	NOTE: A light film of oil on the top portion of the shock reservoir is normal. Inspect each strut or shock absorber for external fluid leakage. Is a strut or shock absorber leaking?	Go to Step 5	Go to Step 4
4	1. Use your hands in order to lift up and push down each corner of the vehicle 3 times. 2. Remove your hands from the vehicle.		

	3. Locate a shock or strut that exceeds 2 cycles. Did you locate a shock or strut that exceeds 2 cycles?	Go to Step 5	Go to Step 6
5	NOTE: Inspect the vehicle trim height in order to correct any possible causes of shock/strut failures. Refer to <u>Trim Height Inspection</u>. Replace the strut or shock absorber. Refer to <u>Strut, Strut Component, or Spring Replacement</u> , or <u>Shock Absorber Replacement</u> .Did you complete the repair?	Go to Step 6	-
6	Operate the vehicle in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

WHEEL BEARINGS DIAGNOSIS

Wheel Bearings Diagnosis

Step	Action	Yes	No
1	Did you review the General Description and perform the necessary inspections?	Go to Step 2	Go to <u>Symptoms - Suspension General Diagnosis</u>
2	Road test the vehicle in order to verify the customer's complaint. Does the vehicle operate normally?	System OK	Go to Step 3
3	1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Inspect for tire or wheel damage. Did you find and correct the condition?	Go to Step 7	Go to Step 4
4	1. Install the CH-39570 chassis ear. 2. Road test the vehicle to verify the location of the wheel bearing noise. Did you find and correct the condition?	Go to Step 6	Go to Step 5
	NOTE: Support the vehicle by the lower control arms or the rear axle to prevent movement during wheel bearing/hub inspection. 1. Mount and secure the J-8001 dial indicator. 2. Ensure that the dial indicator contacts the vertical surface of the wheel as close as possible to the top wheel stud.		

5	3. Push and pull on the top of the tire in order to inspect the total travel indicated by the dial indicator.		
	Specification Maximum allowable wheel bearing end play: 0.127 mm (0.005 in)		
	Is the measurement greater than the specified value?	Go to Step 6	System OK
6	Replace the wheel bearing. Refer to <u>Front Wheel Bearing and Hub Replacement</u> , or <u>Rear Wheel Bearing and Hub Replacement</u> .		-
	Did you complete the repair?	Go to Step 7	
7	Road test the vehicle to verify the repair. Does the vehicle operate normally?	System OK	Go to Step 3

TRIM HEIGHT INSPECTION

Trim Height Measurement

Trim height is a predetermined measurement relating to vehicle ride height. Incorrect trim heights can cause the vehicle to bottom out over bumps, damage to the suspension components and symptoms similar to wheel alignment problems. Check the trim heights when diagnosing suspension concerns and before checking the wheel alignment.

Perform the following before measuring the trim heights:

- Set the tire pressure to the specifications shown on the certification label. Refer to **Tire Inflation Description** .
- Check the fuel level. Add additional weight if necessary to simulate a full tank.
- Make sure the passenger and rear compartments are empty, except for the spare tire.
- Make sure the vehicle is on a flat and level surface, such as an alignment rack.
- Check that all the vehicle doors are securely closed.
- Check that the vehicle hood and rear deck lids are securely closed.
- Check for installed after market accessories or modifications that could affect trim height measurement.

Measuring the Trim Height

NOTE: All dimensions are measured vertical to the ground. Trim height should be within ± 10 mm (± 39 in) to be considered correct.

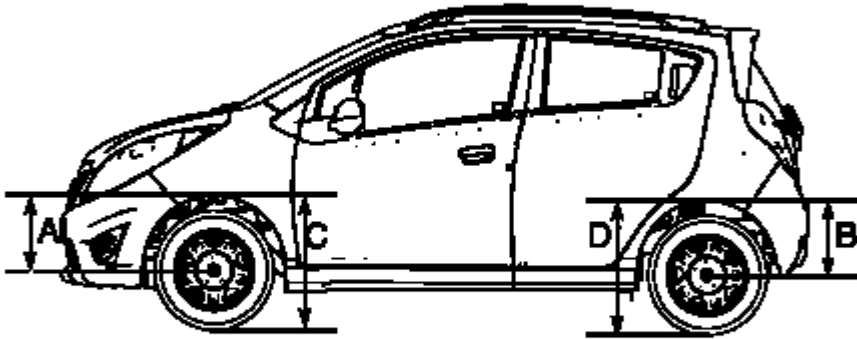


Fig. 2: Identifying Trim Height

Courtesy of GENERAL MOTORS COMPANY

NOTE: The vehicle must be on a flat level surface.

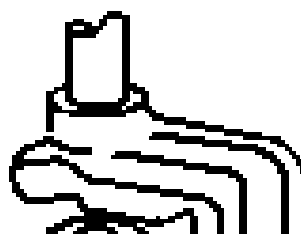
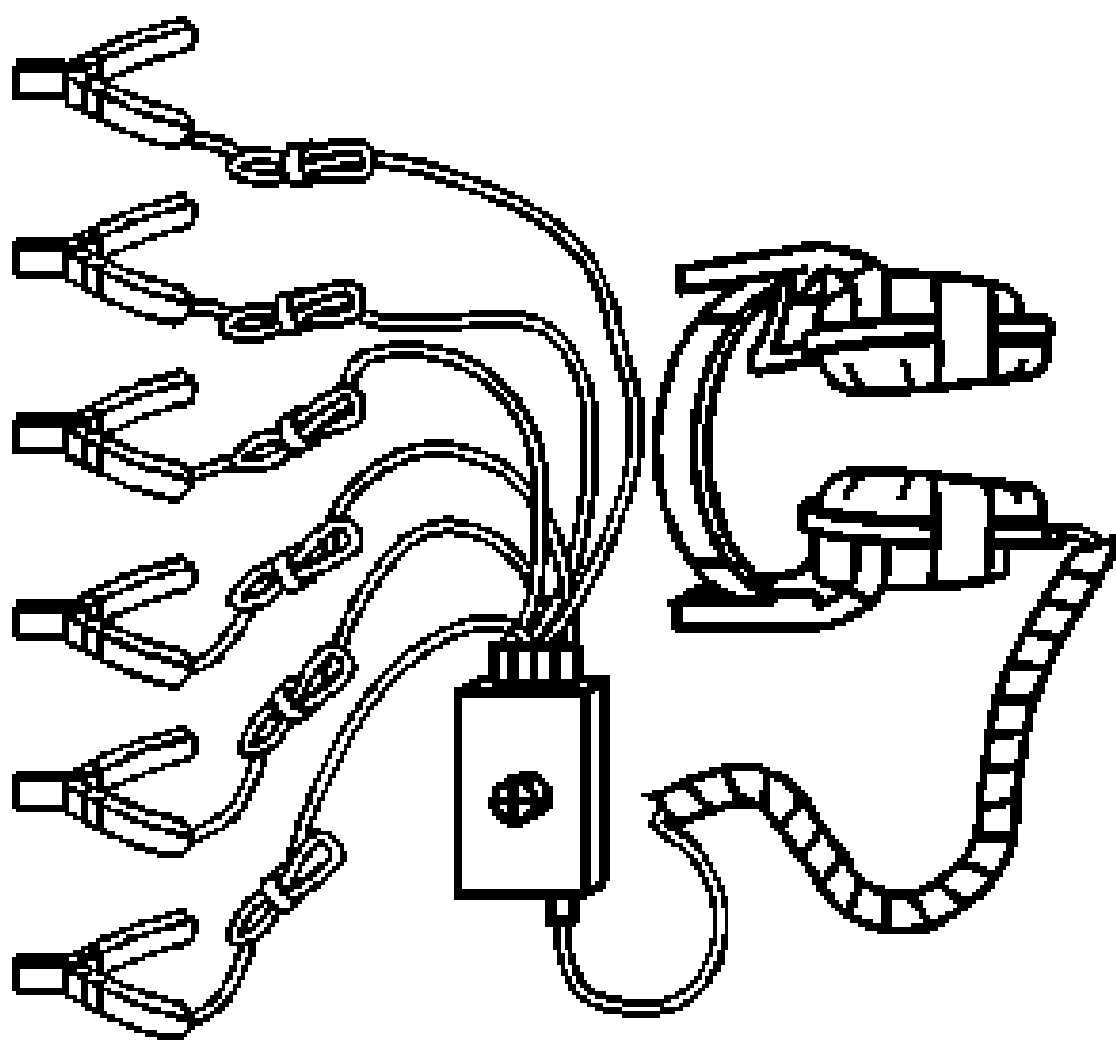
1. Using your hands, lift the front bumper approximately 38 mm (1.49 in).
2. Gently remove your hands and allow the vehicle to lower.
3. Using your hands, bounce the front of the vehicle downward approximately 38 mm (1.49 in).
4. Gently remove your hands and allow the vehicle to rise.
5. Measure and note the C dimension. This height is measured vertically from the ground to the bottom lip of the wheel opening through the centerline of the front wheel.
6. Measure and note the A dimension for the left and right side of the vehicle from the bottom of the front wheel rim to the wheel arc along the centerline of the front wheel.
7. Compare the A and C dimension measurements to the trim height specifications. Refer to **Trim Height Specifications**.
8. If the measurements are not within the specified range, replace the front coil springs as required. Refer to **Strut, Strut Component, or Spring Replacement**.
9. Using your hands, lift the front bumper approximately 38 mm (1.49 in).
10. Gently remove your hands and allow the vehicle to lower.
11. Using your hands, bounce the front of the vehicle downward approximately 38 mm (1.49 in).

12. Gently remove your hands and allow the vehicle to rise.
13. Measure and note the C dimension. This height is measured vertically from the ground to the bottom lip of the wheel opening through the centerline of the rear wheel.
14. Measure and note the B dimension for the left and right side of the vehicle from the bottom of the rear wheel rim to the wheel arc along the centerline of the rear wheel.
15. Compare the B and D dimension measurements to the trim height specifications. Refer to **Trim Height Specifications**.
16. If the measurements are not within the specified range, replace the rear coil springs as required. Refer to **Rear Spring Replacement** .

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description
	CH-39570 J-39570 Chassis Ear



CH-8001 J-8001 Dial Indicator Set

SYSTEM WIRING DIAGRAMS

Chevrolet - Spark

AIR CONDITIONING

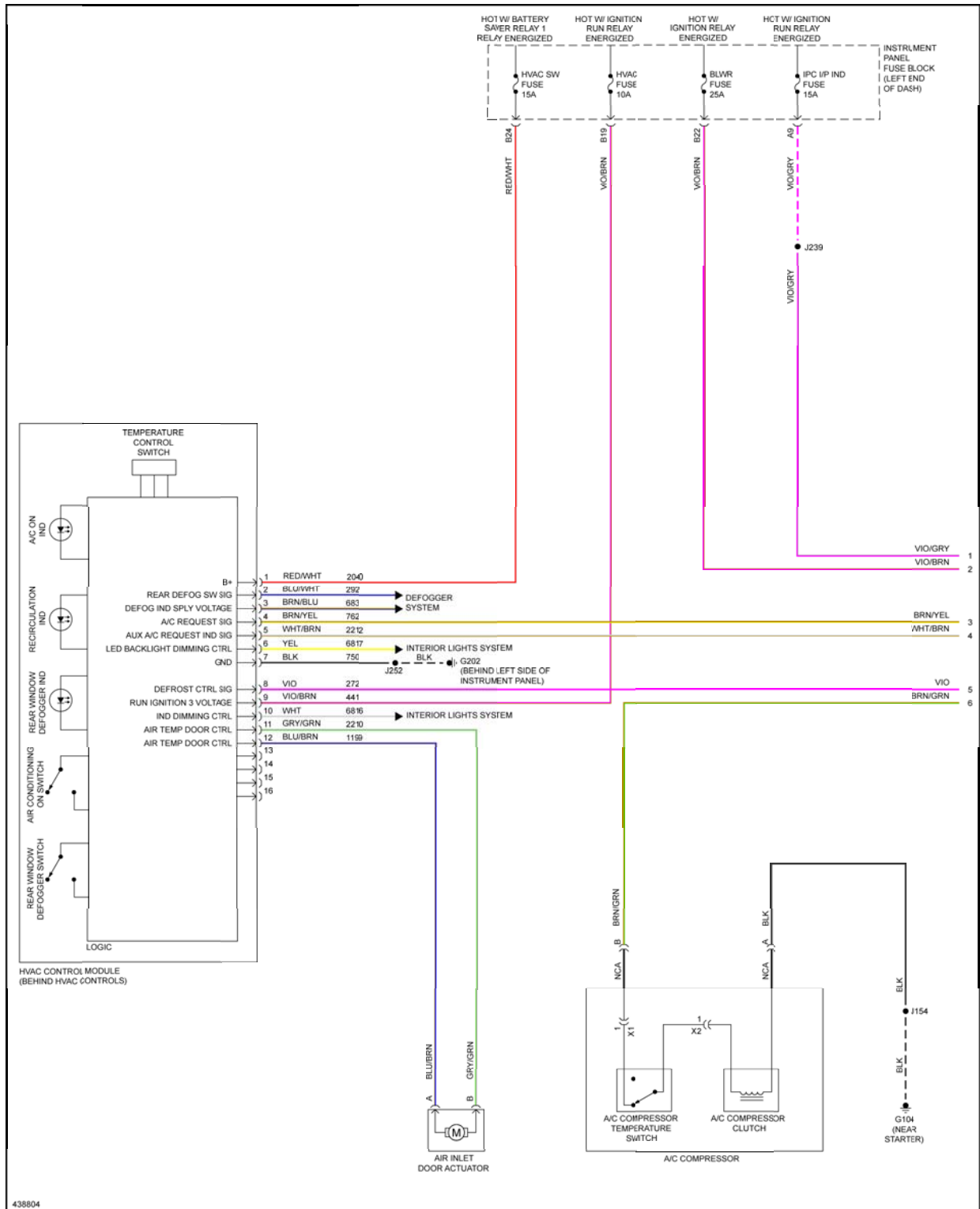


Fig. 1: Manual A/C Circuit (1 of 3)

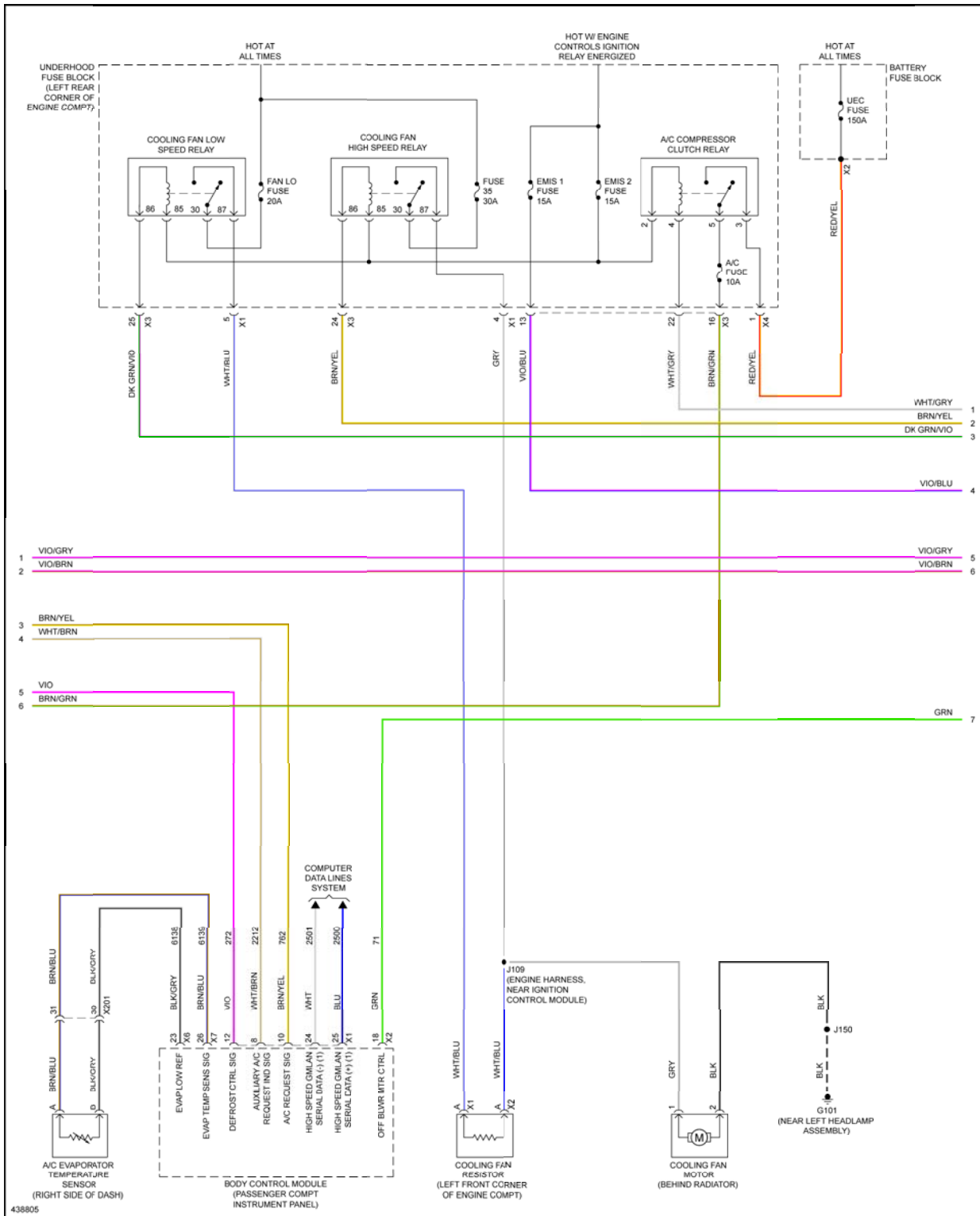


Fig. 2: Manual A/C Circuit (2 of 3)

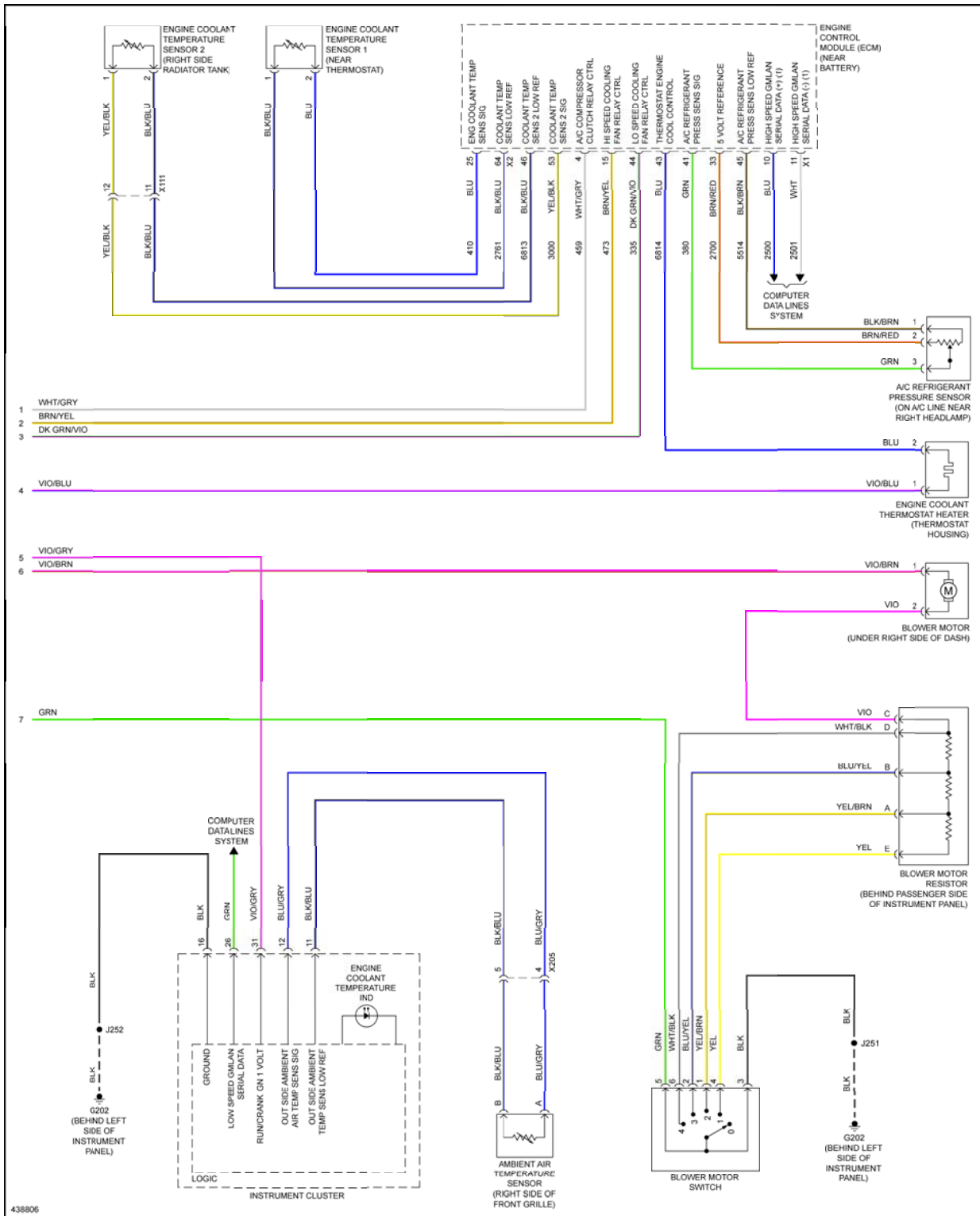
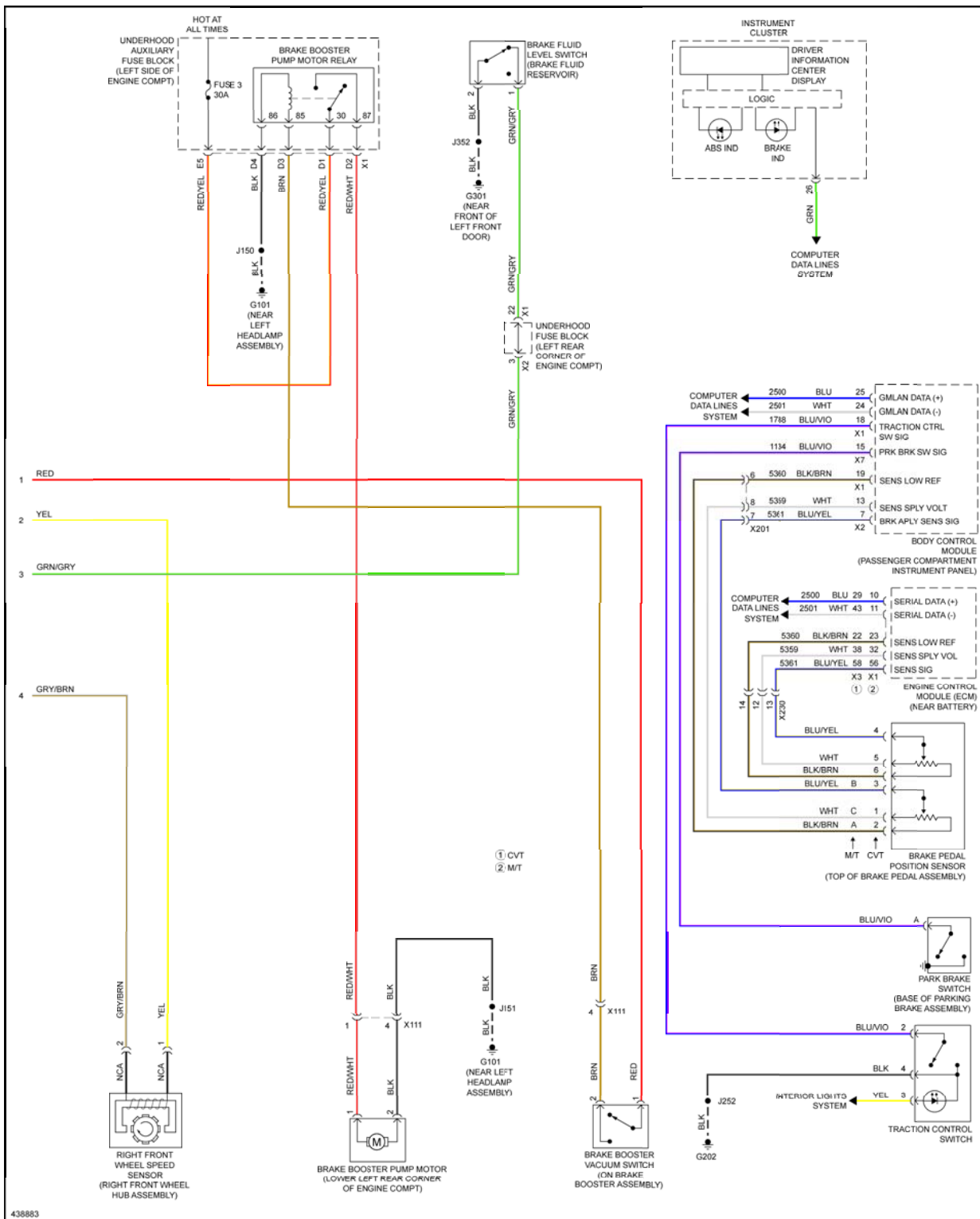


Fig. 3: Manual A/C Circuit (3 of 3)

ANTI-LOCK BRAKES





ANTI-THEFT

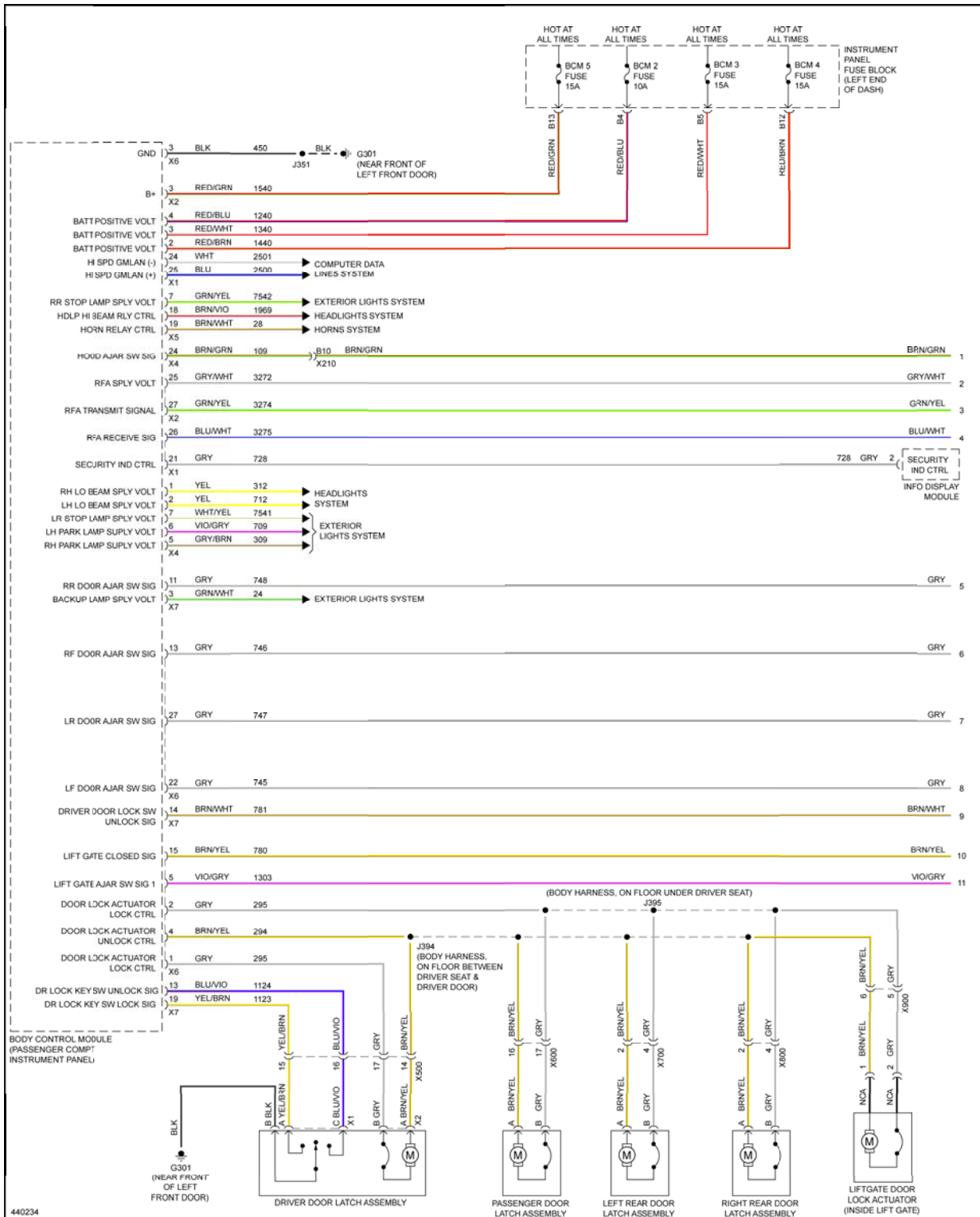


Fig. 6: Forced Entry Circuit (1 of 2)

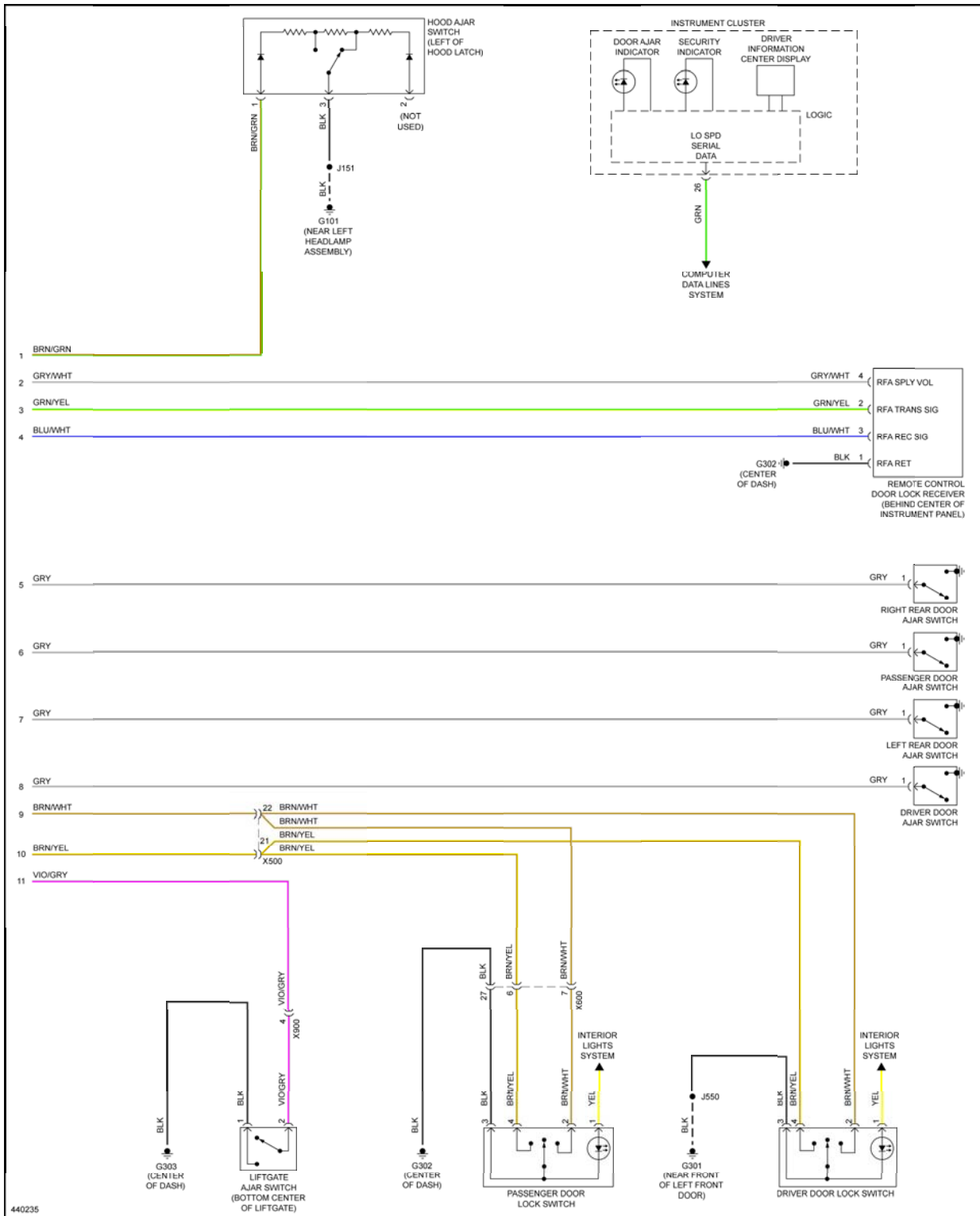


Fig. 7: Forced Entry Circuit (2 of 2)

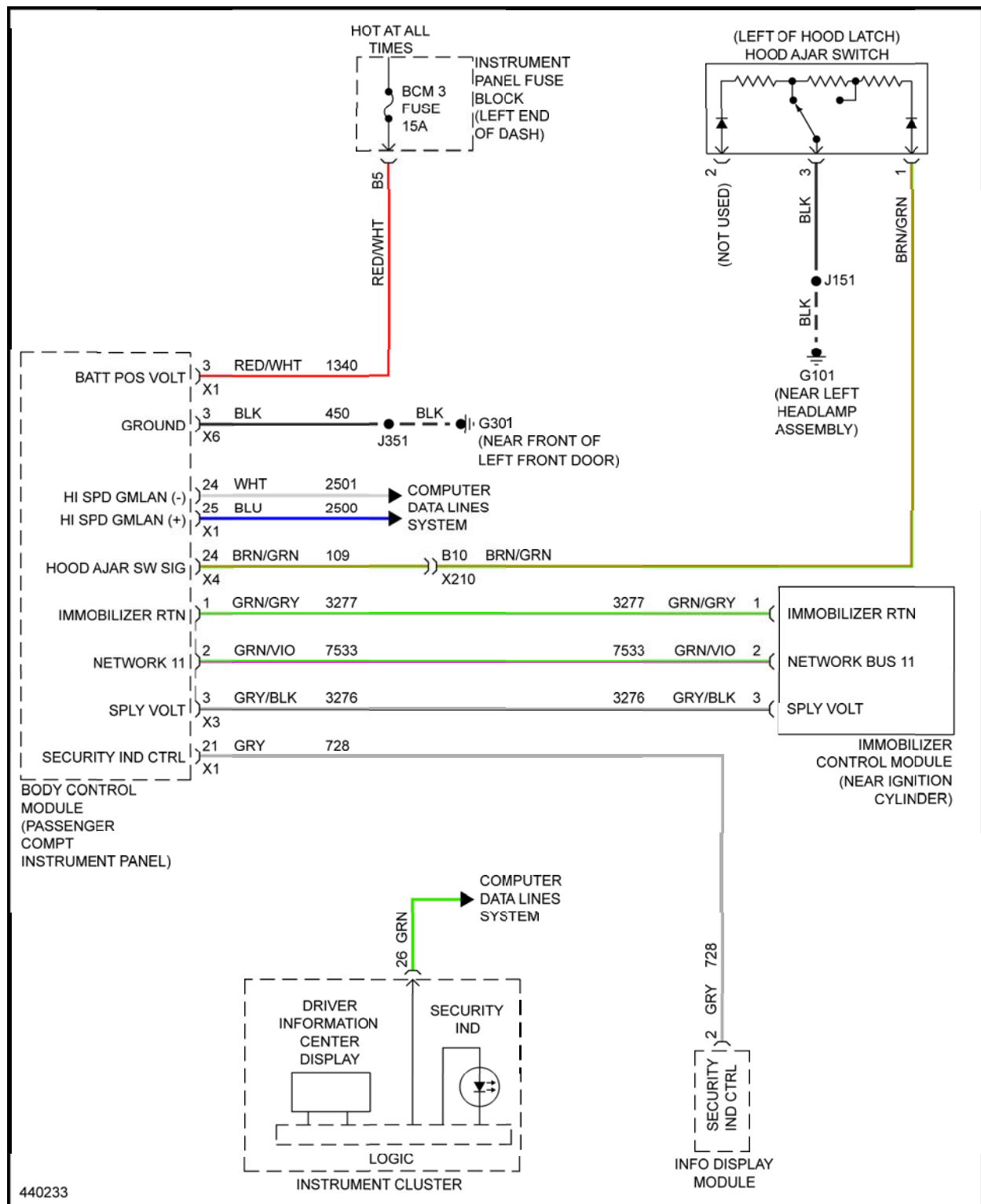


Fig. 8: Pass-Key Circuit

BODY CONTROL MODULES

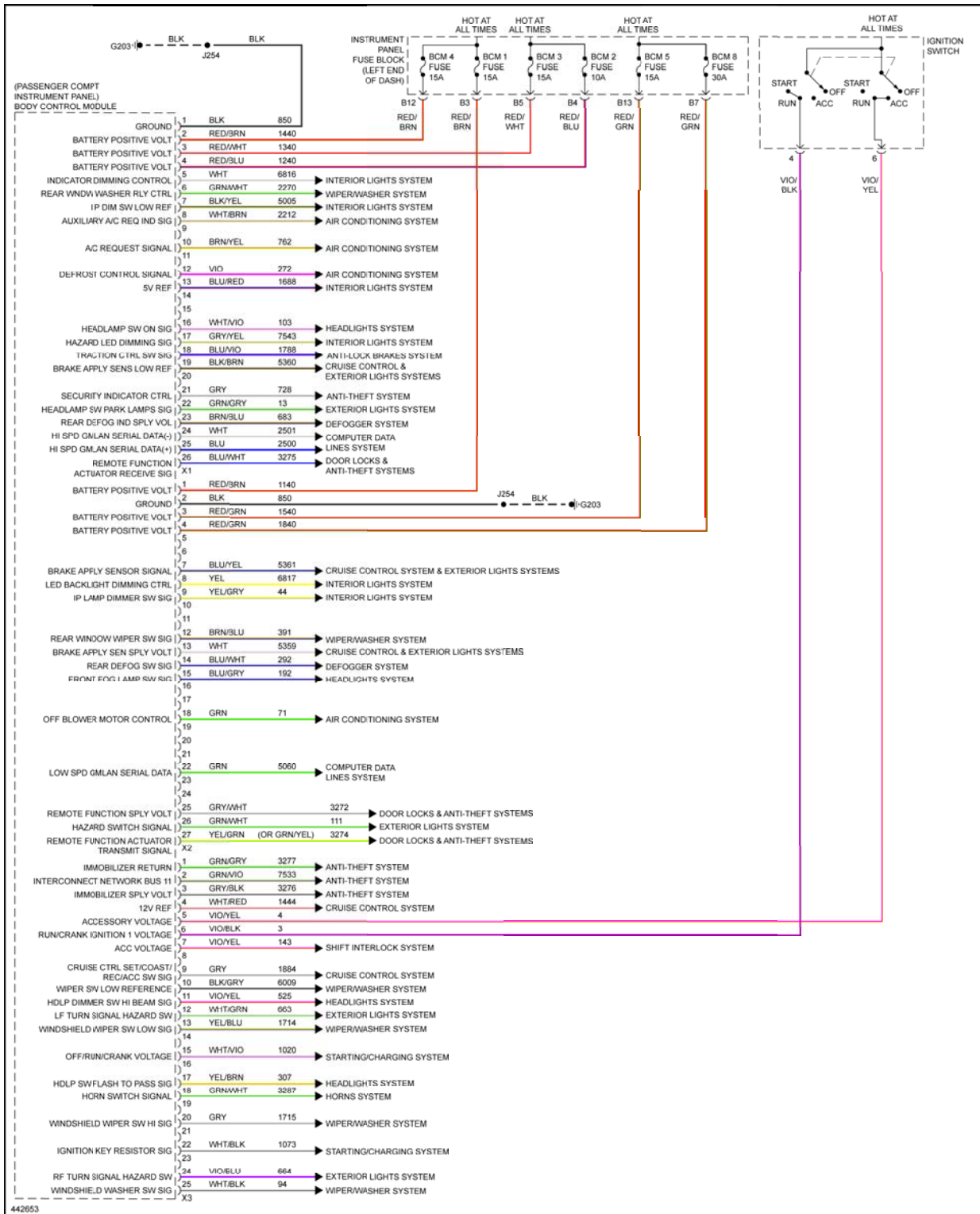


Fig. 9: Body Control Modules Circuit (1 of 2)

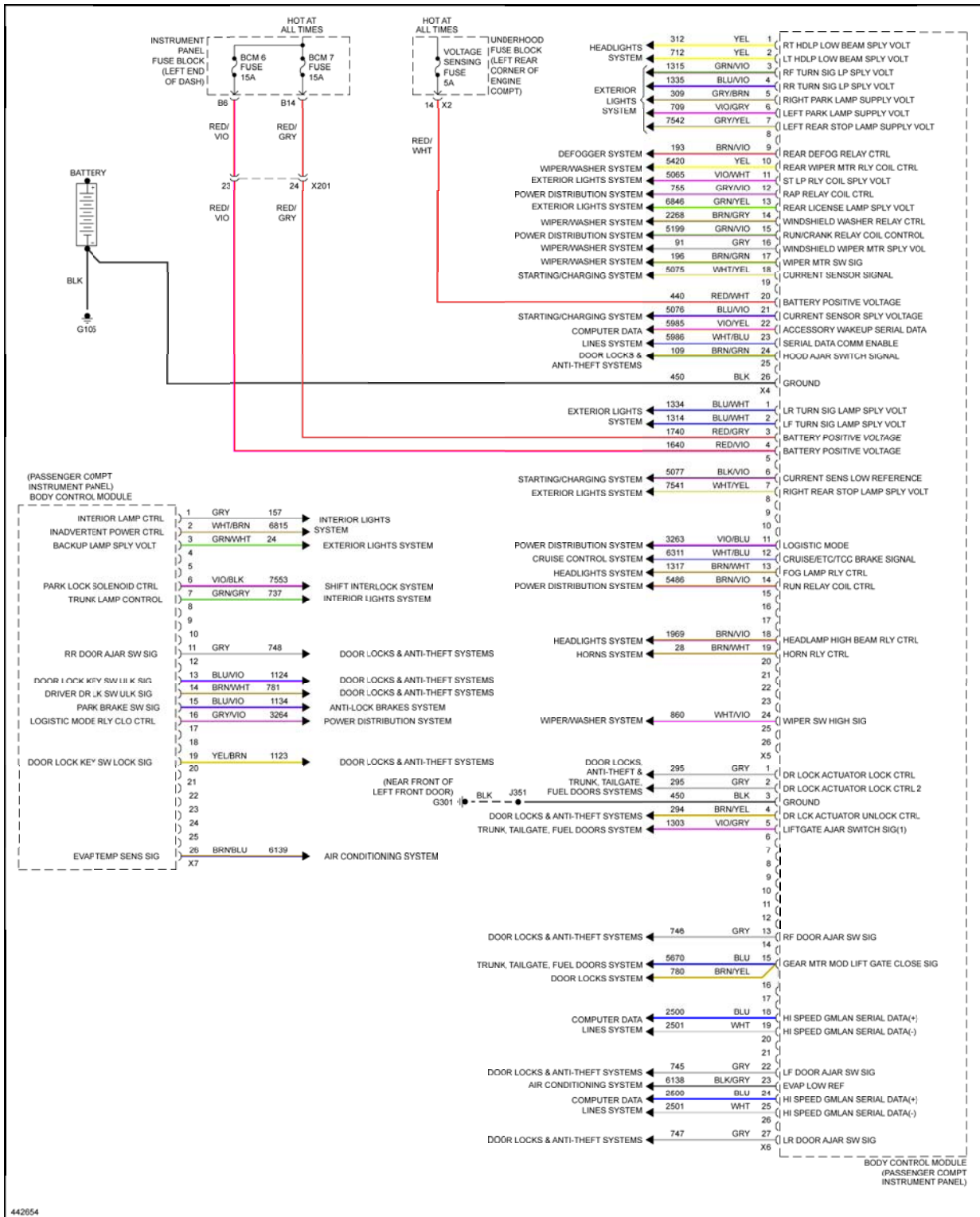


Fig. 10: Body Control Modules Circuit (2 of 2)

COMPUTER DATA LINES

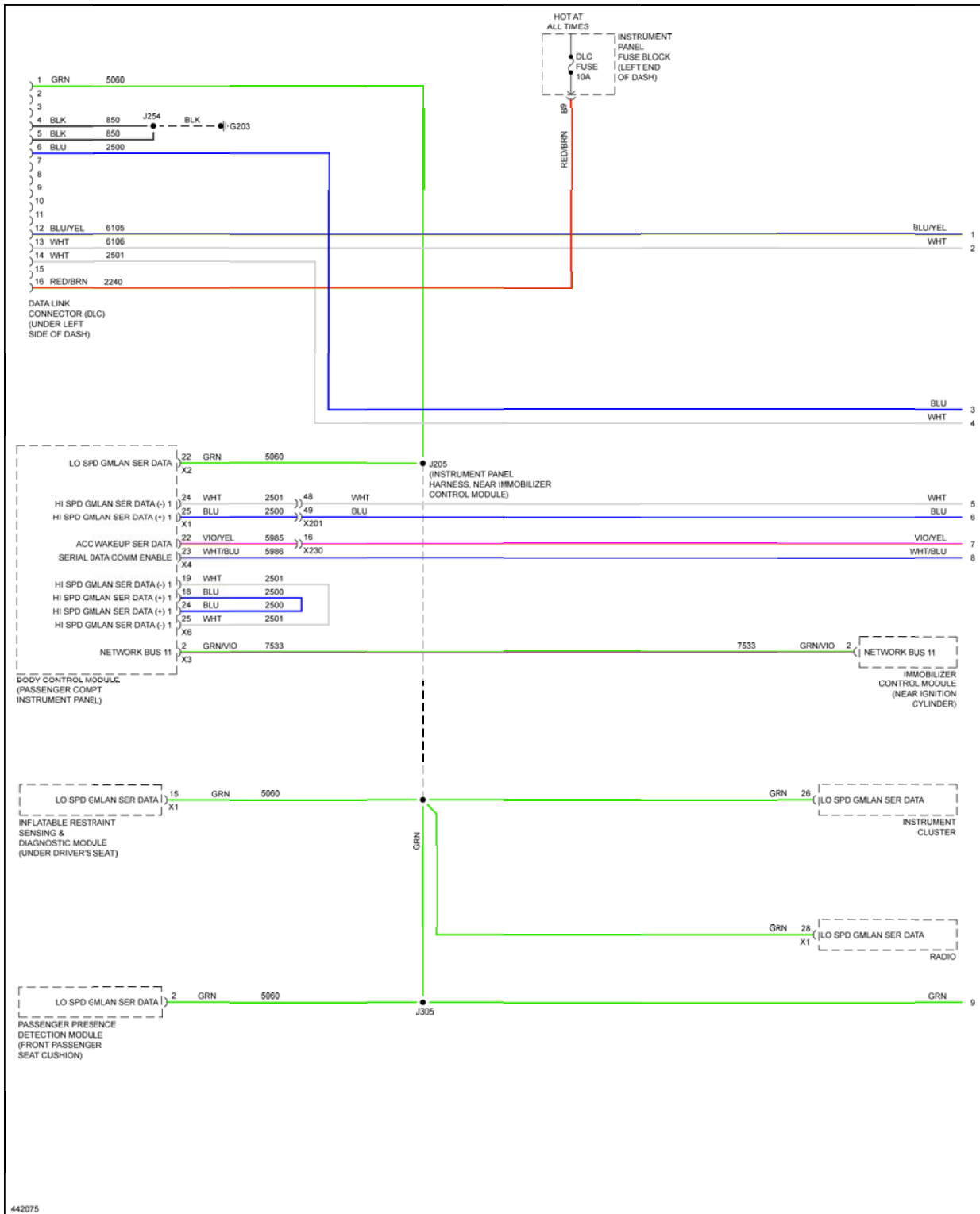


Fig. 11: Computer Data Lines Circuit (1 of 2)

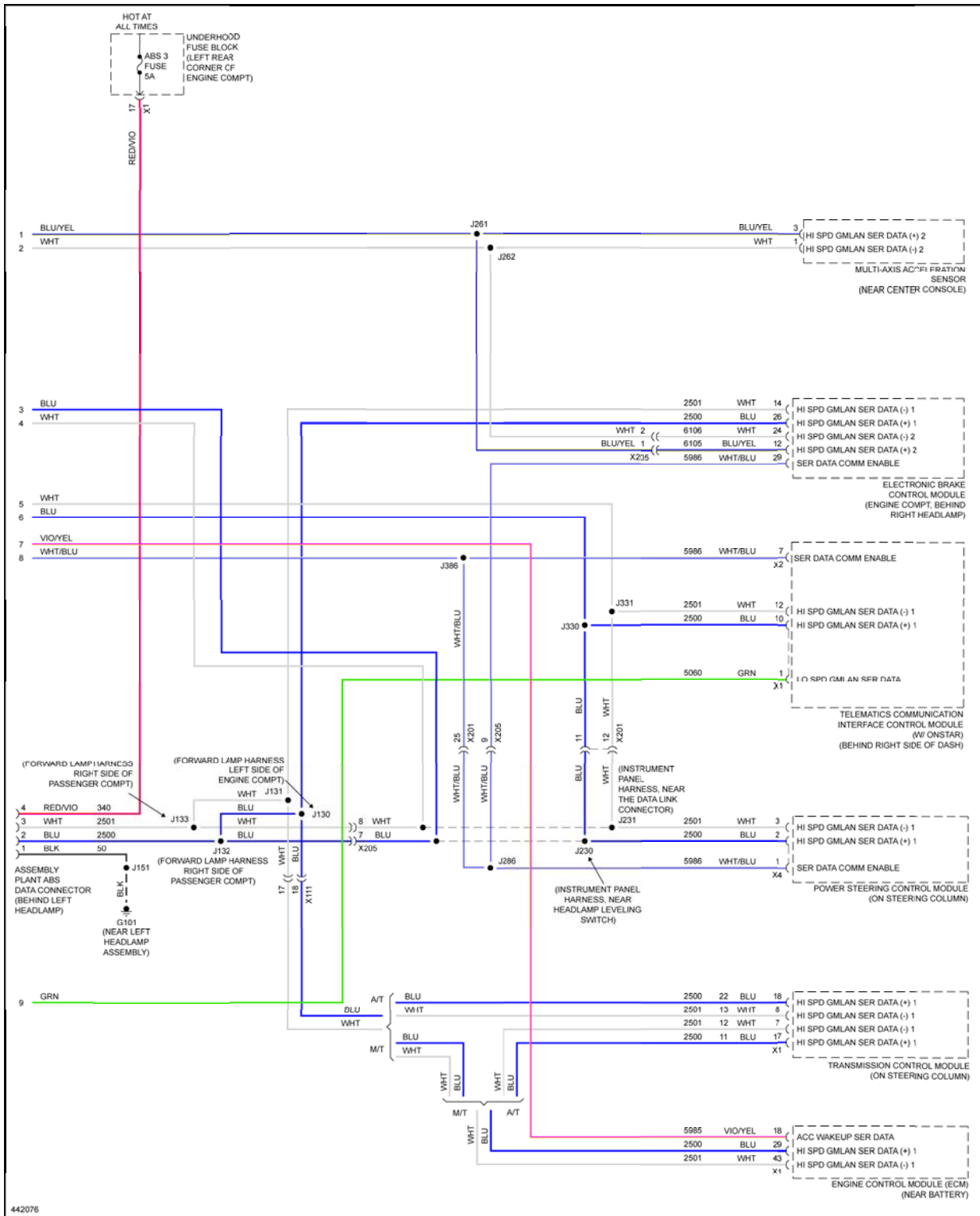


Fig. 12: Computer Data Lines Circuit (2 of 2)

COOLING FAN

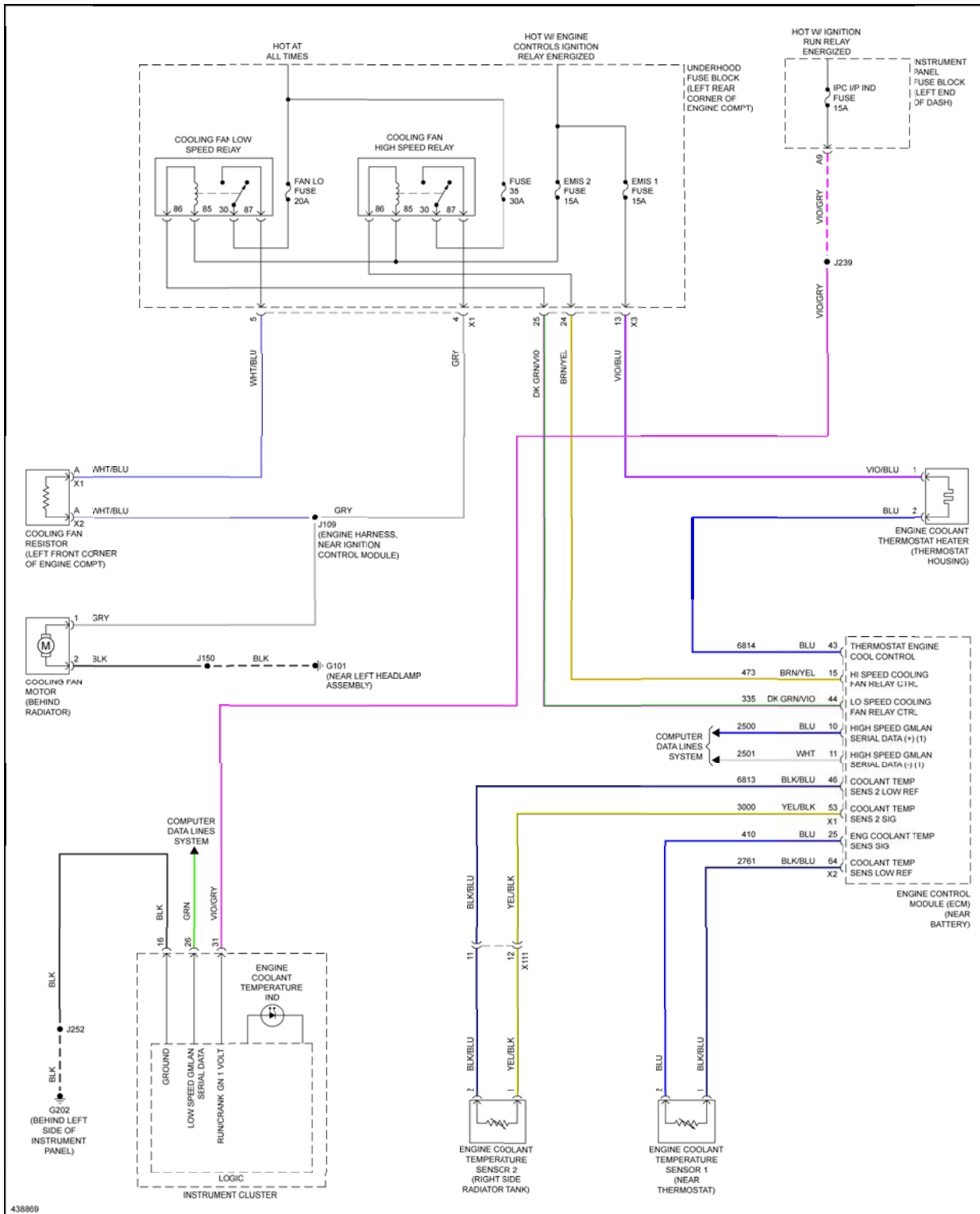


Fig. 13: Cooling Fan Circuit

CRUISE CONTROL

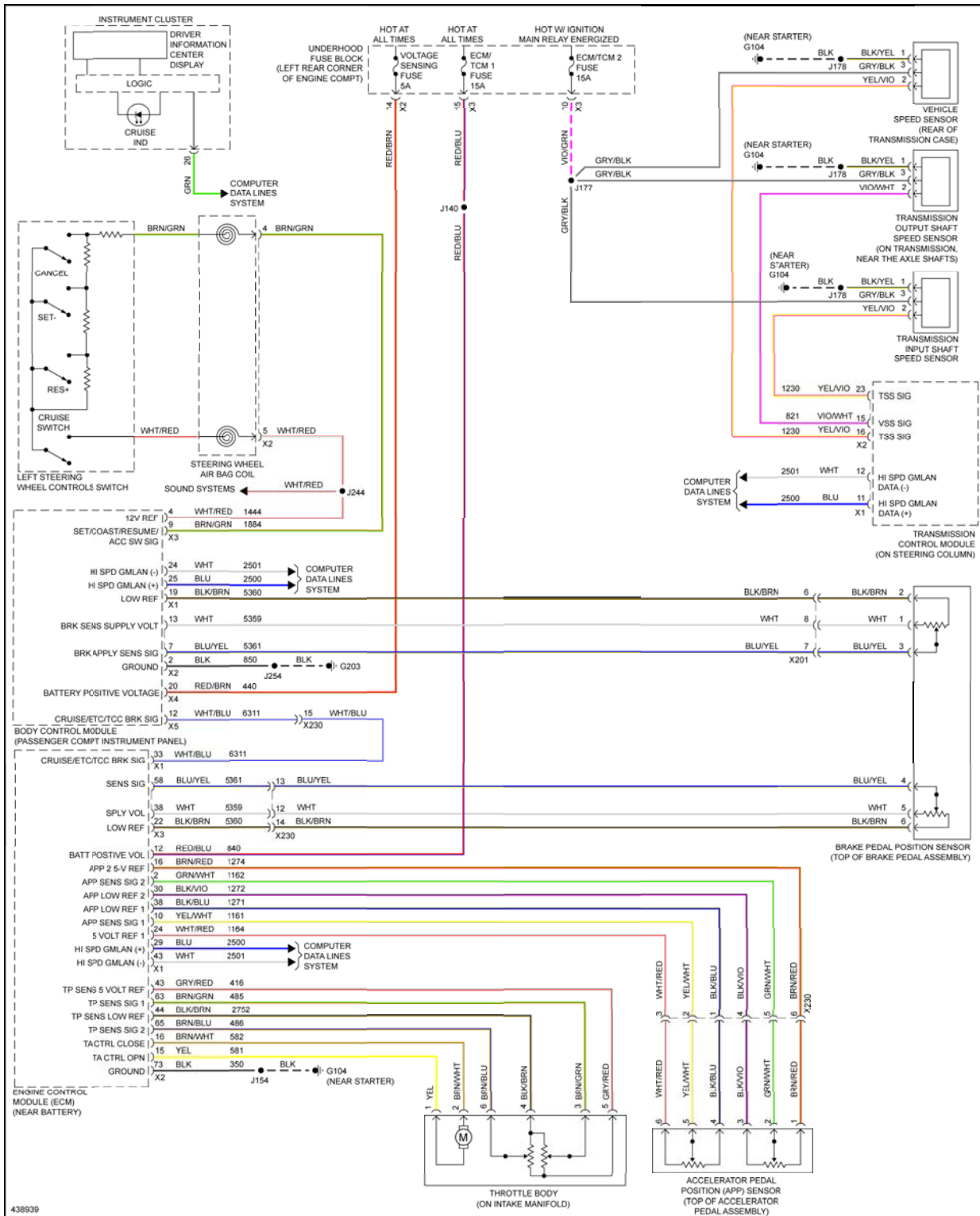


Fig. 14: Cruise Control Circuit, CVT

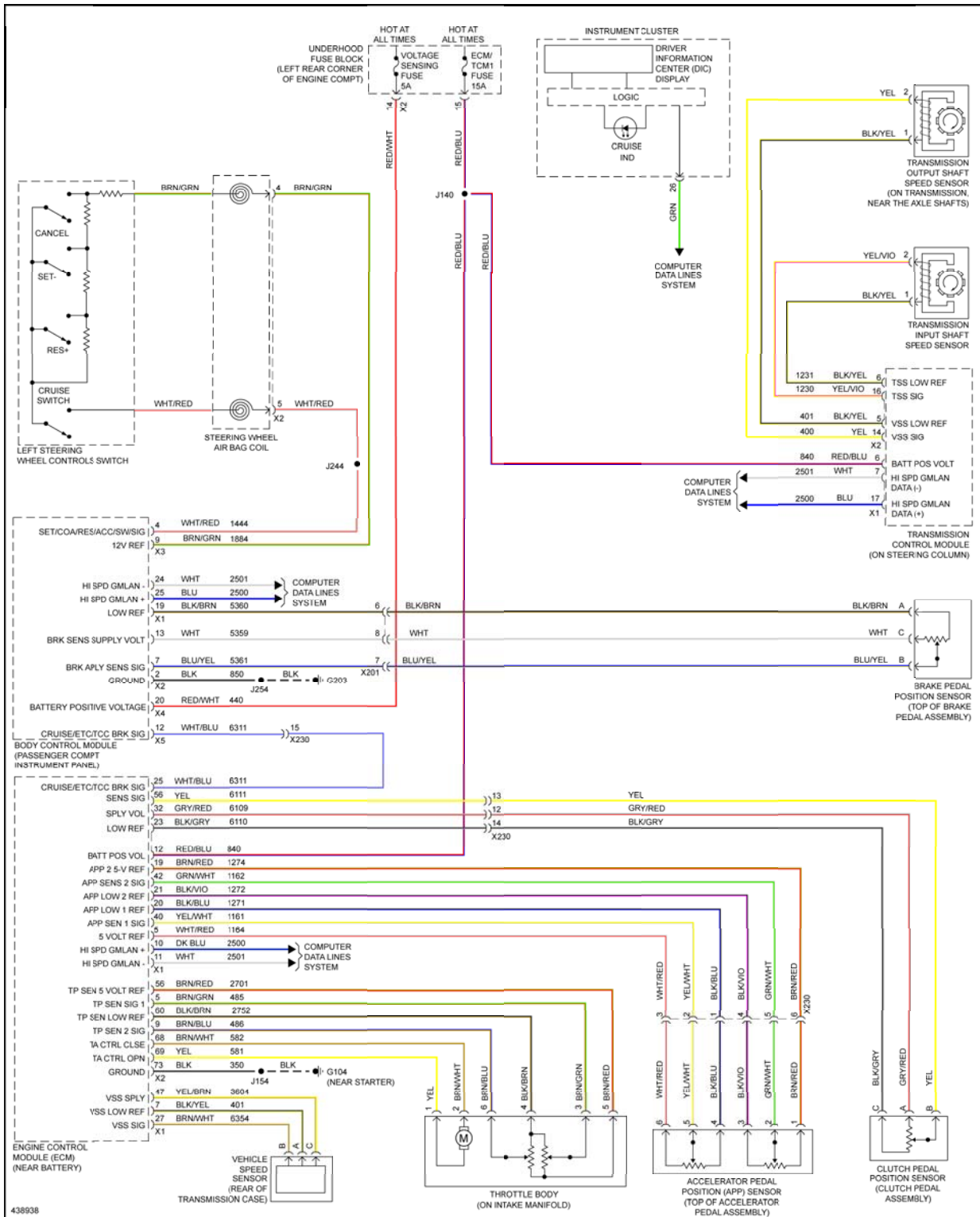


Fig. 15: Cruise Control Circuit, M/T

DEFOGGERS

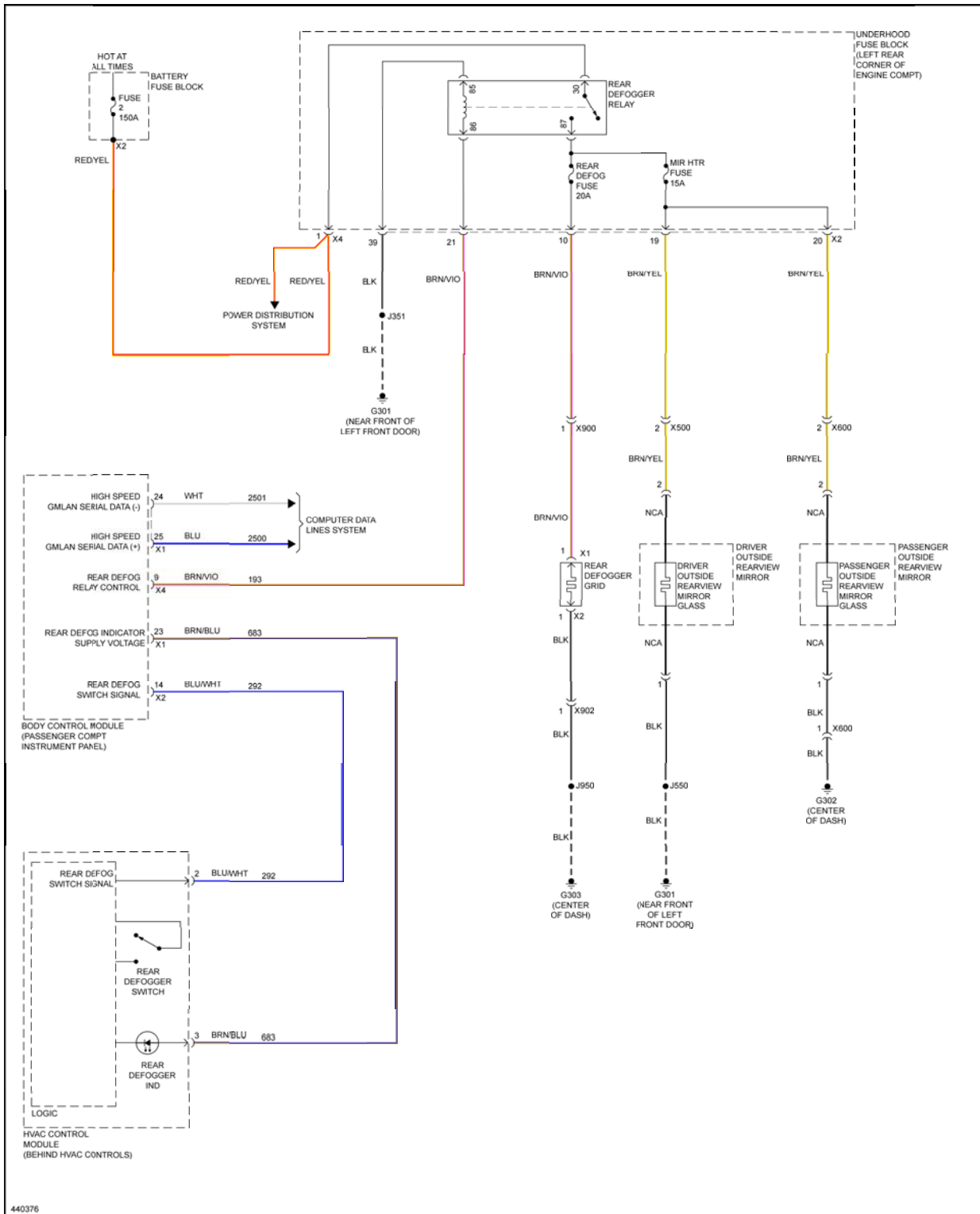


Fig. 16: Defoggers Circuit

ELECTRONIC POWER STEERING

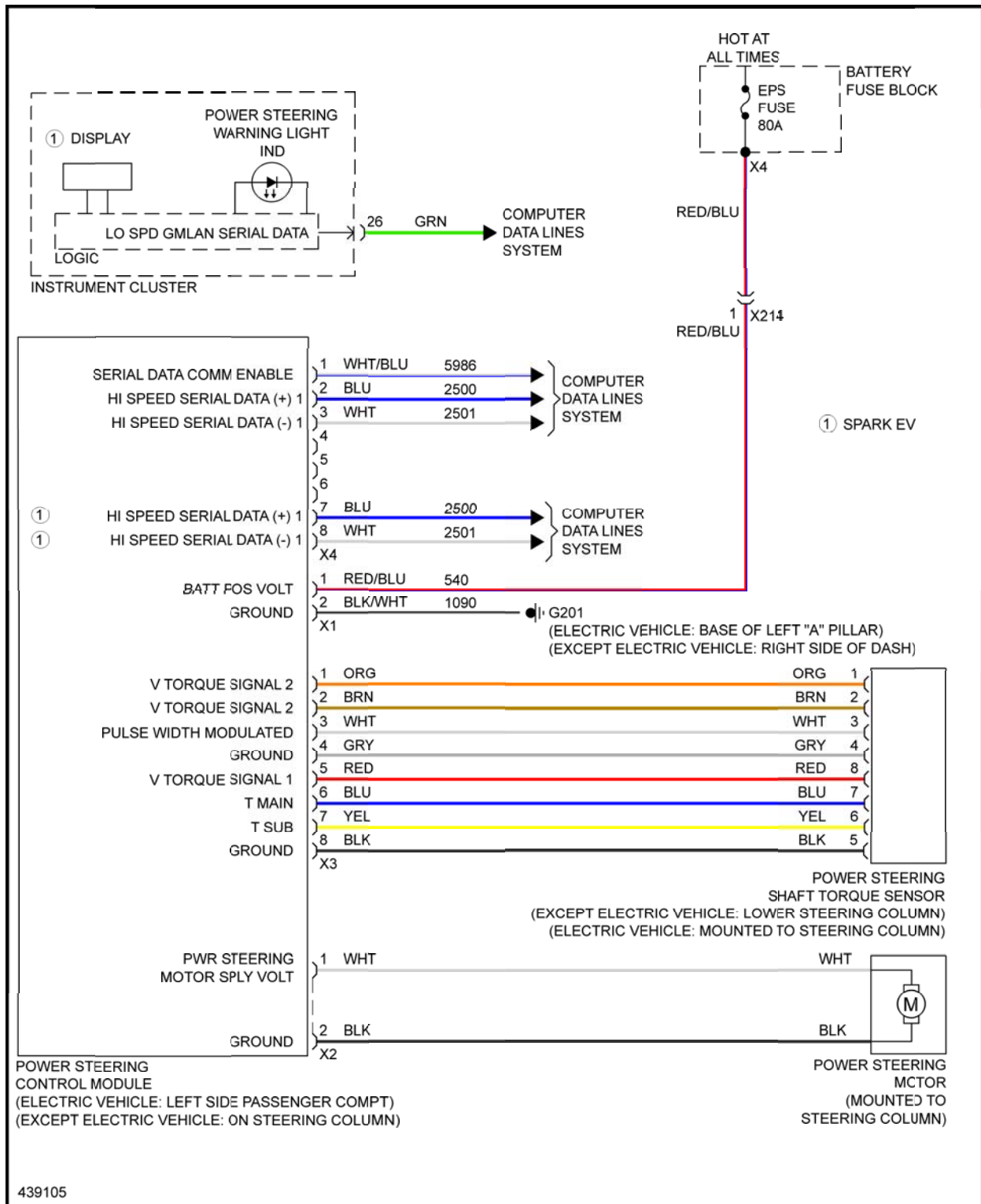


Fig. 17: Electronic Power Steering Circuit

ENGINE PERFORMANCE

1.2L VIN 9

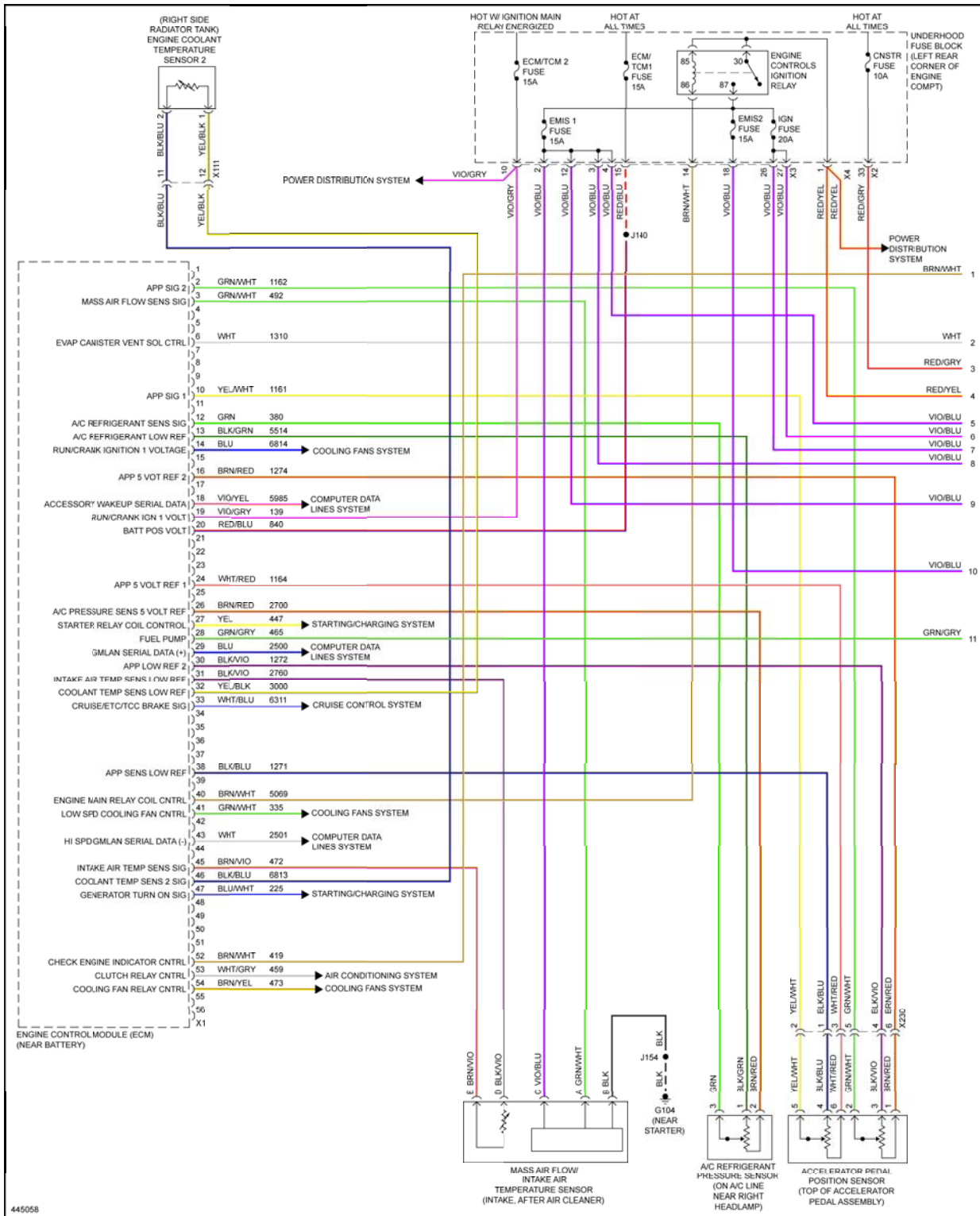


Fig. 18: 1.2L VIN 9, Engine Performance Circuit, CVT (1 of 5)

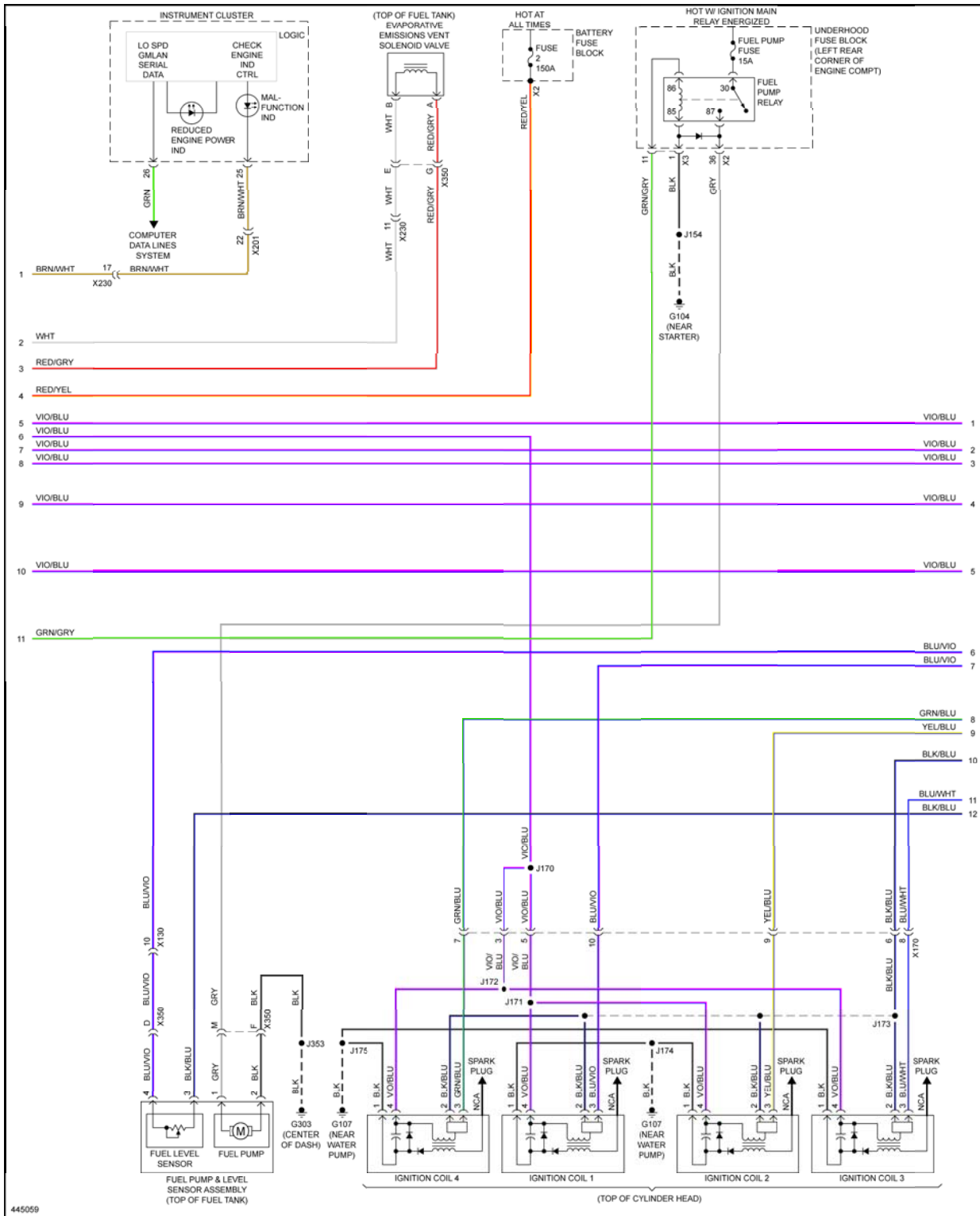


Fig. 19: 1.2L VIN 9, Engine Performance Circuit, CVT (2 of 5)

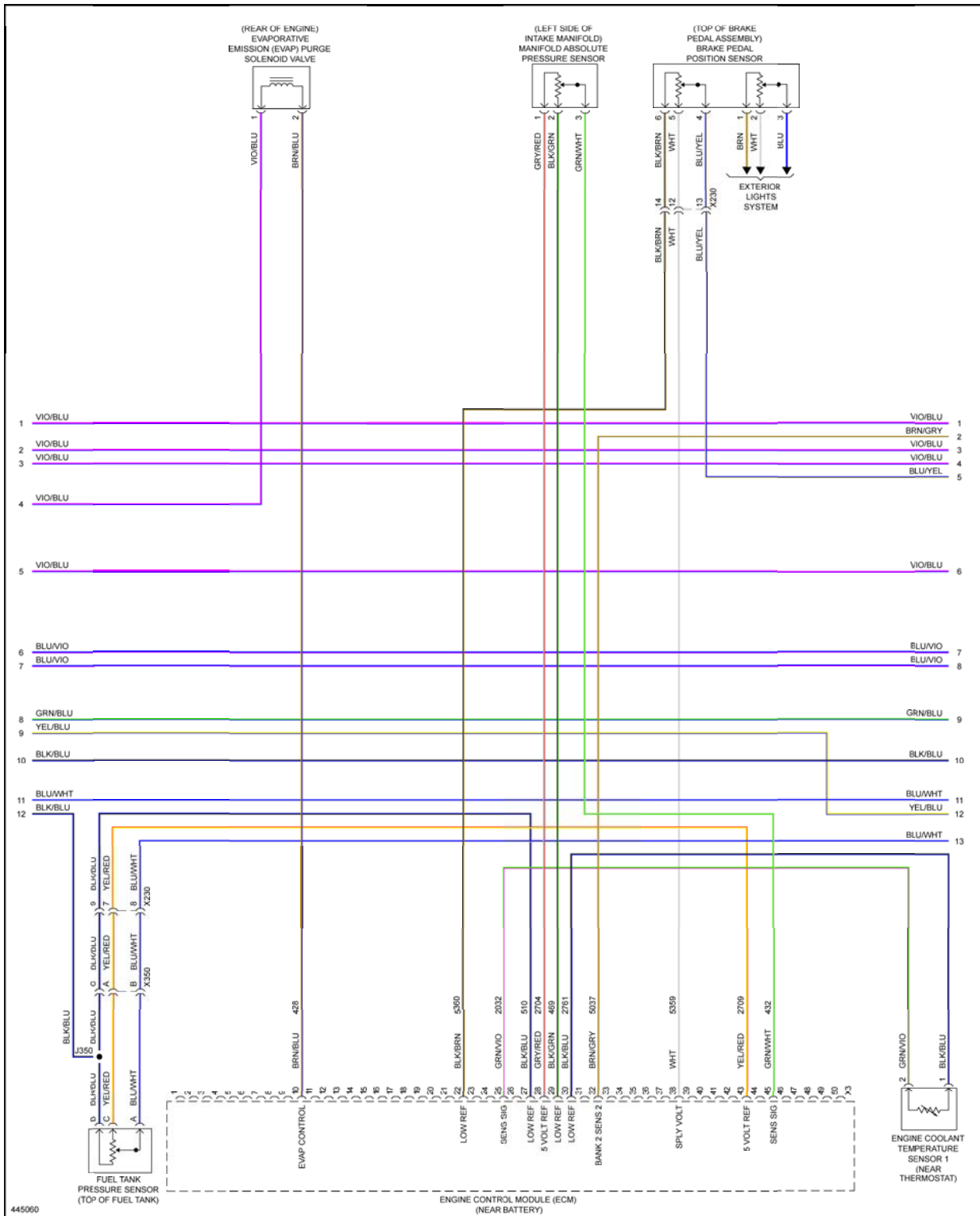


Fig. 20: 1.2L VIN 9, Engine Performance Circuit, CVT (3 of 5)

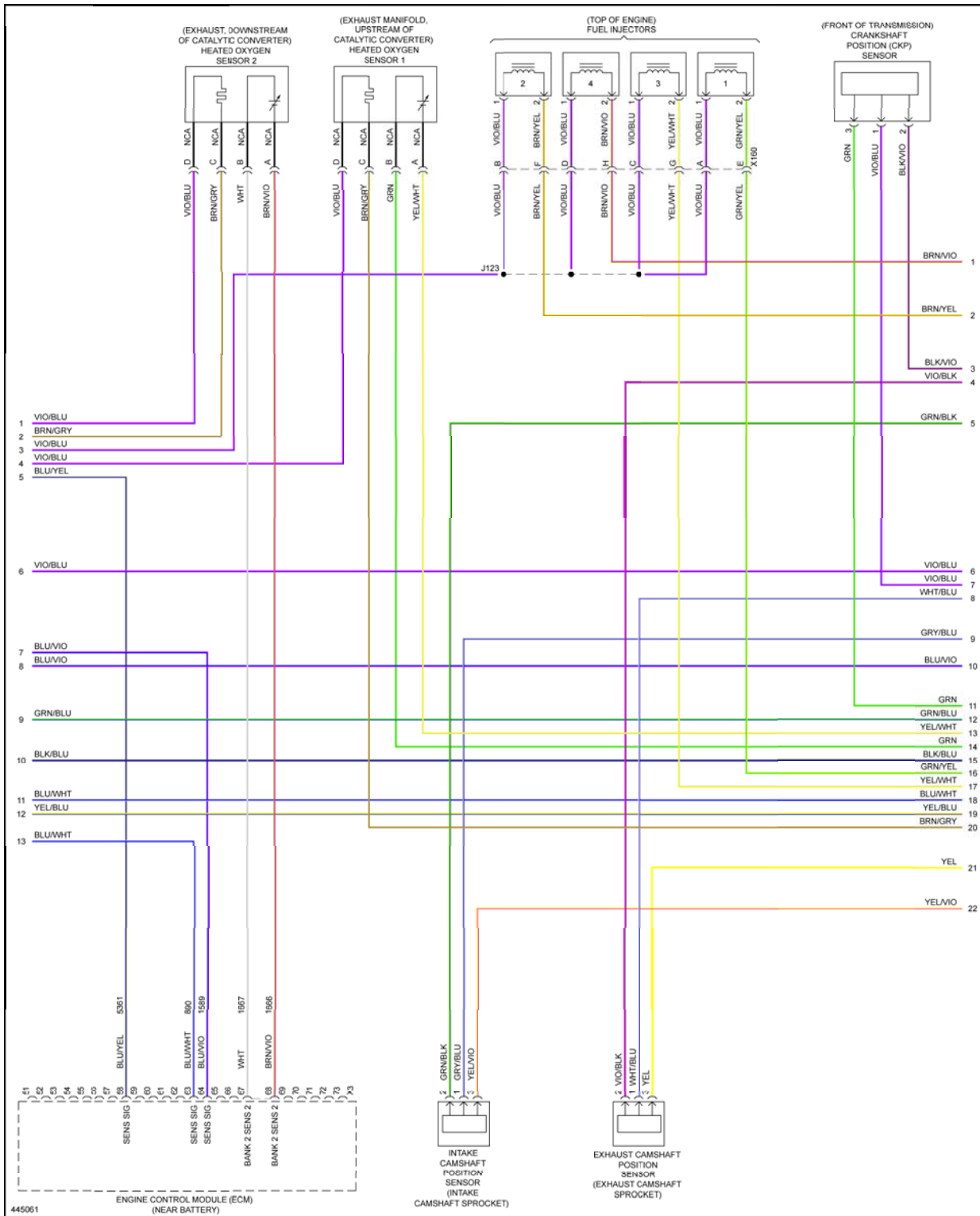


Fig. 21: 1.2L VIN 9, Engine Performance Circuit, CVT (4 of 5)



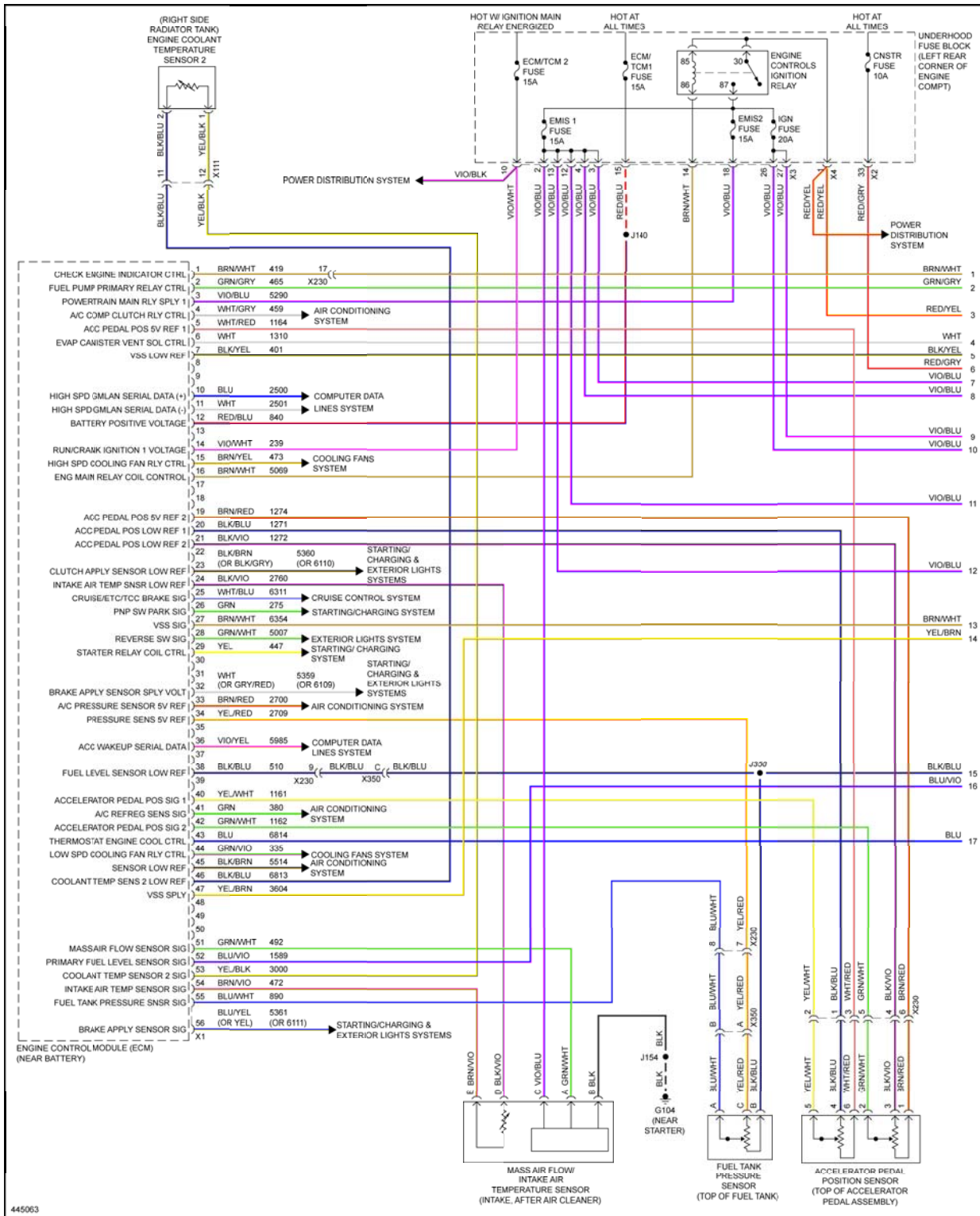


Fig. 23: 1.2L VIN 9, Engine Performance Circuit, M/T (1 of 4)

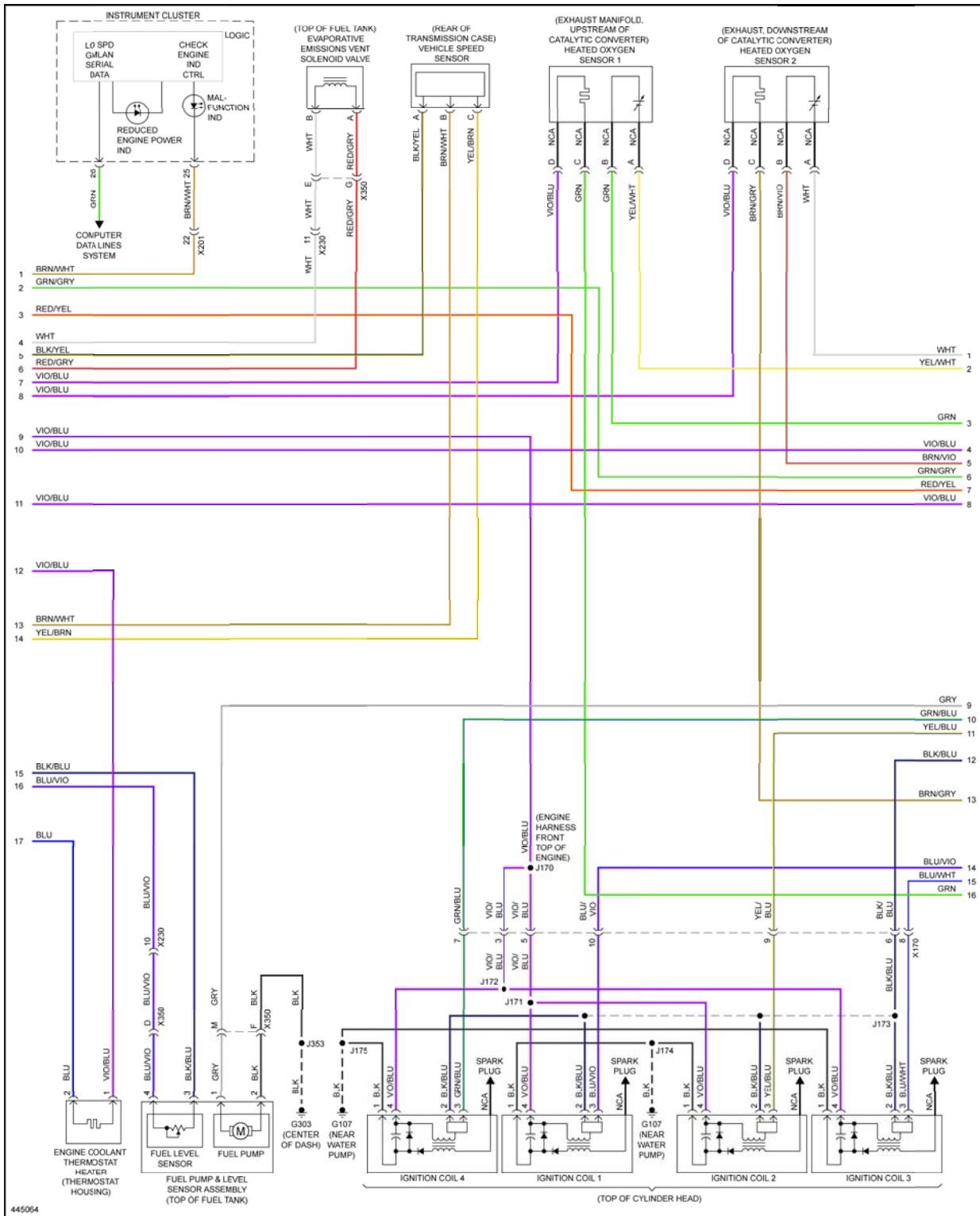


Fig. 24: 1.2L VIN 9, Engine Performance Circuit, M/T (2 of 4)

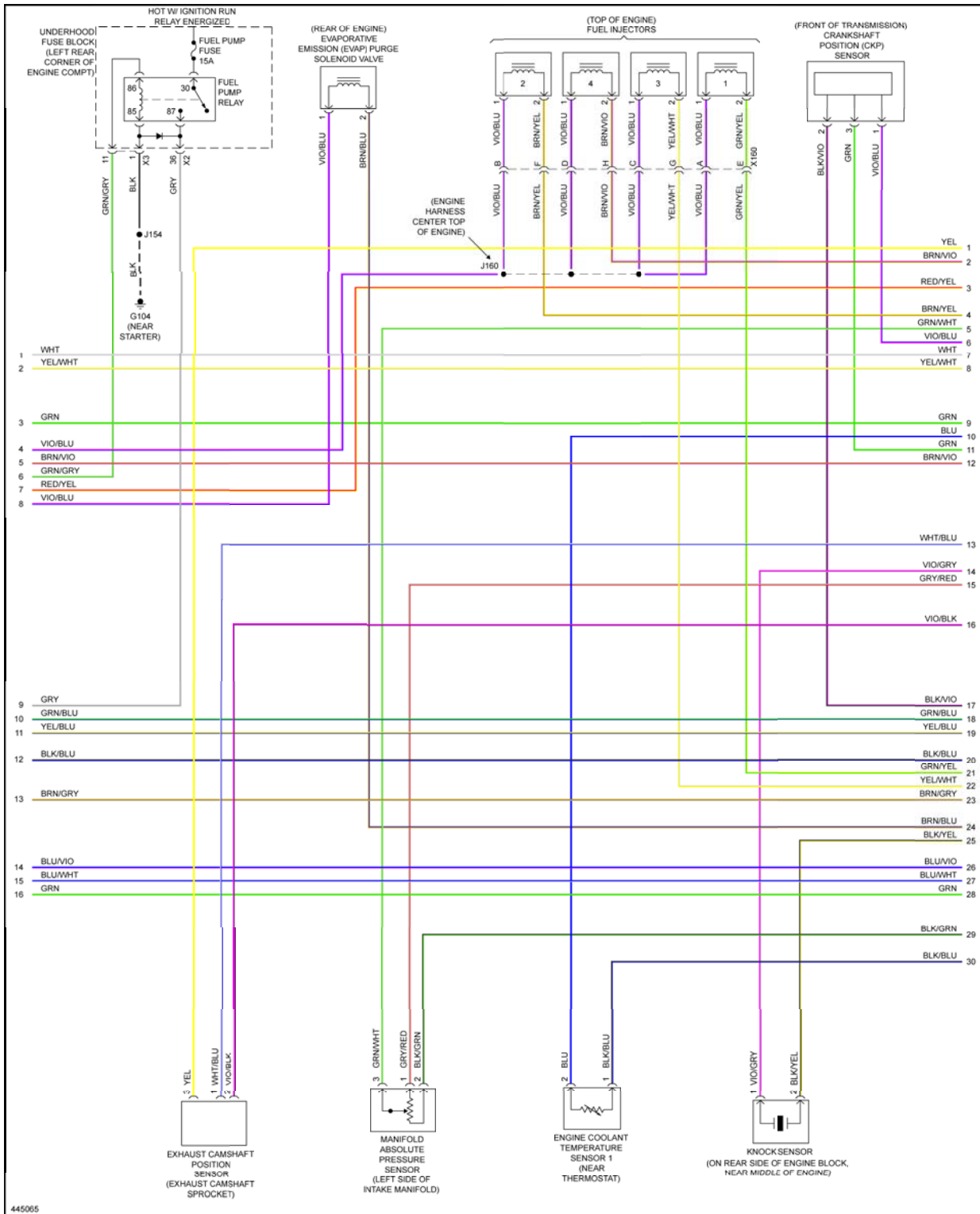


Fig. 25: 1.2L VIN 9, Engine Performance Circuit, M/T (3 of 4)

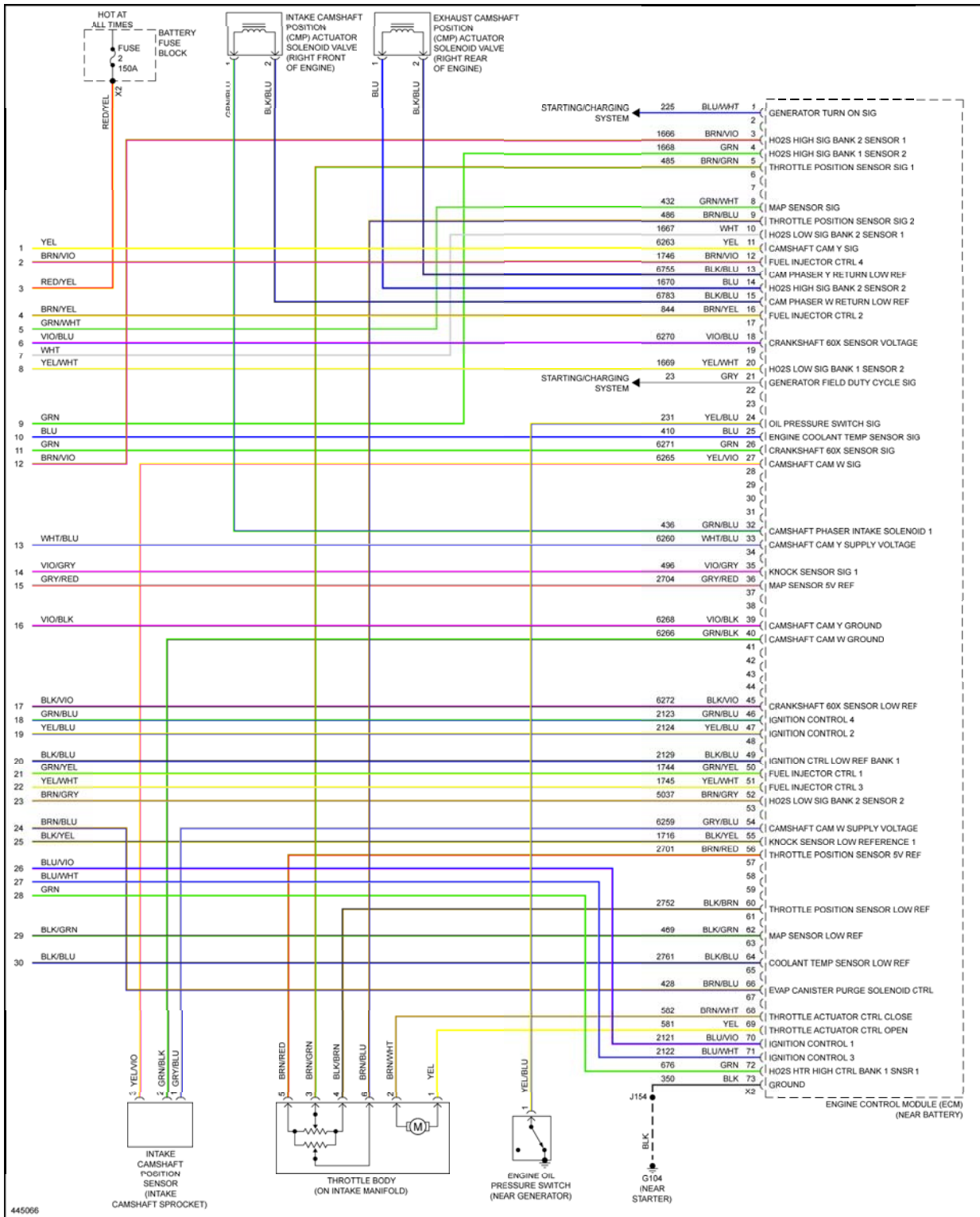


Fig. 26: 1.2L VIN 9, Engine Performance Circuit, M/T (4 of 4)

EXTERIOR LIGHTS

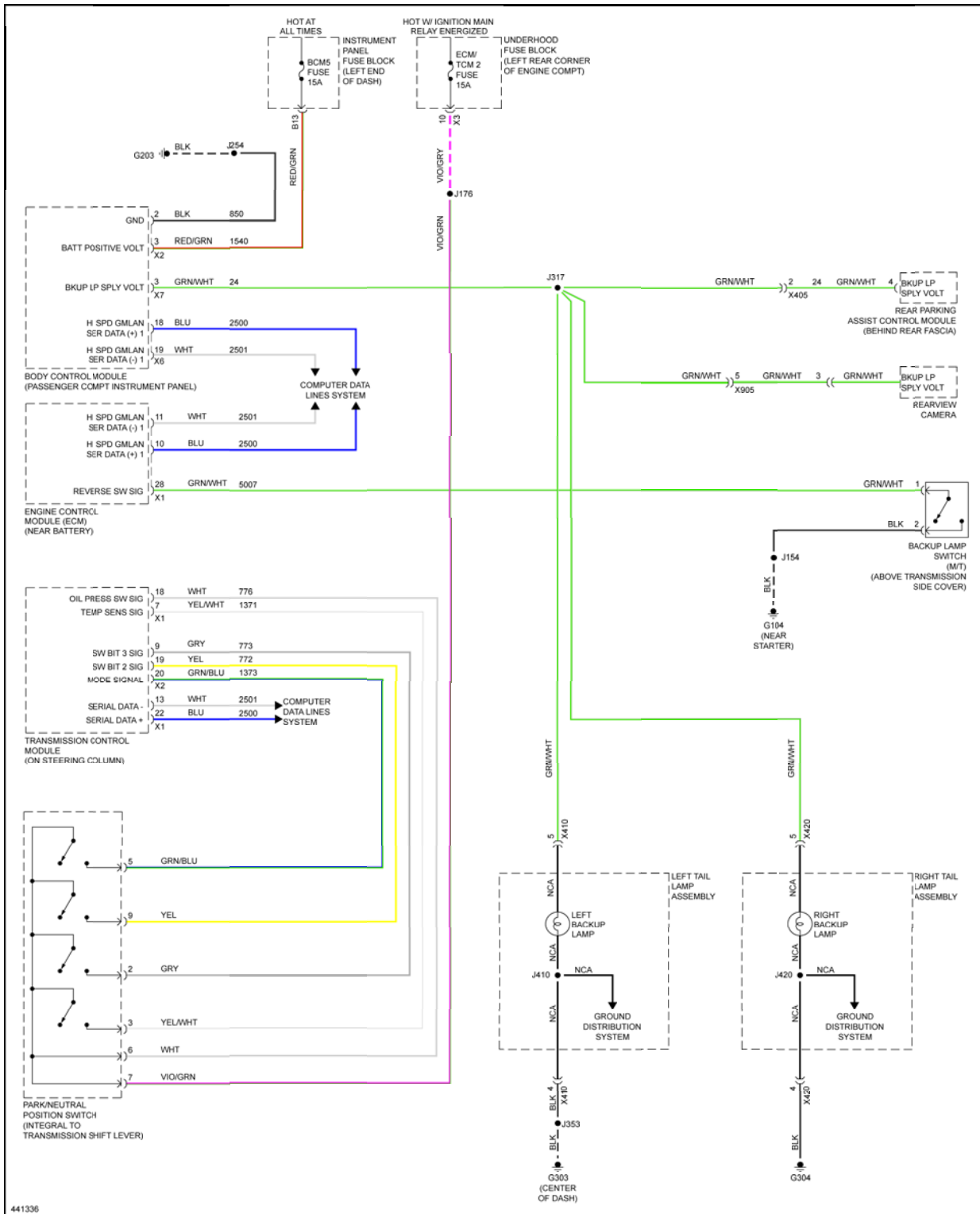


Fig. 27: Backup Lamps Circuit

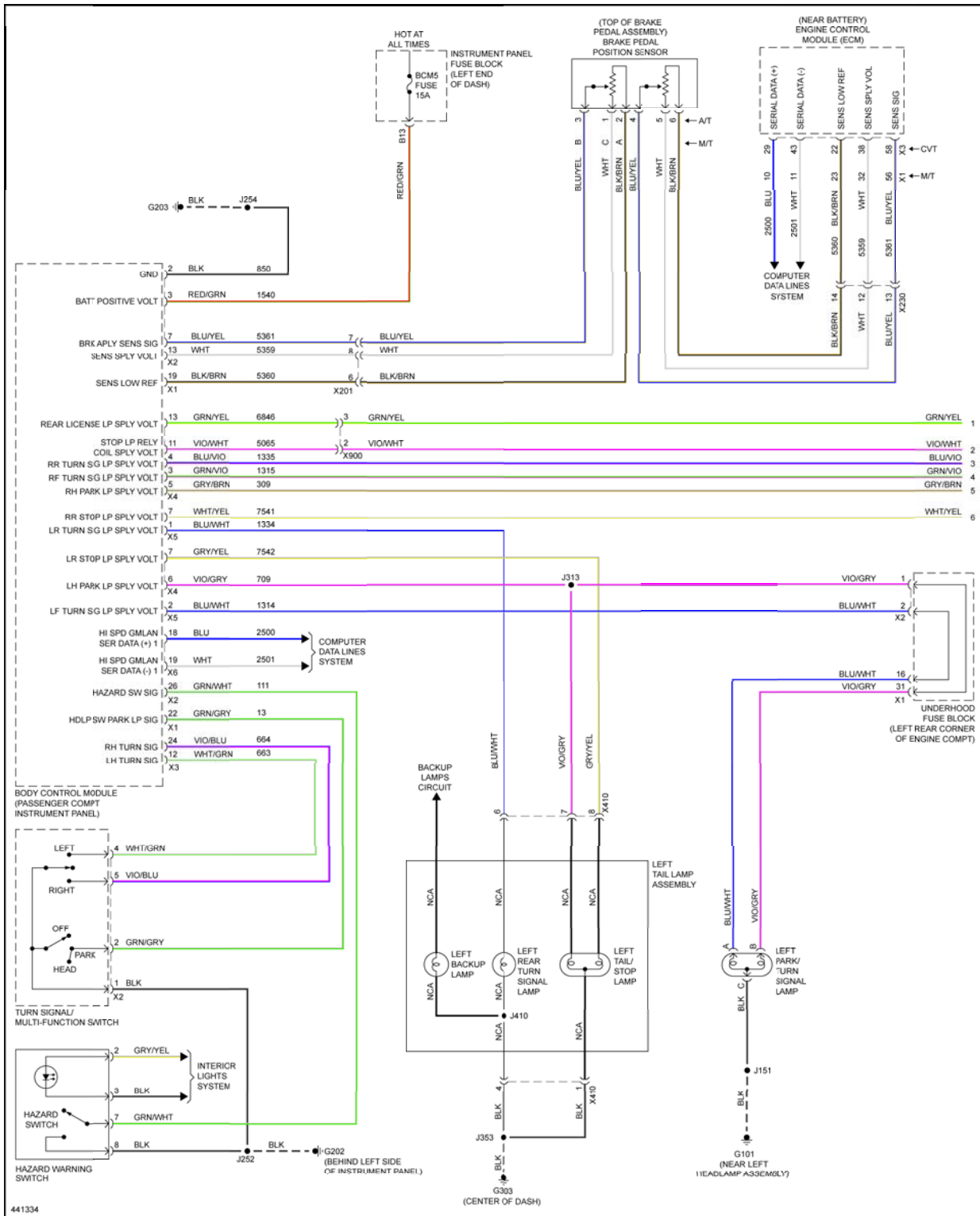


Fig. 28: Exterior Lamps Circuit (1 of 2)

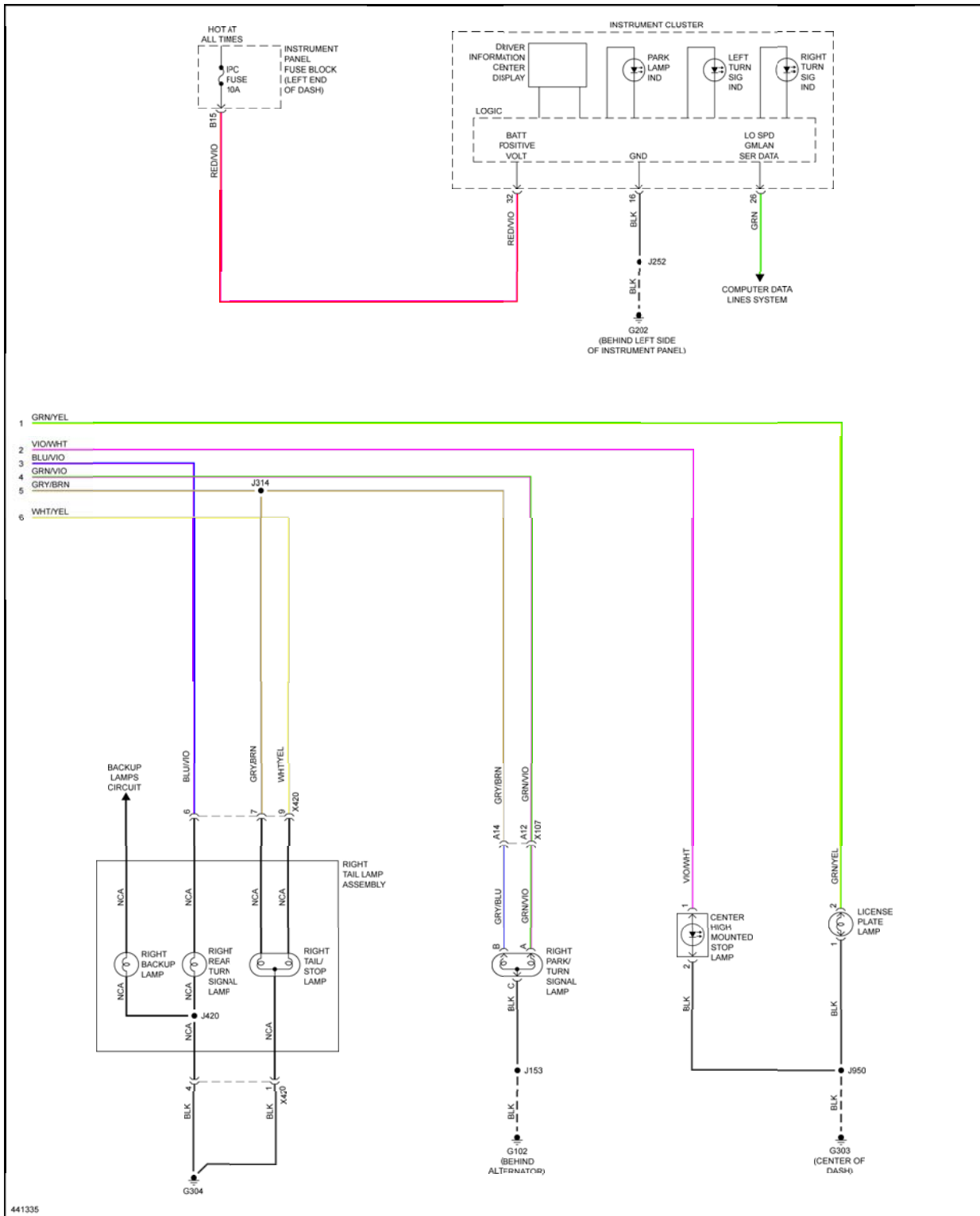


Fig. 29: Exterior Lamps Circuit (2 of 2)

GROUND DISTRIBUTION

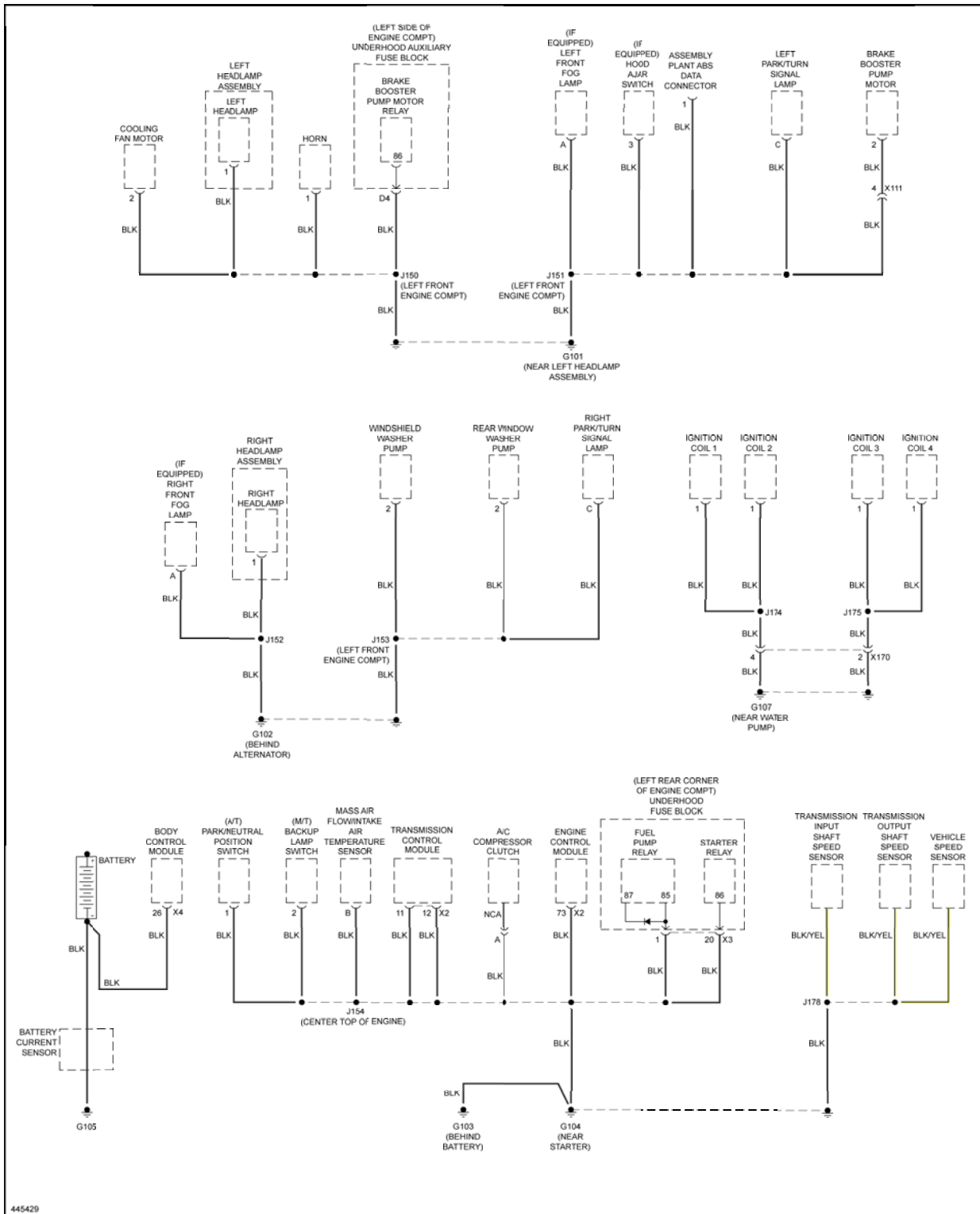


Fig. 30: Ground Distribution Circuit (1 of 3)

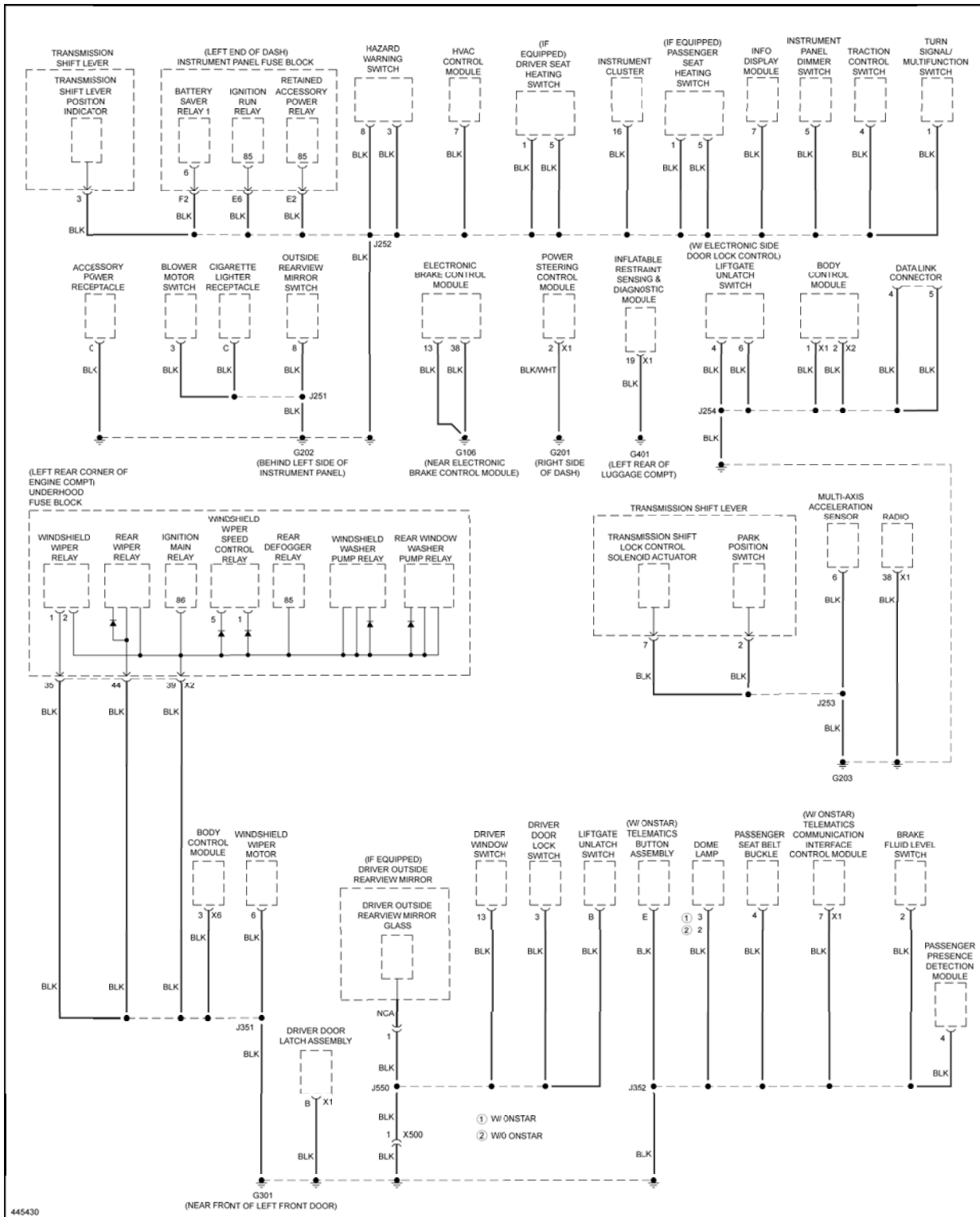


Fig. 31: Ground Distribution Circuit (2 of 3)

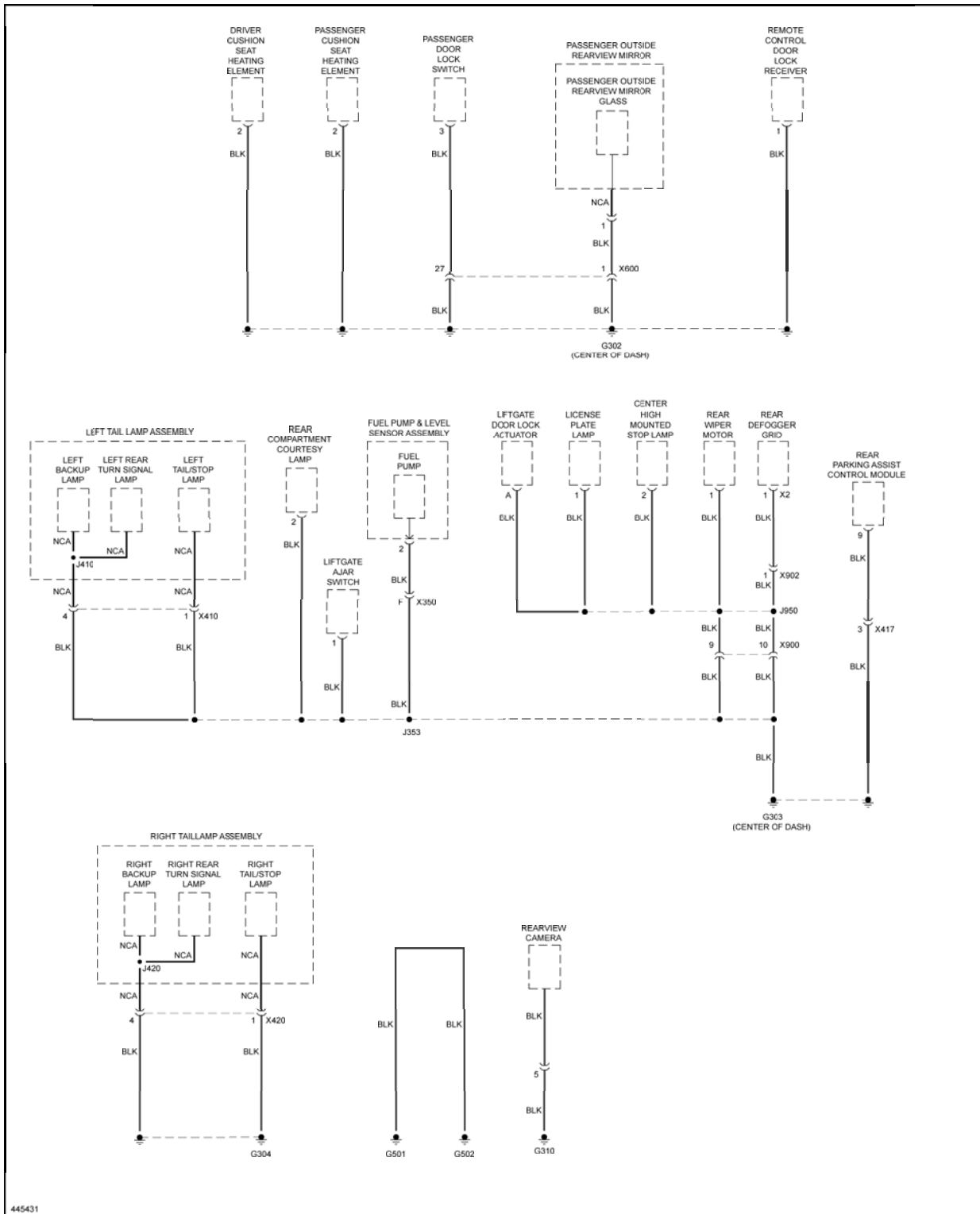


Fig. 32: Ground Distribution Circuit (3 of 3)

HEADLIGHTS

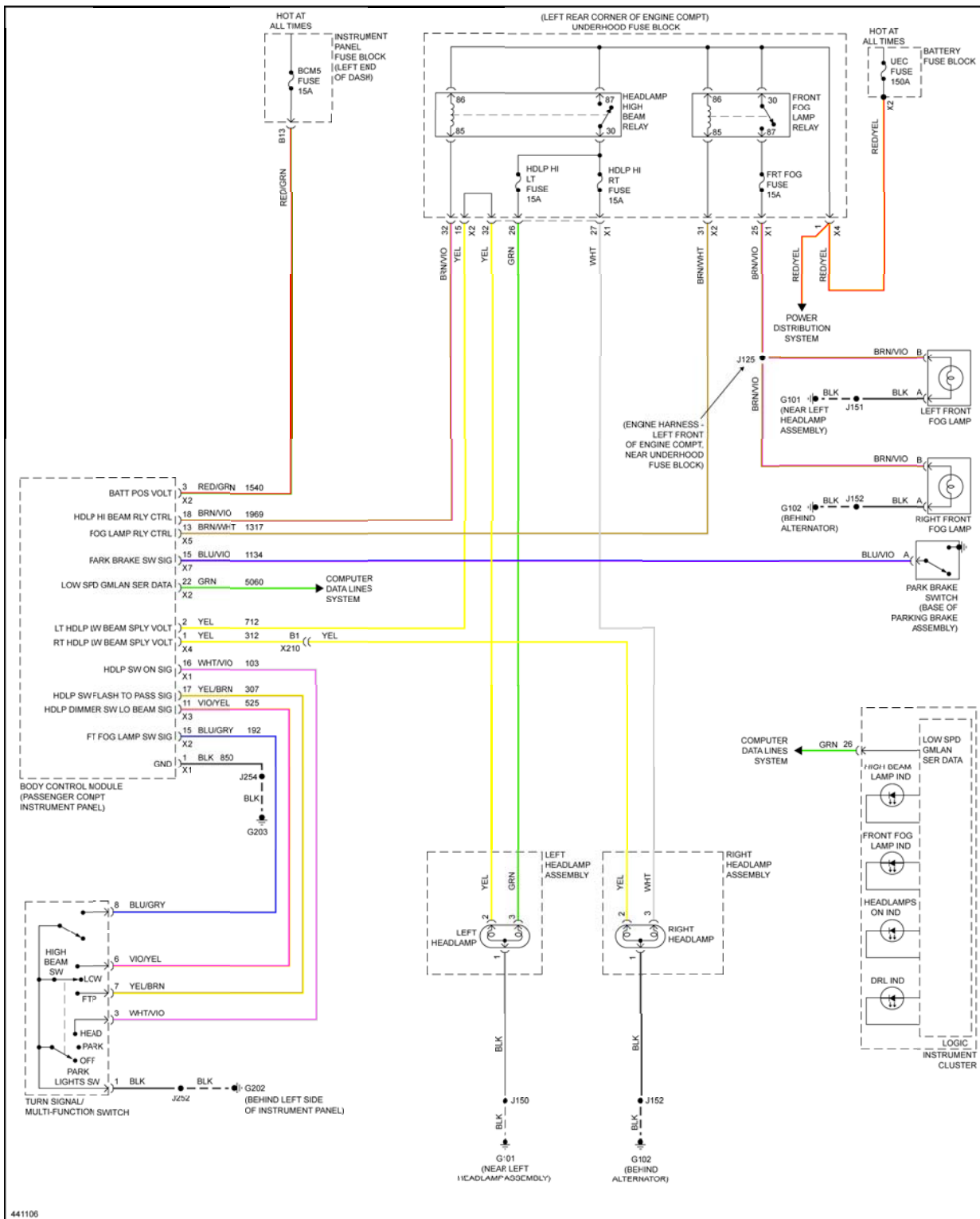


Fig. 33: Headlights Circuit

HORN

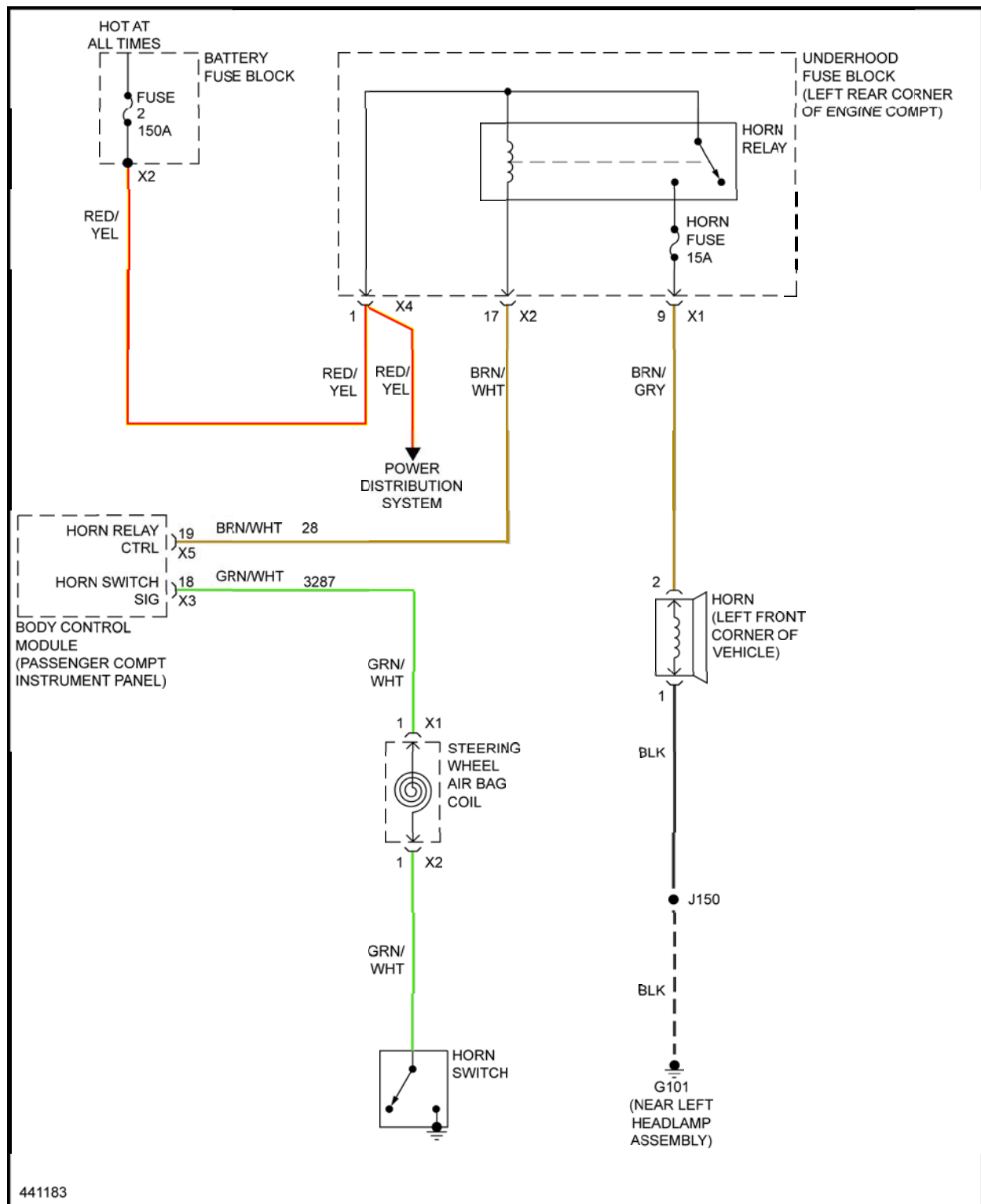


Fig. 34: Horn Circuit

INSTRUMENT CLUSTER

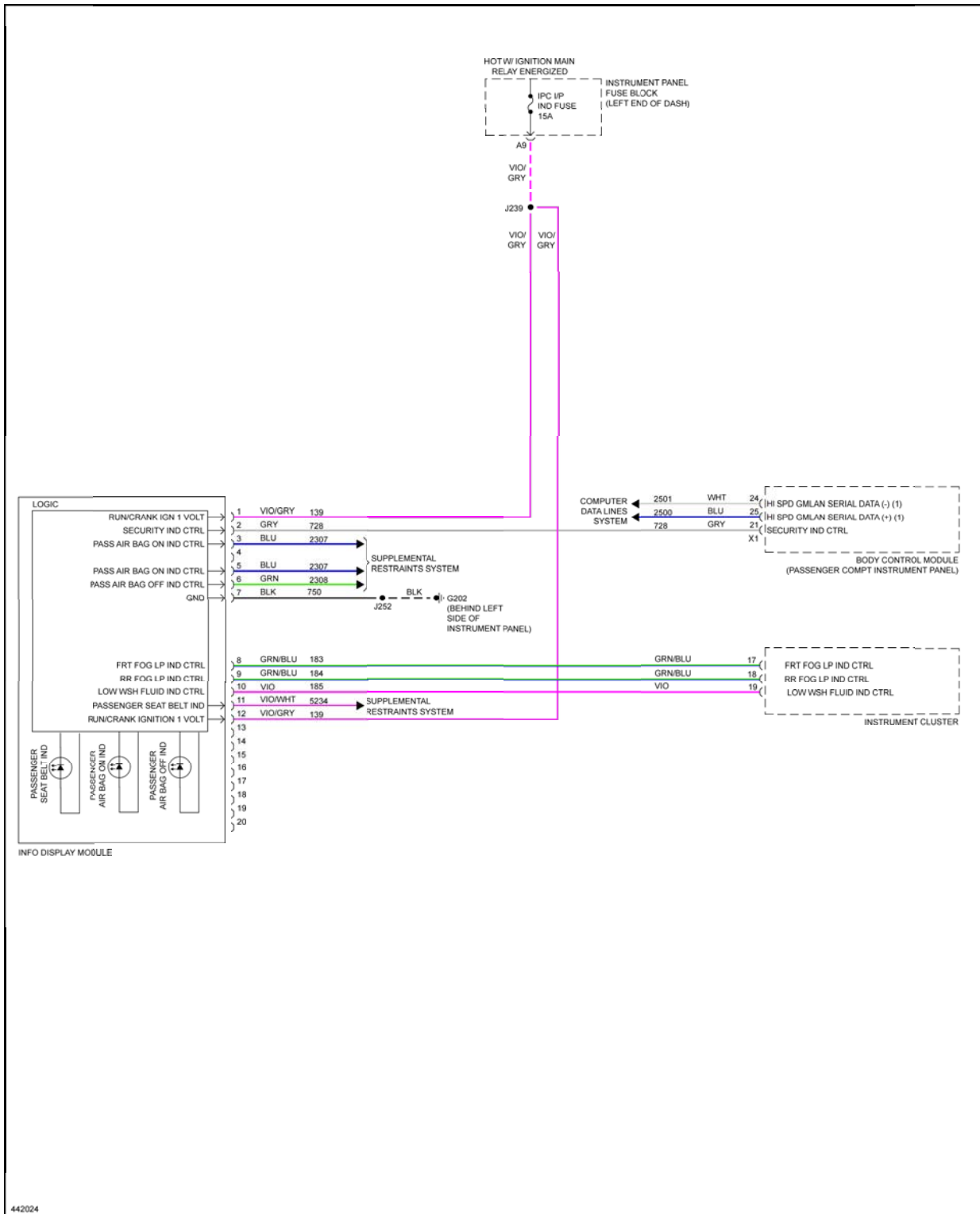


Fig. 35: Information Display Circuit

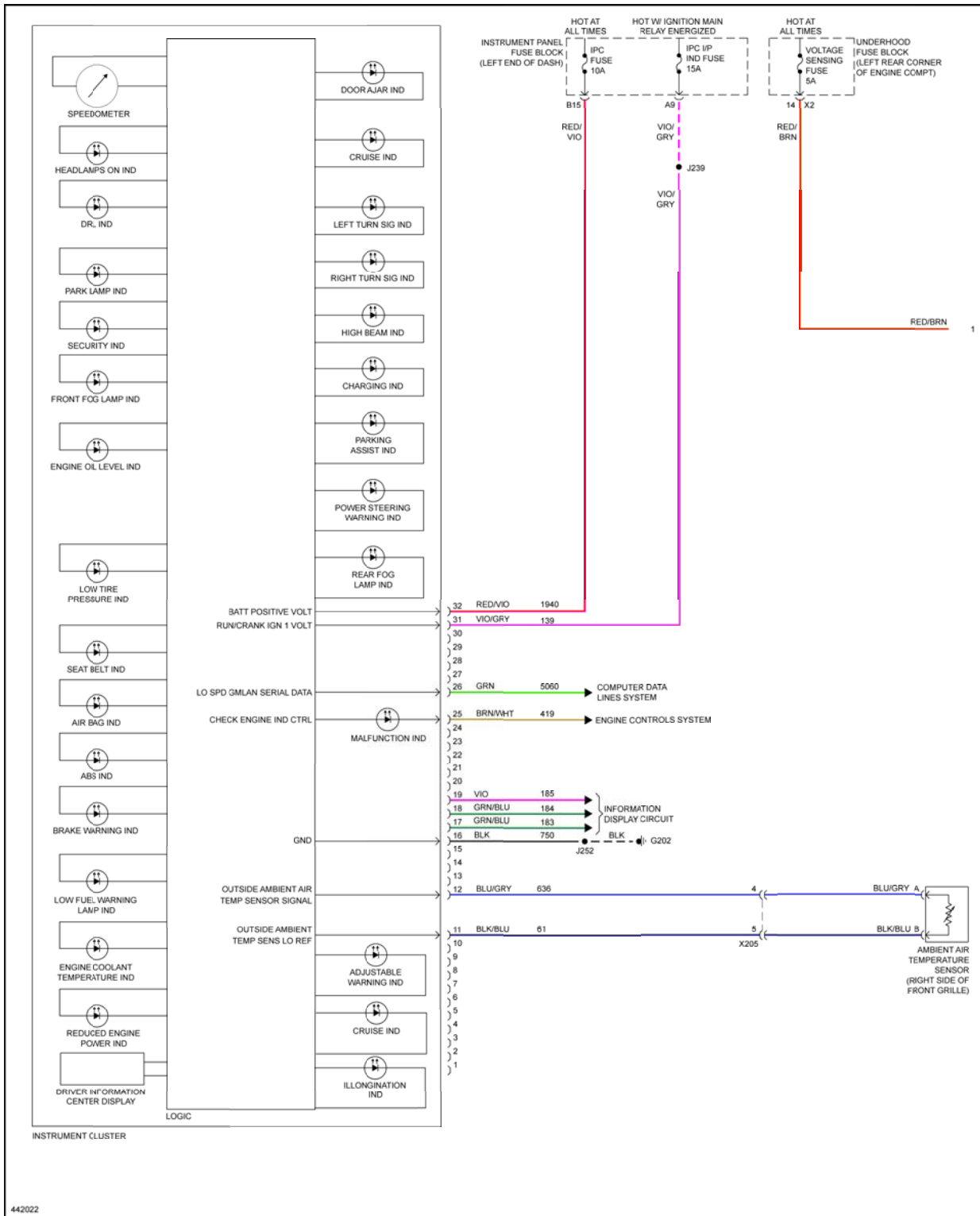


Fig. 36: Instrument Cluster Circuit (1 of 2)

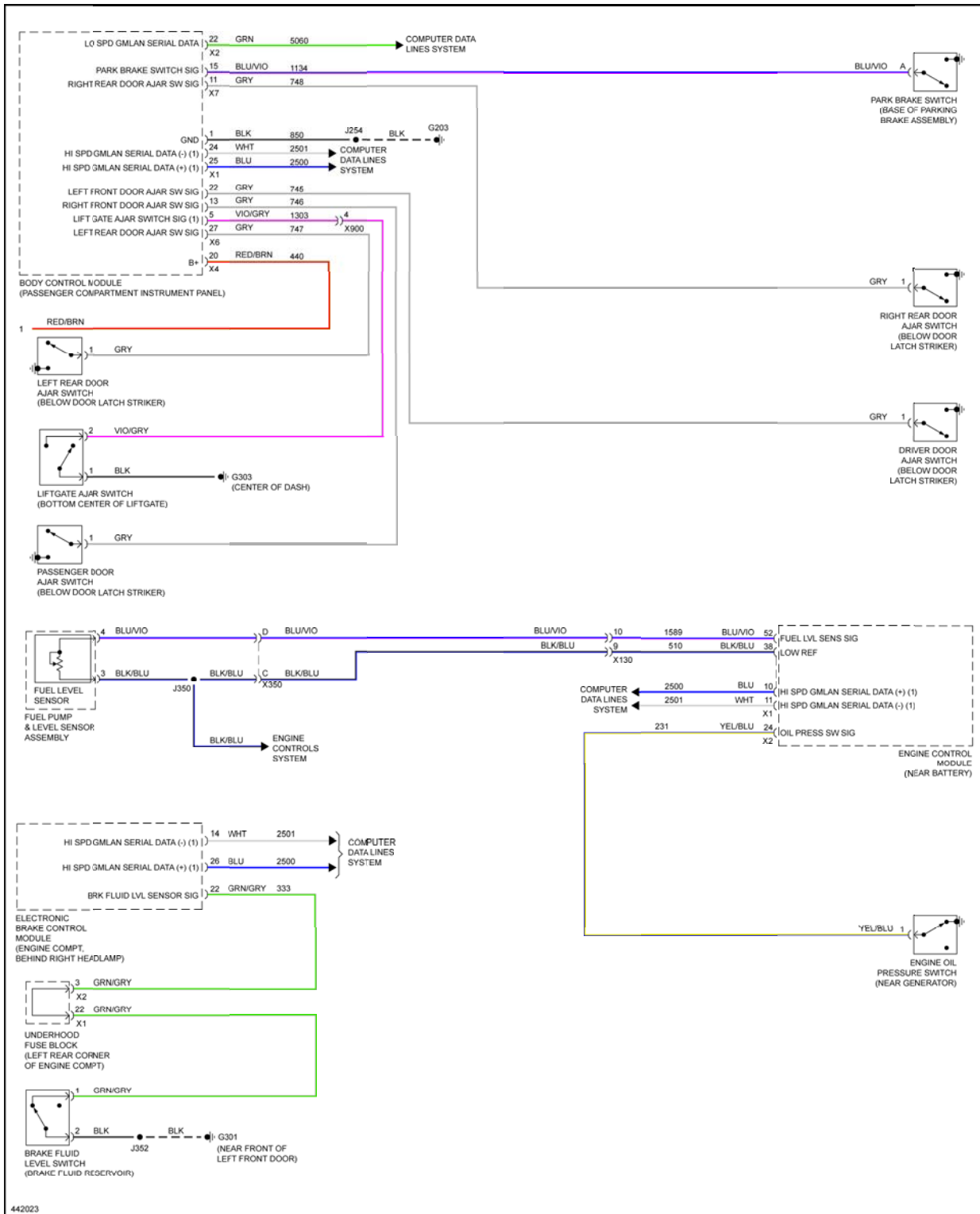


Fig. 37: Instrument Cluster Circuit (2 of 2)

INTERIOR LIGHTS

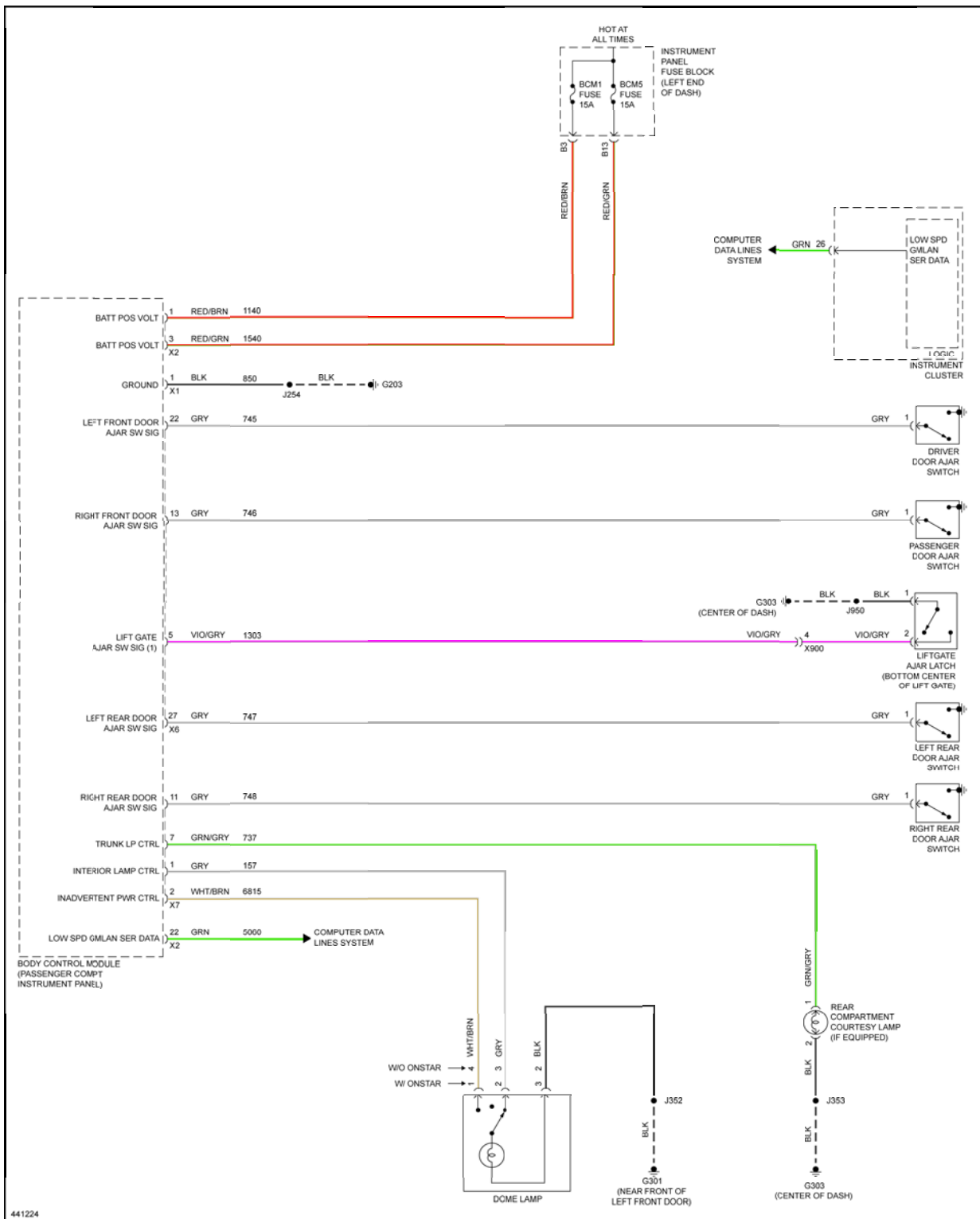


Fig. 38: Courtesy Lamps Circuit

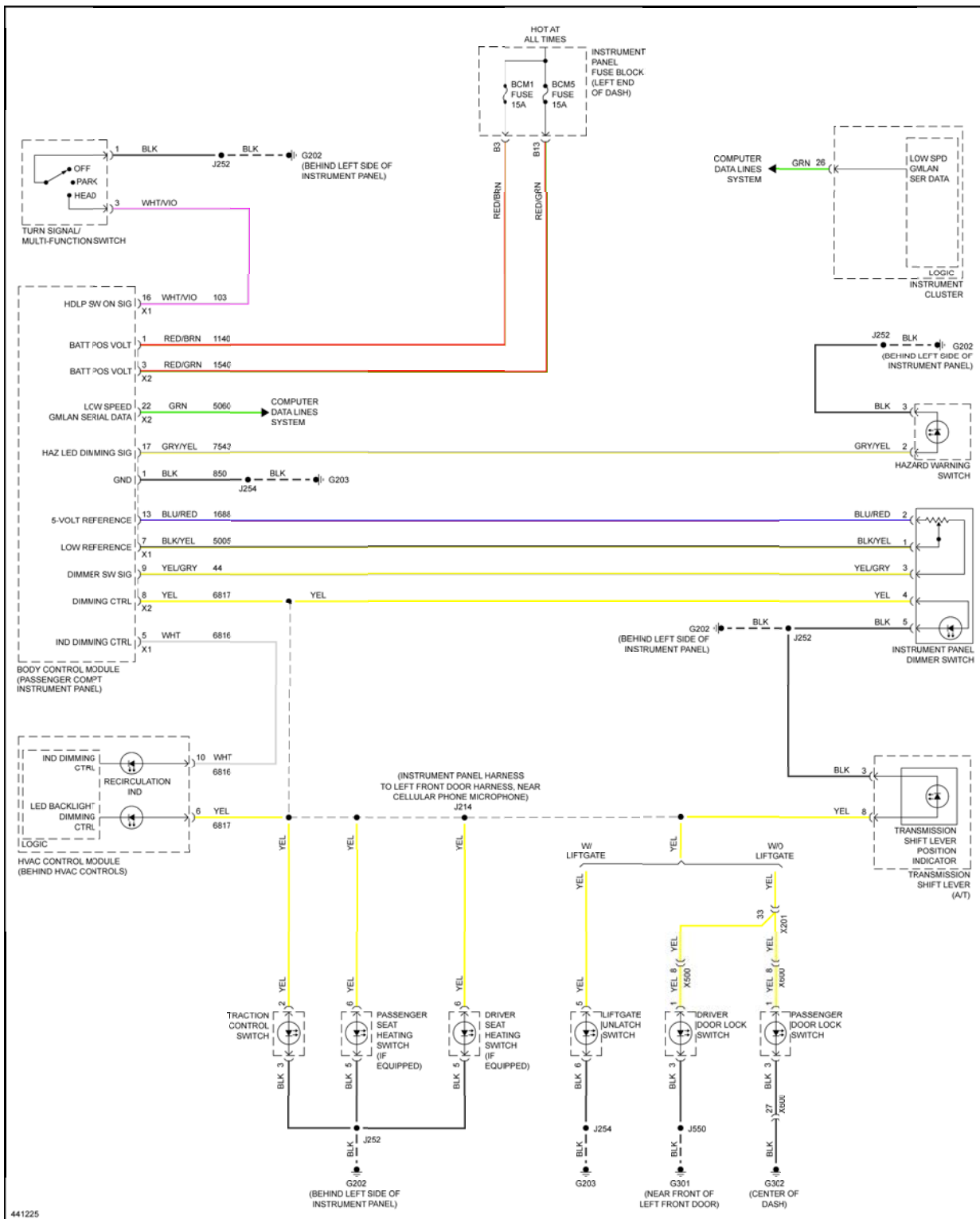


Fig. 39: Instrument Illumination Circuit

NAVIGATION

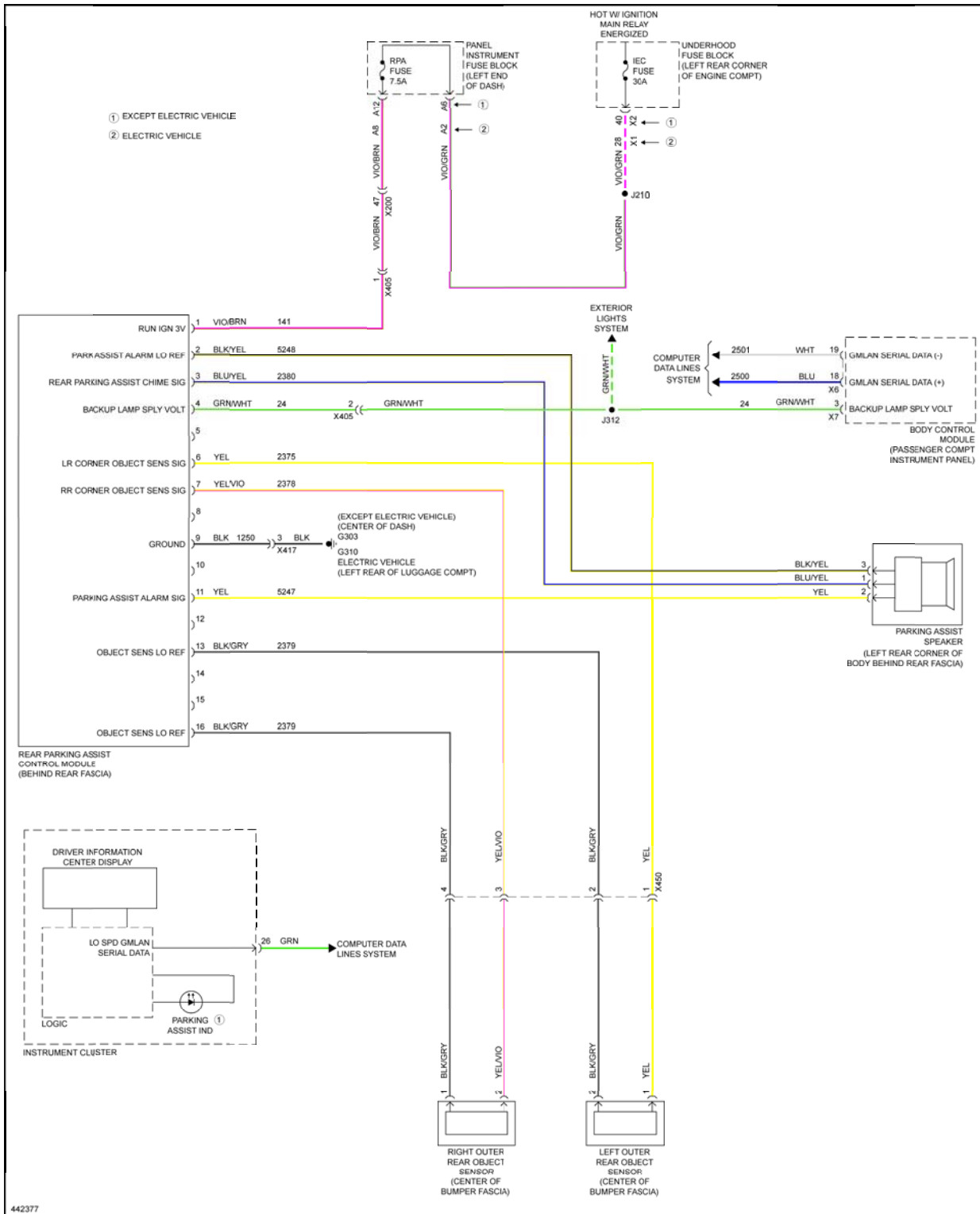


Fig. 40: Parking Assistant Circuit

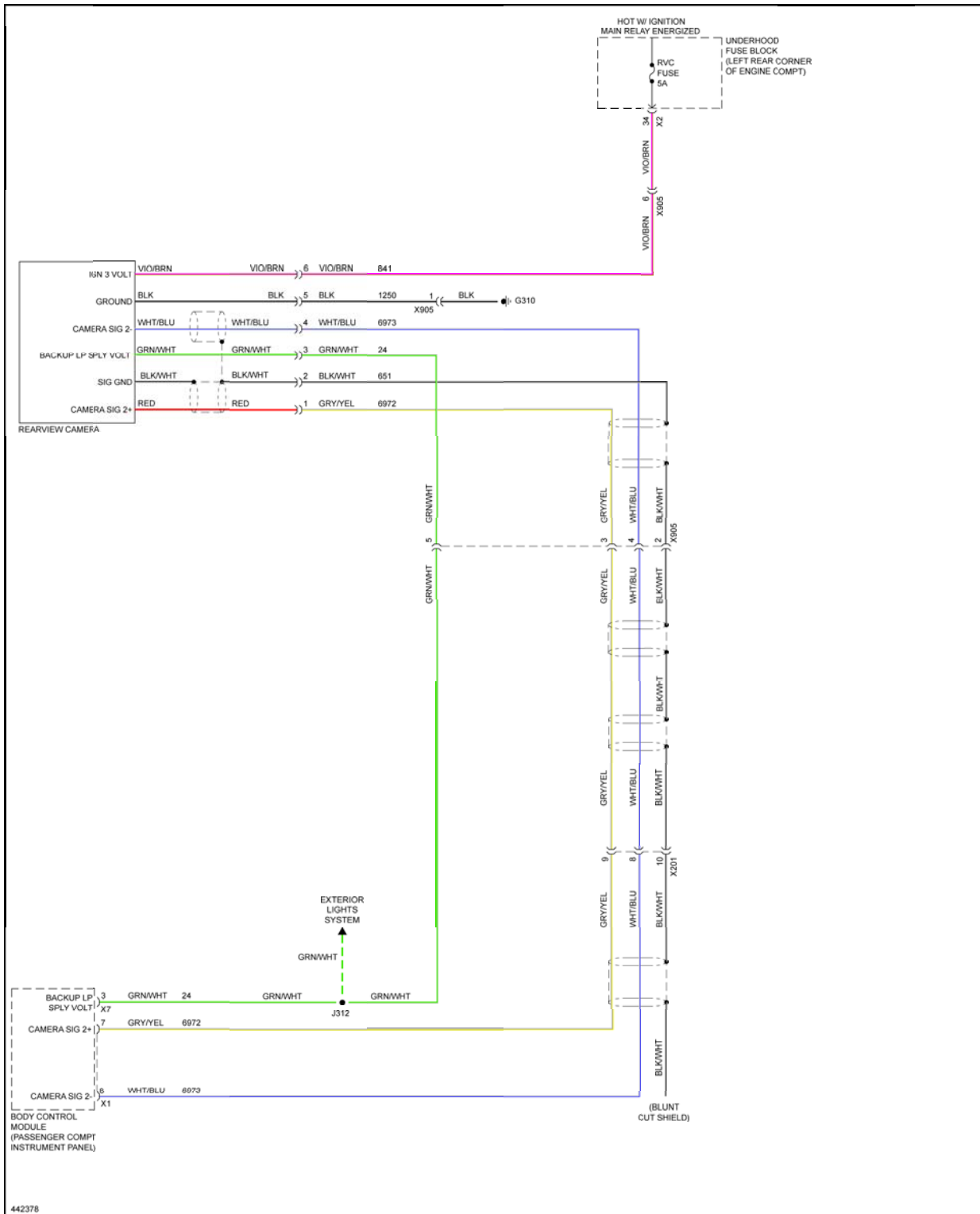


Fig. 41: Rear View Camera Circuit

POWER DISTRIBUTION

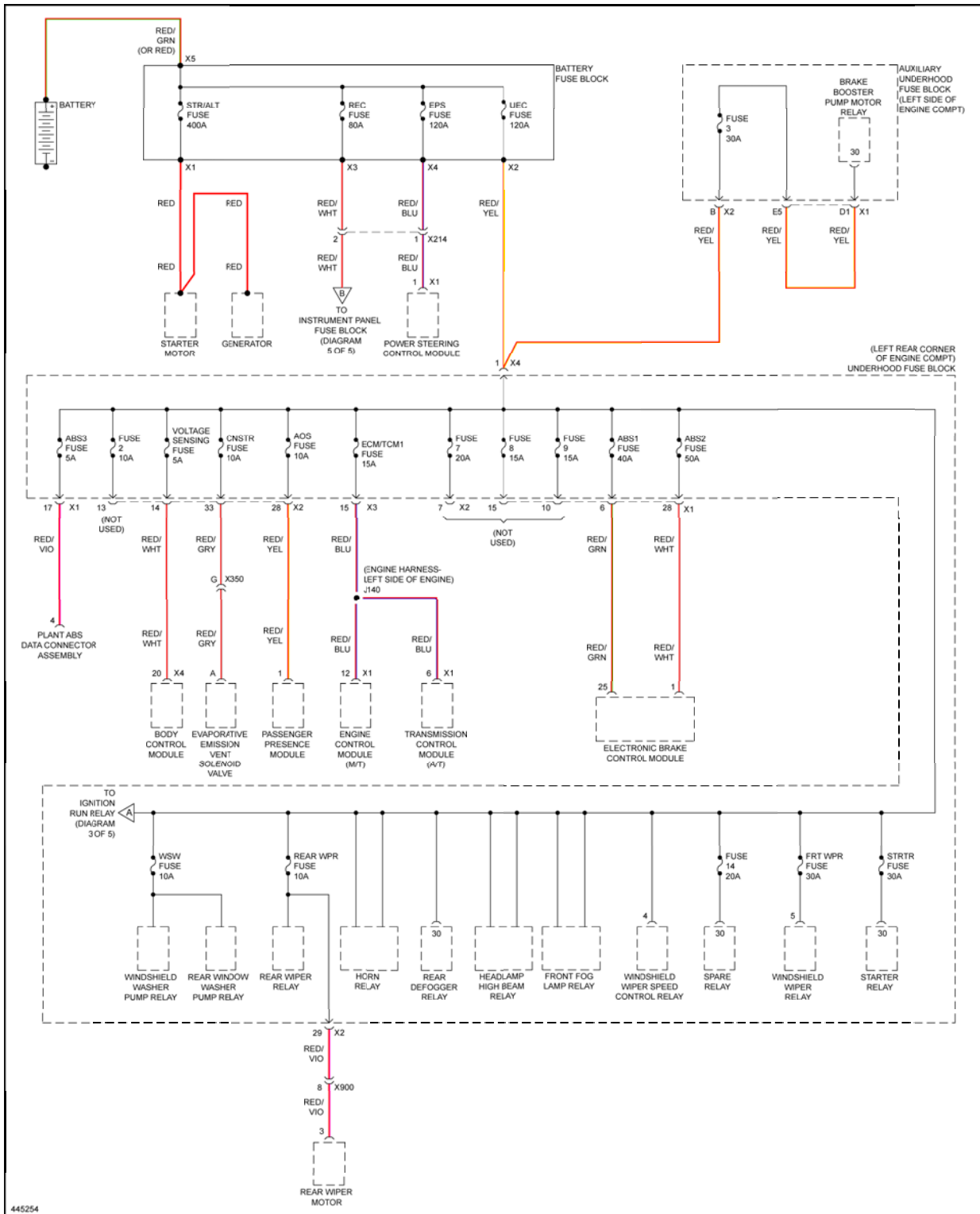


Fig. 42: Power Distribution Circuit (1 of 5)

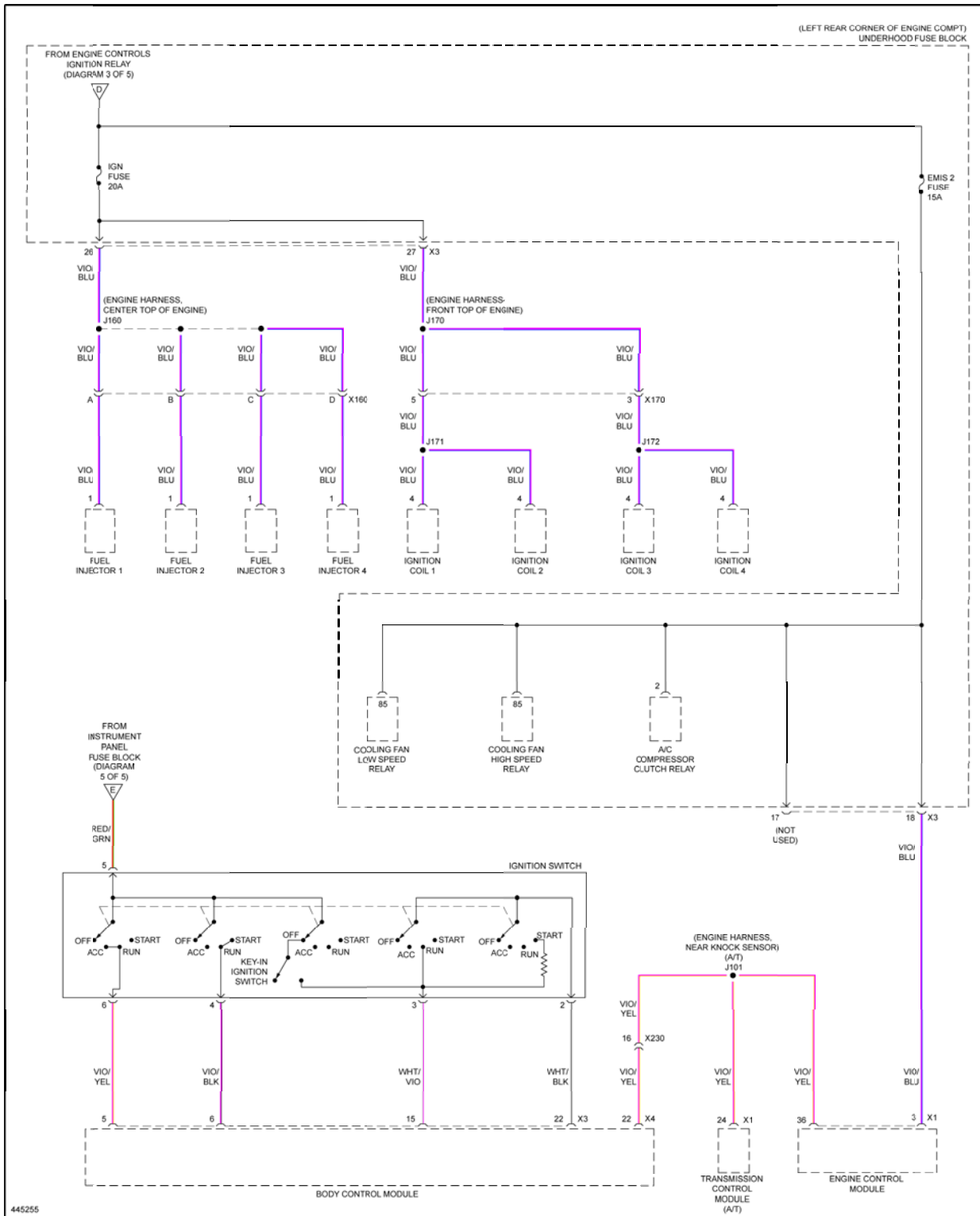
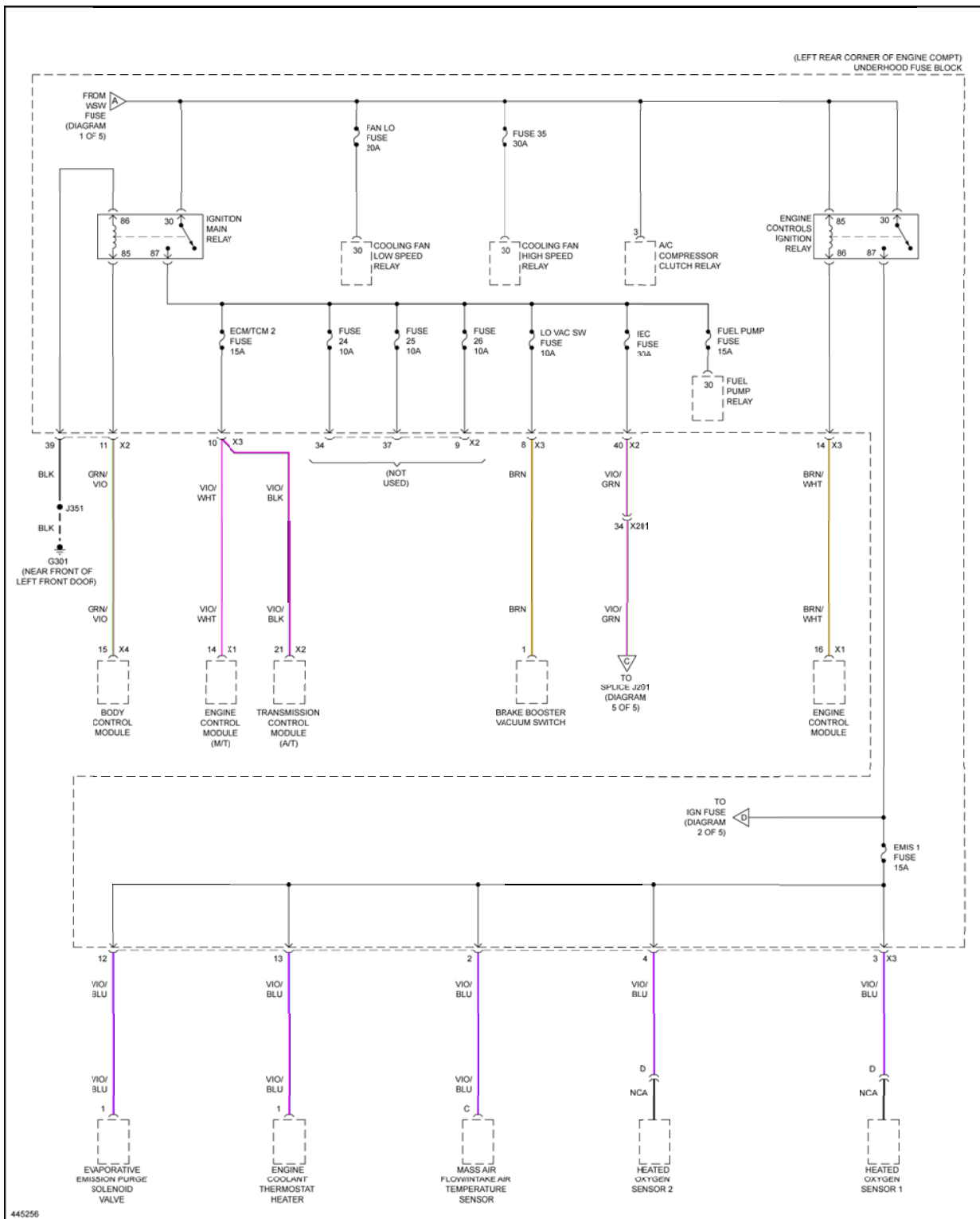
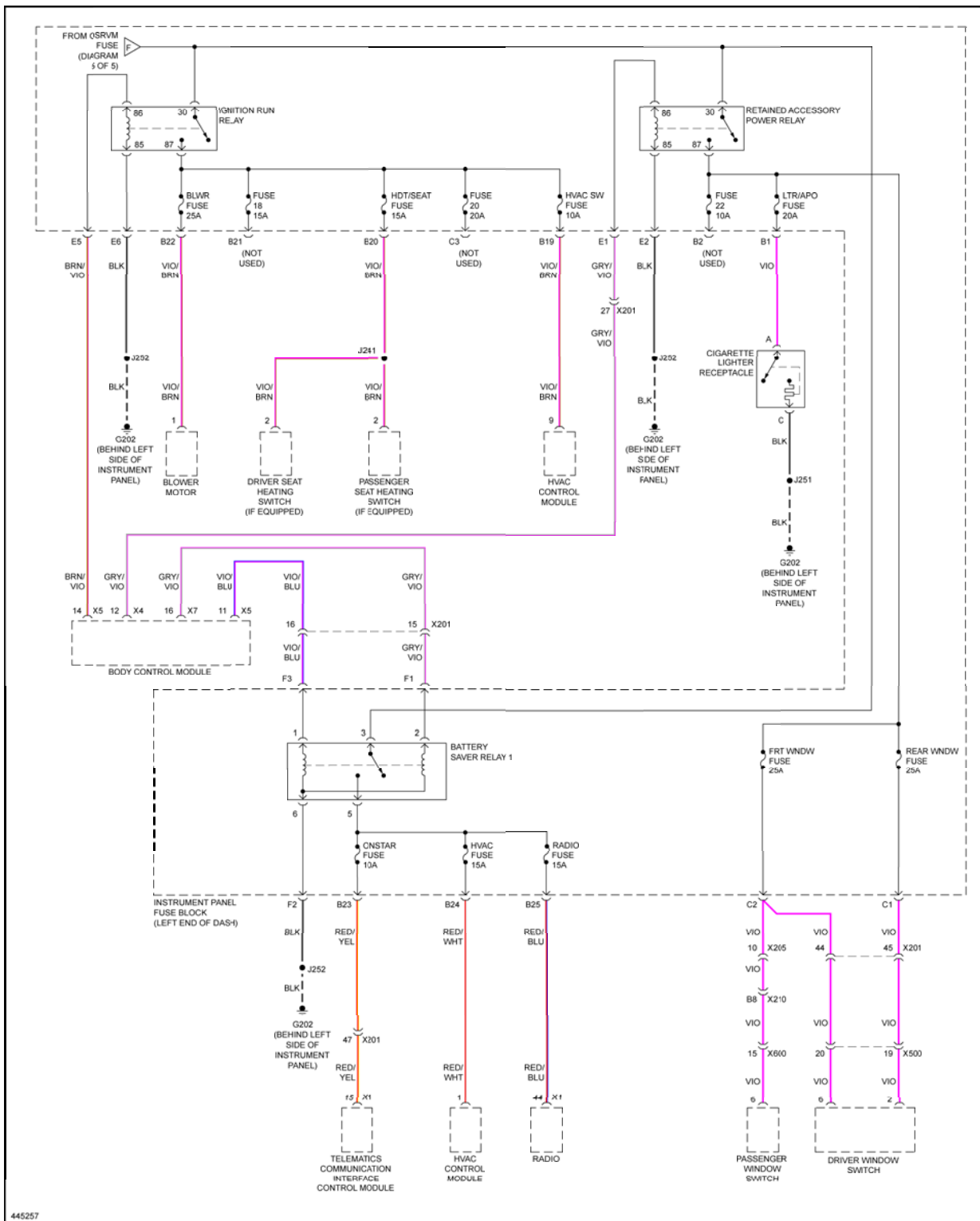


Fig. 43: Power Distribution Circuit (2 of 5)





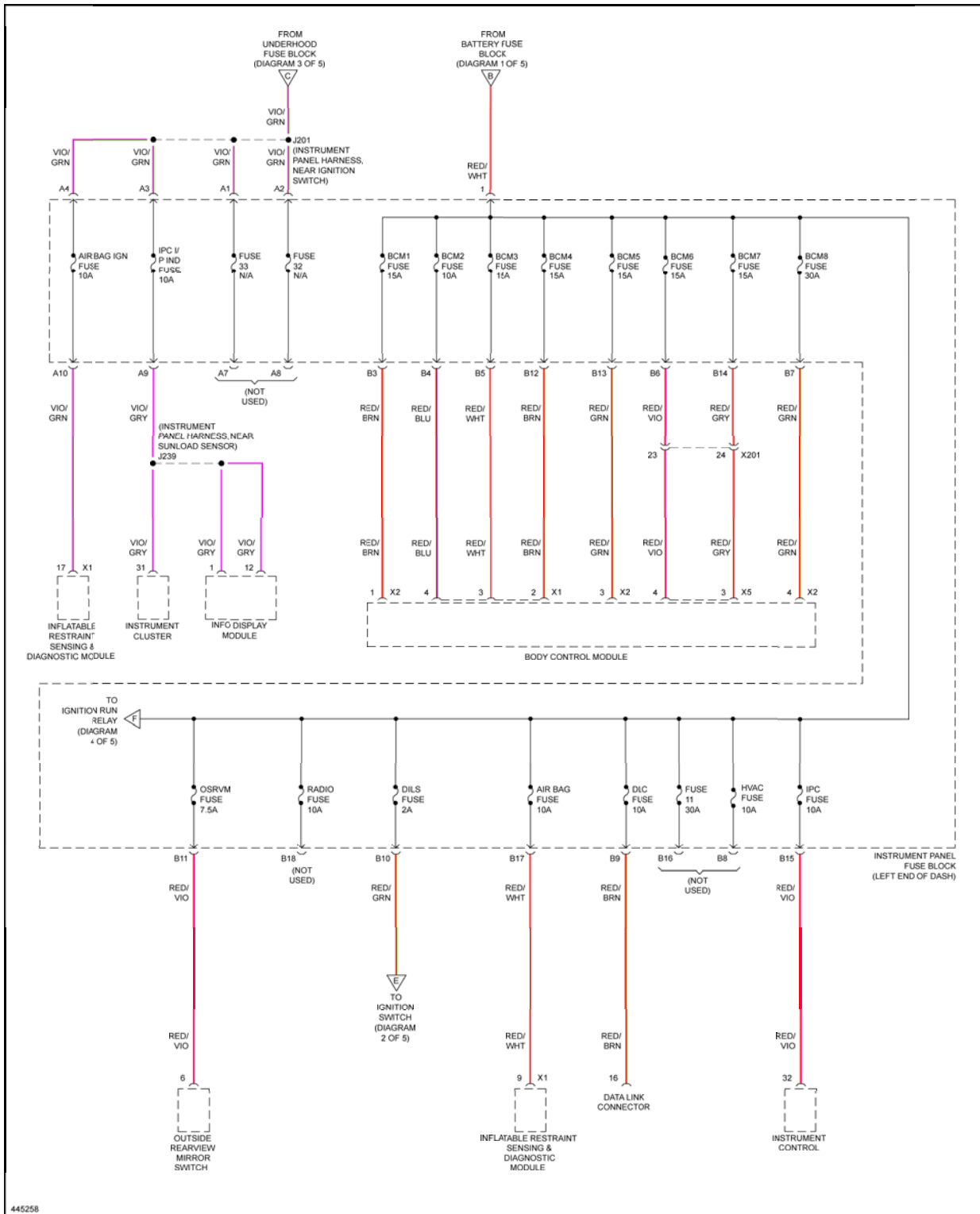


Fig. 46: Power Distribution Circuit (5 of 5)

POWER DOOR LOCKS

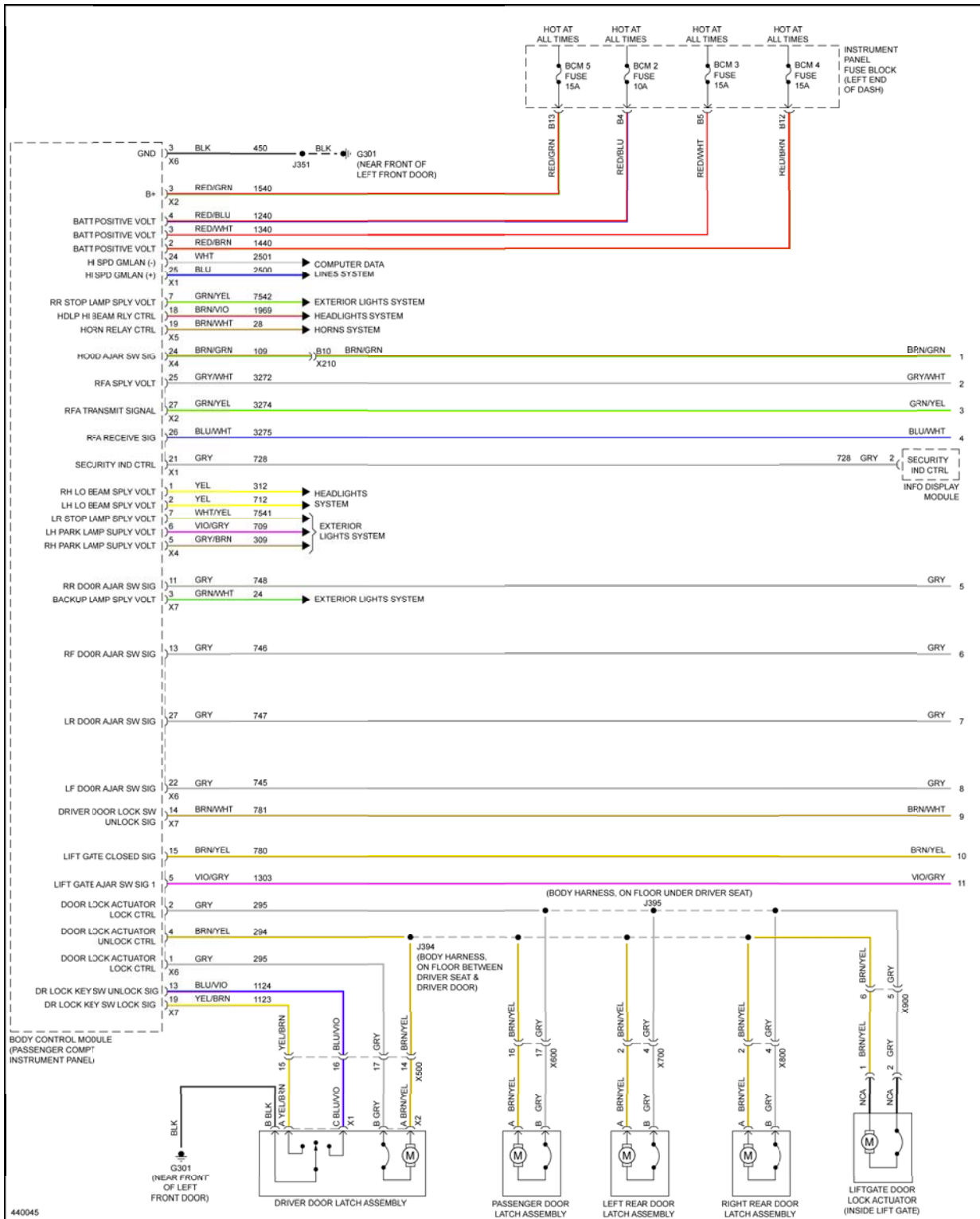


Fig. 47: Power Door Locks Circuit (1 of 2)

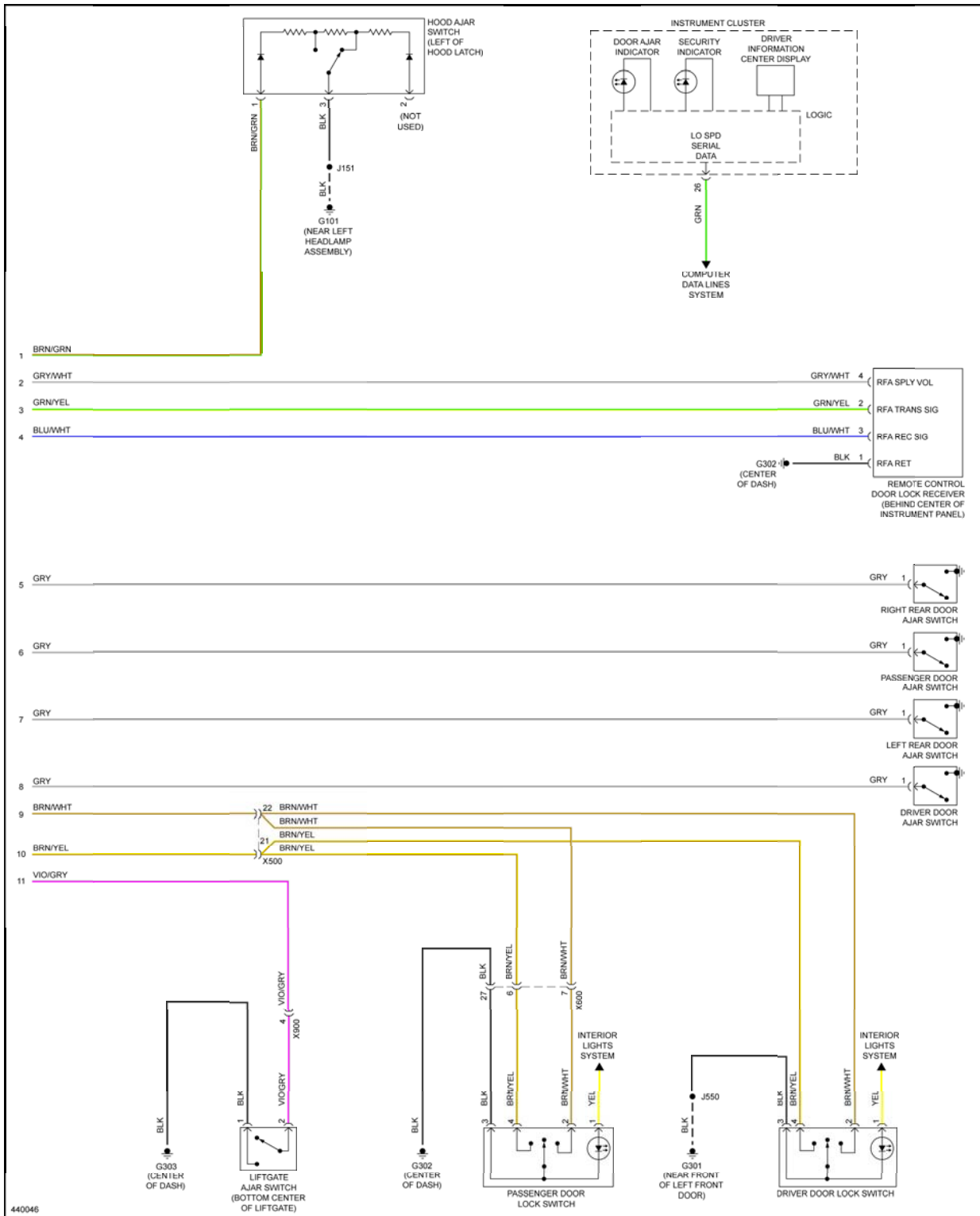


Fig. 48: Power Door Locks Circuit (2 of 2)

POWER MIRRORS



POWER SEATS

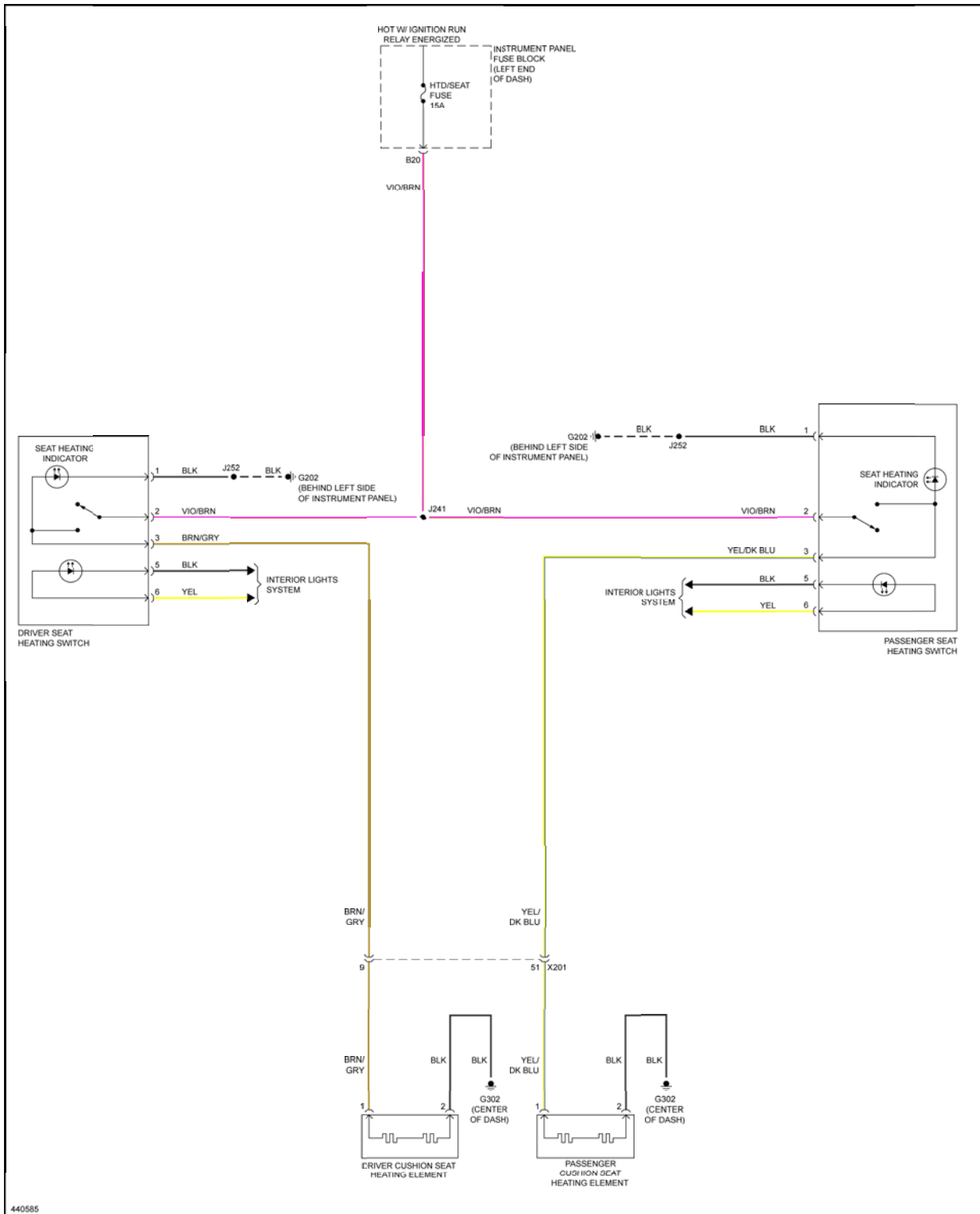


Fig. 50: Power Seats Circuit

POWER WINDOWS

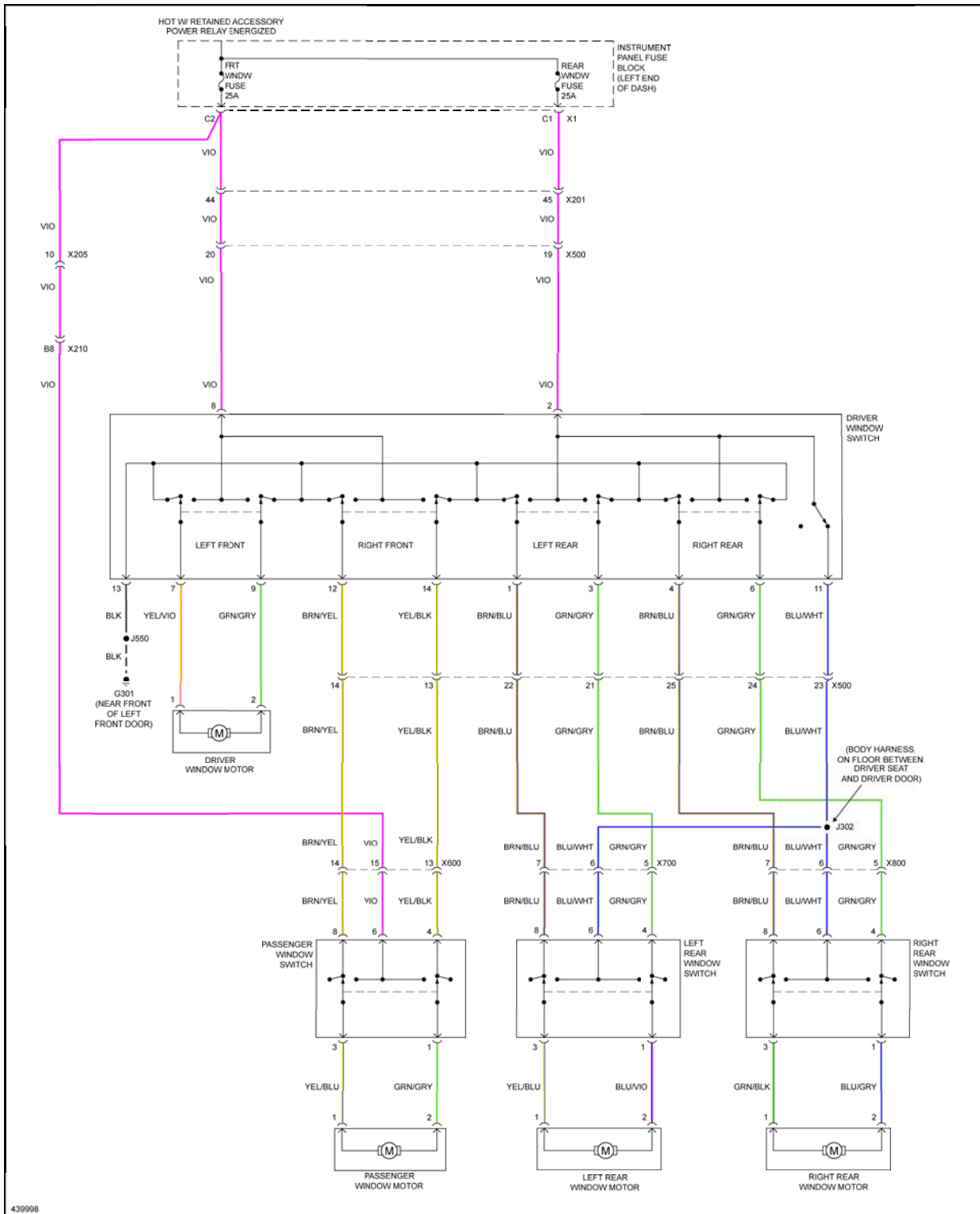


Fig. 51: Power Windows Circuit

RADIO

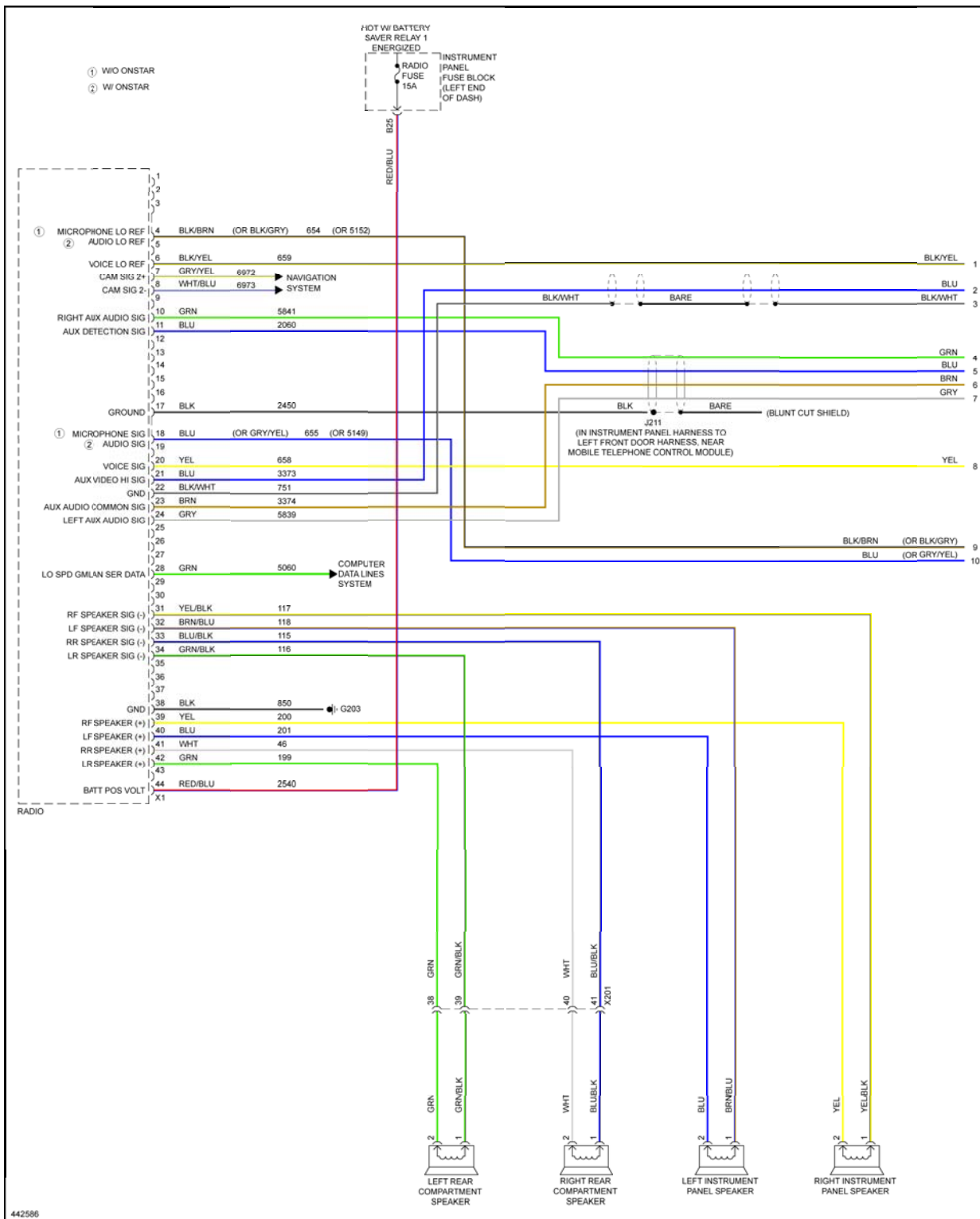
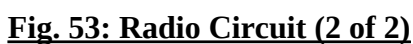


Fig. 52: Radio Circuit (1 of 2)



SHIFT INTERLOCK

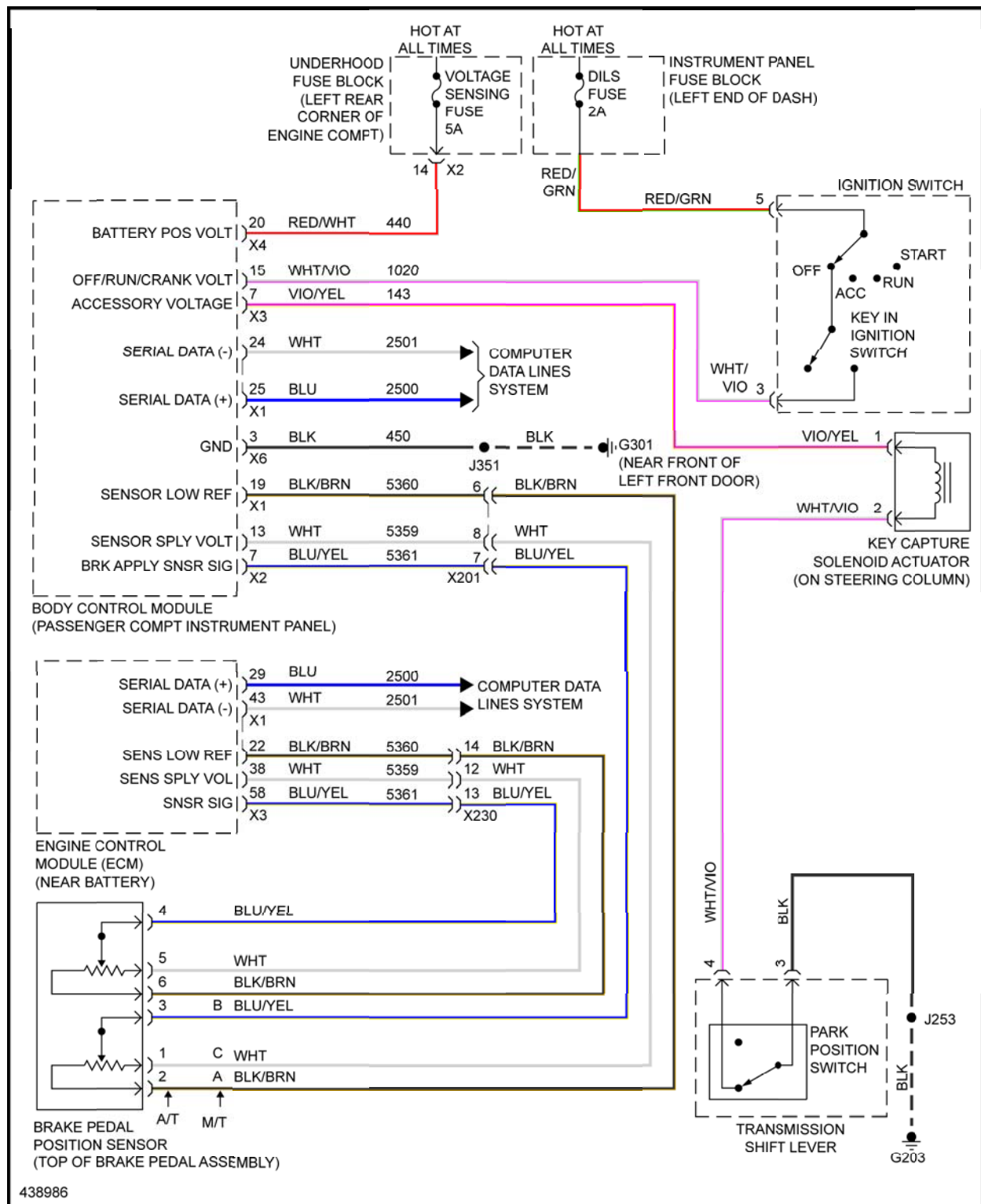


Fig. 54: Ignition Lock Solenoid Circuit

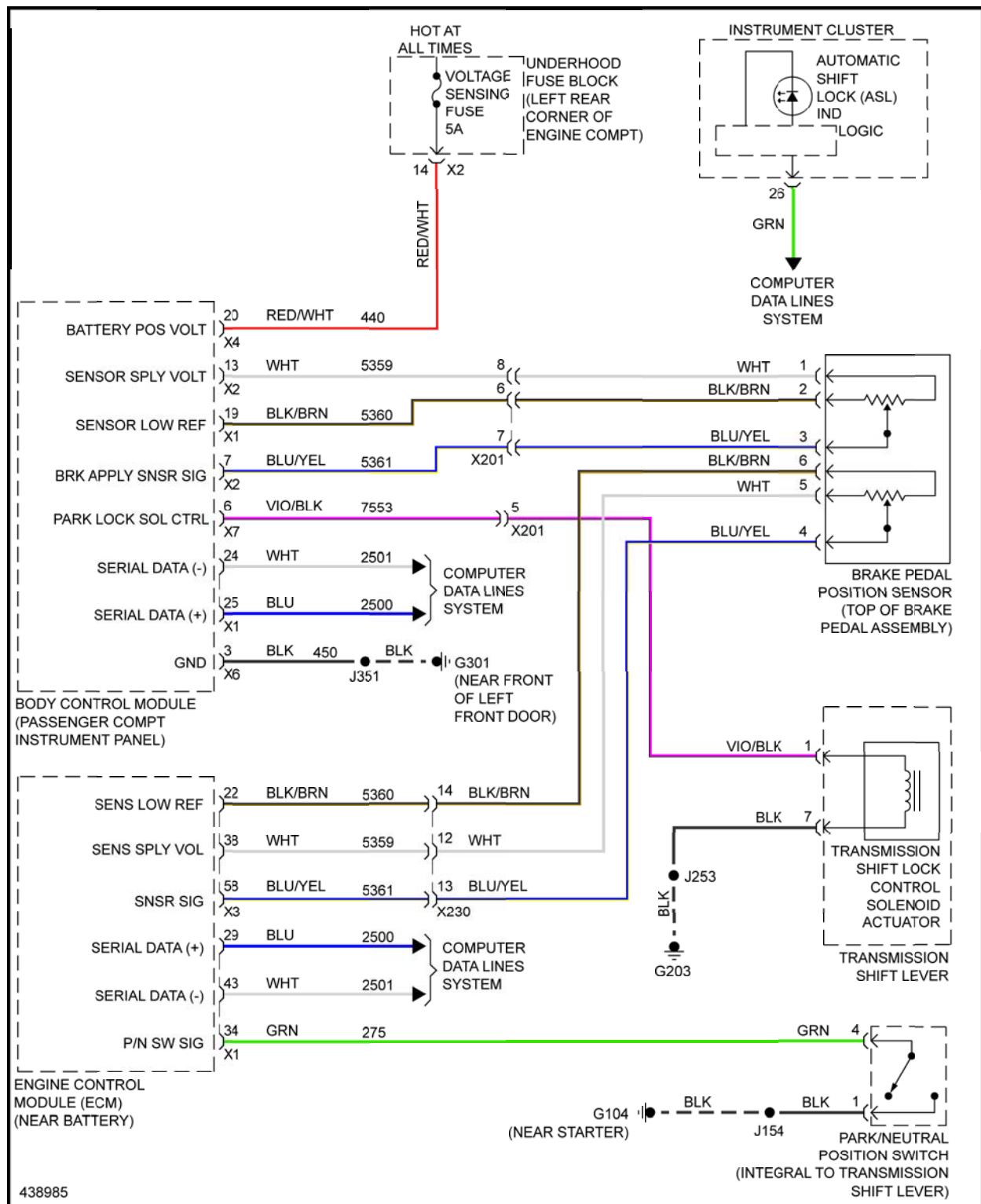


Fig. 55: Shift Interlock Circuit

STARTING/CHARGING

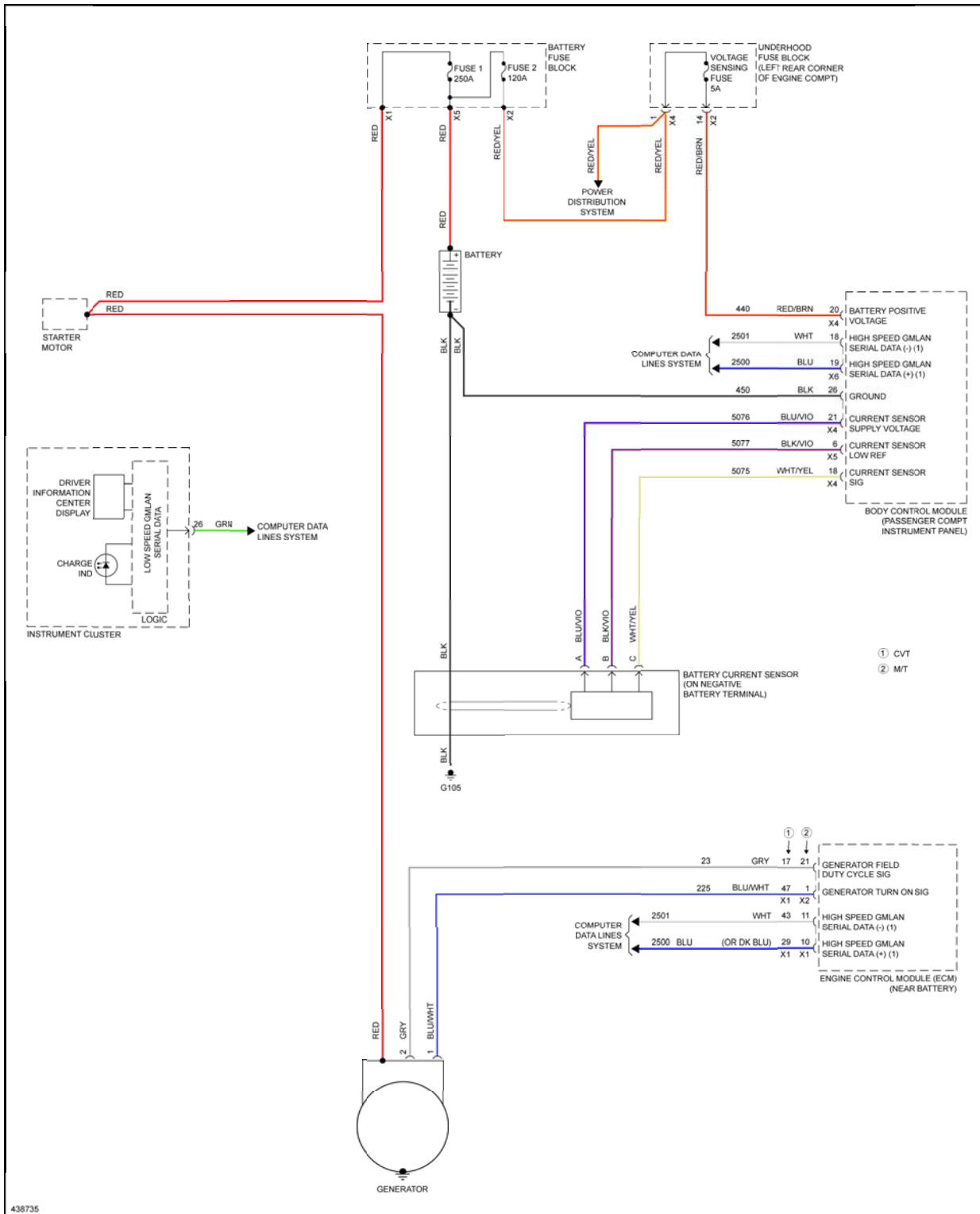


Fig. 56: Charging Circuit

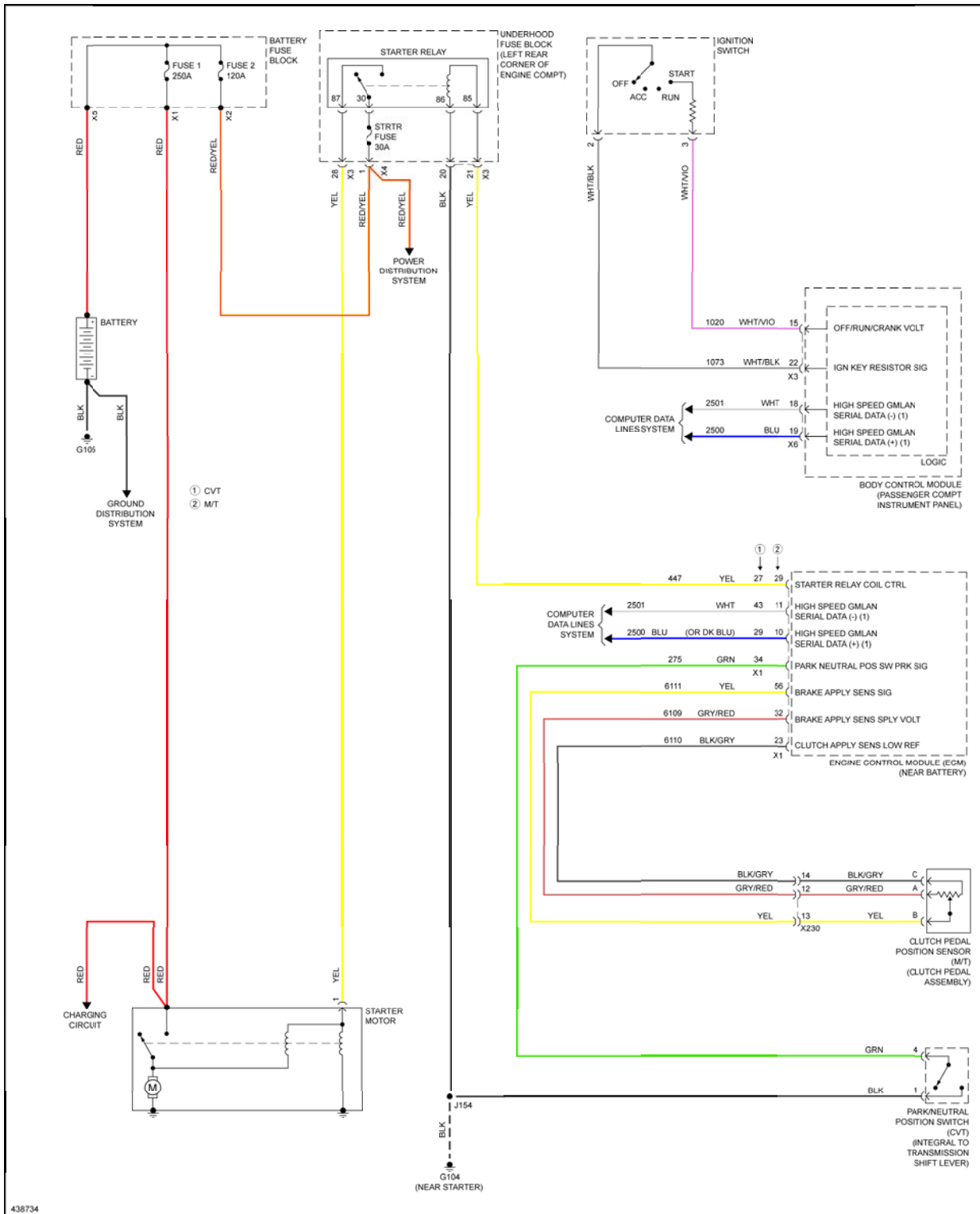


Fig. 57: Starting Circuit

SUPPLEMENTAL RESTRAINTS

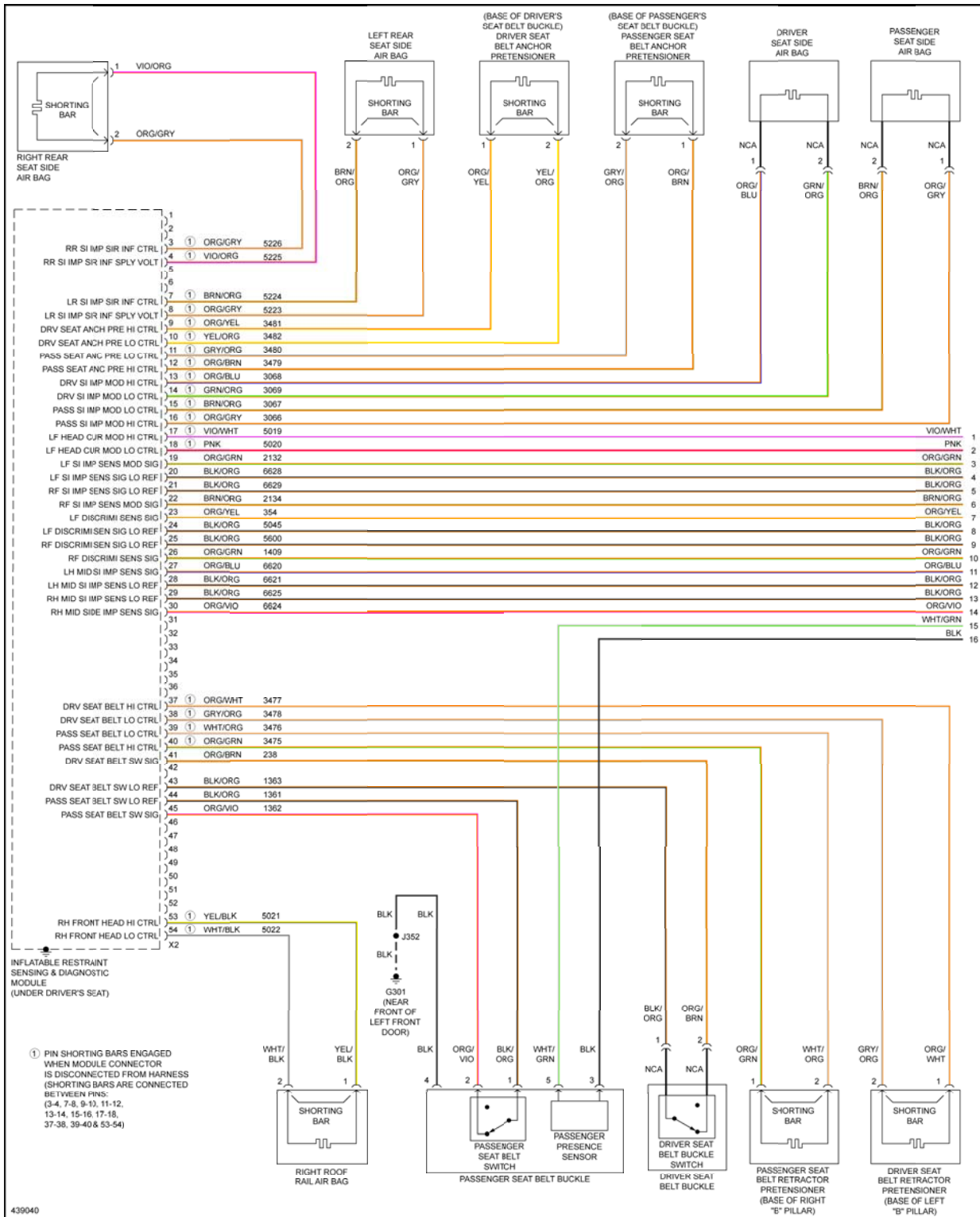


Fig. 58: Supplemental Restraints Circuit (1 of 3)



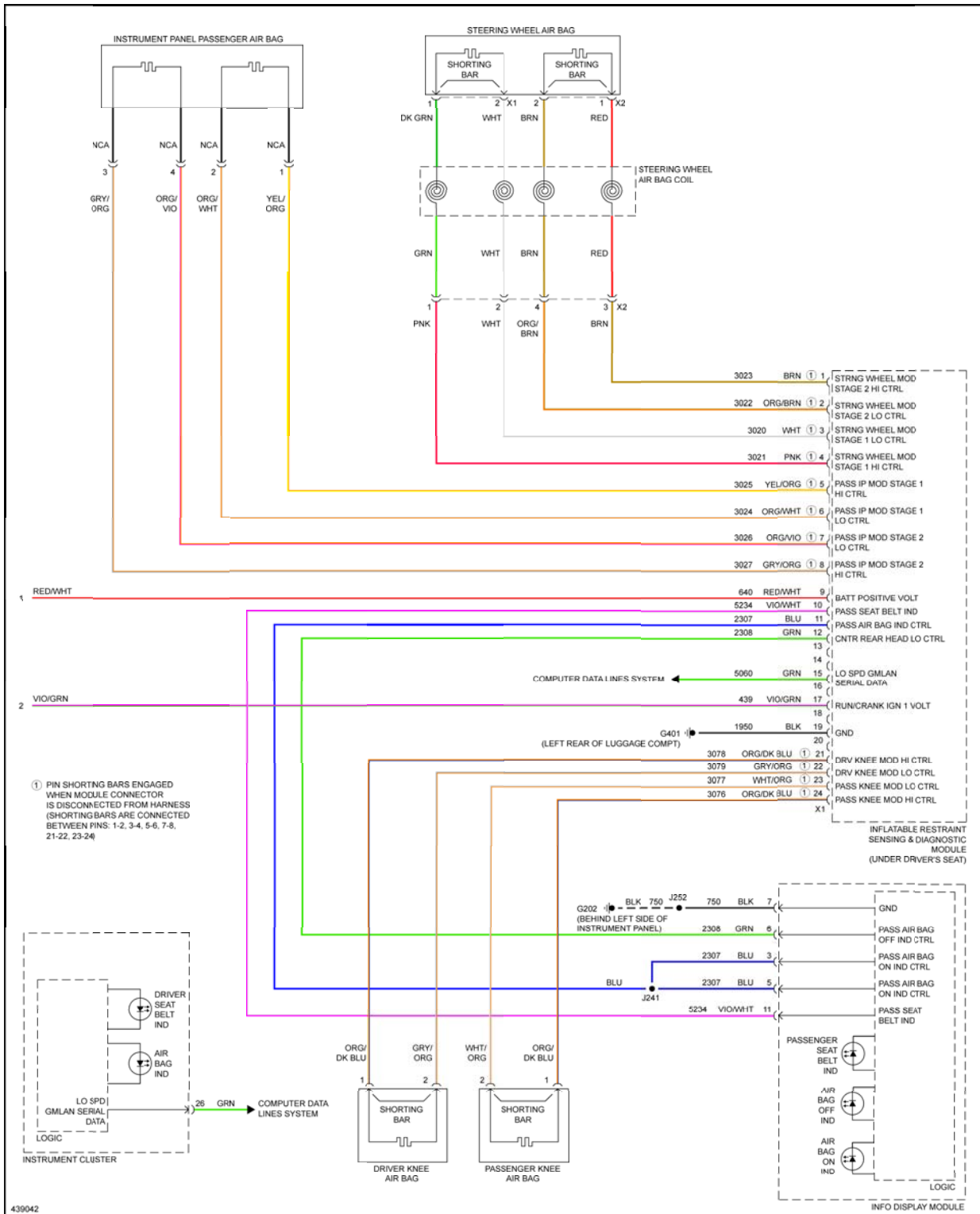


Fig. 60: Supplemental Restraints Circuit (3 of 3)

TRANSMISSION

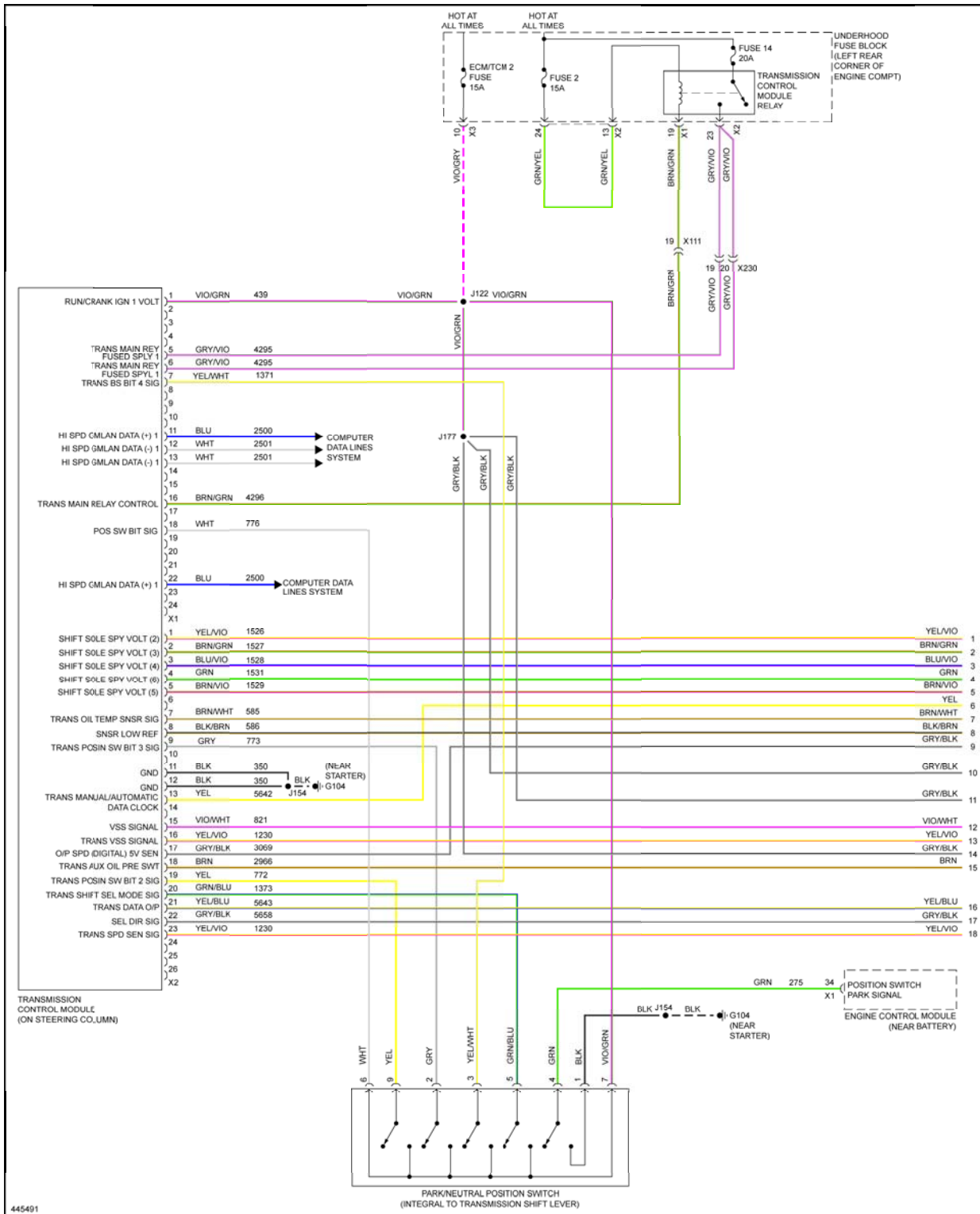


Fig. 61: Transmission Circuit (1 of 2)

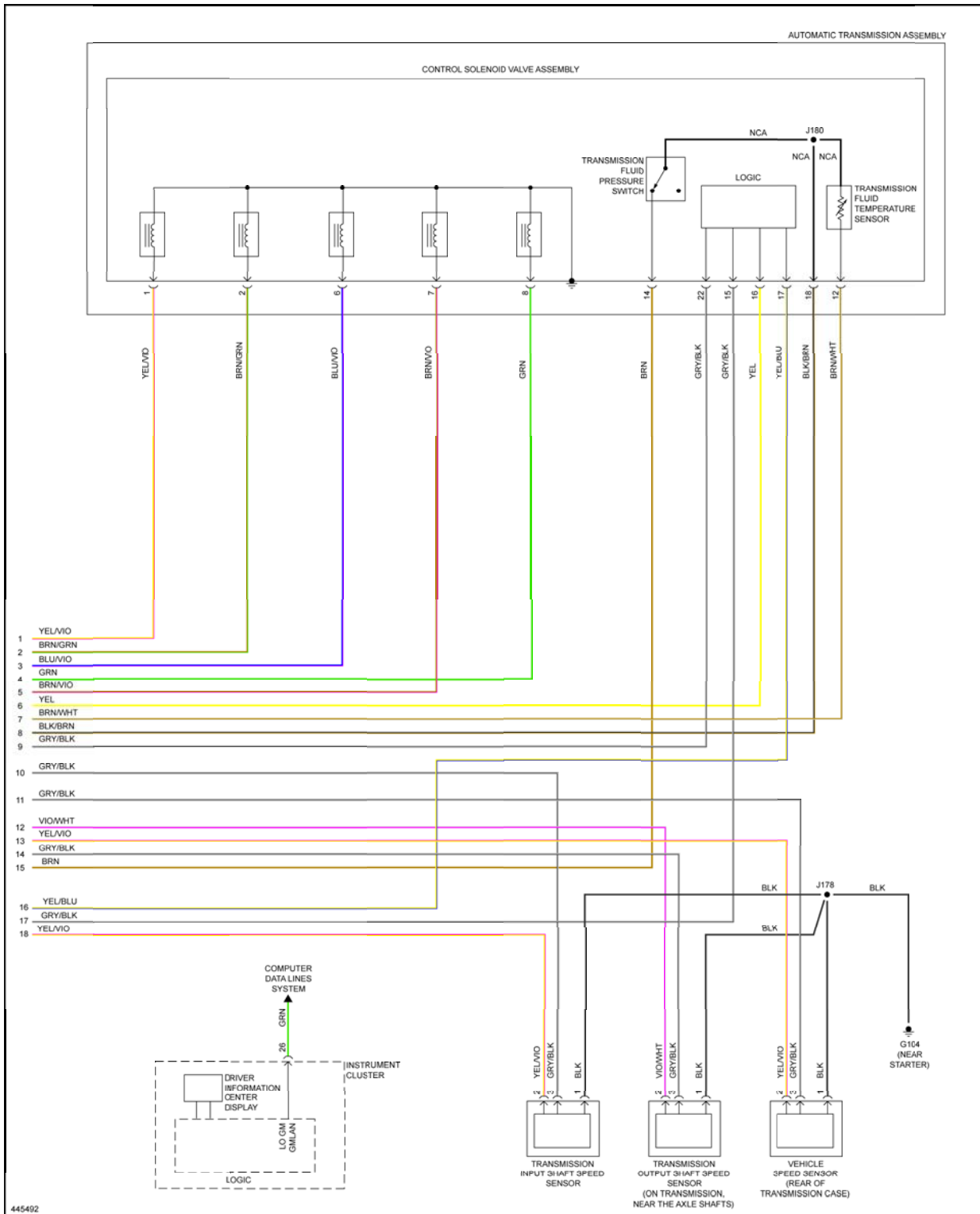


Fig. 62: Transmission Circuit (2 of 2)

TRUNK, TAILGATE, FUEL DOOR



WARNING SYSTEMS

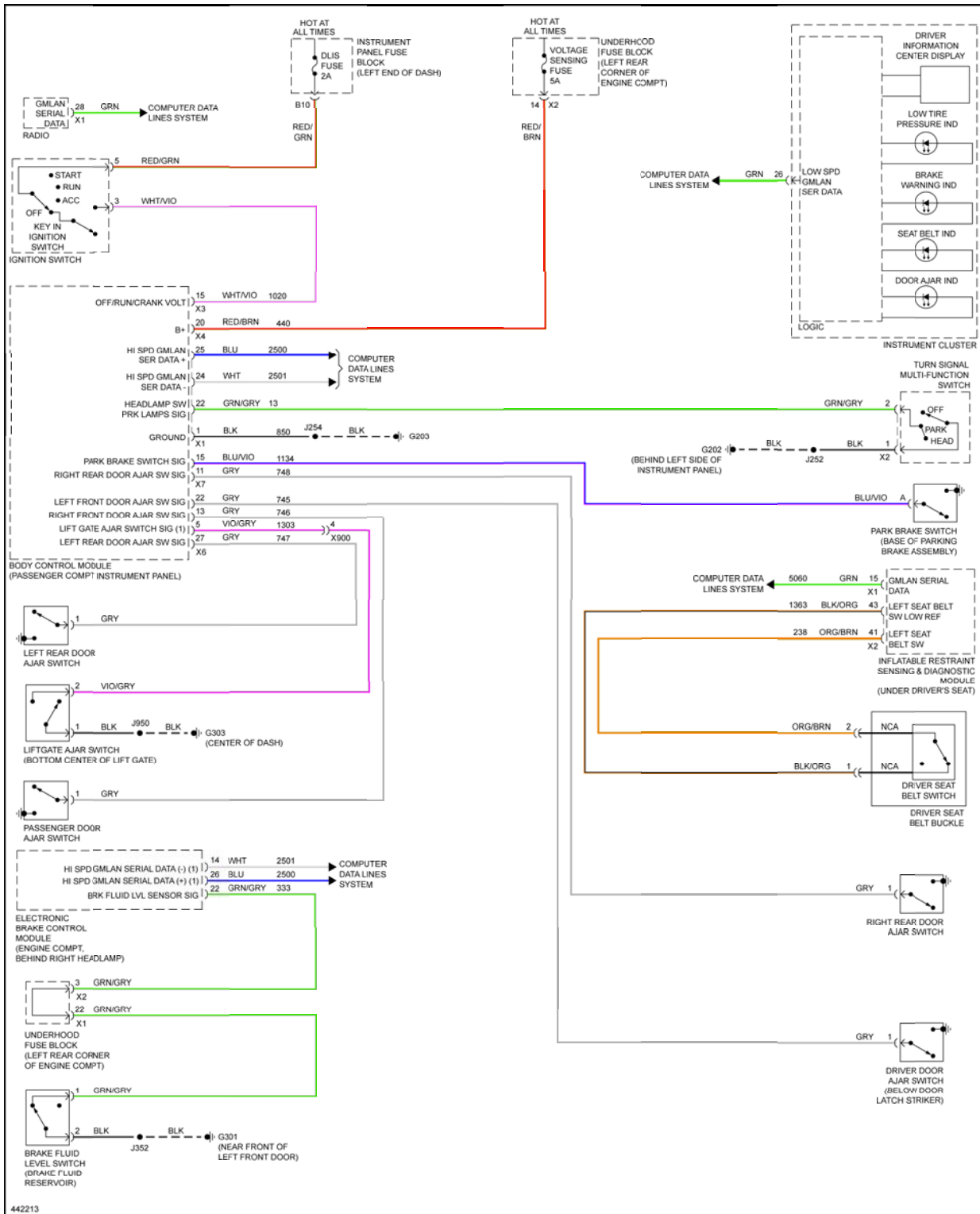


Fig. 64: Warning Systems Circuit

WIPER/WASHER



ACCESSORIES & EQUIPMENT

Theft Deterrent - Spark

SCHEMATIC WIRING DIAGRAMS

THEFT DETERRENT SYSTEM WIRING SCHEMATICS

Theft Deterrent (UTJ) Wiring Schematics

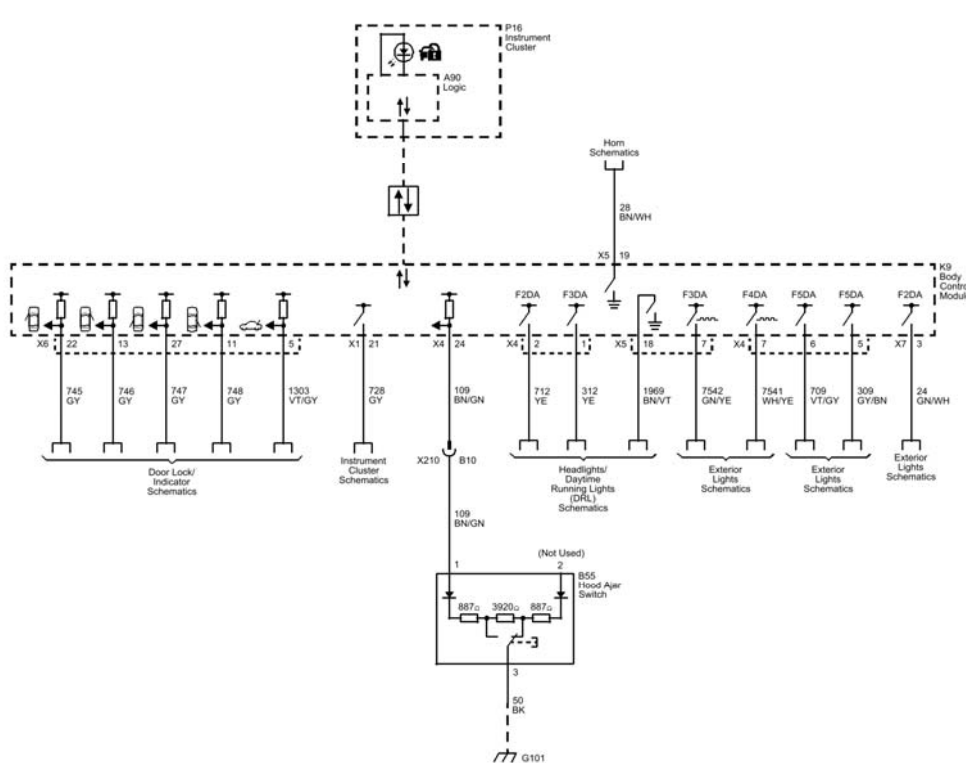


Fig. 1: Theft Deterrent (UTJ) Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

SYMPTOMS - THEFT DETERRENT

NOTE: The following steps must be completed before using the symptom tables.

1. Perform **Diagnostic System Check - Vehicle** in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data link.

2. Review the system operation in order to familiarize yourself with the system functions. Refer to the following **Theft Systems Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Theft Deterrent System. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Content Theft Deterrent Malfunction**
- **Security Indicator Malfunction**

CONTENT THEFT DETERRENT MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The content theft deterrent system is a software based system in which the Body Control Module (BCM) actively monitors certain inputs to determine if unauthorized vehicle access is being attempted. Based on inputs such as the door ajar switches, the rear compartment ajar switch and the hood ajar switch, the BCM determines whether a content theft deterrent alarm is warranted. If unauthorized access is being detected, the BCM will pulse the vehicle horn and flash the exterior lamps as a means of theft deterrence.

Diagnostic Aids

The scan tool BCM Content Theft Deterrent Trigger History 1, 2 and 3 parameters can be used to help isolate an intermittent unwanted content theft deterrent alarm. These parameters are a rolling history of the previous three causes of a theft deterrent alarm. If all three parameters are indicating the same alarm trigger, the indicated input should be the starting point when diagnosing an intermittent concern.

Reference Information

Schematic Reference

Theft Deterrent System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Theft Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify each indicator/message transition between the ajar and closed state while opening and closing each vehicle door, hood and rear compartment.
 - **If the indicator/message does not change**

Refer to **Door Ajar Indicator Malfunction** or **Hood Ajar Indicator/Message Malfunction** .

- **If each indicator/message changes**
3. Completely lower the driver door window and close all vehicle doors, ignition OFF.
 4. Arm the content theft deterrent system by locking the door with the keyless entry transmitter.
 5. Verify the scan tool BCM Content Theft Deterrent Alarm Status parameter is Armed.
 - **If not Armed**

Refer to **Keyless Entry System Malfunction** .

- **If Armed**
6. Without disarming the system, reach in through the open driver window and open the driver door.
 7. Verify the scan tool BCM Content Theft Deterrent Alarm Status parameter is Alarm.
 - **If not Alarm**

Replace the K9 Body Control Module.

- **If Alarm**

8. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Body Control Module replacement, programming and setup

SECURITY INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	2	2	1	-
1. Security Indicator Always On 2. Security Indicator Inoperative				

Circuit/System Description

The security indicator is controlled by the Body Control Module (BCM) based on commands from the content theft deterrent system. The security indicator is located in the driver information center. When the content theft deterrent system requests the indicator be illuminated, the BCM applies voltage to the control circuit, illuminating the indicator.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Theft Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Arm the content theft deterrent system.
2. Verify the security indicator illuminates and/or flash during the arming sequence.
 - **If the indicator does not illuminate and/or flash**

Refer to Circuit/System Testing

- **If the indicator illuminates and/or flashes**
3. All OK

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the A5 Driver Information Center.
2. Connect a test lamp between the control circuit terminal 2 and ground, ignition ON.
3. Verify the test lamp turns ON and OFF when commanding the Security Indicator Active and Inactive with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.

- If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
4. Test or replace the A5 Driver Information Center.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Information Center Telltale Assembly Replacement**
- **Control Module References** for Body Control Module replacement, programming and setup

DESCRIPTION AND OPERATION

THEFT SYSTEMS DESCRIPTION AND OPERATION

When armed, the content theft deterrent system is designed to deter vehicle content theft by pulsing the horns and exterior lamps for approximately 30 seconds when an unauthorized vehicle entry is detected. However, the content theft deterrent system does not affect engine starting.

An unauthorized entry can be any of the following with the content theft deterrent system armed:

- Unauthorized entry into the underhood area
- Unauthorized entry into the rear compartment
- When any door is opened without using the UNLOCK command from a keyless entry transmitter
- After a battery reconnect, if the battery was disconnected with the content theft deterrent system armed

The components of the content theft deterrent system are:

- Body Control Module (BCM)
- Remote control door lock receiver
- Door ajar switches
- Rear compartment ajar switch
- Hood ajar switch

Arming the Content Theft Deterrent System

Use the following procedure in order to arm the system:

1. Place the shift lever in P (park).
2. Turn OFF the ignition.
3. Open any door.

NOTE: **The system is not armed if the doors are locked manually; the power door**

lock switch or remote keyless entry transmitter must be used to arm the content theft deterrent system.

4. Lock the doors with the power door lock switch or by pressing the LOCK button on the transmitter. The system is in standby mode and will not start the arming timer until all doors are closed.
5. The system will begin the arm sequence immediately after the last door is closed. If the keyless entry transmitter is used to arm the system after the vehicle doors are closed, the arm sequence will begin as soon as the LOCK command is received from the transmitter.
6. Pressing the LOCK button on the keyless entry transmitter a second time will bypass the delayed arming function and force the system to arm.

Locking the Vehicle Without Arming the Content Theft Deterrent System

Locking the vehicle may be accomplished without arming the content theft deterrent system. Use of the manual door locks will lock the vehicle, but will not arm the content theft deterrent system.

Disarming an Armed System/Silencing an Alarm

If system arming has been requested by the power door lock switch or the keyless entry transmitter, it must be disarmed.

NOTE: **Disconnecting the battery or removing fuses does not disable the arm or alarm modes, since the BCM stores the content theft deterrent mode status in memory.**

- To disarm the content theft deterrent system in standby mode, perform one of the following:
 - Press the UNLOCK button on the keyless entry transmitter.
 - Insert a valid key into the ignition and switch to the ON position.
- To disarm the content theft deterrent system in the armed mode (non-event) or when activated (during an alarm event):
 - Press the UNLOCK button on the keyless entry transmitter.
 - Insert a valid key into the ignition and switch to the ON position

Content Theft Deterrent Circuit Description

The following is a description of each component used in the content theft deterrent system:

Body Control Module

The content theft deterrent system is an internal function of the BCM which utilizes serial data and various switch inputs information to perform content theft deterrent functions. When the BCM detects an unauthorized entry, it activates the horns and exterior lamps. The BCM has 4 basic modes (disarmed, standby, armed and alarm) for operating the content theft deterrent system. The different modes are described below.

1. The BCM has the content theft deterrent system in a disarmed mode until the following conditions are

detected:

- Ignition key turned to the OFF position.
 - Doors locked by either the power door lock switch or the LOCK button on the transmitter.
2. The BCM enters the standby mode when the above conditions are detected. If a door was already opened when the arm mode was requested, the standby mode does not start the timer until the last door is closed.
 3. When the last door is closed, a 15 second timer is activated. Once the timer has expired, the BCM enters the armed mode. After this delay, any unauthorized entry will activate the alarm mode.
 4. When the BCM detects an unauthorized entry, the BCM enters the alarm mode. The BCM activates the horns and exterior lamps for 30 seconds. This is followed by a three minute time-out with the horn no longer active. If no new intrusions are detected after the time-out, the horn is not active. The system must be disarmed or the intrusion condition removed after the time-out for the system to exit alarm mode.

Remote Control Door Lock Receiver

The keyless entry system can arm and disarm the content theft deterrent system. When the remote control door lock receiver receives a door lock or unlock signal from the transmitter, the remote control door lock receiver sends a message to the BCM via serial data to perform the appropriate arm/disarm functions.

Door Ajar Switches

The content theft deterrent system uses the door ajar switches as a status indicator to activate the alarm. The door ajar switches are monitored by the body control module via a discrete input from each door ajar switch. If the BCM receives a signal indicating a door is opened when the content theft deterrent system is armed, the BCM activates the alarm.

Hood Ajar Switch

The content theft deterrent system uses the hood ajar switch as a status indicator to activate the alarm. The BCM monitors the hood ajar switch via a discrete input from the switch. If the BCM receives a signal indicating the hood has been opened when the content theft deterrent system is armed, the BCM activates the alarm.

Rear Compartment Ajar Switch

The content theft deterrent system uses the rear compartment ajar switch as a status indicator to activate the alarm. The BCM monitors the rear compartment ajar switch via a discrete input from the switch. If the BCM receives a signal indicating the rear compartment has been opened when content theft deterrent system is armed, the BCM activates the alarm.

Inputs

The BCM monitors the following inputs for content theft deterrent:

- Door ajar switches
- Keyless entry transmitter LOCK/UNLOCK buttons; a message from the remote control door lock receiver
- Immobilizer status-The BCM uses the immobilizer status for disarming the system or silencing an alarm

when the correct vehicle key is used to start the vehicle

- Rear compartment ajar switch
- Hood ajar switch

Outputs

The BCM controls the following for content theft deterrent:

- Horn relay
- Exterior lamps

STEERING

Tire Pressure Monitoring - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Tire Pressure Sensor Screw	1.3	11.5 lb in

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC C0569</u>	DTC C0569 00 System Configuration Malfunction
<u>DTC C0750, C0755, C0760, or C0765</u>	DTC C0750 03 Left Front Tire Pressure Sensor Low Voltage
	DTC C0750 29 Left Front Tire Pressure Sensor Too Few Pulses
	DTC C0750 39 Left Front Tire Pressure Sensor Internal Malfunction
	DTC C0755 03 Right Front Tire Pressure Sensor Low Voltage
	DTC C0755 29 Right Front Tire Pressure Sensor Too Few Pulses
	DTC C0755 39 Right Front Tire Pressure Sensor Internal Malfunction
	DTC C0760 03 Left Rear Tire Pressure Sensor Low Voltage
	DTC C0760 29 Left Rear Tire Pressure Sensor Too Few Pulses
	DTC C0760 39 Left Rear Tire Pressure Sensor Internal Malfunction
	DTC C0765 03 Right Rear Tire Pressure Sensor Low Voltage
	DTC C0765 29 Right Rear Tire Pressure Sensor Too Few Pulses
	DTC C0765 39 Right Rear Tire Pressure Sensor Internal Malfunction
	DTC C0775 00 Tire Pressure Monitoring System Sensors Malfunction
<u>DTC C0775</u>	

DTC C0569: SYSTEM CONFIGURATION MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC C0569 00

System Configuration Malfunction

Circuit/System Description

If the tire type and pressure information is not entered during the body control module (BCM) setup, the tire pressure monitor system indicator icon on the instrument cluster will flash for 1 min and then remain illuminated after the ignition is cycled ON and the instrument cluster bulb check is complete. If equipped, the driver information center will also display a service tire monitor type message. Under these circumstances, DTC C0569 will be set and the tire type and pressure information will need to be entered for the system to function correctly.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

The tire type and pressure information is not entered into the BCM during programming and setup.

Action Taken When the DTC Sets

- The tire pressure monitor system indicator icon on the instrument cluster flashes for 1 min and then remains illuminated after the ignition switch is cycled ON and the instrument cluster bulb check is complete.
- If equipped, the driver information center displays a service tire monitor type message.

Conditions for Clearing the DTC

A current DTC will clear when the BCM has undergone the tire type and pressure selection setup procedure and one ignition cycle has occurred.

Diagnostic Aids

A newly replaced BCM will set DTC C0569 after programming on it's initial ignition ON cycle if the module setup information has not been entered.

Reference Information

Description and Operation

Tire Pressure Monitor Description and Operation

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Enter the tire type and pressure information into the K9 Body Control Module with a scan tool. Refer to **Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label**.
3. Ignition OFF, then Ignition ON.
4. Verify DTC C0569 is not set.

- **If the DTC is set**

Replace the K9 Body Control Module.

- **If the DTC is not set.**

5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for BCM replacement, programming, and setup.

DTC C0750, C0755, C0760, OR C0765: TIRE PRESSURE SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC C0750 03

Left Front Tire Pressure Sensor Low Voltage

DTC C0750 29

Left Front Tire Pressure Sensor Too Few Pulses

DTC C0750 39

Left Front Tire Pressure Sensor Internal Malfunction

DTC C0755 03

Right Front Tire Pressure Sensor Low Voltage

DTC C0755 29

Right Front Tire Pressure Sensor Too Few Pulses

DTC C0755 39

Right Front Tire Pressure Sensor Internal Malfunction

DTC C0760 03

Left Rear Tire Pressure Sensor Low Voltage

DTC C0760 29

Left Rear Tire Pressure Sensor Too Few Pulses

DTC C0760 39

Left Rear Tire Pressure Sensor Internal Malfunction

DTC C0765 03

Right Rear Tire Pressure Sensor Low Voltage

DTC C0765 29

Right Rear Tire Pressure Sensor Too Few Pulses

DTC C0765 39

Right Rear Tire Pressure Sensor Internal Malfunction

Circuit/System Description

The tire pressure monitor system has a radio frequency (RF) transmitting pressure sensor in each wheel/tire assembly. As vehicle speed increases, centrifugal force closes the sensors internal roll switch, which puts the sensor into Drive mode. The body control module (BCM) receives and translates the data contained in the tire

pressure sensor RF transmissions into sensor presence, sensor mode, and tire pressure. Once vehicle speed is greater than 40 km/h (25 MPH), the BCM waits for the first sensor to go into Drive mode, then checks if all sensors have gone into Drive mode. If one or more sensors does not go into these modes, or does not transmit at all, the BCM will set DTC C0750, C0755, C0760, or C0765 respectively.

Conditions for Running the DTC

Vehicle speed is greater than 40 km/h (25 MPH).

Conditions for Setting the DTC

- A sensor does not transmit or transmits invalid data to the BCM.
- A sensor low battery condition.

Action Taken When the DTC Sets

- The tire pressure monitor system indicator icon on the instrument cluster flashes for 1 min and then remains illuminated after the ignition switch is cycled ON and the instrument cluster bulb check is complete.
- If equipped, the driver information center displays a service tire monitor type message.

Conditions for Clearing the DTC

A current DTC will clear when the malfunction is no longer present and one ignition cycle occurs.

Diagnostic Aids

- Some aftermarket wheel valve stem holes are located further from the wheel rim than original equipment wheels. When using the tire pressure monitor special tool to activate a sensor, ensure the tool is placed along the tire sidewall and no further than 15 cm (6 in) from the sensor and the antenna is aiming upward.
- Aftermarket wheel valve system locations can cause a sensor to not function correctly.
- A sensor may have been damaged due to a previous wheel/tire service or flat tire event.
- The use of other than GM approved tire sealants can obstruct the sensor pressure sensing port and cause inaccurate tire pressure readings. If this condition is verified, remove the sealer from the tire and replace the sensor. Refer to **Tire Pressure Indicator Sensor Replacement**.
- Occasionally sensor transmissions are not received by the BCM due to vehicle level radio frequency interference from items such as but not limited to aftermarket ignition systems, DVD players, CB radios, or metallic type window tinting.
- The sensor activation procedure may have to be repeated up to 3 times before determining a sensor is malfunctioning. In the event a particular sensor information is displayed on the special tool upon activation but the horn does not chirp, it may be necessary to rotate the wheel valve stem to a different position due to the RF signal being blocked by another component.
- Occasionally sensors can become mislocated due to previous tire rotations where the sensor learn procedure was not performed. Always learn the sensors to ensure the DTC set is for that actual physical corner of the vehicle. Refer to **Tire Pressure Indicator Sensor Learn**.
- A sensor low battery condition will set a sensor DTC but will not illuminate the low tire pressure

indicator or display a message on the driver information center, if equipped. The sensor battery condition can be verified in the scan tool BCM data list. If a sensor low battery condition is indicated on the scan tool, the sensor will need to be replaced. Refer to **Tire Pressure Indicator Sensor Replacement**.

Reference Information

Description and Operation

Tire Pressure Monitor Description and Operation

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify there are no communication DTCs set along with DTC C0750, C0755, C0760, and C0765.
 - **If a communication DTC is set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
 - **If a communication DTC is not set**
2. Perform the **Tire Pressure Indicator Sensor Learn**.
3. Verify the scan tool Tire Pressure Sensor Mode parameters change to Drive while driving the vehicle above 40 km/h (25 mph) for greater than 2 min.
 - **If a Tire Pressure Sensor Mode parameter does not change to Drive**
 1. Replace the appropriate B2 Tire Pressure Sensor.
 2. Perform the **Tire Pressure Indicator Sensor Learn**.
 - **If the Tire Pressure Sensor Mode parameter changes to Drive**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Tire Pressure Indicator Sensor Replacement**
- **Tire Pressure Indicator Sensor Learn**

DTC C0775: TIRE PRESSURE MONITORING SYSTEM SENSORS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC C0775 00

Tire Pressure Monitoring System Sensors Malfunction

Circuit/System Description

If the body control module (BCM) has been reprogrammed or replaced and the tire pressure sensor learn procedure has not been performed, the tire pressure monitor system indicator icon on the instrument cluster will flash for 1 min and then remain illuminated after the power switch is cycled ON and the instrument cluster bulb check is complete. If equipped, the driver information center will also display a service tire monitor type message. Under these circumstances, DTC C0775 will be set in the BCM and the tire pressure sensor learn procedure will need to be performed for the system to function correctly.

Conditions for Running the DTC

Vehicle ON or Vehicle in Service Mode.

Conditions for Setting the DTC

The body control module (BCM) has not learned tire pressure sensor ID and location information from the tire pressure sensors.

Action Taken When the DTC Sets

- The tire pressure monitor system indicator icon on the instrument cluster will flash for 1 min and then remain illuminated after the power switch is cycled ON and the instrument cluster bulb check is complete.
- If equipped, the driver information center displays a service tire monitor type warning message.

Conditions for Clearing the DTC

A current DTC will clear when the BCM has received tire pressure sensor ID and location information from the tire pressure indicator module and at least 1 power switch cycle has occurred.

Reference Information

Description and Operation

Tire Pressure Monitor Description and Operation

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Perform the **Tire Pressure Indicator Sensor Learn**.
2. Verify DTC C0775 is not set.
 - **If the DTC is set**

Replace the K9 Body Control Module.
 - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for BCM replacement, programming, and setup.

SYMPTOMS - TIRE PRESSURE MONITORING

1. Perform the **Diagnostic System Check - Vehicle** , before using the Symptom Tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Tire Pressure Monitor Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Tire Pressure Monitoring (TPM) System. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to **Low Tire Pressure Indicator Malfunction** in order to diagnose the symptom.

LOW TIRE PRESSURE INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The tire pressure monitor system has a radio frequency transmitting pressure sensor in each wheel/tire assembly. As vehicle speed increases, centrifugal force closes the sensor's internal roll switch, which puts the sensor into Drive mode. The sensors send the tire pressure data to the body control module (BCM). The BCM translates the data contained in the tire pressure sensor radio frequency transmissions into sensor presence, sensor mode, and tire pressure. Once vehicle speed is greater than 40 km/h (25 MPH), the BCM waits for the sensors to go into Drive mode.

Each sensor has its own unique identification (ID) code, which it transmits as part of each RF message, that must be learned into the BCM memory. Once all 4 IDs have been learned and vehicle speed is greater than 40 km/h (25 mph), the BCM continuously compares IDs and pressure data in the received transmissions to the learned IDs and pressures to determine if all 4 sensors are present and if one or more tire pressure is low. If the BCM detects a low tire pressure condition or a malfunction in the system, it will send a serial data message to the instrument cluster requesting the appropriate tire pressure monitor indicator illumination and also to display the appropriate data message on the driver information center, if equipped.

Diagnostic Aids

- If unsure about the condition, cycle the ignition and observe the tire pressure monitor indicator icon. If the tire pressure monitor indicator icon is continuously illuminated after the instrument cluster bulb check is completed, a low tire pressure condition is present. Check the tires for damage or leaks and inflate to the tire placard specifications. Refer to **Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label** . If the tire pressure monitor indicator icon flashes for 1 minute after the instrument cluster bulb check is completed and then remains illuminated, a tire pressure monitor system DTC is set. Perform the **Diagnostic System Check - Vehicle** to proceed with the proper diagnosis.
- Temperature can greatly affect tire pressures. Low tire pressure on a cold morning may cause the tire pressure monitor indicator icon to illuminate. The air pressure in the tire increases as the ambient temperature rises or as the tire warms up while the vehicle is driven. The pressure may increase enough to exceed the predetermined low pressure threshold which will turn OFF the tire pressure monitor indicator icon.
- Some aftermarket wheel valve stem holes are located further from the wheel rim than original equipment wheels. When using the tire pressure monitor special tool to activate a sensor, ensure the tool is placed along the tire sidewall and no further than 15 cm (6 in) from the sensor and the antenna is aiming upward.
- Aftermarket wheel valve stem locations can cause a sensor to not function correctly.
- A sensor may have been damaged due to a previous wheel/tire service or flat tire event.
- The use of other than GM approved tire sealants can obstruct the sensor pressure sensing port and cause inaccurate tire pressure readings. If this condition is verified, remove the sealer from the tire and replace the sensor. Refer to **Tire Pressure Indicator Sensor Replacement**.
- The sensor activation procedure may have to be repeated up to 3 times before determining a sensor is malfunctioning. In the event a particular sensor's information is displayed on the special tool upon activation but the horn does not chirp, it may be necessary to rotate the wheel valve stem to a different position due to the RF signal being blocked by another component.

- Occasionally sensor transmissions are not received by the BCM due to vehicle level RF interference from items such as but not limited to aftermarket ignition systems, DVD players, CB radios, or metallic type window tinting.

Reference Information

Description and Operation

Tire Pressure Monitor Description and Operation

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: Low tire pressure in one or more tires is indicated by a continuously illuminated tire pressure monitor indicator icon after the instrument cluster bulb check is completed. If equipped with a driver information center, a check tire pressure type message will also be displayed.

When a tire pressure monitor DTC is set, the tire pressure monitor indicator icon will flash for 1 min after the instrument cluster bulb check is completed and then remains illuminated. If equipped with a driver information center, a service tire monitor type message will also be displayed.

- Adjust all tire pressures to the correct pressure. Refer to Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label.
- Drive the vehicle over 40 km/h (25 MPH) for greater than 2 minutes.
- Verify the low tire pressure indicator is OFF.
 - If the low tire pressure indicator is ON**
 - Perform the Tire Pressure Indicator Sensor Learn.
 - Record each tire pressure as indicated by the appropriate scan tool parameter.
 - Check and record the tire pressures with a known accurate hand held tire pressure gauge.
 - Verify that the pressure readings from the scan tool do not differ more than 27.6 kPa (4 PSI) from the actual tire pressure readings.
 - If the pressure readings differ more than 27.6 kPa (4 psi), replace the appropriate B2 Tire Pressure Sensor then perform the Tire Pressure Indicator Sensor Learn.
 - If the pressure readings do not differ more than 27.6 kPa (4 PSI)
- Verify the BCM Tire Type and Pressure selections are setup correctly with a Scan Tool. Refer to the Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label.
 - If the BCM Tire Type and Pressure selections are incorrect, input the proper placard values for the vehicle with the Scan Tool then drive the vehicle over 40 km/h (25 MPH) for greater than 2 min.

- If the BCM Tire Type and Pressure selections are correct
- 6. Ignition ON.
- 7. Verify the tire pressure monitor indicator icon turns ON and OFF when commanding All Indicators ON and OFF with a scan tool.
 - If the tire pressure monitor icon does not turn ON and OFF, replace the P16 Instrument Cluster.
 - If the tire pressure monitor icon turns ON and OFF
- 8. All OK
 - **If the tire pressure indicator is OFF**
- 4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Tire Pressure Indicator Sensor Replacement**
- **Tire Pressure Indicator Sensor Learn**
- **Control Module References** for Instrument Cluster or BCM replacement, programming, and setup

REPAIR INSTRUCTIONS

TIRE PRESSURE INDICATOR SENSOR REPLACEMENT

Removal Procedure

1. Raise the vehicle on a suitable support. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the tire/wheel assembly from the vehicle. Refer to **Tire and Wheel Removal and Installation** .
3. Dismount the tire from the rim. Refer to **Tire Dismounting and Mounting** .

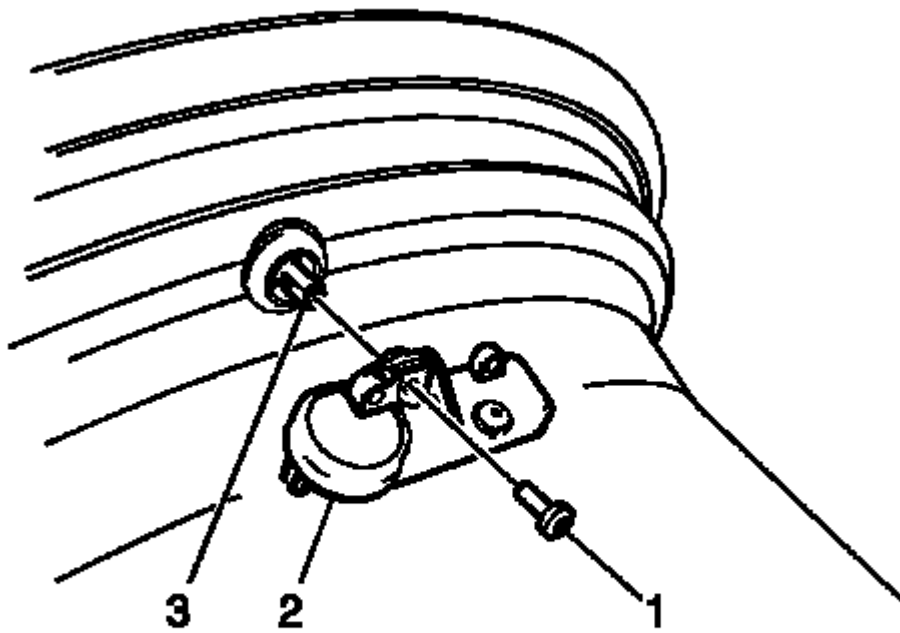


Fig. 1: View Of Tire Pressure Indicator Sensor
Courtesy of GENERAL MOTORS COMPANY

NOTE: When servicing the tire pressure sensor always use a new Schrader® tire pressure monitoring (TPM) sensor and a new TORX screw during installation.

4. Remove the TORX screw (1) from the tire pressure sensor (2) and pull it straight off the tire pressure valve stem (3).

CAUTION: Do not scratch or damage the clear coating on aluminum wheels with the tire changing equipment. Scratching the clear coating could cause the aluminum wheel to corrode and the clear coating to peel from the wheel.

5. Remove the tire pressure valve stem by pulling it through the rim.

Installation Procedure

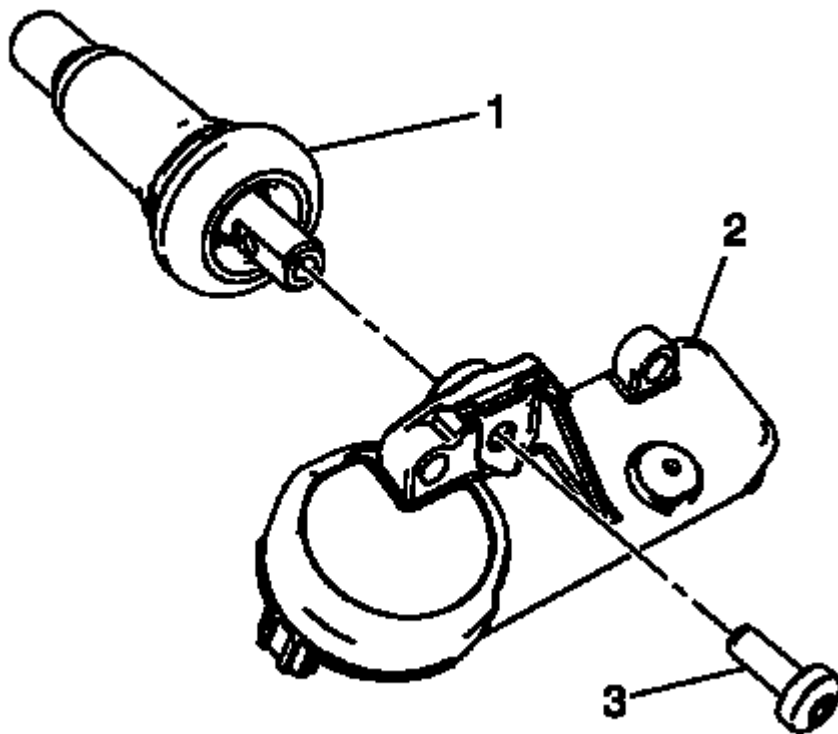


Fig. 2: View Of Tire Pressure Indicator Sensor
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

NOTE:

- Ensure the flat of the valve, lines up with the flats of the snap in the enclosure.
- TPM valves and TORX screws are single use items.

1. Assemble the tire pressure sensor (2) to the valve stem and install the new TORX screw (3), tighten to 1.3 (11.5 lb in).

NOTE:

Use an approved tire mounting lubricant. **DO NOT** use silicon or corrosive base compounds to lubricate the tire bead and the wheel rim. A corrosive type compound can cause tire or rim deterioration.

2. Apply tire soap to the rubber portion of the valve stem (1).

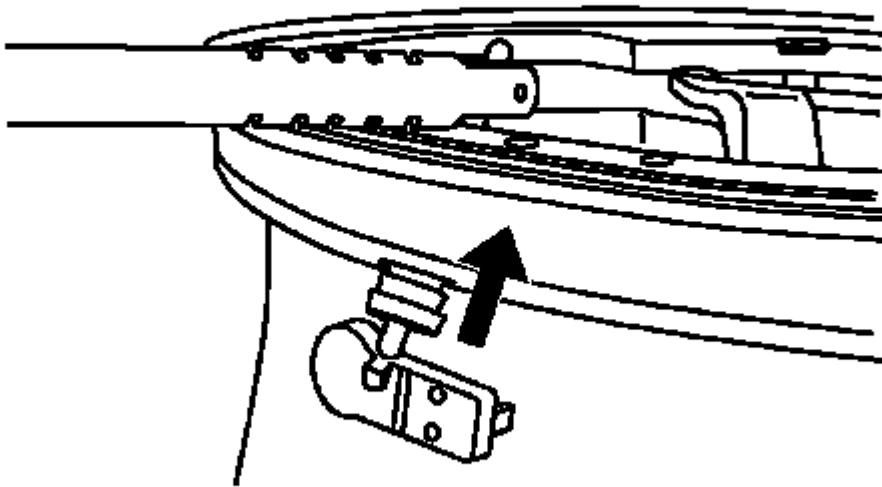


Fig. 3: View Of Tire Valve Stem Mounting Tool
Courtesy of GENERAL MOTORS COMPANY

3. Using a tire valve stem mounting tool, pull the valve stem through in a direction parallel to the valve hole on the rim.

NOTE: Snap Fit TPM sensors are shipped in the OFF mode. The sensor will exit its OFF state when the tire is inflated.

4. Mount the tire to the rim. Refer to **Tire Dismounting and Mounting** .
5. Install the tire/wheel assembly on the vehicle. Refer to **Tire and Wheel Removal and Installation** .
6. Lower the vehicle.
7. Learn the tire pressure sensors. Refer to **Tire Pressure Indicator Sensor Learn**.

TIRE PRESSURE INDICATOR SENSOR LEARN

Special Tools

- **EL-46079** Tire Pressure Monitor Diagnostic Tool
- **EL-50448** Tire Pressure Monitor Sensor Activation Tool

For equivalent regional tools, refer to **Special Tools**.

Learn Mode Description

The tire pressure monitor system uses the instrument cluster, body control module (BCM), 4 radio frequency transmitting pressure sensors, and the serial data circuit to perform the tire pressure monitor learn mode functions. The sensor learn procedure must be performed after every tire rotation, BCM replacement, or sensor replacement. Once the Learn mode has been enabled, each of the sensors unique identification codes can be learned into the BCM memory. When a sensor ID has been learned, the BCM sounds a horn chirp indicating the sensor has transmitted its ID and the BCM has received and learned it. The BCM must learn the sensor IDs in the proper sequence to determine correct sensor location. The first learned ID is assigned to the left front location, the second to right front, the third to right rear and the fourth to left rear. The turn signals will individually illuminate indicating which location is to be learned in the proper sequence.

Sensor Functions Using EL-46079, EL-50448, or Equivalent

Each sensor has an internal low frequency coil. When the tire pressure monitor special tool is used in activate mode, it produces a low frequency transmission that activates the sensor. The sensor responds to a low frequency activation by transmitting in Learn Mode-Remotely Triggered. When the BCM receives a learn mode transmission while in Learn mode, it will assign that sensors ID to the location on the vehicle relative to the order in which it was learned.

Learn Mode Cancellation

The Learn mode will cancel if the ignition is cycled to OFF or if more than 2 minutes has elapsed for any sensor that has not been learned. If the relearn mode is cancelled before the first sensor is learned, the original sensor IDs will be maintained. If the relearn mode is canceled after the first sensor is learned, the following will occur:

- All stored sensor IDs will be invalidated in the BCM memory.
- If equipped, the driver information center will display dashes instead of tire pressures.
- DTC C0775 will be set.

These conditions will now require the Learn procedure to be repeated for the system to function properly.

Tire Pressure Monitor Learn Procedure

NOTE: In the event when a particular sensor is activated and the horn does not chirp, it may be necessary to rotate the wheel valve stem to a different position due to the sensor signal is being blocked by another component.

1. Apply park brake (manual transmission only).
2. Ignition ON, using a scan tool or driver information center buttons, initiate the Tire Pressure Sensors Learn mode. A double horn chirp will sound indicating the Learn mode has been enabled. The left front turn signal will also be illuminated.
3. Starting with the left front tire, active the sensor by holding the antenna of the tire pressure monitor special tool aimed upward against the tire sidewall close to the wheel rim at the valve stem location. Press

and release the activate button. Ensure that the transmit indicator on the special tool indicates that the sensor activation signal is being transmitted. Wait for a horn chirp. If the horn does not chirp, repeat the sensor activation sequence with the tool. Once the horn chirp has sounded, the sensor information is learned and the turn signal in the next location to be learned will illuminate.

4. After the horn chirp has sounded and the right front turn signal is illuminated, repeat step 3 for the remaining 3 sensors in the following order:
 1. Right front
 2. Right rear
 3. Left rear
5. When the left rear sensor has been learned and a double horn chirp has sounded, the learn process is complete and the BCM exits the Learn mode.

DESCRIPTION AND OPERATION

TIRE PRESSURE MONITOR DESCRIPTION AND OPERATION

Tire Pressure Monitoring Block Diagram

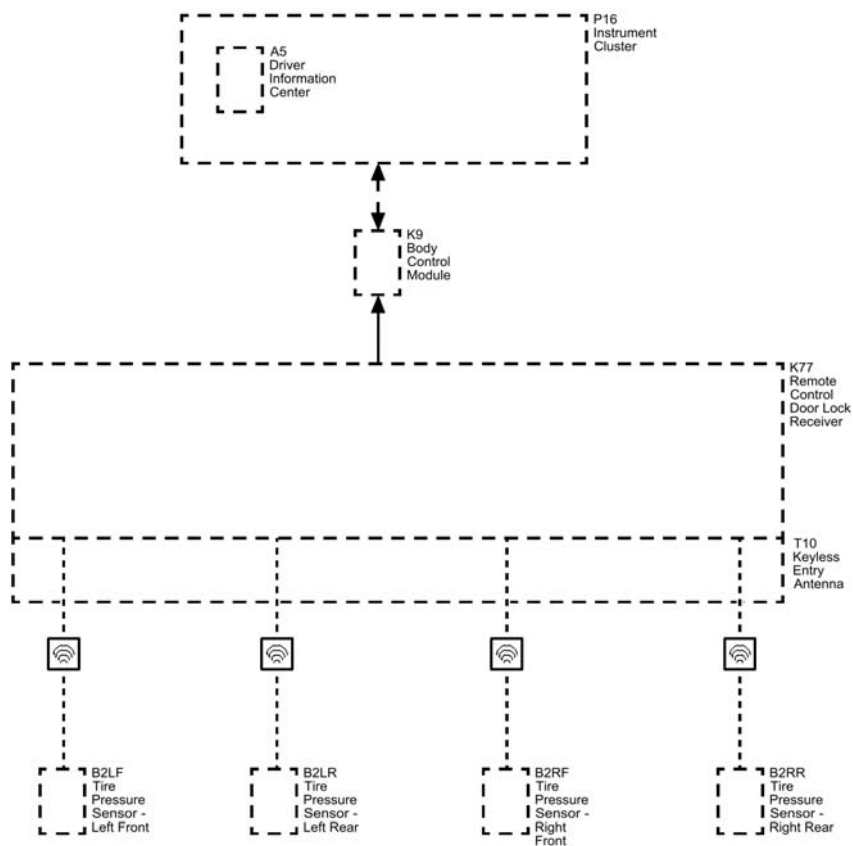


Fig. 4: Tire Pressure Monitoring System Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
DA	Serial Data
HW	Hard-Wired
WL	Wireless
WL	Wireless
WL	Wireless
WL	Wireless
P16	P16 Instrument Cluster
P9	P9 Driver Information Center Display
K9	K9 Body Control Module
K77	K77 Remote Control Door Lock Receiver
T10	T10 Keyless Entry Antenna
B2LF	B2LF Tire Pressure Sensor - Left Front

B2LR	B2LR Tire Pressure Sensor - Left Rear
B2RF	B2RF Tire Pressure Sensor - Right Front
B2RR	B2RR Tire Pressure Sensor - Right Rear

Special Tools

- **EL-46079/J-46079** Tire Pressure Monitor Diagnostic Tool
- **EL-50448** Tire Pressure Monitor Sensor Activation Tool

For equivalent regional tools, refer to **Special Tools**.

The tire pressure monitor system warns the driver when a significant loss, or gain of tire pressure occurs in any of the 4 tires and allows the driver to display the individual tire pressures and their locations on the driver information center.

The system uses the body control module (BCM), driver information center, instrument cluster, a radio frequency (RF) transmitting pressure sensor in each wheel/tire assembly, and the serial data circuit to perform the system functions. Each sensor has an internal power supply with an approximate 10 year service life.

When the vehicle is stationary, the sensor's internal accelerometer is inactive, which puts the sensors into a Stationary state. In this state the sensors sample tire pressure once every 30 seconds and do not transmit at all if the tire pressure does not change. As vehicle speed increases, centrifugal force activates the sensors internal accelerometer causing the sensors to go into Wake and then Drive mode. In Drive mode, the sensors sample tire pressure once every 30 seconds and transmit in Drive mode once every 60 seconds. The BCM receives and translates the data contained in each sensors RF transmission into sensor presence, sensor mode, and tire pressure. The BCM sends the tire pressure and tire location data to the driver information center via the serial data circuit where they are displayed.

The sensors continuously compare their last pressure sample to their current pressure sample and will transmit in Learn Mode-Pressure Triggered if a 8.3 kPa (1.2 psi) change in tire pressure has been detected in either a Stationary or Drive state. When the tire pressure monitor system detects a significant loss, or gain of tire pressure, the tire pressure monitor indicator icon is illuminated on the instrument cluster and if equipped, a check tire pressure type message is displayed on the driver information center. Both the indicator icon and driver information center message can be cleared by adjusting the tire pressures to the recommended pressures and driving the vehicle above 40 km/h (25 mph) for at least 2 minutes.

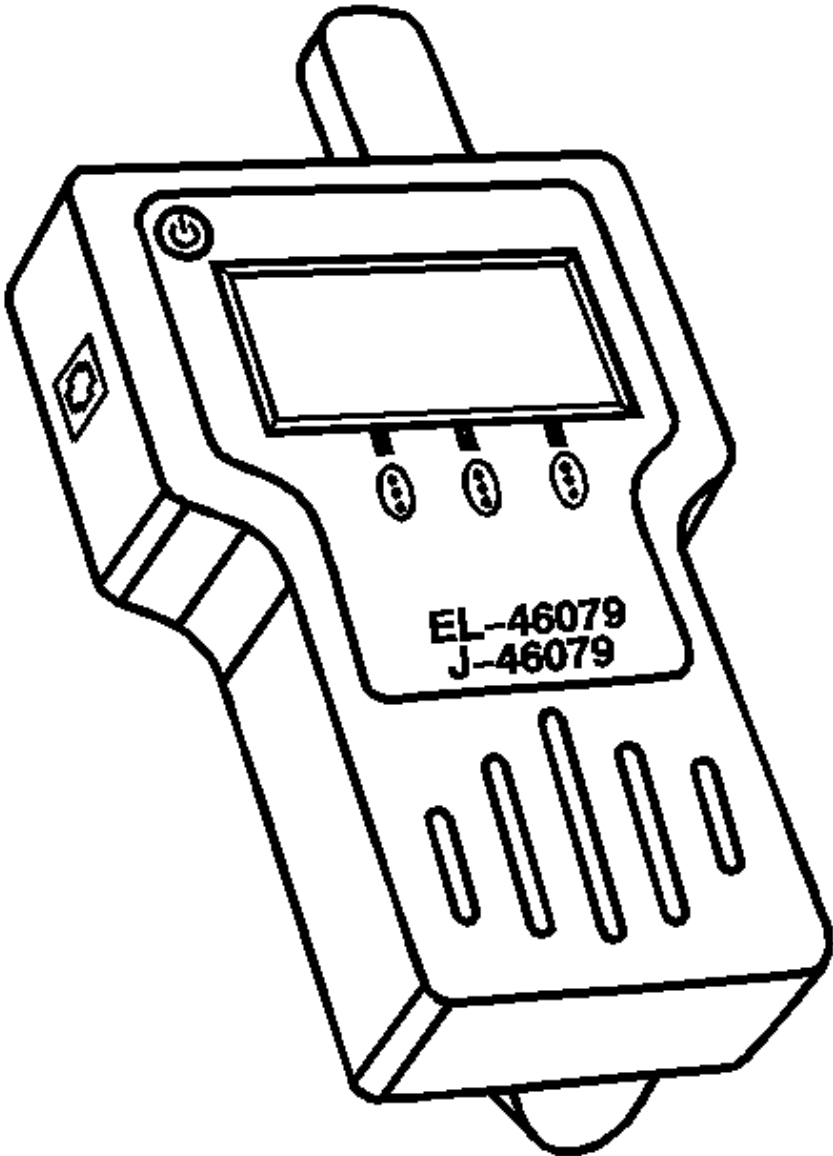
If power is disconnected from the BCM or if the vehicle battery is disconnected, each tire pressure monitor sensor ID is retained but all of the tire pressure information is lost. Under these circumstances the BCM cannot assume that the tire pressures were maintained over an unknown period of time. If equipped, the driver information center will display all dashes and the scan tool will indicate a default tire pressure value of 1020 kPa (148 psi) for each tire. Driving the vehicle above 40 km/h (25 mph) for at least 2 minutes will activate the sensors causing the driver information center to display the current tire pressures. The **EL-46079/J-46079** tire pressure monitor diagnostic tool, **EL-50448** tire pressure monitor sensor activation tool, or equivalent may also be used to activate the sensors as well.

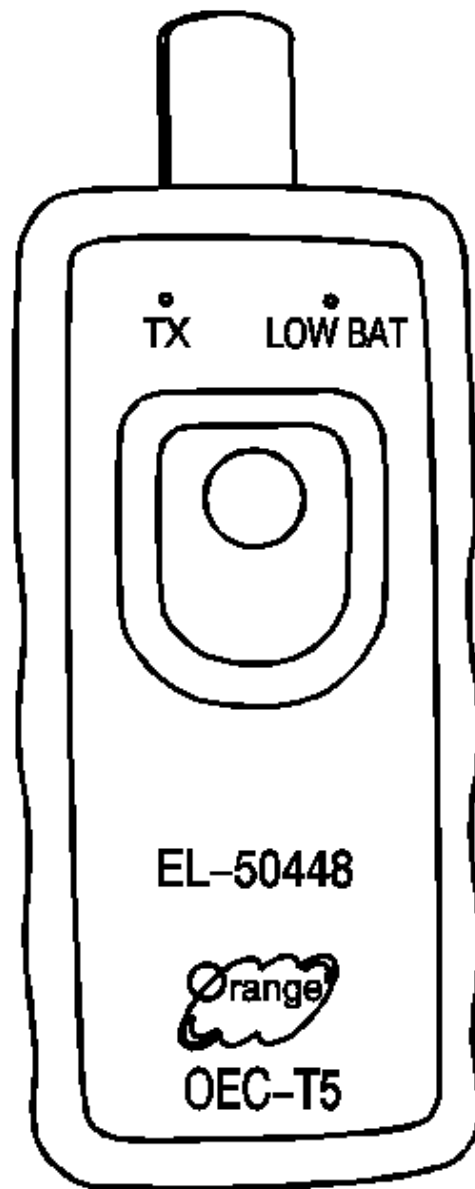
The BCM has the ability to detect malfunctions within the tire pressure monitor system. In the event a DTC is set, the tire pressure monitor indicator icon on the instrument cluster will flash for 1 minute and then remain

illuminated after the ignition is turned ON and the instrument cluster bulb check has been completed. Any malfunction detected will cause the driver information center to display a service tire monitor system type message. For more information on other functions of the BCM, refer to Keyless Entry System Description and Operation .

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Descrip
	EL 46079 Tire Pressure Monitor Diagnos Tool



EL 50448
Tire Pressure
Monitor Senso
Activation Toc

SUSPENSION

Tires and Wheels - Spark

SPECIFICATIONS

TIRE AND WHEEL SPECIFICATIONS

Tire Inflation Pressure Specifications

Market	Wheel	Tire Designation	Recommended Cold Inflation at Max. Load			
			Front		Rear	
			kPa	psi	kPa	psi
Korea	4.5J x 13	155/80R13	220 for Gasoline + MT/AT 230 for LPG + MT/AT	32 for Gasoline + MT/AT 33 for LPG + MT/AT	220 for Gasoline + MT/AT 230 for LPG + MT/AT	32 for Gasoline + MT/AT 33 for LPG + MT/AT
	4.5J x 14	155/70R14				
	5.0J x 15	165/60R15				
Europe	4.5J x 13	155/80R13	220	32	220	32
	4.5J x 14	165/65R14	220	32	220	32
	5.0J x 15	165/60R15	220	32	220	32
General	4.5J x 13	155/80R13	220	32	220	32
	4.5J x 14	155/70R14	220	32	220	32
	4.5J x 14	165/65R14	220	32	220	32
US/Canada	6.0J x 15	185/55R15	275	40	275	40

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Wheel Nuts	140	103 lb ft

DIAGNOSTIC INFORMATION AND PROCEDURES

TIRE DIAGNOSIS - IRREGULAR OR PREMATURE WEAR

Tire Wear



Fig. 1: View Of Tire Diagnosis - Irregular or Premature Wear
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Under-Inflation, Hard Cornering, Lack of Regular Rotation
2	Incorrect Wheel Alignment, Hard Cornering, Lack of Regular Rotation
3	Incorrect Wheel Alignment, Shock Absorber Failure
4	Over-Inflation, Heavy Acceleration, Lack of Regular Rotation
5	Normal Wear to the Wear Indicator

Inspection Procedure

1. Inspect front tire for wear and damage.
2. Inspect rear tire for wear and damage.
3. Rotate the tires if any of the following conditions exist:
 - The amount of time or distance since the last tire rotation matches the maintenance schedule.
 - The outer tread blocks are worn more than the middle tread blocks (1).
 - The outer tread blocks are worn more than the inner tread blocks (2).
 - The middle tread blocks are worn more than the outer tread blocks (4).
4. Measure the wheel alignment if any of the following conditions exist:

- The tread blocks have feathered edges (3).
 - The outer tread blocks are worn more than the inner tread blocks (2).
 - The inner tread blocks are worn more than the outer tread blocks (2).
5. Inspect the struts or the shock absorbers if the tire tread exhibits a cupped appearance (3).

TIRE DIAGNOSIS - WADDLE COMPLAINT

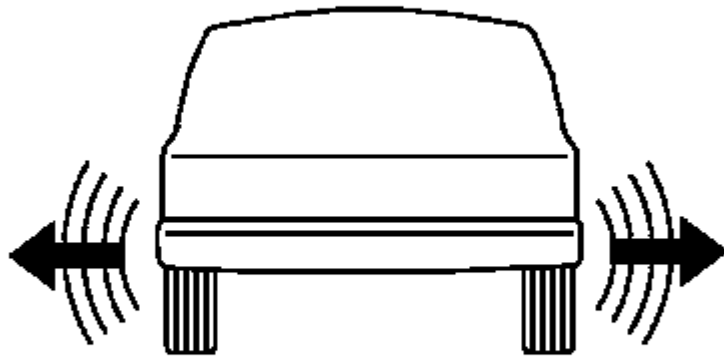


Fig. 2: View Of Tire Diagnosis - Waddle Complaint
Courtesy of GENERAL MOTORS COMPANY

Tire waddle is a side to side movement at the front of the vehicle and/or the rear of the vehicle. Tire waddle can be caused by the following conditions:

- A steel belt not being straight within the tire
- Excessive lateral runout of the tire
- Excessive lateral runout of the wheel

Tire waddle is most noticeable at a low speed of about 8-48 km/h (5-30 mph). Tire waddle may appear as ride roughness at 80-113 km/h (50-70 mph). Tire waddle may appear as a vibration at 80-113 km/h (50-70 mph).

Inspection Procedure

CAUTION: Refer to Lifting and Jacking the Vehicle .

1. Raise and support the vehicle with safety stands.

WARNING: Wear gloves when inspecting the tires in order to prevent personal injury from steel belts sticking through the tire.

2. Perform the following preliminary inspection:
 1. Mark the tire with a crayon in order to note the start and the stop position.
 2. Rotate each tire and wheel by hand.
 3. Inspect the tire for bulges or bent wheels. Replace as necessary.
3. Use a tire substitution in order to identify the faulty tire. Perform the following steps for a tire substitution check:
 1. Use a comparable tire in order to replace each tire, one at a time.
 2. Test drive the vehicle.
 3. If the problem is tire or wheel related, you will eliminate the problem when you remove the faulty tire from the vehicle.

RADIAL TIRE LEAD/PULL CORRECTION

Radial Tire Lead/Pull Correction

Step	Action	Yes	No
DEFINITION: Lead/pull is the deviation of the vehicle from a straight path on a level road with no pressure on the steering wheel.			
1	Did you perform the Vehicle Leads/Pull diagnostic table?	Go to Step 2	Go to <u>Vehicle Leads/Pulls</u>
2	Road test the vehicle to verify the complaint. Select a smooth level surface to perform the test. Does the condition exist?	Go to Step 3	System OK
3	1. Cross-switch the front tire/wheel assemblies. Refer to <u>Tire and Wheel Removal and Installation</u> . 2. Road test the vehicle on a smooth level surface. Does the vehicle still lead/pull?	Go to Step 4	System OK
4	Does the vehicle lead/pull in the opposite direction?	Go to Step 5	Go to <u>Wheel Alignment Measurement</u>
	1. Cross-switch the left front tire/wheel assembly with the left rear tire/wheel		

5	assembly. Refer to <u>Tire and Wheel Removal and Installation</u>. 2. Road test the vehicle on a smooth level surface. Does the vehicle still lead/pull?	Go to Step 6	Go to Step 7
6	1. Cross-switch the right front tire/wheel assembly with the right rear tire/wheel assembly. Refer to <u>Tire and Wheel Removal and Installation</u>. 2. Road test the vehicle on a smooth level surface. Does the vehicle still lead/pull?	Go to <u>Wheel Alignment Measurement</u>	Go to Step 8
7	Replace the left rear tire. Refer to <u>Tire Dismounting and Mounting</u>. Is the repair complete?	Go to Step 9	-
8	Replace the right rear tire. Refer to <u>Tire Dismounting and Mounting</u>. Is the repair complete?	Go to Step 9	-
9	Verify proper vehicle operation. Does the original condition still exist?	Go to Step 1	System OK

REPAIR INSTRUCTIONS

ALUMINUM WHEEL POROSITY REPAIR

1. Remove the tire and wheel. Refer to **Tire and Wheel Removal and Installation**.
2. Inflate the tire to the manufactures specified pressure as stated on the tire.
3. Submerge the tire/wheel into a water bath in order to locate the leak.
4. Inscribe a mark on the wheel in order to indicate the leak areas.
5. Inscribe a mark on the tire at the valve stem in order to indicate the orientation of the tire to the wheel.

NOTE: Do not damage the exterior surface of the wheel.

6. Remove the tire from the wheel. Refer to **Tire Dismounting and Mounting**.
7. Use number 80 grit sandpaper to scuff the inside of the rim surface at the leak area.
8. Use general purpose cleaner to clean the leak area.
9. Apply 3 mm (0.12 in) thick layer of adhesive/sealant to the leak area.
10. Allow for the adhesive/sealant to dry.
11. Align the inscribed mark on the tire with the valve stem on the wheel.
12. Install the tire to the wheel. Refer to **Tire Dismounting and Mounting**.

13. Pressurize the tire to 276 kPa (40 psi).
14. Submerge the tire/wheel into a water bath in order to ensure the leak is sealed.
15. Inflate the tire to the specified pressure as stated on the tire placard.
16. Balance the tire and wheel. Refer to **Tire and Wheel Assembly Balancing - Off Vehicle** .
17. Install the tire and wheel. Refer to **Tire and Wheel Removal and Installation**.

ALUMINUM WHEEL REFINISHING

Finish Damage Evaluation Procedure

NOTE:

- If the wheels are chrome-plated, do not re-plate or refinish the wheels.
- If the wheels are polished aluminum, do not refinish the wheels in the dealer environment. Utilize a refinisher that meets manufacturer guidelines.

1. Inspect the wheels for damage from uncoated wheel balance weights or from automatic car wash facilities.
2. Inspect the wheels for the following conditions:
 - Corrosion
 - Scrapes
 - Gouges
3. Verify the damage is not deeper than what sanding can remove.
4. Inspect the wheels for cracks. If a wheel has cracks, discard the wheel.
5. Inspect the wheels for bent rim flanges. If a rim flange is bent, discard the wheel.

Refinishing Procedure

WARNING: To avoid serious personal injury when applying any two part component paint system, follow the specific precautions provided by the paint manufacturer. Failure to follow these precautions may cause lung irritation and allergic respiratory reaction.

1. Remove the tire and wheel assembly from the vehicle. Refer to **Tire and Wheel Removal and Installation**.
2. Remove the balance weights from the wheel.
3. Remove the tire from the wheel. Refer to **Tire Dismounting and Mounting**.

NOTE:

- Do not re-machine the wheel.
- Do not use chemicals in order to strip the paint from the wheel.

4. Use a suitable cleaner in order to remove the following contaminants from the wheel:

- Lubricants
 - Wax
 - Dirt
5. Use plastic media blasting in order to remove the paint from the wheel.
 6. If the wheel had a machined aluminum finish, spin the wheel and use sand paper in order to restore the circular machined appearance.

NOTE: The wheel mounting surface and the wheel nut contact surface must remain free of paint.

7. Mask the wheel mounting surface and the wheel nut contact surface.
8. Follow the paint manufacturer instructions for painting the wheel.
9. Install a new valve stem.

NOTE: Use new coated balance weights in order to balance the wheel.

10. Install the tire to the wheel. Refer to **Tire Dismounting and Mounting**.
11. Use a suitable cleaner in order to remove the following contaminants from the wheel mounting surface:
 - Corrosion
 - Overspray
 - Dirt
12. Install the tire and wheel assembly to the vehicle. Refer to **Tire and Wheel Removal and Installation**.

TIRE AND WHEEL REMOVAL AND INSTALLATION

Removal Procedure

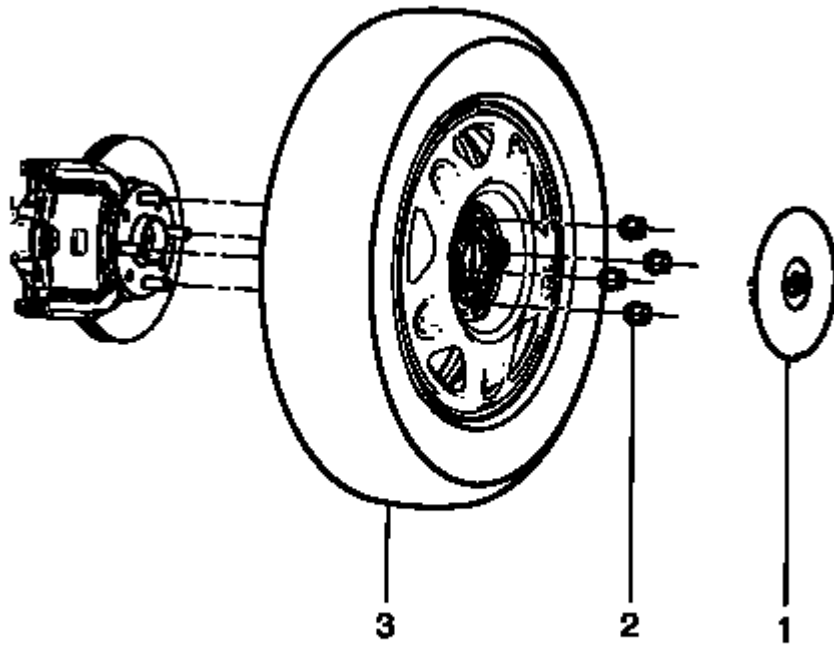


Fig. 3: View Of Wheel Cap And Wheel Nuts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Lifting and Jacking the Vehicle .

1. Raise and support the vehicle.
2. Remove the wheel cap (1), if equipped.
3. Mark the wheel in relation to the wheel hub flange.
4. Remove the wheel nuts (2).

WARNING: If penetrating oil gets on the vertical surfaces between the wheel and the rotor or drum it could cause the wheel to work loose as the vehicle is driven, resulting in loss of control and an injury accident.

CAUTION: Removing the wheel may be difficult because of foreign materials or a tight fit between the wheel and the hub/rotor. Slightly tap the tire side wall with a rubber mallet in order to remove the wheel. Failure to follow these instructions may result in damage to the wheel.

5. Remove the tire and wheel assembly (3) from the vehicle. If the tire and wheel assembly is difficult to

remove, perform the following steps:

1. Install and tighten all wheel nuts on the affected wheel.
2. Loosen each wheel nut two turns.
3. Lower the vehicle to the ground.
4. Rock the vehicle from side to side.

CAUTION: Refer to Lifting and Jacking the Vehicle .

5. Raise and support the vehicle.
6. Remove the wheel nuts.
7. Remove the tire and wheel assembly.

Installation Procedure

WARNING: Before installing the wheels, remove any buildup of corrosion on the wheel mounting surface and brake drum or disc mounting surface by scraping and wire brushing. Installing wheels with poor metal-to-metal contact at the mounting surfaces can cause wheel fasteners to loosen. This can cause a wheel to come off when the vehicle is moving, causing loss of control and possibly personal injury.

NOTE: Wheel nuts, studs and mounting surfaces must be clean and dry.

1. Remove any corrosion or foreign material from the wheel and the hub mounting surfaces.
2. Clean the threads on the wheel studs and wheel nuts.

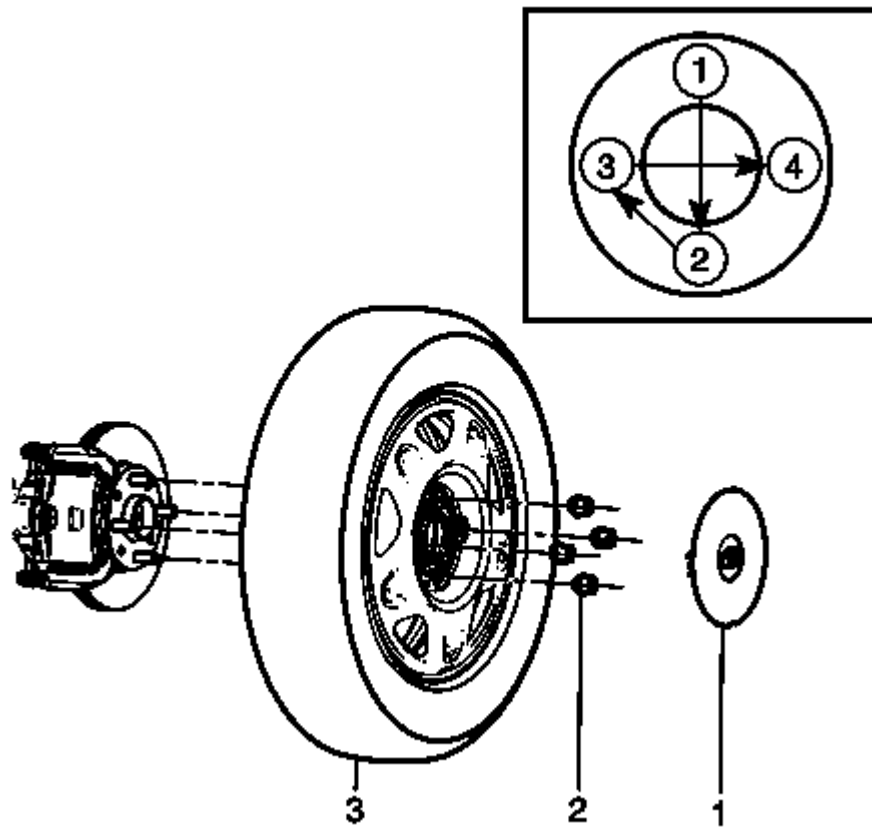


Fig. 4: Tire And Wheel Assembly
Courtesy of GENERAL MOTORS COMPANY

3. Install the tire and wheel assembly (3). Align the locating mark of the wheel to the hub.

CAUTION: Refer to Fastener Caution .

NOTE: Tighten the nuts evenly and alternatively in the sequence shown, in order to avoid excessive runout.

4. Install the wheel nuts (2) and tighten in sequence shown to 140 (103 lb ft).
5. Install the wheel cap (1), if equipped.
6. Lower the vehicle to the ground.

TIRE DISMOUNTING AND MOUNTING

CAUTION: Use a tire changing machine in order to dismount tires. Do not use hand tools or tire irons alone in order to remove the tire from the wheel. Damage to the tire beads or the wheel rim could result.

CAUTION: Do not scratch or damage the clear coating on aluminum wheels with the tire changing equipment. Scratching the clear coating could cause the aluminum wheel to corrode and the clear coating to peel from the wheel.

CAUTION: Damage to either the tire bead or the wheel mounting holes can result from the use of improper wheel attachment or tire mounting procedures. It takes up to 70 seconds for all of the air to completely exhaust from a large tire. Failure to follow the proper procedures could cause the tire changer to put enough force on the tire to bend the wheel at the mounting surface. Such damage may result in vibration and/or shimmy and under severe usage lead to wheel cracking.

1. Deflate the tire completely.
2. Use the tire changer in order to remove the tire from the wheel.
3. Use a wire brush or coarse steel wool in order to remove any rubber, light rust or corrosion from the wheel bead seats.

CAUTION: When mounting the tires, use an approved tire mounting lubricant. **DO NOT** use silicon or corrosive base compounds to lubricate the tire bead and the wheel rim. A silicon base compound can cause the tire to slip on the rim. A corrosive type compound can cause tire or rim deterioration.

4. Apply an approved lubricant to the tire bead and the wheel trim.
5. Use the tire changer in order to install the tire to the wheel.

WARNING: To avoid serious personal injury, do not stand over tire when inflating. The bead may break when the bead snaps over the safety hump. Do not exceed 275 kPa (40 psi) pressure when inflating any tire if beads are not seated. If 275 kPa (40 psi) pressure will not seat the beads, deflate, relubricate the beads and reinflate. Overinflation may cause the bead to break and cause serious personal injury.

6. Inflate the tire to the proper air pressure.
7. Ensure that the locating rings are visible on both sides of the tire in order to verify that the tire bead is fully seated on the wheel.

TIRE ROTATION

Rotate the tire and wheel assemblies at frequent intervals to equalize wear. Refer to the Maintenance Schedule in the Owner's Manual. In addition to scheduled rotation, rotate the tire and wheel assembly whenever uneven tire wear is noticed.

Radial tires tend to wear faster in the shoulder area, particularly in front positions. Radial tires in non-drive locations may develop an irregular wear pattern that may increase tire noise. This makes regular rotation

especially necessary.

1. Remove the tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation.**

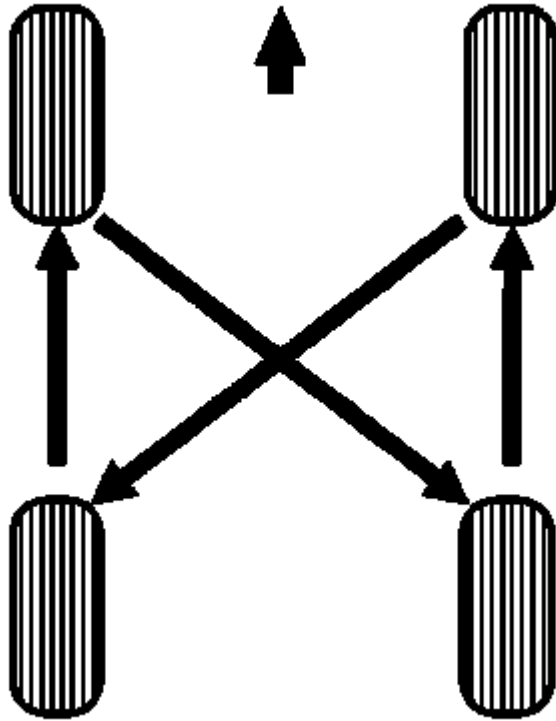


Fig. 5: Tire And Wheel Assemblies
Courtesy of GENERAL MOTORS COMPANY

2. Rotate the tire and wheel assemblies as shown in the above diagram.
3. Install the tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation.**
4. Check the tire inflation pressure and adjust to the tire inflation specifications as necessary.

DESCRIPTION AND OPERATION

P-METRIC SIZED TIRES DESCRIPTION

The tire sidewall has a coded marking system, which provides information about the tire.

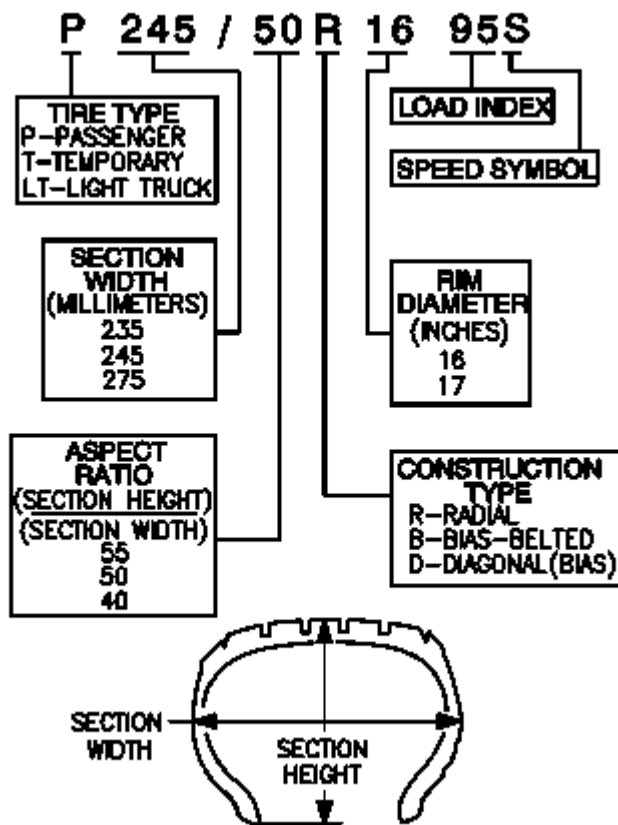


Fig. 6: Identifying P-Metric Sized Tires Description
Courtesy of GENERAL MOTORS COMPANY

Tire Marking Example:		
P 245 50 R 16 95 S		
P	Passenger Vehicle Designation	
245	Section Width in mm (245 mm)	
50	Aspect Ratio% (Section Height to Section Width) (50= 50%)	
R	Tire Construction (R= Radial)	
16	Rim Diameter in inches (16= 16")	
95	Max Load Index	91= 615 kg
		92= 630 kg
		93= 650 kg
		94= 670 kg
		95= 690 kg
		96= 710 kg

S	Speed Rating	97= 730 kg
		99= 775 kg
		104= 900 kg
		106= 950 kg
		R = 170 km/h
		S = 180 km/h
		H = 210 km/h
		V = 240 km/h
		W = 270 km/h

Most P-metric tire sizes do not have exact corresponding alphanumeric tire sizes. Replacement tires should be of the same tire performance criteria TPC specification number including the same size, the same load range and the same construction as those originally installed on the vehicle.

Consult a tire dealer if you must replace the P-metric tire with other sizes. Tire companies can best recommend the closest match of alphanumeric to P-metric sizes within their own tire lines.

The above illustration may not correspond with your vehicle, but is meant as an example.

REPLACEMENT WHEELS DESCRIPTION

Replace the wheel if any of the following conditions exist:

- The wheel exhibits excessive runout.
- The wheel is bent.
- The wheel is cracked.
- The wheel is severely rusted.
- The wheel is severely corroded.

NOTE: Air leaks caused by porosity on aluminum wheels are repairable.

- The wheel leaks air.

WARNING: If you are replacing the wheel(s), the wheel stud(s), the wheel nut(s) or the wheel bolt(s), install only new GM original equipment parts. Installation of used parts or non-GM original equipment parts may cause the wheel to loosen, loss of tire air pressure, poor vehicle handling and loss of vehicle control resulting in personal injury.

CAUTION: The use of non-GM original equipment wheels may cause:

- Damage to the wheel bearing, the wheel fasteners and the wheel
- Tire damage caused by the modified clearance to the adjacent

vehicle components

- **Adverse vehicle steering stability caused by the modified scrub radius**
- **Damage to the vehicle caused by the modified ground clearance**
- **Speedometer and odometer inaccuracy**

Replace the wheel, the wheel studs and the wheel nuts, if any of the following conditions exist:

- The wheel has elongated wheel stud holes.
- The wheel nuts loosen repeatedly.

STEEL WHEEL REPAIR DESCRIPTION

CAUTION: Do not heat wheels in an attempt to soften them for straightening or repair damage from striking curbs, etc. Do not weld wheels. The alloy used in these wheels is heat-treated and uncontrolled heating from welding affects the properties of the material.

CAUTION: The use of tubes in tubeless tires is not a recommended repair due to the fact that speed ratings are greatly reduced.

If leaks are found in a steel wheel, replace the wheel with a wheel of original equipment quality.

TIRE INFLATION DESCRIPTION

This vehicle has been engineered to operate up to the stated load capacity with wheel and tire assemblies of the type, size, construction and configuration as originally installed. Maintenance of the tire inflation pressures is critical to the continued satisfactory performance, handling and operating economy of the vehicle.

Operating the vehicle with improperly inflated tires can adversely affect vehicle performance and may contribute to the following:

- Reduced fuel economy
- Tire overloading
- Shortened tire life
- Excessive tire wear
- Uneven tire wear
- Vehicle handling concerns

Inspect the tire pressures when the vehicle has not been driven for at least 3 hours or not more than 1.6 km (1 mi) and when the tires are cool to the touch.

Tire inflation pressures should be inspected monthly and before an extended trip and adjusted to meet the specifications listed for the particular vehicle. Replace any missing or damaged tire valve stem extensions

and/or caps to prevent the intrusion of water and contaminants.

One pound per square inch (psi) equals 6.9 kilopascals (kPa). The following table illustrates the conversion of kilopascals to pounds per square inch:

Inflation Pressure Conversion (Kilopascals to PSI)

kPa	psi	kPa	psi
140	20	215	31
145	21	220	32
155	22	230	33
160	23	235	34
165	24	240	35
170	25	250	36
180	26	275	40
185	27	310	45
190	28	345	50
200	29	380	55
205	30	415	60
Conversion: 6.9 kPa = 1 psi			

For the correct inflation pressures refer to the vehicle Tire Placard.

Tires inflated to a higher than recommended pressure can contribute to the following conditions:

- A hard ride
- Tire bruising
- Rapid tread wear at the center of the tire

Tires inflated to a lower than recommended pressure can contribute to the following conditions:

- Tire squeal on turns
- Hard steering
- Rapid and/or uneven wear on the outer edges of the tread
- Tire rim bruises and tire rim rupture
- Tire cord breakage
- High tire temperatures
- Sluggish vehicle handling
- Higher fuel consumption

Unequal pressure on the same axle can cause the following conditions:

- Uneven braking action
- Steering lead

- Imprecise vehicle handling

TIRES AND WHEELS DESCRIPTION AND OPERATION

The factory installed tires are designed to operate satisfactorily with loads up to and including the full rated load capacity when these tires are inflated to the recommended pressures.

The following factors have an important influence on tire life:

- Correct tire pressures
- Correct wheel alignment
- Proper driving techniques
- Tire rotation

The following factors increase tire wear:

- Heavy cornering
- Excessively rapid acceleration
- Heavy braking

TRANSMISSION

Transmission Cooling - Spark

DIAGNOSTIC INFORMATION AND PROCEDURES

TRANSMISSION FLUID COOLER FLUSHING AND FLOW TEST (JATCO CVT)

GM studies indicate that plugged or restricted transmission oil coolers and pipes cause insufficient transmission lubrication and elevated operating temperatures which can lead to premature transmission failure. Many repeat repair cases could have been prevented by following published procedures for transmission oil cooler flushing and flow checking. This procedure includes flow checking and flushing the auxiliary transmission oil cooler, if equipped.

NOTE: Use the DT-45096 flush and flow test tool or equivalent to flush and flow test the transmission oil cooler and the oil cooler pipes after the transaxle is repaired.

Only the appropriate GM transmission fluid should be used when doing a repair on a GM transmission.

Time allowance for performing the cooler flow checking and flushing procedure has been included in the appropriate labor time guide operations since the 1987 model year. The service procedure steps for oil cooler flushing and flow testing are as follows:

Cooler Flow Check and Flushing Steps

1. Machine Set-up
2. Determine Minimum Flow Rate
3. Back Flush
4. Forward Flush
5. Flow Test
6. Code Recording Procedure
7. Clean-up

For equivalent regional tools, refer to **Special Tools**.

Special Tools

- **DT-45096** Transmission Oil Cooling System Flush and Flow Test Tool
- **DT-45096-50** Transmission Cooler Flush Adapter
- Shop air supply with water/oil filters, regulator and pressure gauge - minimum 90 psi
- Eye protection
- Rubber gloves

Machine Set-Up

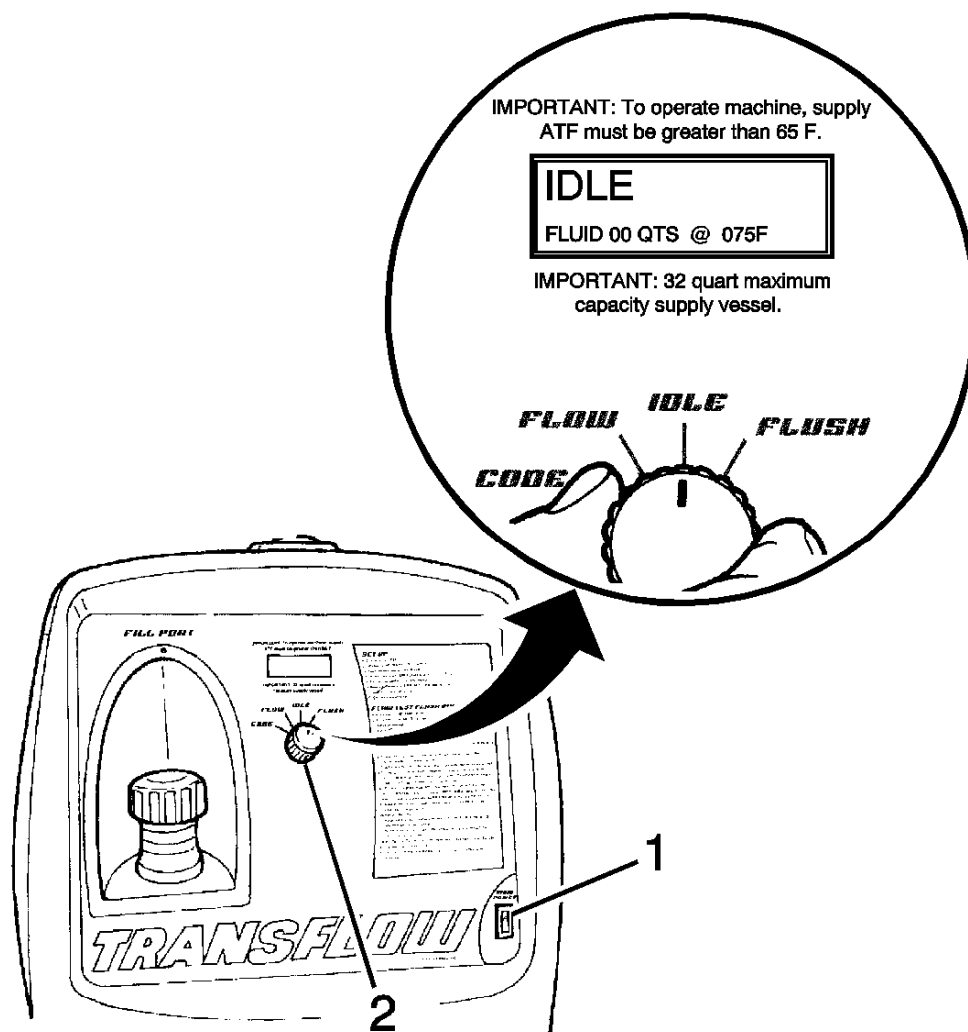


Fig. 1: View Of Main Power Switch & Main Function Switch
Courtesy of GENERAL MOTORS COMPANY

1. Verify that the main power switch (1) is in the OFF position.
2. Place the main function switch (2) in the IDLE position.

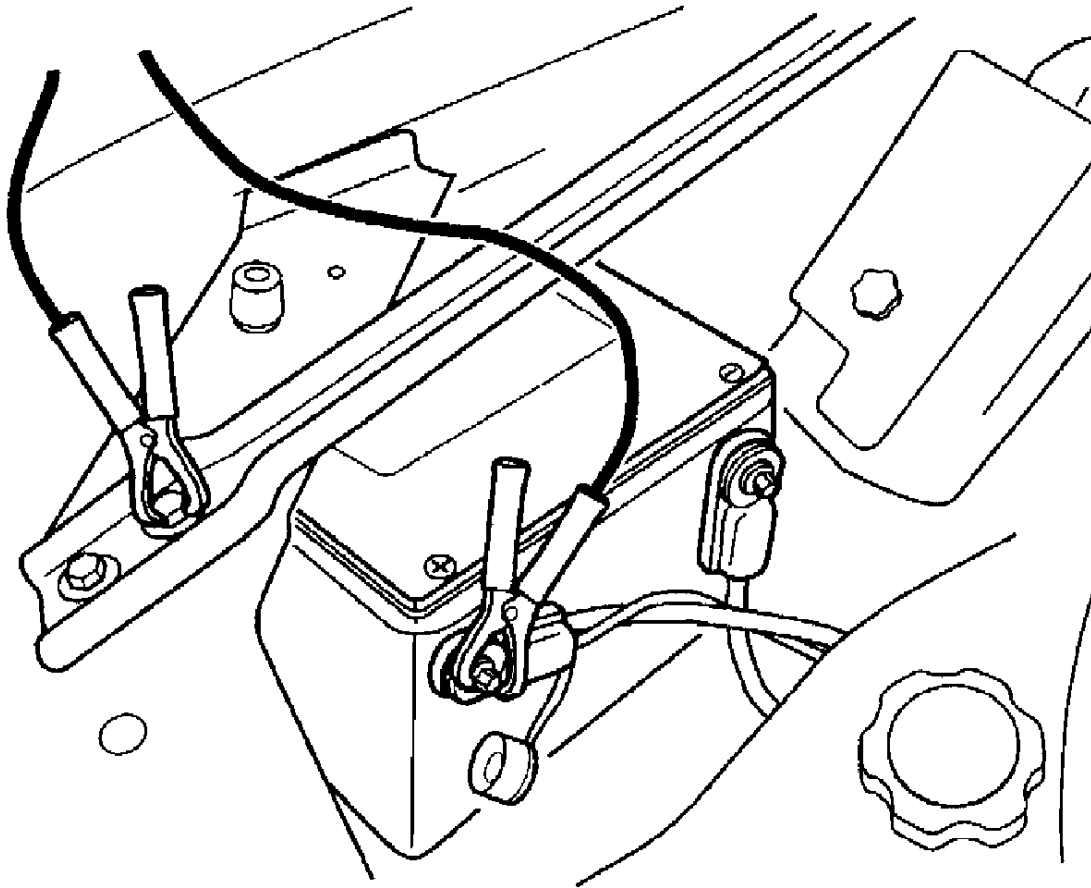


Fig. 2: Connecting To 12V DC Power Source
Courtesy of GENERAL MOTORS COMPANY

3. Connect **DT-45096** flush and flow test tool to the vehicle 12V DC power source by connecting the red battery clip to the positive, +, battery post on the vehicle and connect the negative lead to a known good chassis ground.
4. Turn the main power switch to the ON position.

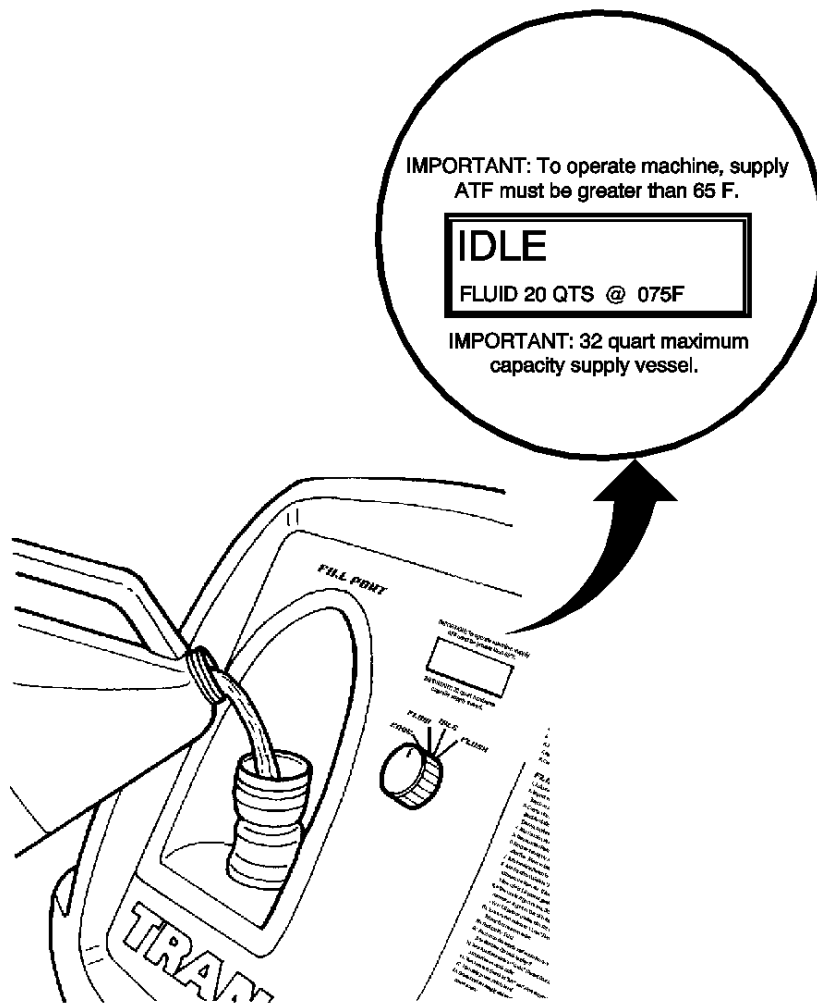


Fig. 3: Filling Supply Tank With Transmission Fluid
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Do not overfill the supply vessel. Damage to the unit may result. To verify the fluid level, view the LCD screen display while filling the unit, to ensure the fluid level does not exceed 30 L (32 qt).

5. Fill the supply tank with Dexron®VI through the fill port.
6. Reinstall and tighten the fill cap.

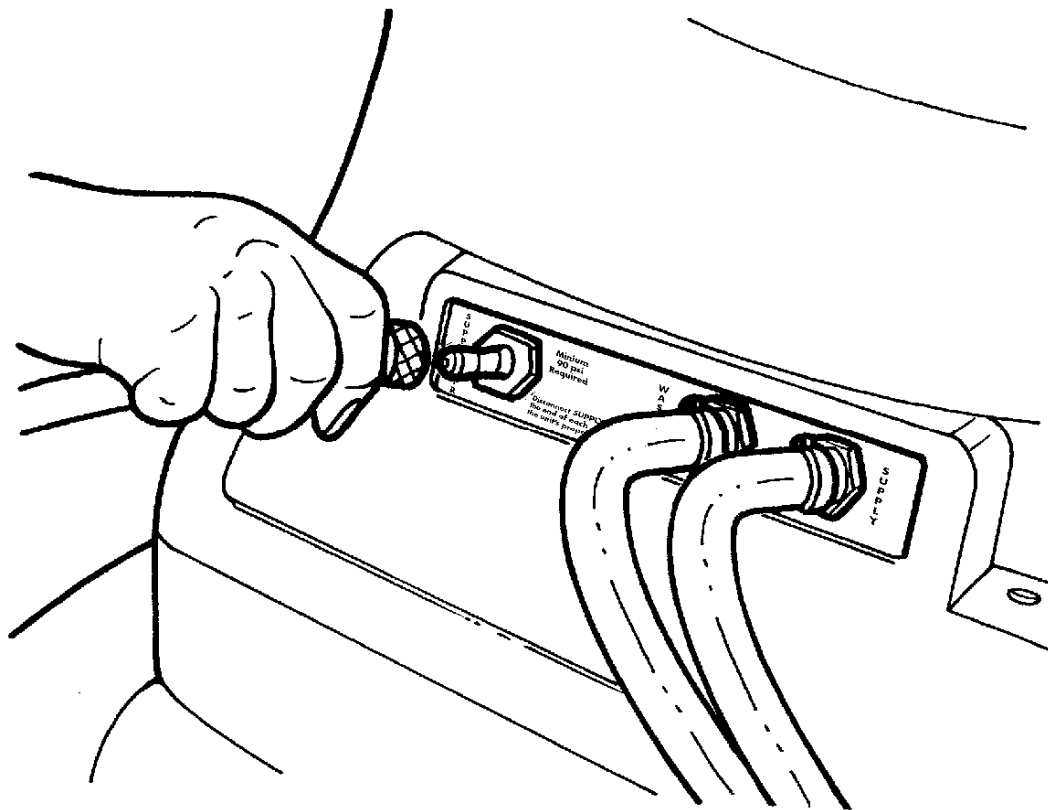


Fig. 4: Applying Shop Air Supply Hose To Quick-Disconnect
Courtesy of GENERAL MOTORS COMPANY

7. Connect a shop air supply hose to the quick-disconnect on the rear panel marked SUPPLY AIR.

Determine Minimum Flow Rate

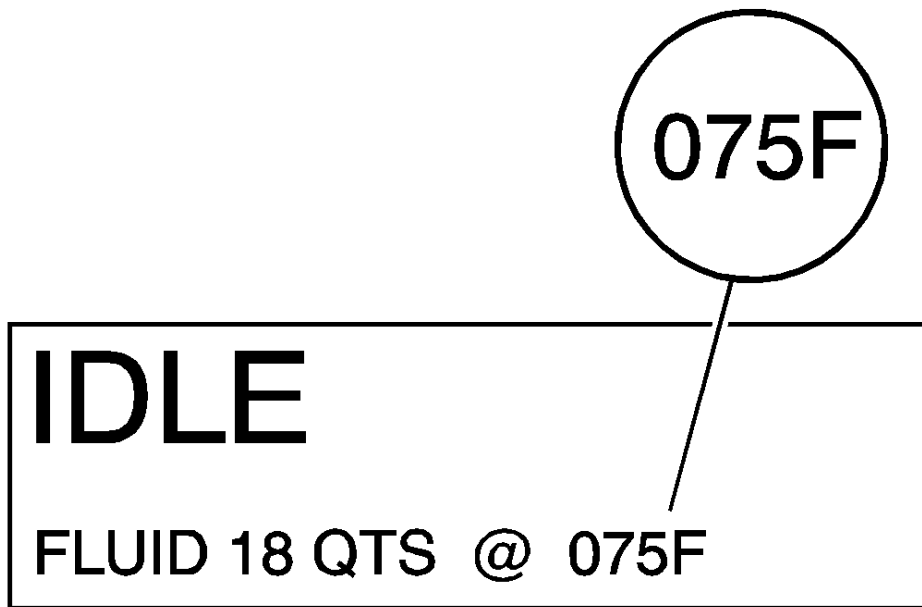


Fig. 5: Identifying Machine Display Of Automatic Transmission Fluid Temperature
Courtesy of GENERAL MOTORS COMPANY

1. From the machine display, identify the temperature of the automatic transmission fluid that is stored in the supply vessel of **DT-45096** flush and flow test tool.

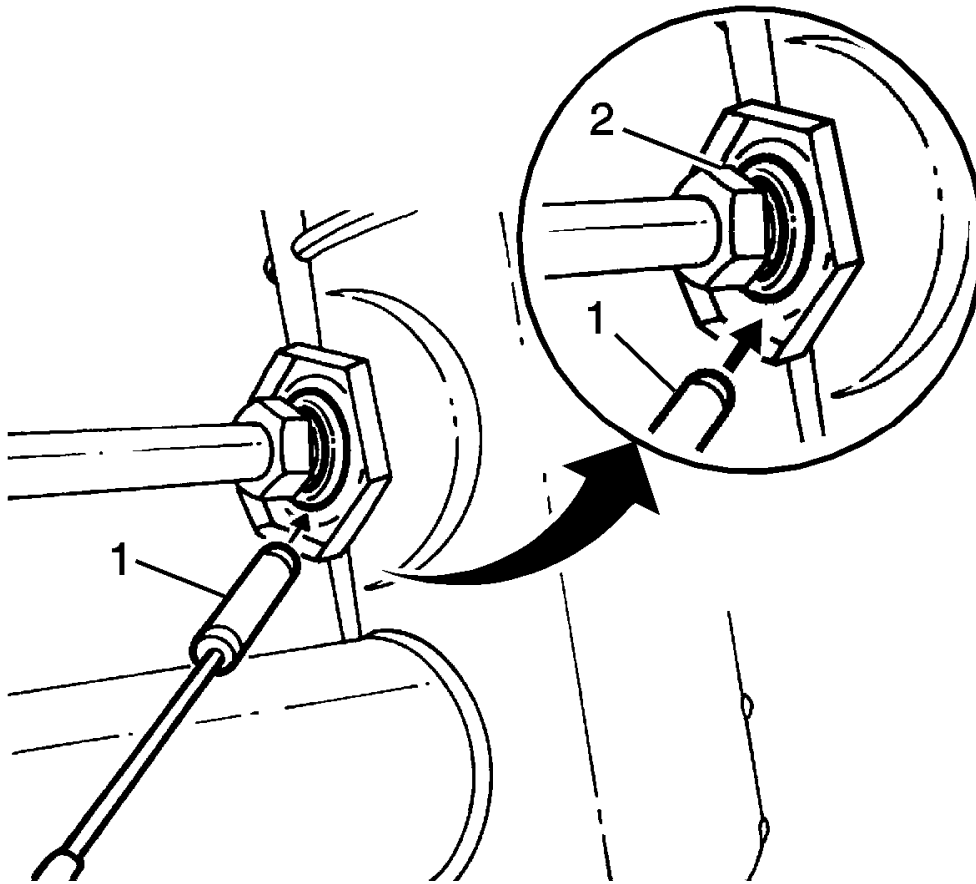


Fig. 6: Identifying Transmission Oil Cooler Metal Composition
 Courtesy of GENERAL MOTORS COMPANY

2. Determine whether the transmission oil cooler is steel or aluminum by using a magnet (1) at the cooler flange (2) at the radiator.
3. Refer to the table below. Using the temperature from step 1, locate on either the Steel MINIMUM Flow Rate table or the Aluminum MINIMUM Flow Rate table the minimum flow rate in gallons per minutes (GPM). Record the minimum flow rate in GPMs and the supply fluid temperature for further reference.
 - Fluid temperature: 75°F
 - Cooler type: Steel

The MINIMUM flow rate for this example would be 0.8 GPM.

4. Inspect transmission oil cooler lines for damage or kinks that could cause restricted oil flow. Repair as needed and refer to the appropriate GM service manual procedures.

Minimum Flow Rate in Gallons Per Minute (gpm)

Temperature Range	Steel	Aluminum
-------------------	-------	----------

65-66°F	0.6 gpm	0.5 gpm
67-70°F	0.7 gpm	0.6 gpm
71-75°F	0.8 gpm	0.7 gpm
76-80°F	0.9 gpm	0.8 gpm
81-84°F	1.0 gpm	0.9 gpm
85-89°F	1.1 gpm	1.0 gpm
90-94°F	1.2 gpm	1.1 gpm
95-98°F	1.3 gpm	1.2 gpm
99-103°F	1.4 gpm	1.3 gpm
104-108°F	1.5 gpm	1.4 gpm
109-112°F	1.6 gpm	1.5 gpm
113-117°F	1.7 gpm	1.6 gpm
118-120°F	1.8 gpm	1.7 gpm

Back Flush Procedure

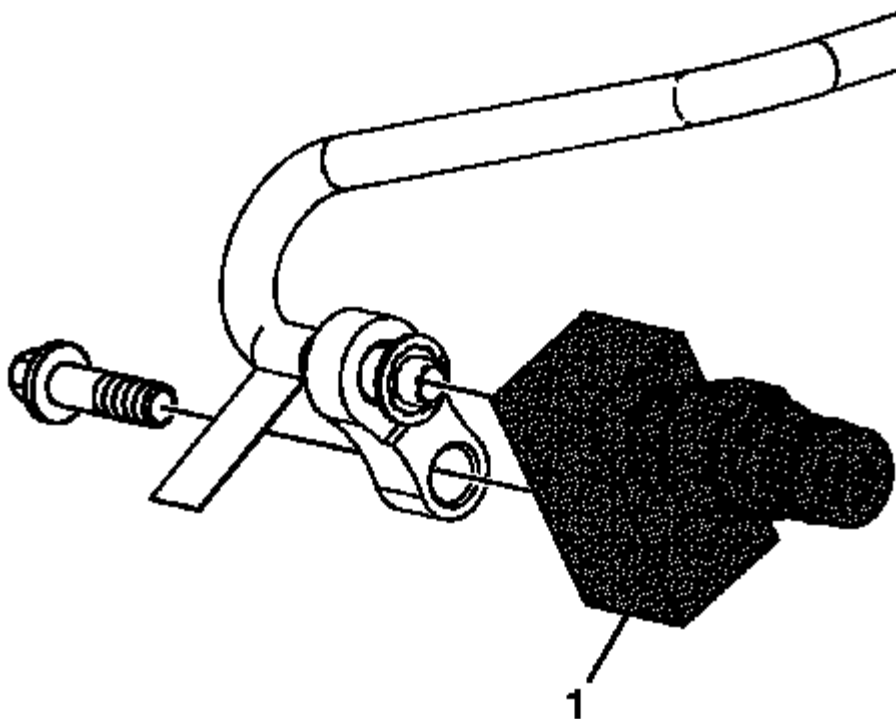


Fig. 7: Identifying Special Tool - J 45096-50
Courtesy of GENERAL MOTORS COMPANY

1. Connect the **DT-45096-50** cooler flush adapter (1) to the vehicle transmission oil cooler supply and return

lines at the transmission.

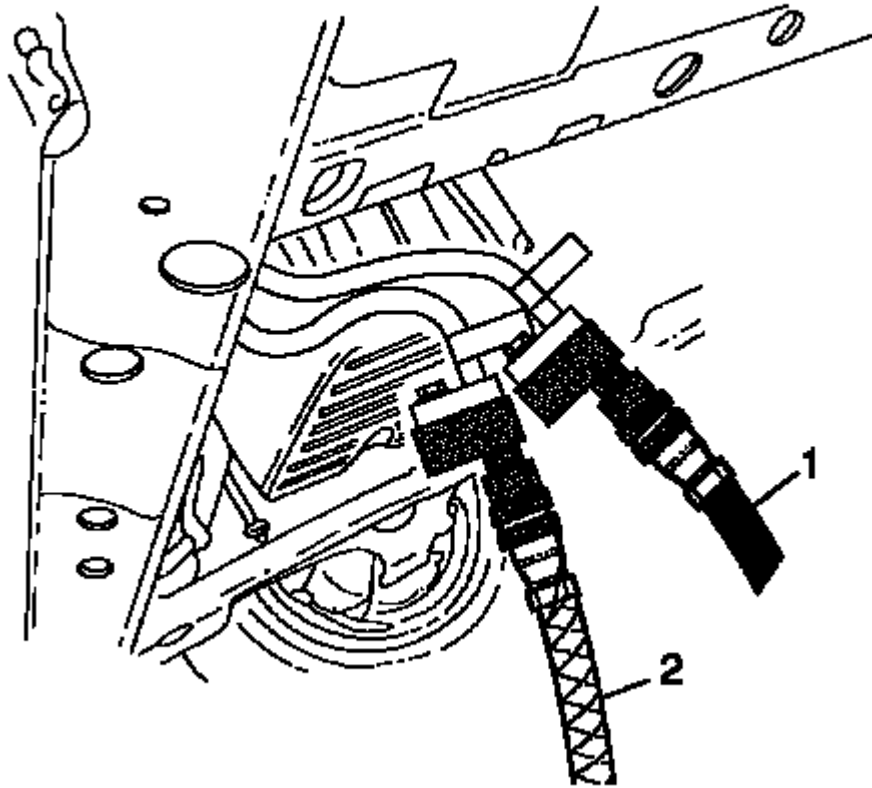


Fig. 8: View Of Black Supply Hose And Clear Waste Hose
Courtesy of GENERAL MOTORS COMPANY

2. Connect the black supply hose (1) to the return line, top connector of the transmission, and the clear waste hose (2) to the feed line, bottom connector of the transmission, to the vehicle cooler lines. This is the reverse flow - backflush direction.

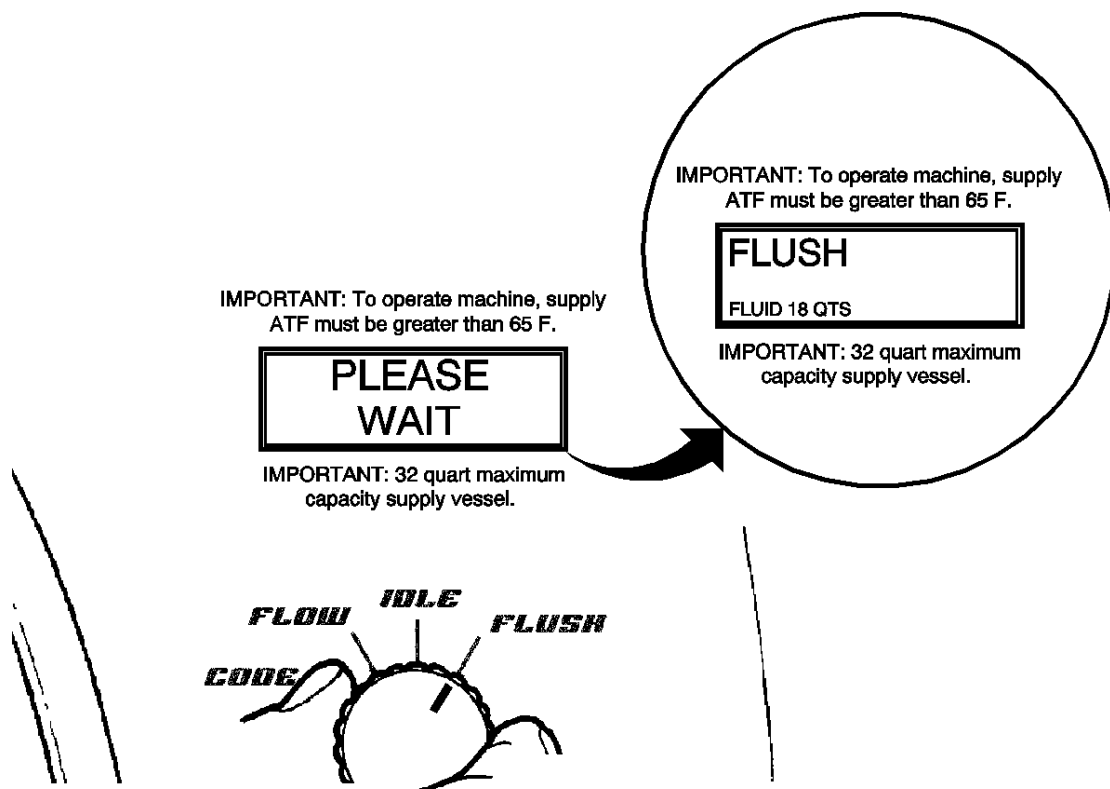


Fig. 9: View Of Main Function Switch FLUSH Position
Courtesy of GENERAL MOTORS COMPANY

3. Turn the main function switch to the FLUSH position. Allow the machine to operate for 30 seconds.

IMPORTANT: To operate machine, supply
ATF must be greater than 65 F.

IDLE

FLUID 16 QTS @ 075F

IMPORTANT: 32 quart maximum
capacity supply vessel.

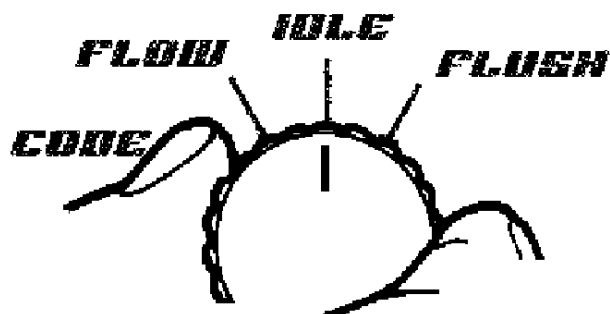


Fig. 10: View Of Main Function Switch IDLE Position
Courtesy of GENERAL MOTORS COMPANY

4. Turn the main function switch to the IDLE position and allow the supply vessel pressure to dissipate.

Forward Flush

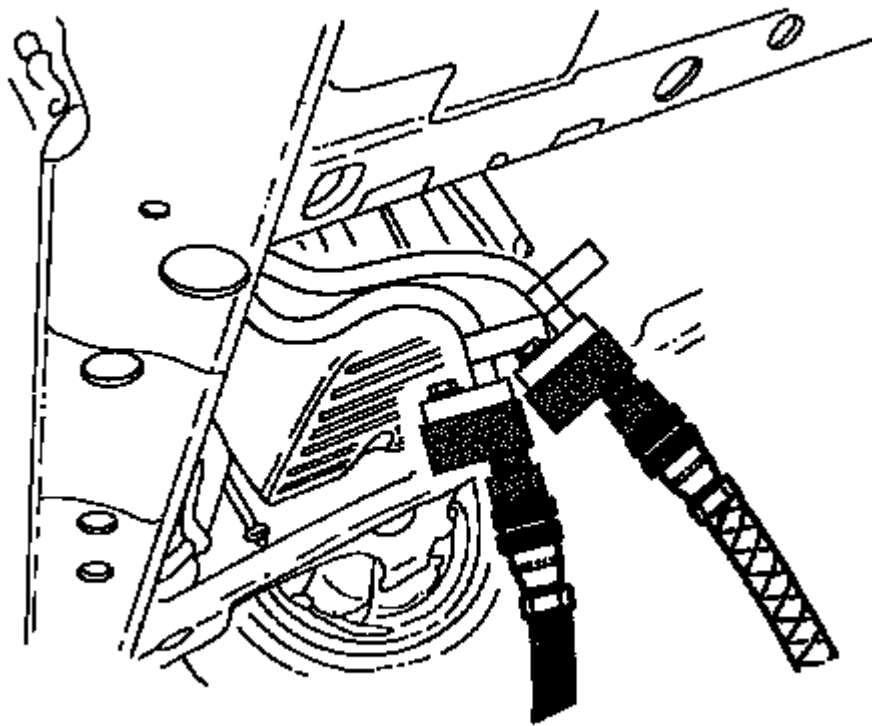


Fig. 11: Identifying Supply And Waste Hoses
Courtesy of GENERAL MOTORS COMPANY

1. Disconnect the supply and waste hoses from the vehicle cooler lines. Reverse the supply and waste hoses to provide a normal flow direction.

IMPORTANT: To operate machine, supply
ATF must be greater than 65 F.

FLUSH

FLUID 18 QTS

IMPORTANT: 32 quart maximum
capacity supply vessel.

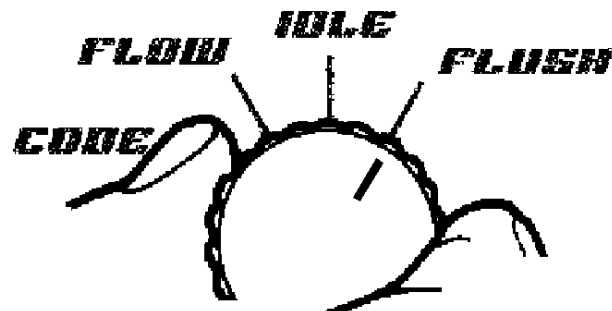


Fig. 12: View Of Main Function Switch FLUSH Position
Courtesy of GENERAL MOTORS COMPANY

2. Turn the main function switch to the FLUSH position and allow machine to operate for 30 seconds.

Flow Test

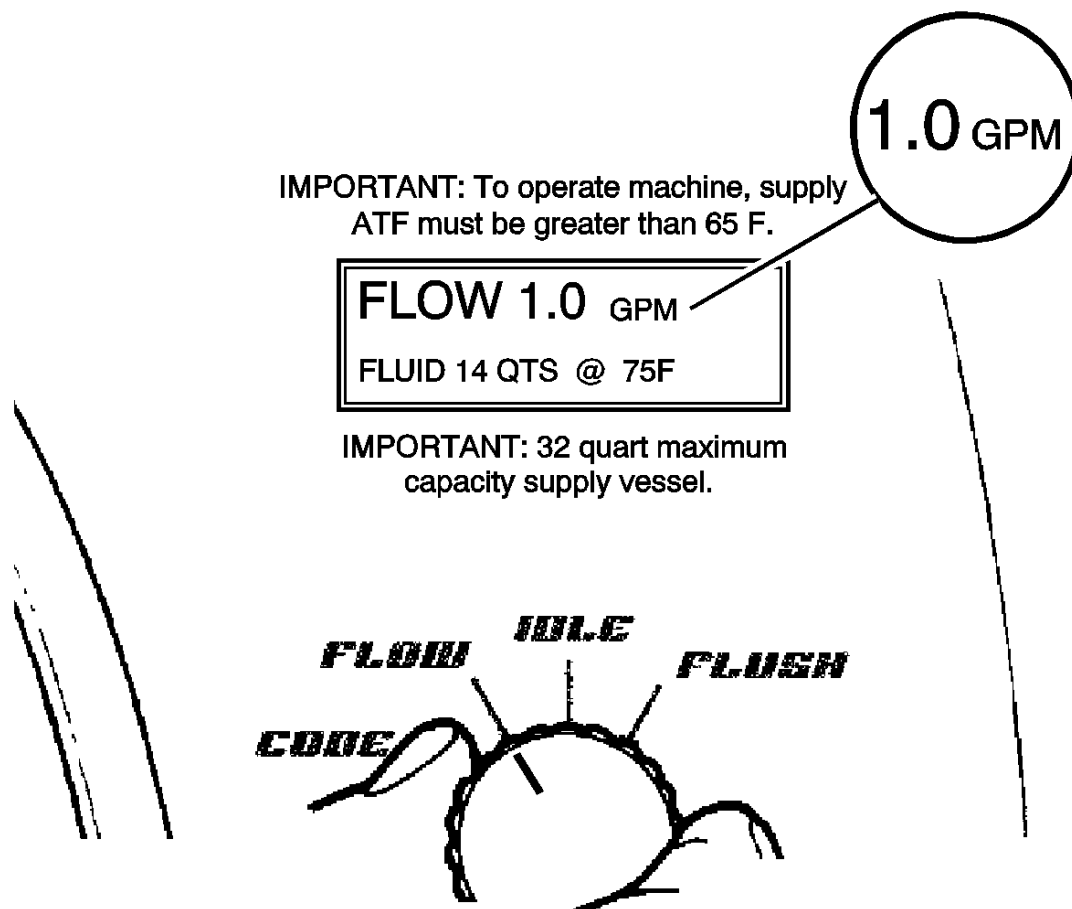


Fig. 13: View Of Main Function Switch FLOW Position
Courtesy of GENERAL MOTORS COMPANY

NOTE: If the flow rate is less than 0.5 gpm, the LCD displays an error message. Refer to the Troubleshooting section of the operation manual.

1. Turn the main function switch to the FLOW position and allow the oil to flow for 15 seconds. Observe and note the flow rate; this is the TESTED flow rate.
2. Compare the TESTED flow rate to the MINIMUM flow rate information previously recorded.
 - If the TESTED flow rate is equal to or greater than the MINIMUM flow rate recorded, the oil cooling system is functioning properly. Perform Code Recording Procedure.
 - If the TESTED flow rate is less than the MINIMUM flow rate previously recorded, repeat the back flush and forward flush procedures.
3. If the TESTED flow rate is less than the MINIMUM flow rate after the second test, perform Code Recording Procedure.

1. Replace the transmission oil cooler.
2. Reconnect supply and waste hoses to the cooler lines in the normal flow direction. Perform Flow Test.
3. Perform Code Recording Procedure.

Code Recording Procedure

IMPORTANT: To operate machine, supply
ATF must be greater than 65 F.

FLOW 1.0 @ 75F CYCLE 6
A10DFB2

IMPORTANT: 32 quart maximum
capacity supply vessel.

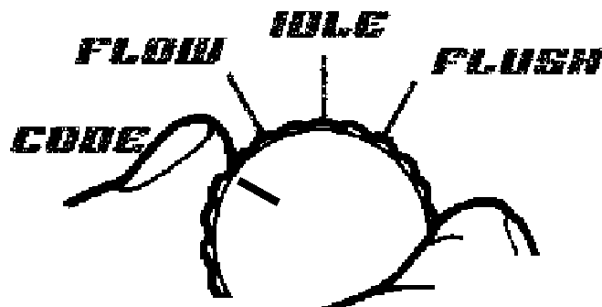


Fig. 14: View Of Main Function Switch CODE Position
Courtesy of GENERAL MOTORS COMPANY

1. Turn the main function switch to the CODE position.

NOTE:

- If power is interrupted prior to the recording of the seven-character code, the code will be lost and the flow rate test will need to be repeated.

- The flow test must run for a minimum of 8-10 seconds and be above 0.5 GPM for a code to be generated.

2. Record TESTED flow rate, temperature, cycle and seven-character flow code information on repair order.

Clean-Up

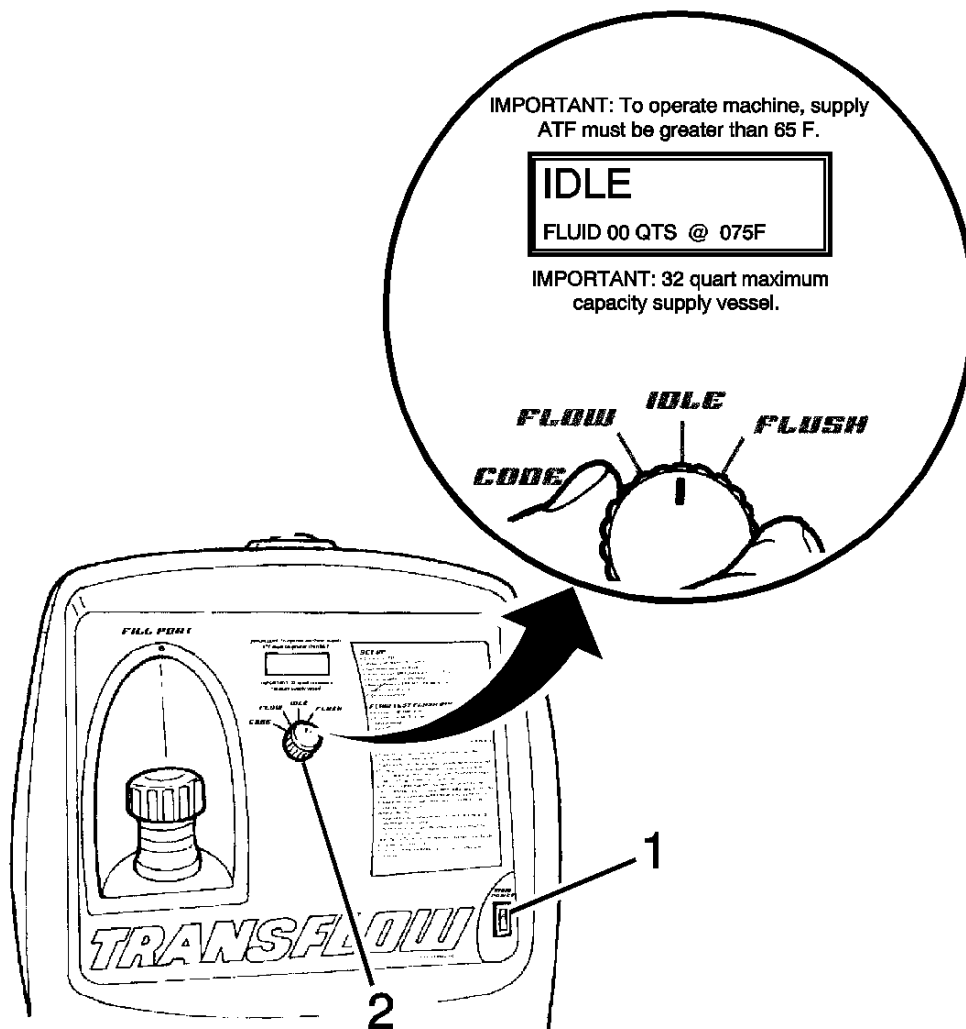


Fig. 15: View Of Main Power Switch & Main Function Switch
Courtesy of GENERAL MOTORS COMPANY

1. Turn the main function switch (2) to the IDLE position and allow the supply vessel pressure to dissipate.
2. Turn the main power switch (1) to the OFF position.

NOTE: A small amount of water may drain from the bottom of the unit when the air supply is disconnected. This is a normal operation of the built-in water

separator.

3. Disconnect the supply and waste hoses and the 12-volt power source from the vehicle.

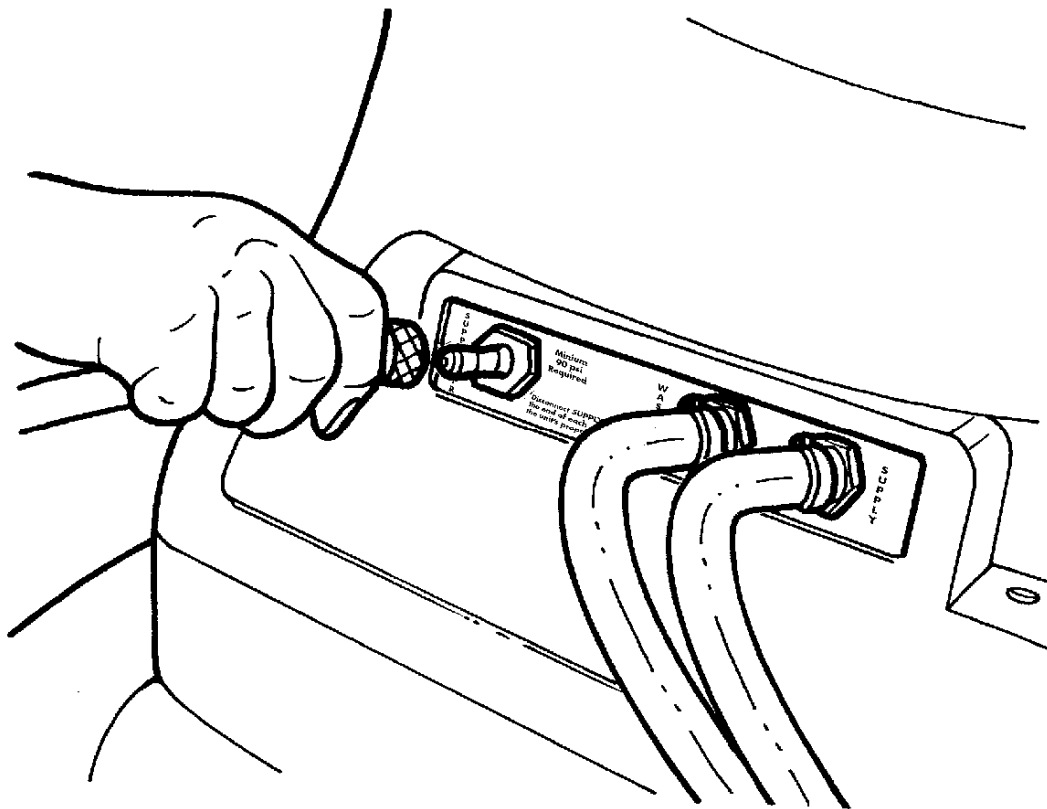


Fig. 16: Applying Shop Air Supply Hose To Quick-Disconnect
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the air supply hose from **DT-45096** flush and flow test tool.
5. Dispose of the waste ATF in accordance with all applicable federal, state, and local requirements.

Dissimilar Fluid

1. If the transmission uses fluid other than DEXRON @VI fluid, blow out residual fluid from cooler and cooler lines with compressed air.
2. Connect the oil cooler supply line to the transmission.

3. Put the return line in waste oil container.

CAUTION: Do not run engine for more than 10 seconds or transmission damage may occur.

4. Fill transmission with 6.38 liters (6.75 quarts) of transmission fluid.
5. Run engine at idle for 10 seconds.
6. Remove air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
7. Connect the oil cooler return line to the transmission.
8. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .

TRANSMISSION FLUID COOLER FLUSHING AND FLOW TEST (AISIN 80-40LE)

GM studies indicate that plugged or restricted transmission oil coolers and pipes cause insufficient transmission lubrication and elevated operating temperatures which can lead to premature transmission failure. Many repeat repair cases could have been prevented by following published procedures for transmission oil cooler flushing and flow checking. This procedure includes flow checking and flushing the auxiliary transmission oil cooler, if equipped.

NOTE: Use the DT-45096 flush and flow test tool or equivalent to flush and flow test the transmission oil cooler and the oil cooler pipes after the transmission is removed for repairs.

Only use the appropriate GM Goodwrench automatic transmission fluid when doing a repair on a GM transmission.

Time allowance for performing the cooler flow checking and flushing procedure has been included in the appropriate labor time guide operations since the 1987 model year. The service procedure steps for oil cooler flushing and flow testing are as follows:

Cooler Flow Check and Flushing Steps

1. Machine Set-up
2. Determine Minimum Flow Rate
3. Back Flush
4. Forward Flush
5. Flow Test
6. Code Recording Procedure
7. Clean-up

Special Tools

- **DT-45096** Transmission Oil Cooling System Flush and Flow Test Tool

- **J-45096-55** Transmission Cooler Flush Adapter
- Shop air supply with water/oil filters, regulator and pressure gauge - minimum 90 psi
- Eye protection
- Rubber gloves

For equivalent regional tools, refer to **Special Tools**.

Machine Set-Up

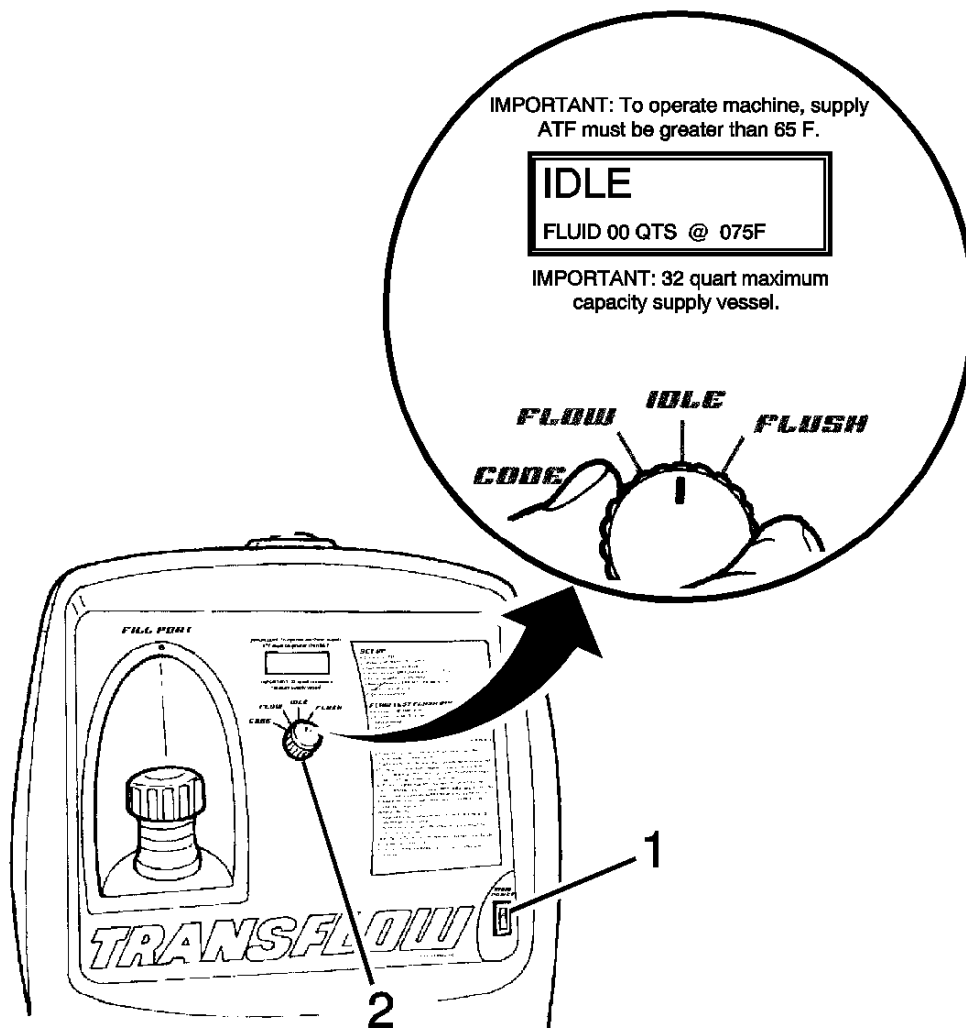


Fig. 17: View Of Main Power Switch & Main Function Switch
 Courtesy of GENERAL MOTORS COMPANY

1. Verify that the main power switch (1) is in the OFF position.
2. Place the main function switch (2) in the IDLE position.

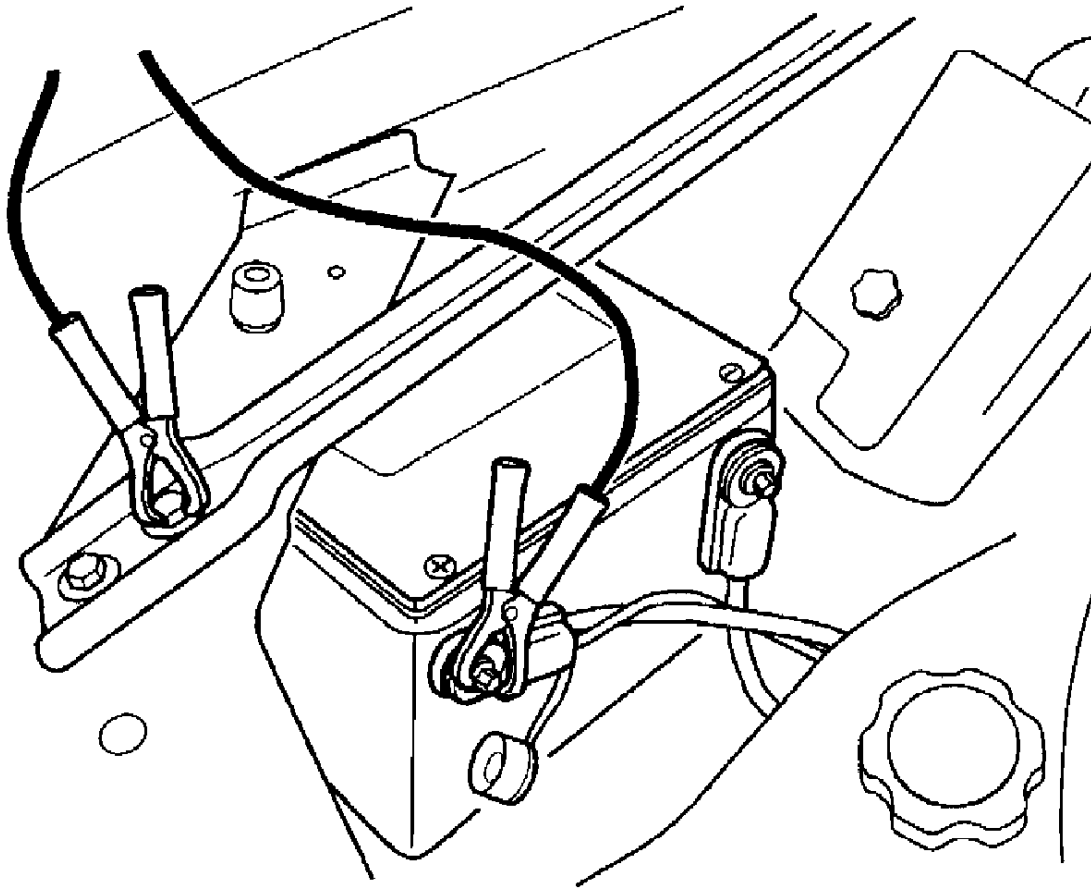


Fig. 18: Connecting To 12V DC Power Source
Courtesy of GENERAL MOTORS COMPANY

3. Connect **DT-45096** flush and flow test tool to the vehicle 12V DC power source by connecting the red battery clip to the positive, +, battery post on the vehicle and connect the negative lead to a known good chassis ground.
4. Turn the main power switch to the ON position.

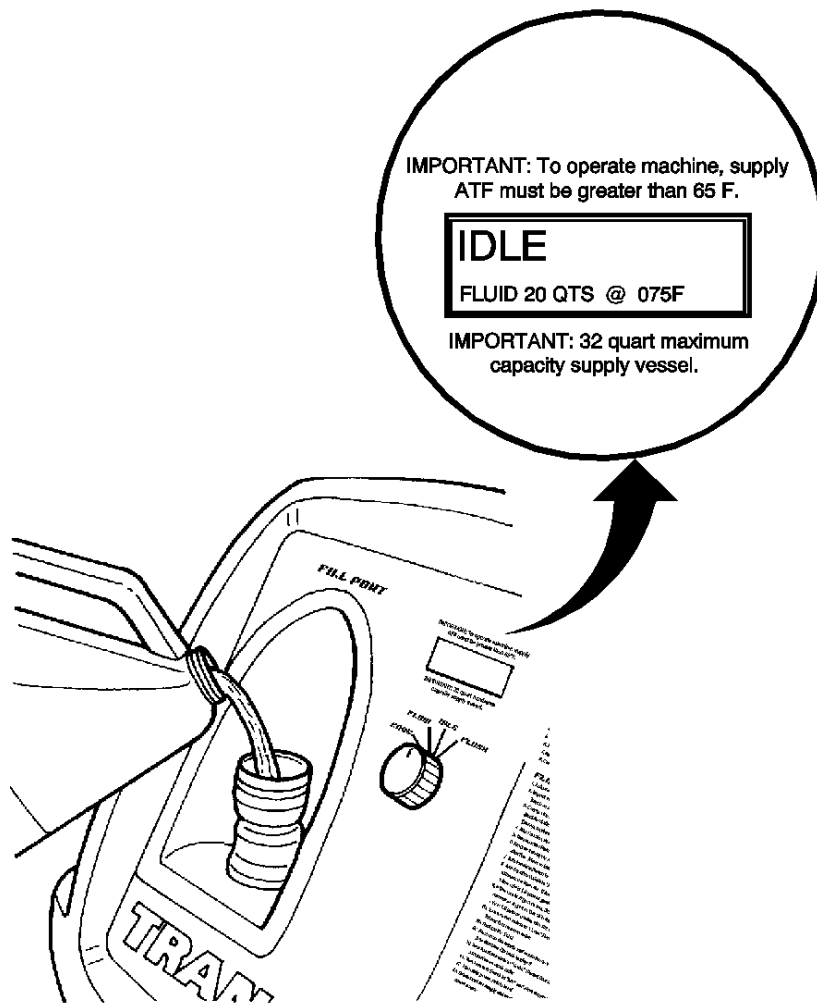


Fig. 19: Filling Supply Tank With Transmission Fluid
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Do not overfill the supply vessel. Damage to the unit may result. To verify the fluid level, view the LCD screen display while filling the unit, to ensure the fluid level does not exceed 30 L (32 qt).

5. Fill the supply tank with the appropriate transmission fluid through the fill port.
6. Reinstall and tighten the fill cap.

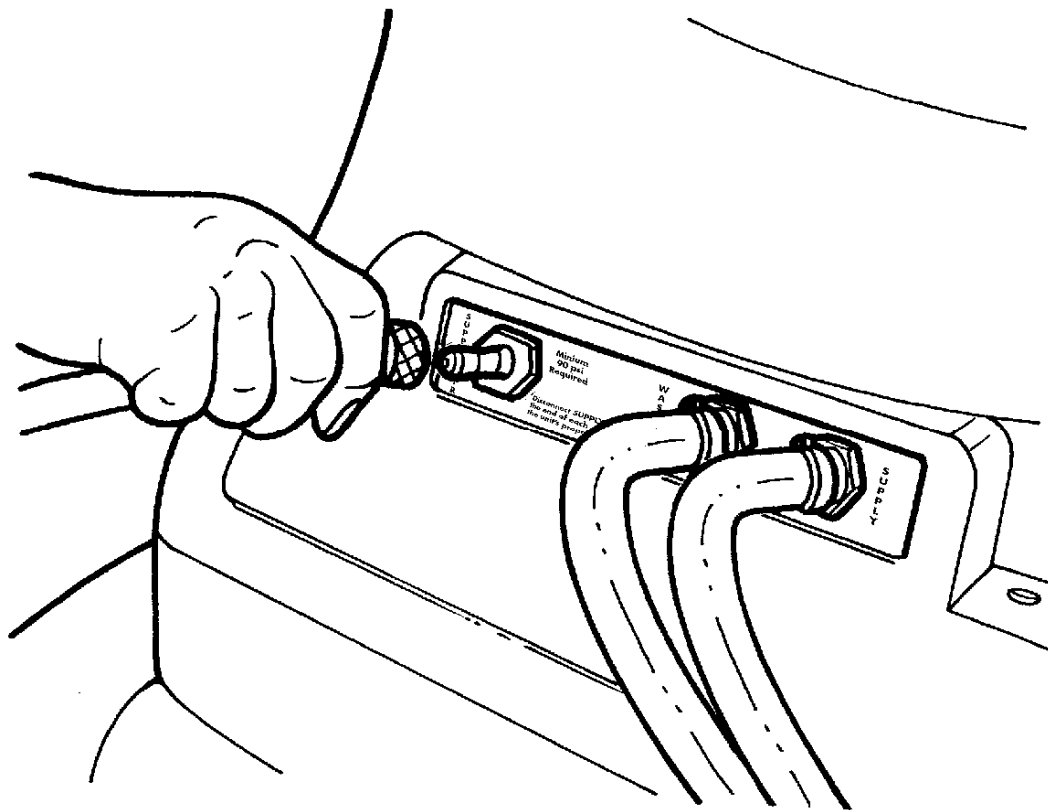


Fig. 20: Applying Shop Air Supply Hose To Quick-Disconnect
Courtesy of GENERAL MOTORS COMPANY

7. Connect a shop air supply hose to the quick-disconnect on the rear panel marked SUPPLY AIR.

Determine Minimum Flow Rate

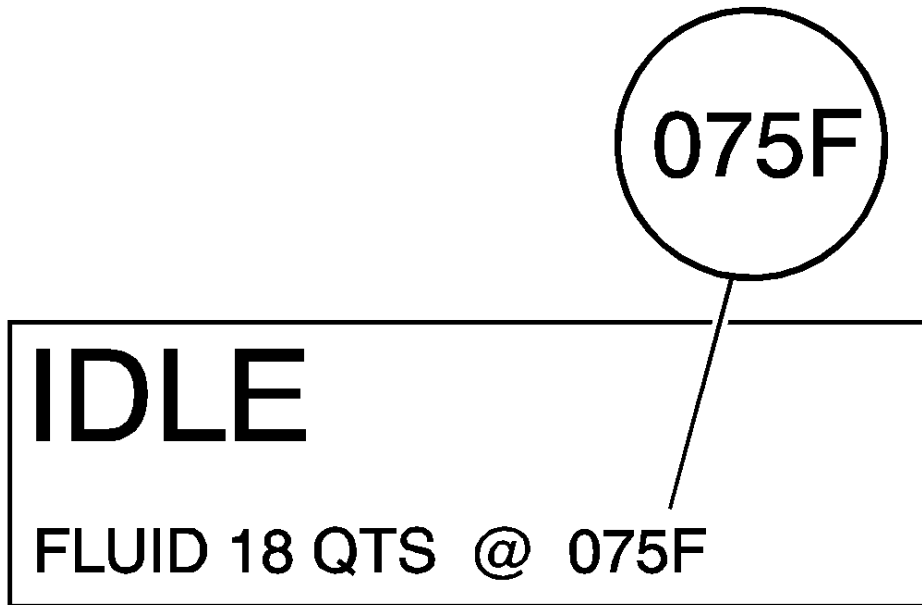


Fig. 21: Identifying Machine Display Of Automatic Transmission Fluid Temperature
Courtesy of GENERAL MOTORS COMPANY

NOTE: Due to the large size of the oil cooling system components and the flow capacity of the DT-45096 flush and flow test tool, fluid temperature in excess of 100 degrees Fahrenheit can cause inaccurate flow readings.

1. From the machine display, identify the temperature of the automatic transmission fluid that is stored in the supply vessel of **DT-45096** flush and flow test tool.
2. Refer to the table below. Using the temperature from step 1, locate on the MINIMUM Flow Rate table the minimum flow rate in gallons per minutes (GPM). Record the minimum flow rate in GPMs and the supply fluid temperature for further reference.

Example

- Fluid temperature: 75°F
 - The MINIMUM flow rate for this example would be 1.7 GPM.
3. Inspect transmission oil cooler lines for damage or kinks that could cause restricted oil flow. Repair as needed and refer to the appropriate GM service manual procedures.

Minimum Flow Rate in Gallons Per Minute (gpm)

Temperature Range	Minimum Flow Rate
65-66°F	1.4 gpm
67-71°F	1.5 gpm
72-74°F	1.6 gpm
75-82°F	1.7 gpm
83-91°F	1.8 gpm
92-96°F	1.9 gpm
97-104°F	2.1 gpm
105-113°F	2.2 gpm

Back Flush Procedure

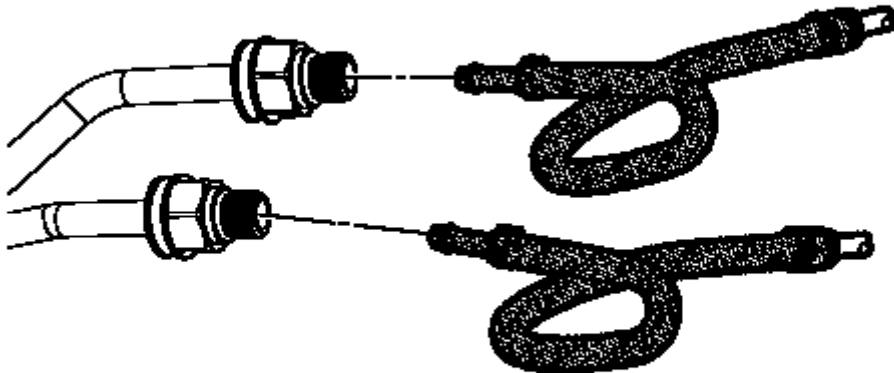


Fig. 22: Cooler Flush Adapter
Courtesy of GENERAL MOTORS COMPANY

1. Connect the **J-45096-55** cooler flush adapter (1) to the vehicle transmission oil cooler supply and return lines at the transmission.

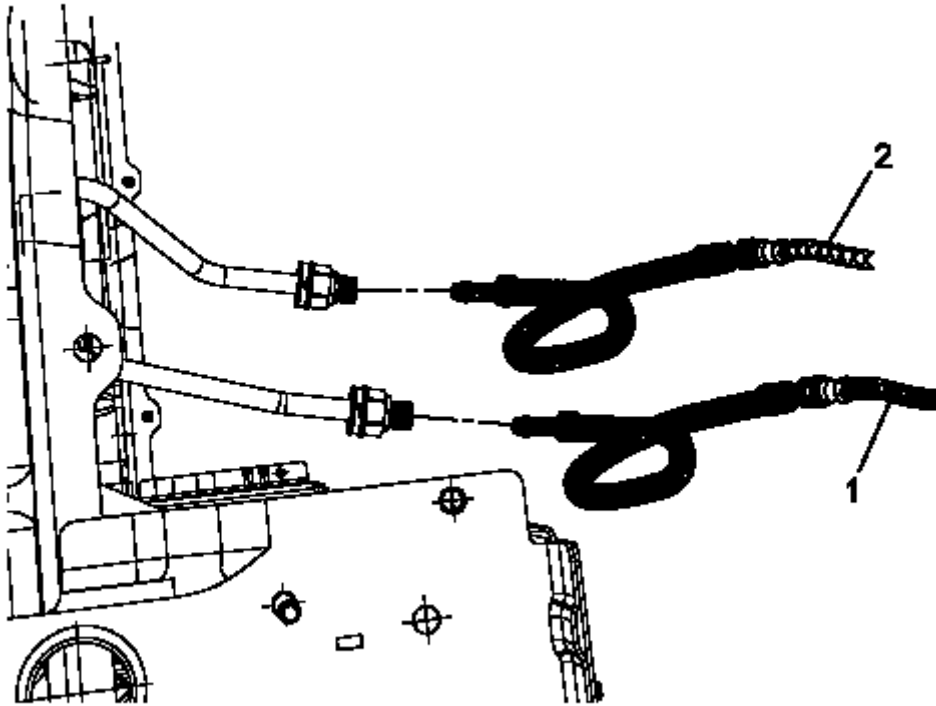


Fig. 23: Black Supply Hose

Courtesy of GENERAL MOTORS COMPANY

2. Connect the black supply hose (1) to the return line, bottom connector of the transmission, and the clear waste hose (2) to the feed line, top connector of the transmission, to the vehicle cooler lines. This is the reverse flow - backflush direction.

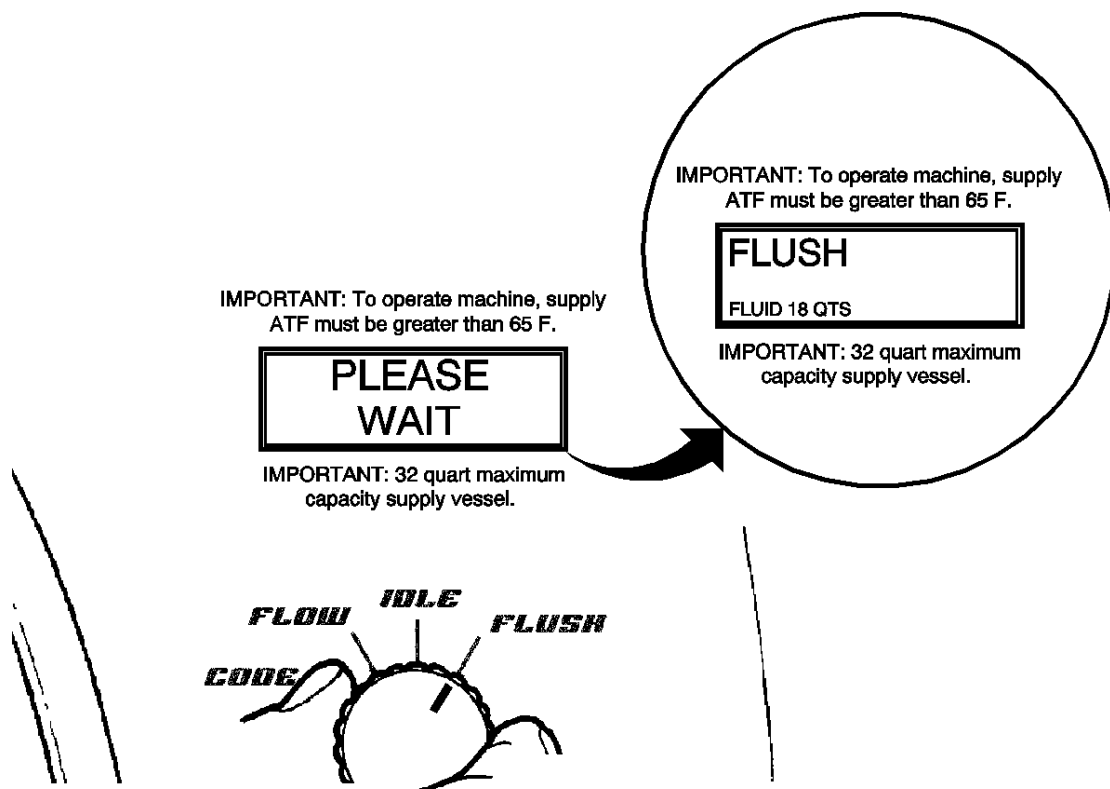


Fig. 24: View Of Main Function Switch FLUSH Position
Courtesy of GENERAL MOTORS COMPANY

3. Turn the main function switch to the FLUSH position. Allow the machine to operate for 30 seconds.

IMPORTANT: To operate machine, supply
ATF must be greater than 65 F.

IDLE

FLUID 16 QTS @ 075F

IMPORTANT: 32 quart maximum
capacity supply vessel.

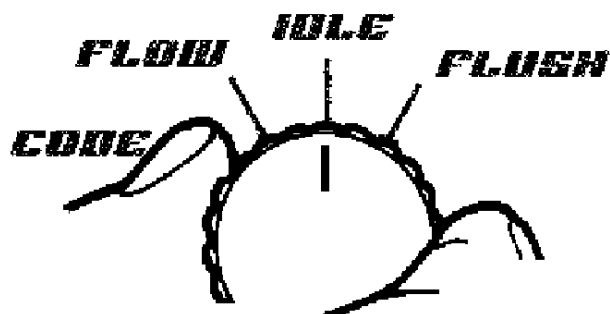


Fig. 25: View Of Main Function Switch IDLE Position
Courtesy of GENERAL MOTORS COMPANY

4. Turn the main function switch to the IDLE position and allow the supply vessel pressure to dissipate.

Forward Flush

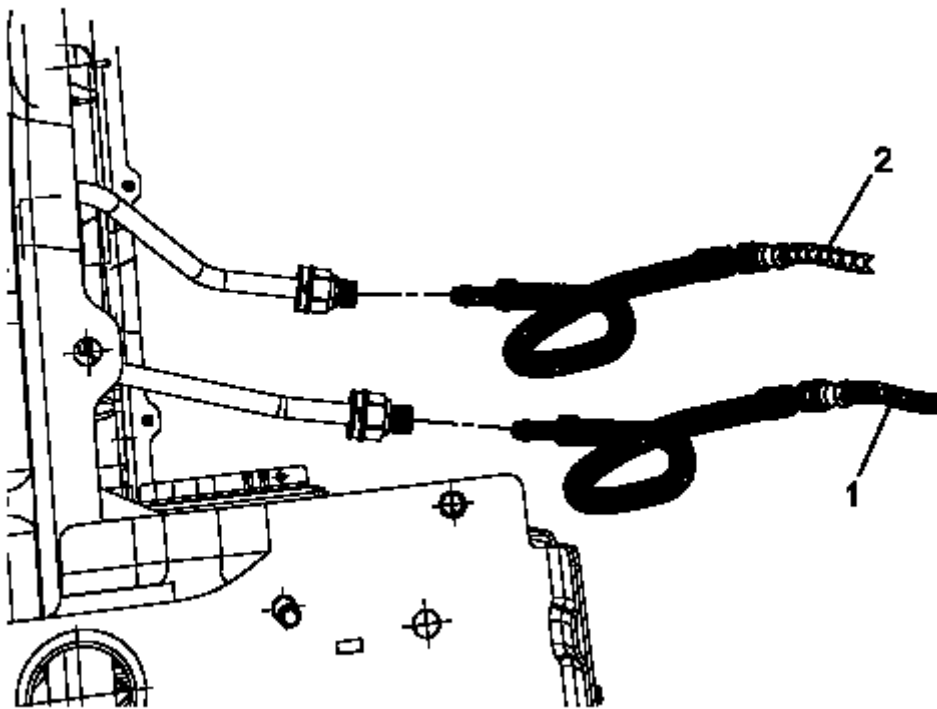


Fig. 26: Black Supply Hose

Courtesy of GENERAL MOTORS COMPANY

1. Disconnect the supply hose (1) and waste hose (2) from the vehicle cooler lines. Reverse the supply and waste hoses to provide a normal flow direction.

IMPORTANT: To operate machine, supply
ATF must be greater than 65 F.

FLUSH

FLUID 18 QTS

IMPORTANT: 32 quart maximum
capacity supply vessel.

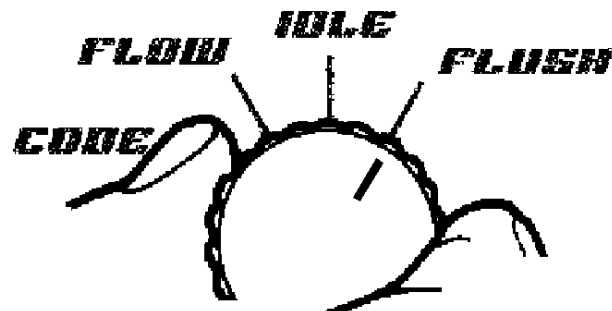


Fig. 27: View Of Main Function Switch FLUSH Position
Courtesy of GENERAL MOTORS COMPANY

2. Turn the main function switch to the FLUSH position and allow machine to operate for 30 seconds.

Flow Test

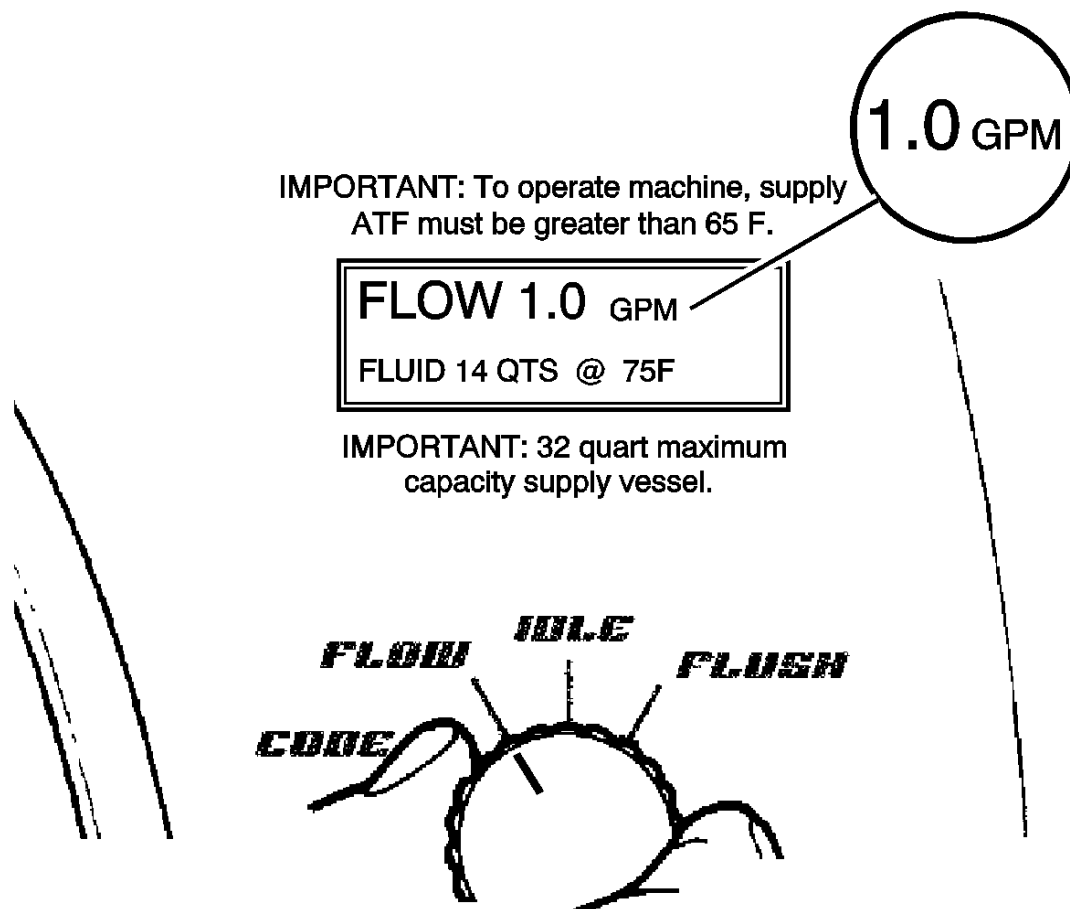


Fig. 28: View Of Main Function Switch FLOW Position
Courtesy of GENERAL MOTORS COMPANY

NOTE: If the flow rate is less than 0.5 gpm, the LCD displays an error message. Refer to the Troubleshooting section of the operation manual.

1. Turn the main function switch to the FLOW position and allow the oil to flow for 15 seconds. Observe and note the flow rate; this is the TESTED flow rate.
2. Compare the TESTED flow rate to the MINIMUM flow rate information previously recorded.
 - If the TESTED flow rate is equal to or greater than the MINIMUM flow rate recorded, the oil cooling system is functioning properly. Perform Code Recording Procedure.
 - If the TESTED flow rate is less than the MINIMUM flow rate previously recorded, repeat the back flush and forward flush procedures.
3. If the TESTED flow rate is less than the MINIMUM flow rate after the second test, perform Code Recording Procedure.

1. Replace the transmission oil cooler.
2. Reconnect supply and waste hoses to the cooler lines in the normal flow direction. Perform Flow Test.
3. Perform Code Recording Procedure.
4. Disconnect the supply hose and waste hose from the vehicle cooler lines.
5. Use compressed air to blow the residual transmission fluid out of the oil cooler and lines if the fluid in the **DT-45096** flush and flow test tool is different than what is used in the transmission.

Code Recording Procedure

IMPORTANT: To operate machine, supply
ATF must be greater than 65 F.

FLOW 1.0 @ 75F CYCLE 6
A10DFB2

IMPORTANT: 32 quart maximum
capacity supply vessel.



Fig. 29: View Of Main Function Switch CODE Position
Courtesy of GENERAL MOTORS COMPANY

1. Turn the main function switch to the CODE position.

NOTE:

- If power is interrupted prior to the recording of the seven-character code, the code will be lost and the flow rate test will need to be repeated.
- The flow test must run for a minimum of 8-10 seconds and be above 0.5 GPM for a code to be generated.

2. Record TESTED flow rate, temperature, cycle and seven-character flow code information on repair order.

Clean-Up

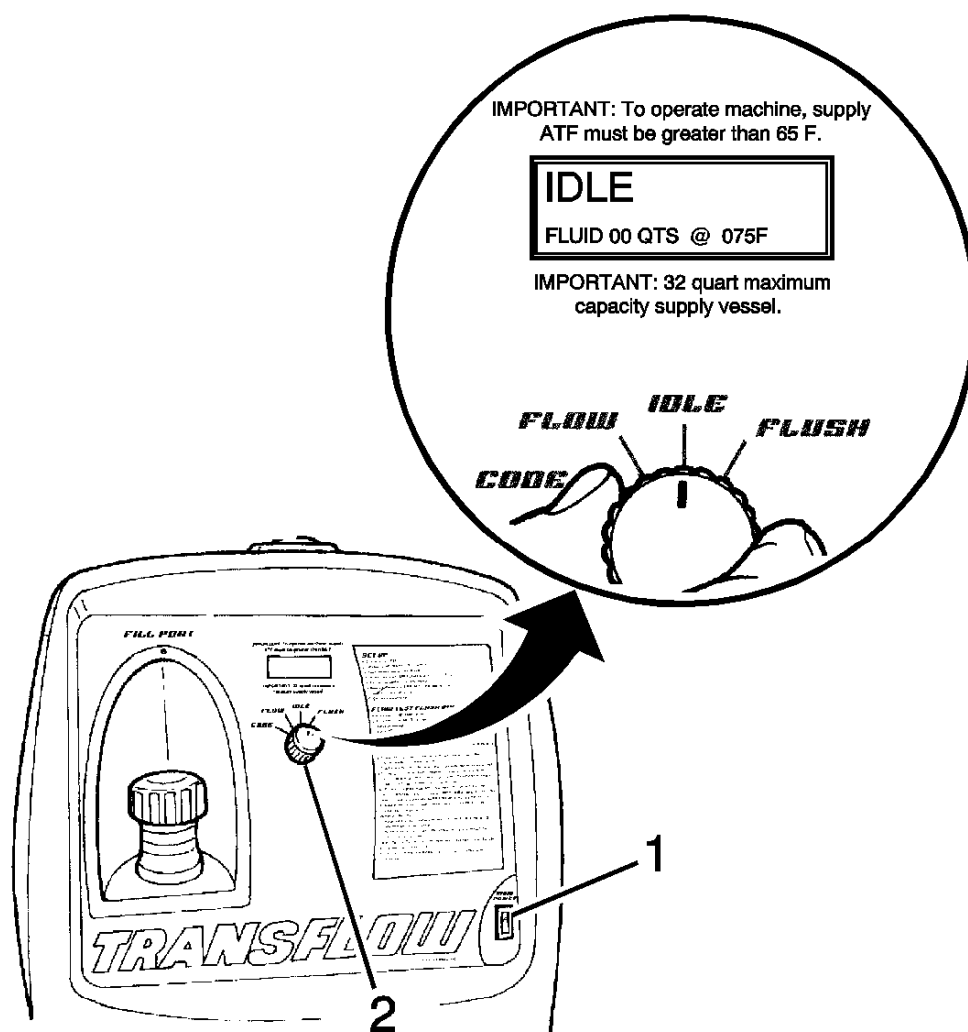


Fig. 30: View Of Main Power Switch & Main Function Switch
Courtesy of GENERAL MOTORS COMPANY

1. Turn the main function switch (2) to the IDLE position and allow the supply vessel pressure to dissipate.
2. Turn the main power switch (1) to the OFF position.

NOTE: A small amount of water may drain from the bottom of the unit when the air supply is disconnected. This is a normal operation of the built-in water separator.

3. Disconnect the supply and waste hoses and the 12-volt power source from the vehicle.

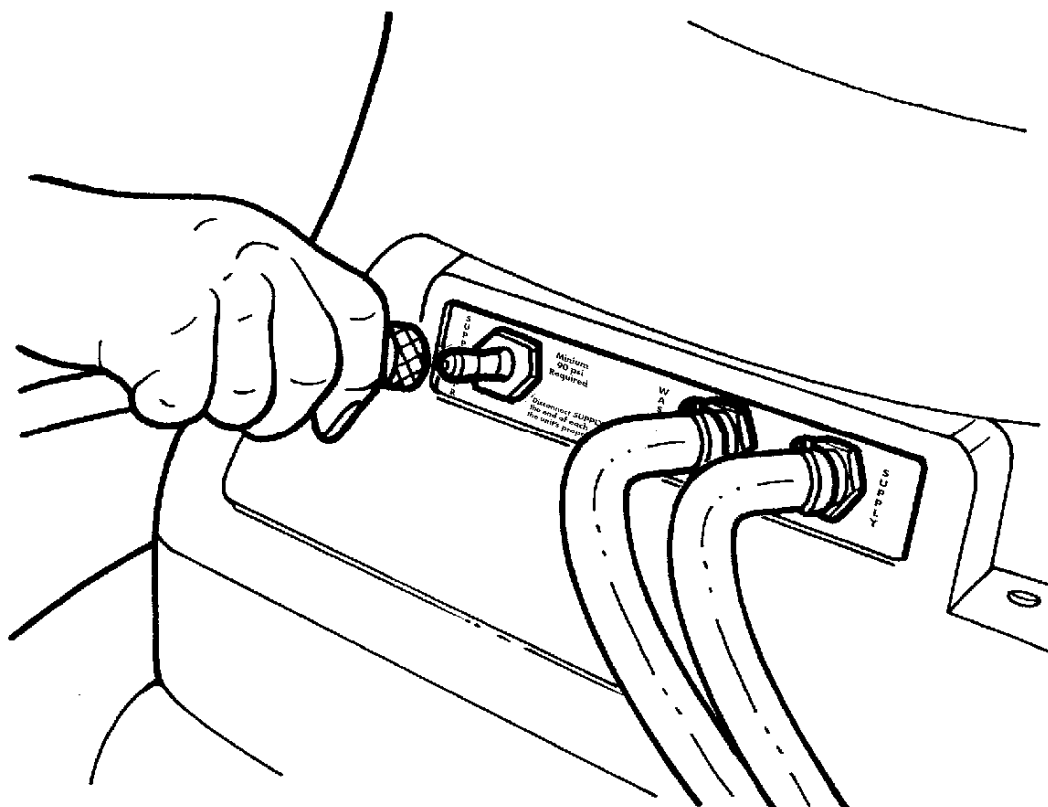


Fig. 31: Applying Shop Air Supply Hose To Quick-Disconnect
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the air supply hose from **DT-45096** flush and flow test tool.
5. Dispose of the waste transmission fluid in accordance with all applicable federal, state, and local requirements.

REPAIR INSTRUCTIONS

TRANSMISSION FLUID COOLER INLET AND OUTLET PIPE REPLACEMENT (AISIN 80-40LE)

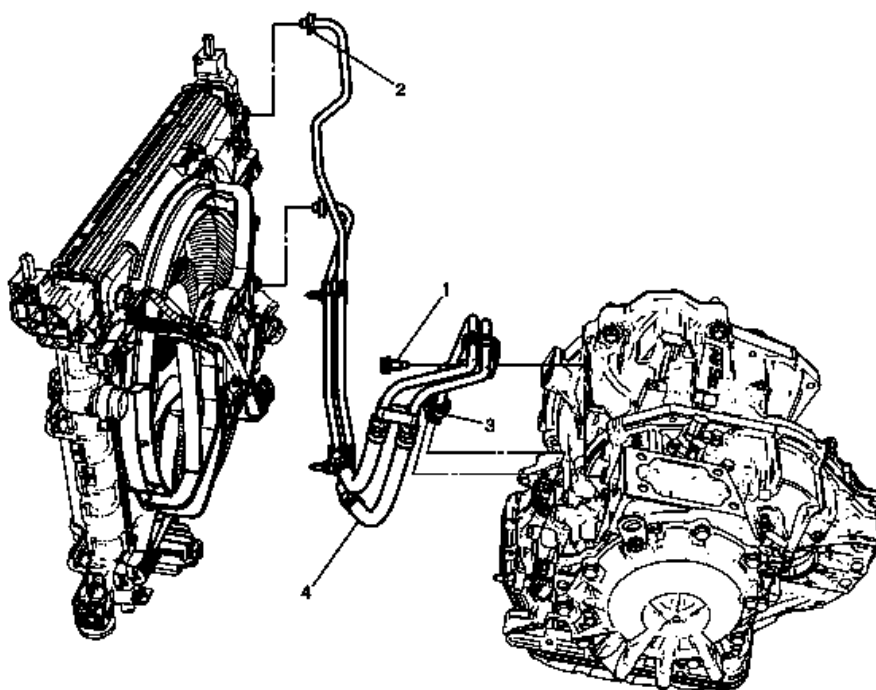


Fig. 32: Transmission Cooler Pipes and Hoses
 Courtesy of GENERAL MOTORS COMPANY

Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (Aisin 80-40LE)

Callout	Component Name
Preliminary Procedures 1. Remove the front bumper fascia opening lower cover. Refer to <u>Front Bumper Fascia Opening Lower Cover Replacement</u> . 2. Remove the range selector lever cable bracket. Refer to <u>Range Selector Lever Cable Bracket Replacement</u> .	
1	Transmission Fluid Cooler Pipe Bracket Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 22 (16 lb ft)
2	Transmission Fluid Cooler Pipe Quick Connect
3	Transmission Fluid Cooler Pipe Fitting Nut Tighten 16 (12 lb ft)
	Transmission Fluid Cooler Pipe Procedure

4

1. Note the routing of the transmission line to ensure proper installation.
2. Remove the transmission line from the clips securing the line to the fan shroud. Refer to **Transmission Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection** .
3. Inspect the transmission fluid level. Refer to **Transmission Fluid Level and Condition Check** .

TRANSMISSION FLUID COOLER INLET AND OUTLET PIPE REPLACEMENT (JATCO CVT)

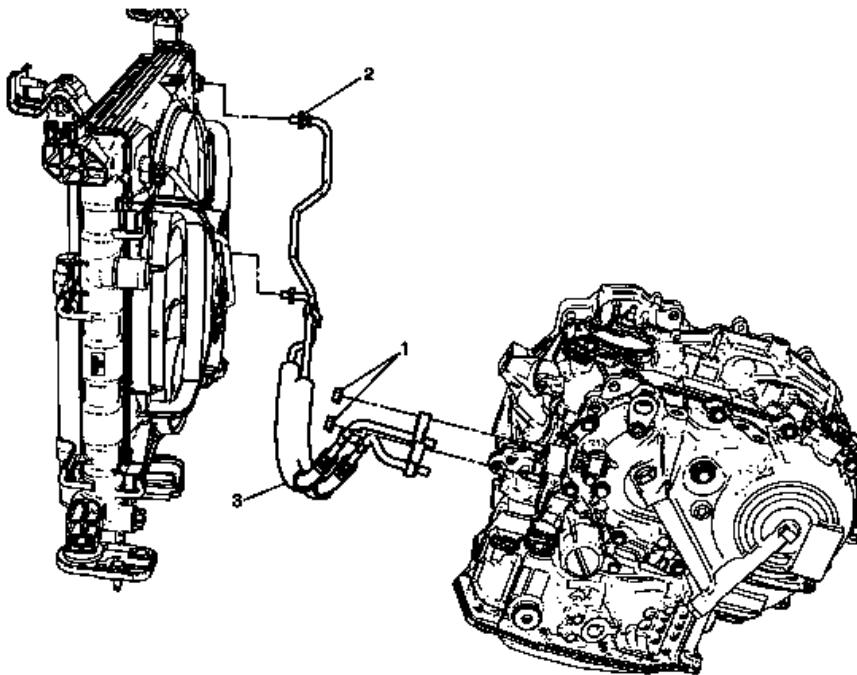


Fig. 33: Transmission Fluid Cooler Inlet and Outlet Pipe
Courtesy of GENERAL MOTORS COMPANY

Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (Jatco CVT)

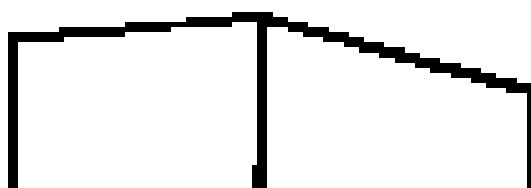
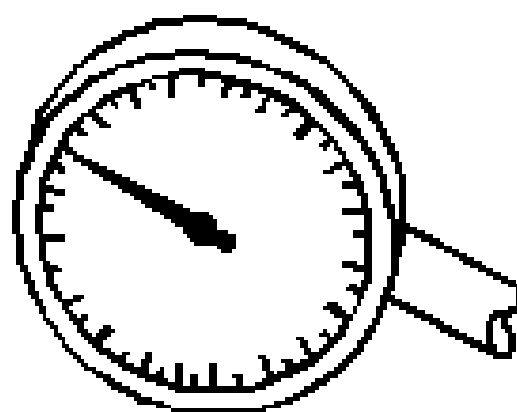
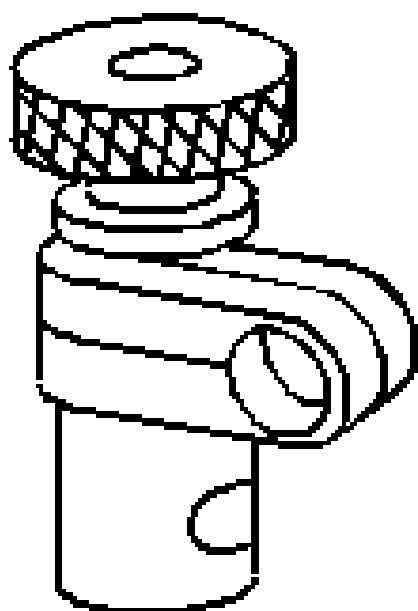
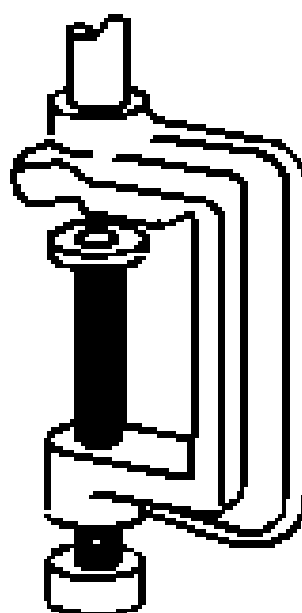
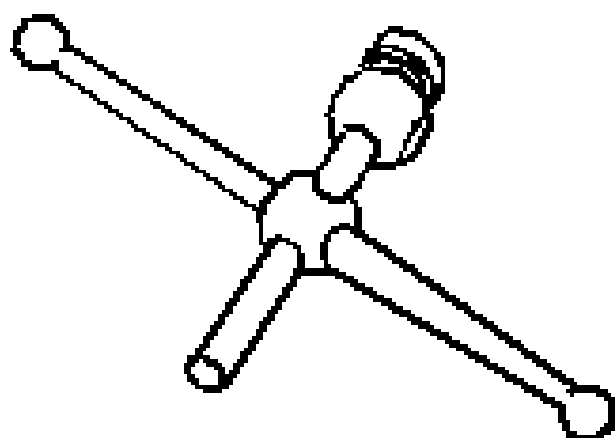
Callout	Component Name
Preliminary Procedures	
1. Remove the air cleaner assembly. Refer to <u>Air Cleaner Assembly Replacement</u> . 2. Remove the front bumper fascia opening lower cover. Refer to <u>Front Bumper Fascia Opening Lower Cover Replacement</u> .	
1	Transmission Fluid Cooler Pipe Nut (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> .

	Tighten 11 (97 lb in)
2	Transmission Fluid Cooler Pipe Quick Connect
3	Transmission Fluid Cooler Pipe Procedure 1. Note the routing of the transmission line to ensure proper installation. 2. Remove the transmission line from the clips securing the line to the fan shroud. Refer to <u>Transmission Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection</u> . 3. Inspect the transmission fluid level. Refer to <u>Transmission Fluid Level and Condition Check</u> .

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description
	DT-45096 J-45096 Transmission Oil Cooling System Flush and Flow Test Tool



DT-45096- 50 J-45096-50 Transmission Oil Cooler Flush Adapter

TRANSMISSION

Clutch - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Clutch Actuator Cylinder Bolts	22	16 lb ft
Clutch Master Cylinder Nuts	22	16 lb ft
Clutch Pedal Arm Bolt and Nut	17	13 lb ft
Clutch Pedal Position Sensor Bolt	3	27 lb in
Clutch Pressure Plate-to-Flywheel Bolts	28	21 lb ft

GENERAL SPECIFICATIONS

General Specifications

Application	Specification	
	Metric	English
Clutch Disc		
Type	Single Dry Plate	
• Outside Diameter- Standard	190 mm	7.480 in
• Inside Diameter- Standard	127.5 mm	5.020 in
• Thickness- Standard	8.4 mm	0.331 in
• Rivet Head Depth- Standard	1.1 mm	0.043 in
• Rivet Head Depth- Limit	0.4 mm	0.016 in
• Disc Runout Limit in Rotational Direction- Limit	0.7 mm	0.028 in

DIAGNOSTIC INFORMATION AND PROCEDURES

SYMPTOMS - CLUTCH

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom.

- Clutch Does Not Disengage
- Clutch Slipping
- Clutch Grabbing

- **Clutch Rattle**
- **Release Bearing Noisy with Clutch Engaged**
- **Clutch Noisy**
- **Clutch Pedal Hard to Push**

CLUTCH DOES NOT DISENGAGE

Clutch Does Not Disengage

Causes	Actions
DEFINITION: When the pedal is pressed to the floor, the shift lever does not move freely in and out of reverse gear.	
Damaged clutch disc	Replace the clutch assembly. Refer to <u>Clutch Pressure and Driven Plate Replacement</u> .
Clutch disc hub binding on the input shaft splines	Replace the clutch assembly. Refer to <u>Clutch Pressure and Driven Plate Replacement</u> .
Warped or bent clutch disc	Replace the clutch assembly. Refer to <u>Clutch Pressure and Driven Plate Replacement</u> .
Pedal blocked from full travel	1. Inspect for obstacles that will prevent the pedal from going to the floor. 2. Clear any obstacles from under the pedal area, such as floor mats or interior panels.
Too much travel between pedal and hydraulic clutch master cylinder	1. Inspect the pedal for worn bushings. 2. Replace the pedal bushings if worn.
Hydraulic clutch master cylinder seized or binding	1. Inspect the master cylinder for the piston being able to move freely and full range of travel. 2. Replace the clutch master cylinder as required. Refer to <u>Clutch Master Cylinder Replacement</u>.
Air in the hydraulic clutch system	Bleed the hydraulic clutch system. Refer to <u>Hydraulic Clutch System Bleeding</u> .
Hydraulic clutch actuator cylinder seized or binding	1. Inspect the clutch actuator piston for moving freely. 2. Replace the clutch actuator cylinder if the piston is binding. Refer to <u>Clutch Actuator Cylinder Replacement</u>.
Hydraulic clutch master cylinder leaking internally	1. Inspect for proper pedal reserve. 1. Let up halfway on pedal. 2. Apply the pedal a few times. 3. Inspect to ensure there is still the proper pedal reserve. 2. Replace the clutch master cylinder if it will not hold pedal reserve. Refer to <u>Clutch Master Cylinder Replacement</u>.

CLUTCH SLIPPING

Clutch Slipping

Condition	Action
DEFINITION: The clutch does not engage completely after the pedal is released, after shifting gears, or the clutch slips during maximum engine loads, such as climbing hills or high vehicle speeds. Clutch slipping is identified by increase in engine RPM without increase in vehicle speed. Review the <u>Symptoms - Clutch</u> and perform the necessary inspections.	
Incorrect clutch pedal height, not allowing the clutch master cylinder to return.	Adjust the clutch pedal position switch. Refer to <u>Clutch Pedal Position Sensor Replacement</u> .
The clutch pedal return spring is broken or missing.	Replace the clutch pedal return spring, if equipped. Refer to <u>Clutch Pedal Replacement</u> .
The clutch pedal is binding or sticking.	1. Clear away any items that may be contacting the pedal. 2. Inspect the pedal bushings for ease of movement. 3. Replace the clutch pedal if it is faulty. Refer to <u>Clutch Pedal Replacement</u>.
Clutch master cylinder binding or seized.	Replace the clutch master cylinder. Refer to <u>Clutch Master Cylinder Replacement</u> .
Clutch actuator cylinder binding or seized.	Replace the clutch actuator cylinder. Refer to <u>Clutch Actuator Cylinder Replacement</u> .
Kinked or damaged clutch actuator cylinder front pipe.	1. Inspect for the correct routing of the clutch actuator cylinder front pipe. 2. Route the clutch actuator cylinder front pipe properly. 3. Inspect for loose or faulty engine mounts that may allow the clutch actuator cylinder front pipe to be kinked or pinched. 4. Repair or replace faulty engine mounts. 5. Replace the clutch actuator cylinder front pipe if it is damaged. Refer to <u>Clutch Actuator Cylinder Front Pipe Replacement</u>.
Grease or oil contamination of the clutch disc.	1. Repair the source of the oil leak. 2. Repair the source of the grease leak. 3. Clean the contamination from the clutch components. 4. If contaminants cannot be removed, replace the clutch assembly. Refer to <u>Clutch Pressure and Driven Plate Replacement</u>.
Oil-soaked clutch disc.	Correct the leak at its source and install a new clutch disc.
Weak diaphragm spring.	Replace the clutch assembly. Refer to <u>Clutch Pressure and Driven Plate Replacement</u> .
Driven plate that is not seated.	Start the engine 30-40 times. Do not overheat the engine.
Driven plate is overheated.	Allow the driven plate to cool.
Worn or damaged flywheel.	Replace the engine flywheel.
Worn clutch disc facing.	Replace the clutch assembly. Refer to <u>Clutch Pressure and Driven Plate Replacement</u> .
Burnt or glazed clutch discs.	Replace the clutch assembly. Refer to <u>Clutch Pressure and Driven Plate Replacement</u> .

Improper resurfacing of the flywheel.

Replace the flywheel if it has been improperly resurfaced, allowing contact of the clutch disc hub or insufficient clamping load of the pressure plate.

CLUTCH GRABBING

Clutch Grabbing

Causes	Actions
DEFINITION: The clutch grabs, or chatters, or the clutch is unable to release without the vehicle jerking. An abrupt engagement of the clutch. Review the <u>Symptoms - Clutch</u> and perform the necessary inspections.	
Grease or oil contamination on the clutch facings	1. Repair the cause of the oil leak or grease contamination. 2. Clean the clutch facings. 3. Replace the clutch components if they will not clean. Refer to <u>Clutch Pressure and Driven Plate Replacement</u>.
Loose or faulty engine mounts	1. Inspect the engine mounts for being loose or faulty. 2. Repair or replace the engine/transmission mounts as required.
Clutch pedal sticking	1. Inspect the clutch pedal for correct operation. 2. Replace the clutch pedal if it is faulty. Refer to <u>Clutch Pedal Replacement</u>.
Clutch actuator binding	1. Inspect the clutch actuator for the piston seals binding or sticking. 2. Replace the clutch actuator if it is binding. Refer to <u>Clutch Actuator Cylinder Replacement</u>.
Clutch master cylinder binding	1. Inspect the clutch master cylinder for the piston binding or sticking in the cylinder. 2. Replace the master cylinder if it is faulty. Refer to <u>Clutch Master Cylinder Replacement</u>.
Warped clutch cover	1. Inspect the clutch cover for distortion caused by improperly tightening the clutch cover bolts. 2. Replace the clutch cover if it is distorted. Refer to <u>Clutch Pressure and Driven Plate Replacement</u>.
Improper clutch installation	1. Inspect the pressure plate for distortion caused by improperly tightening the pressure plate bolts. 2. Inspect the clutch disc for a bent hub caused by forcing the installation of the transmission. 3. Inspect for the correct clutch disc. 4. Inspect the clutch disc for being installed backwards. 5. Replace the clutch assembly if it is damaged or the wrong components were installed. Refer to <u>Clutch Pressure and Driven Plate Replacement</u>.
Clutch disc binding on the input	1. Inspect the input shaft for rust dirt or debris.

shaft	- Clean and lubricate the input shaft. - Inspect the clutch disc for a bent hub. - Replace the clutch assembly if the clutch disc is faulty. Refer to <u>Clutch Pressure and Driven Plate Replacement</u>. - Inspect the input shaft for excessive wear on the splines, causing the clutch disc to bind. - Replace the transmission input shaft if it is worn. Refer to <u>Input Shaft Disassemble (HD)</u>.
Clutch pressure plate damaged	- Inspect the pressure plate for bent drive straps caused by improper vehicle use. - Replace the clutch assembly if the clutch pressure plate is damaged. Inform the customer. Refer to <u>Clutch Pressure and Driven Plate Replacement</u>.
Flywheel improperly machined	- Inspect the flywheel for being improperly machined, and causing interference with the clutch disc. - Replace the flywheel if it has been improperly machined.
Flywheel uneven	- Inspect the flywheel surface for being warped or uneven. - Replace the flywheel if it is faulty.

CLUTCH RATTLE

Clutch Rattle

Condition	Action
DEFINITION: A rattle noise coming from the clutch components with the clutch disengaged or engaged. Review the <u>Symptoms - Clutch</u> and perform the necessary inspections.	
Idle rattle clutch engaged	Replace the clutch disc, due to faulty damper springs. Refer to <u>Clutch Pressure and Driven Plate Replacement</u> .
Clutch is improperly installed	Remove the clutch and install it correctly. Refer to <u>Clutch Pressure and Driven Plate Replacement</u> .
Clutch disc damper worn or damaged	- Inspect the clutch disc for a broken or worn damper. - Replace the clutch assembly. Refer to <u>Clutch Pressure and Driven Plate Replacement</u>.
Oil in the driven plate damper	Correct the cause of the oil leak and replace the clutch assembly. Refer to <u>Clutch Pressure and Driven Plate Replacement</u> .
Clutch disc splines and input shaft splines worn	- Inspect the clutch disc hub to input shaft splines for excessive clearance. - Replace the clutch assembly if the clutch splines are worn. Refer to <u>Clutch Pressure and Driven Plate Replacement</u>. - Replace the transmission input shaft if it is worn. Refer to <u>Input Shaft Disassemble (HD)</u>.

RELEASE BEARING NOISY WITH CLUTCH ENGAGED

Release Bearing Noisy with Clutch Engaged

Condition	Action
Check for a binding release bearing.	Clean and re-lubricate the release bearing. Inspect the release bearing for burrs and nicks.
Inspect for an improperly installed release lever.	Remove and reinstall the release lever properly.

CLUTCH NOISY

Clutch Noisy

Condition	Action
Clutch release bearing damaged or worn.	Replace the clutch release bearing. Refer to <u>Clutch Release Bearing Replacement</u> .

CLUTCH PEDAL HARD TO PUSH

Clutch Pedal Hard to Push

Condition	Action
DEFINITION: The clutch pedal requires high effort to operate. Review the <u>Symptoms - Clutch</u> and perform the necessary inspections.	
Incorrect hydraulic fluid.	1. Inspect for the correct fluid in the master cylinder. Refer to <u>Hydraulic Clutch System Bleeding</u>. 2. If mineral oil is found, replace the clutch master cylinder, the clutch actuator cylinder, and flush the hydraulic system and fill with the correct fluid. Refer to <u>Clutch Master Cylinder Replacement</u>, and <u>Hydraulic Clutch System Bleeding</u>.
Contaminated hydraulic fluid.	1. Inspect the hydraulic fluid for water. 2. Inspect the hydraulic fluid for dirt or debris. 3. Inspect the clutch hydraulic fluid for contamination of mineral oil. If contaminated, replace the clutch master cylinder and the clutch actuator cylinder. Refer to <u>Clutch Master Cylinder Replacement</u>. 4. Flush the hydraulic system and fill with the correct fluid. Refer to <u>Hydraulic Clutch System Bleeding</u>.
Clutch pedal binding.	1. Inspect the pedal for binding. 2. Replace the pedal. Refer to <u>Clutch Pedal Replacement</u>.
Clutch pedal spring worn.	1. Inspect the clutch pedal spring for wear. 2. Replace the clutch pedal. Refer to <u>Clutch Pedal Replacement</u>.
Kinked or damaged clutch actuator cylinder front pipe.	1. Inspect for a kinked or damaged clutch actuator cylinder front pipe.

	2. Replace the clutch actuator cylinder front pipe. Refer to <u>Clutch Actuator Cylinder Front Pipe Replacement</u> .
Clutch disc worn too thin.	Replace the clutch assembly. Refer to <u>Clutch Pressure and Driven Plate Replacement</u> .

REPAIR INSTRUCTIONS

CLUTCH PEDAL REPLACEMENT

NOTE: The clutch pedal is part of the brake, accelerator, and clutch pedal assembly and cannot be serviced separately.

To replace the brake, accelerator and clutch pedal assembly. Refer to Brake Pedal Assembly Replacement (Left Hand Drive) , Brake Pedal Assembly Replacement (Right Hand Drive) .

CLUTCH PEDAL RETURN SPRING REPLACEMENT

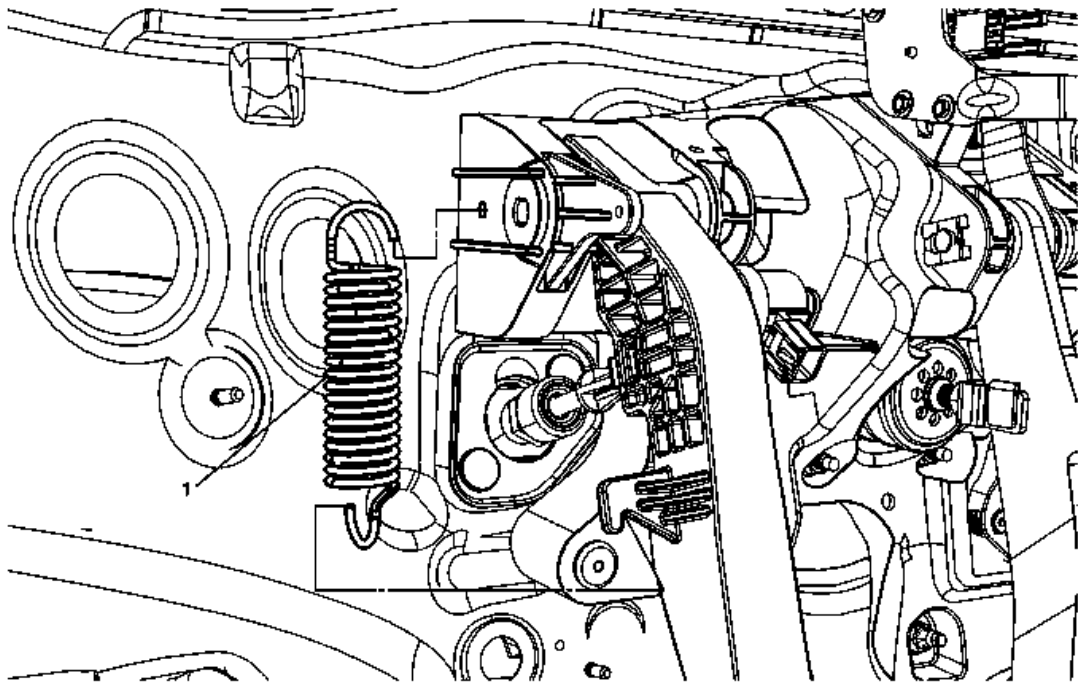


Fig. 1: Clutch Pedal Return Spring
 Courtesy of GENERAL MOTORS COMPANY

Clutch Pedal Return Spring Replacement

Callout	Component Name
Preliminary Procedure	
Remove the instrument panel lower reinforcement bracket. Refer to <u>Instrument Panel Lower Reinforcement Bracket Replacement</u> .	

1

Clutch Pedal Return Spring

Procedure

Disengage the clutch pedal return spring, using suitable pliers.

CLUTCH MASTER CYLINDER RESERVOIR HOSE REPLACEMENT

Removal Procedure

1. Remove the engine control module (ECM). Refer to **Engine Control Module Replacement** .

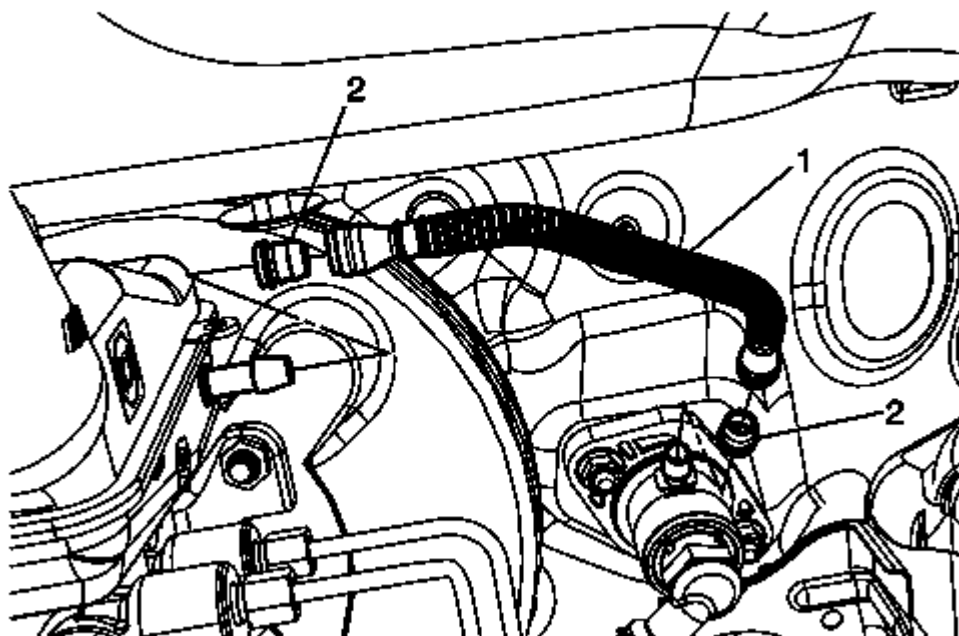


Fig. 2: Clutch Master Cylinder Reservoir Hose And Hose Seal

Courtesy of GENERAL MOTORS COMPANY

NOTE: Before disconnecting the reservoir hose, remove the clutch/brake fluid from the reservoir tank.

2. Remove the clutch master cylinder reservoir hose (1) and hose seal (2) from the reservoir tank and the master cylinder.

Installation Procedure

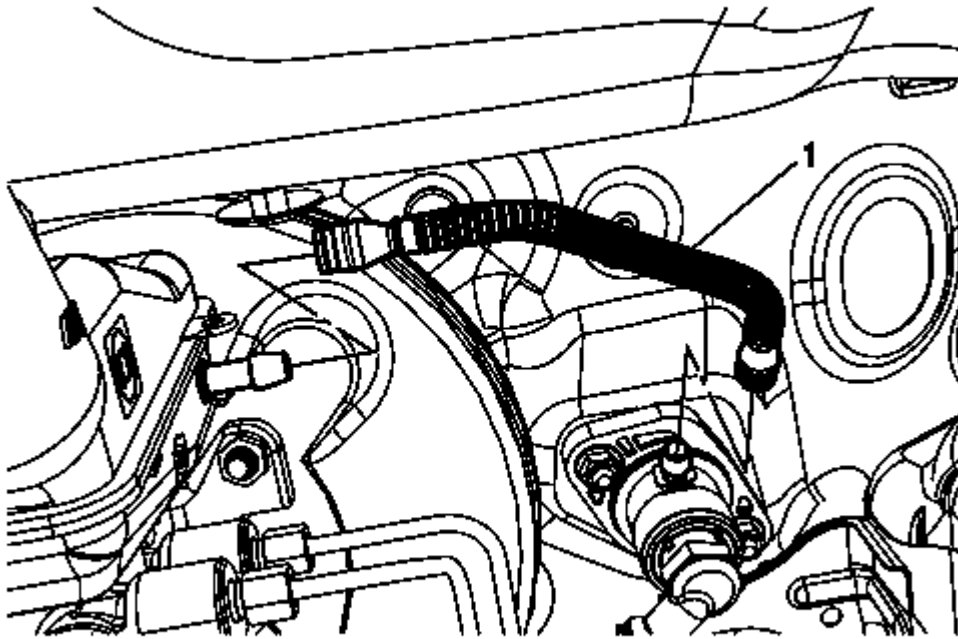


Fig. 3: Clutch Master Cylinder Reservoir Hose Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Install the NEW clutch master cylinder reservoir hose assembly (1) to the reservoir tank and the master cylinder.
2. Bleed hydraulic clutch system. Refer to **Hydraulic Clutch System Bleeding**.
3. Fill the reservoir with clutch/brake fluid up to the MAX level.
4. Install the engine control module (ECM). Refer to **Engine Control Module Replacement** .

CLUTCH MASTER CYLINDER REPLACEMENT

Removal Procedure

1. Remove the battery tray. Refer to **Battery Tray Replacement** .

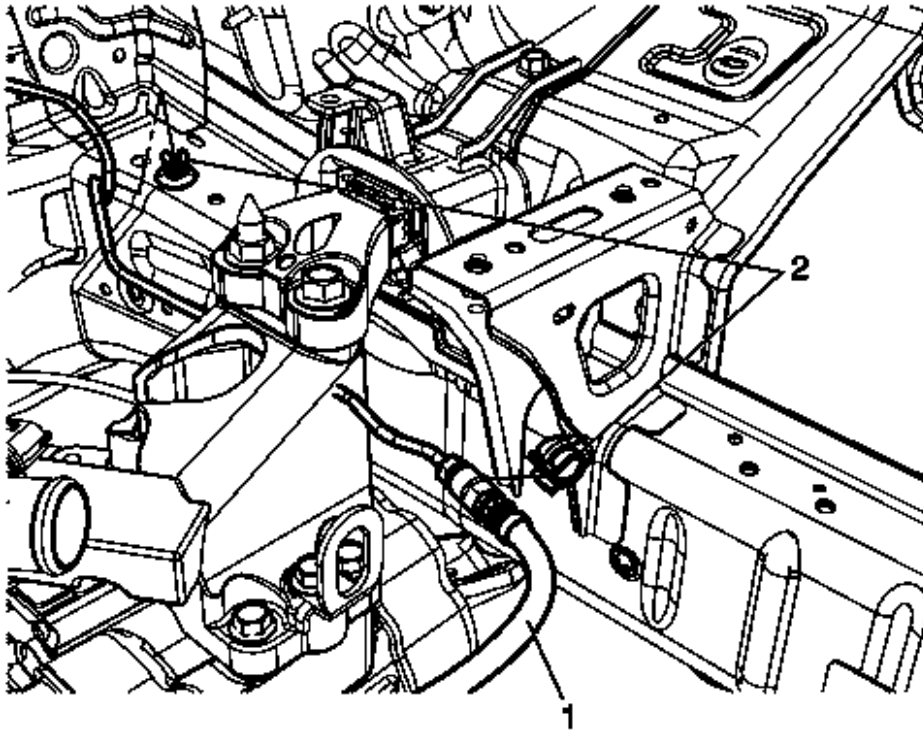


Fig. 4: Clutch Actuator Cylinder Front Pipe
Courtesy of GENERAL MOTORS COMPANY

NOTE: Before disconnecting the clutch actuator cylinder front pipe, remove the clutch/brake fluid from the reservoir tank.

2. Unclip the clutch actuator cylinder front pipe (1) from the retainers (2).

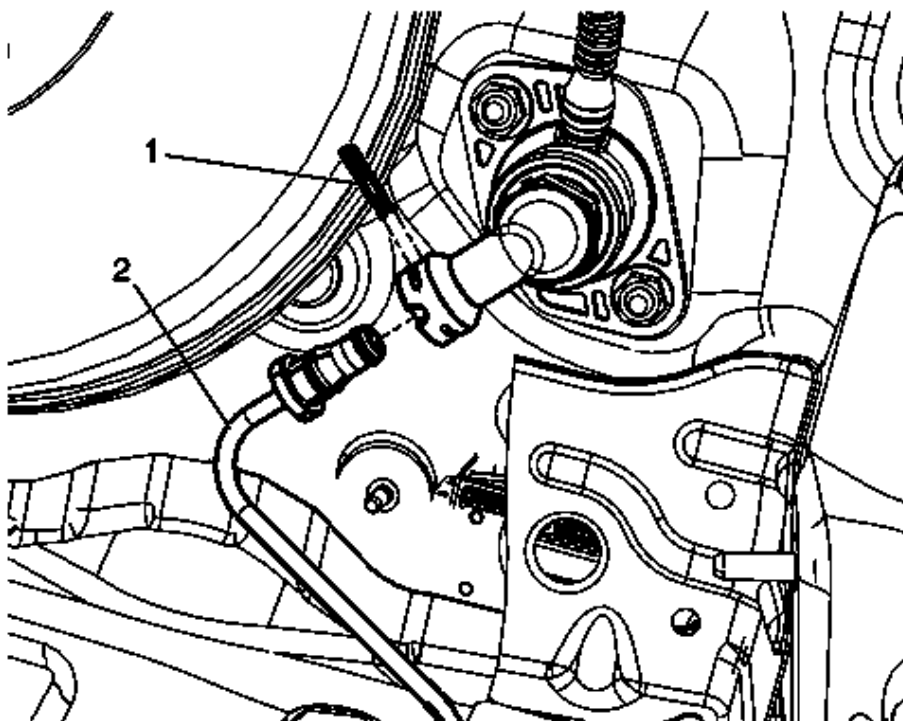


Fig. 5: Retaining Clip And Clutch Actuator Cylinder Front Pipe
Courtesy of GENERAL MOTORS COMPANY

3. Remove the retaining clip (1).
4. Disconnect the clutch actuator cylinder front pipe (2) from the clutch master cylinder.
5. Remove the clutch master cylinder reservoir hose from the master cylinder. Refer to **Clutch Master Cylinder Reservoir Hose Replacement**.

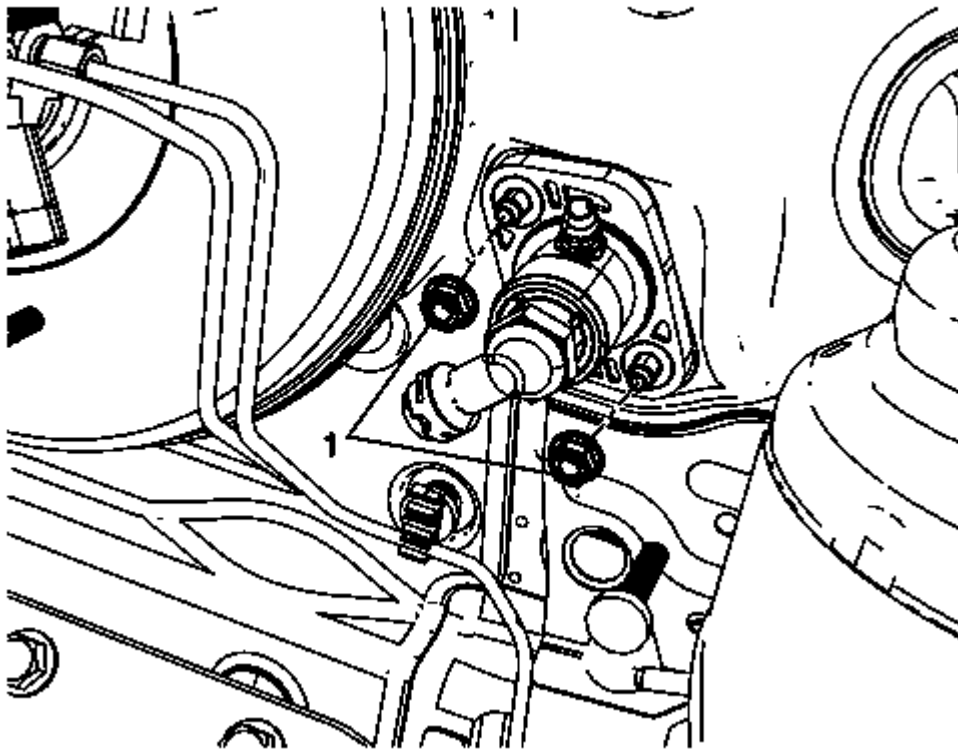


Fig. 6: 2 Clutch Master Cylinder Mount Nuts
Courtesy of GENERAL MOTORS COMPANY

6. Remove the 2 clutch master cylinder mount nuts (1).

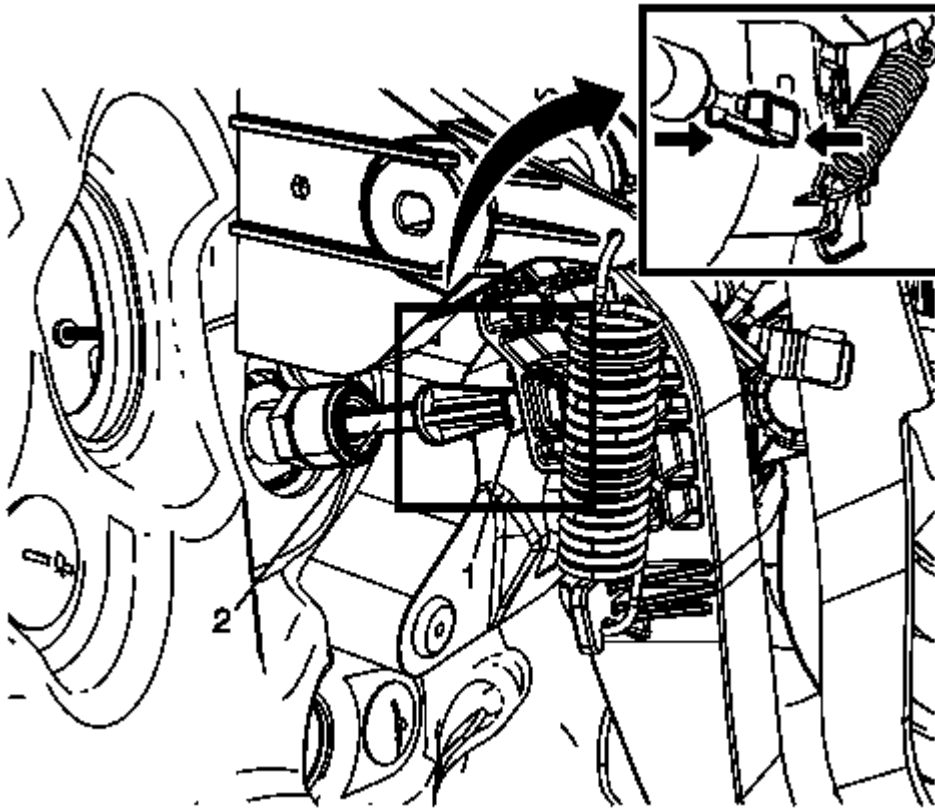


Fig. 7: Push Rod Retainer

Courtesy of GENERAL MOTORS COMPANY

NOTE: Press the 2 latches (arrows) together.

7. Remove the instrument panel lower reinforcement bracket. Refer to **Instrument Panel Lower Reinforcement Bracket Replacement**.
8. Disconnect the push rod retainer (1) from the clutch pedal.
9. Remove the clutch master cylinder (2).

Installation Procedure

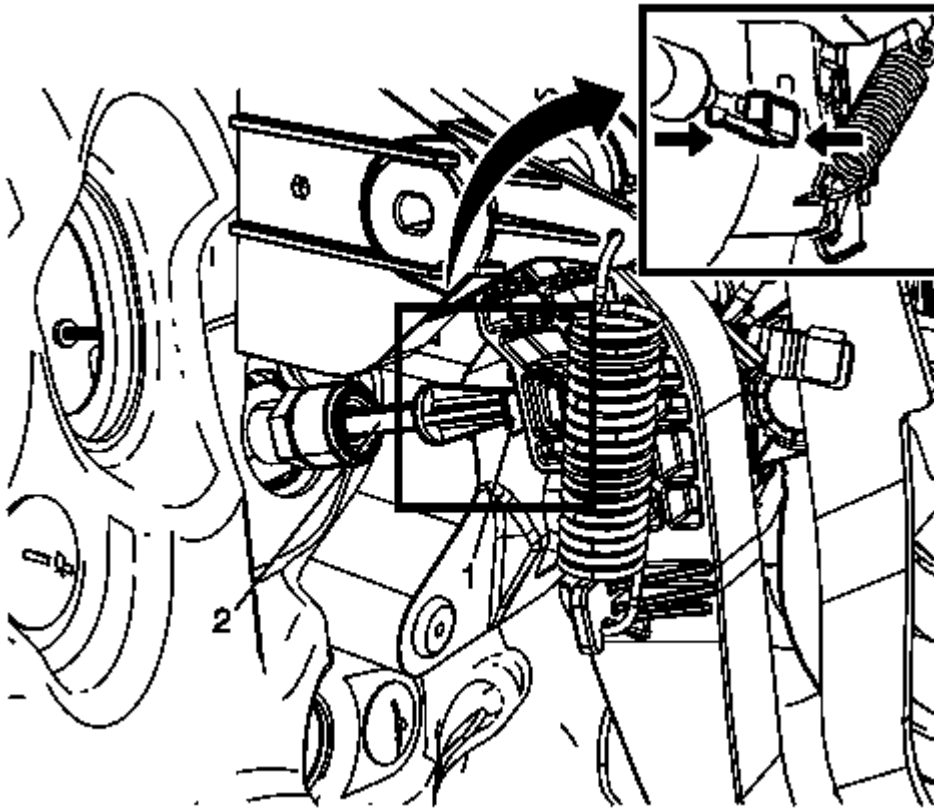


Fig. 8: Push Rod Retainer

Courtesy of GENERAL MOTORS COMPANY

NOTE: The retaining clip (arrows) has to engage audibly.

1. Install the clutch master cylinder (2).
2. Connect the push rod retainer (1) to the clutch pedal.
3. Install the instrument panel lower reinforcement bracket. Refer to **Instrument Panel Lower Reinforcement Bracket Replacement** .

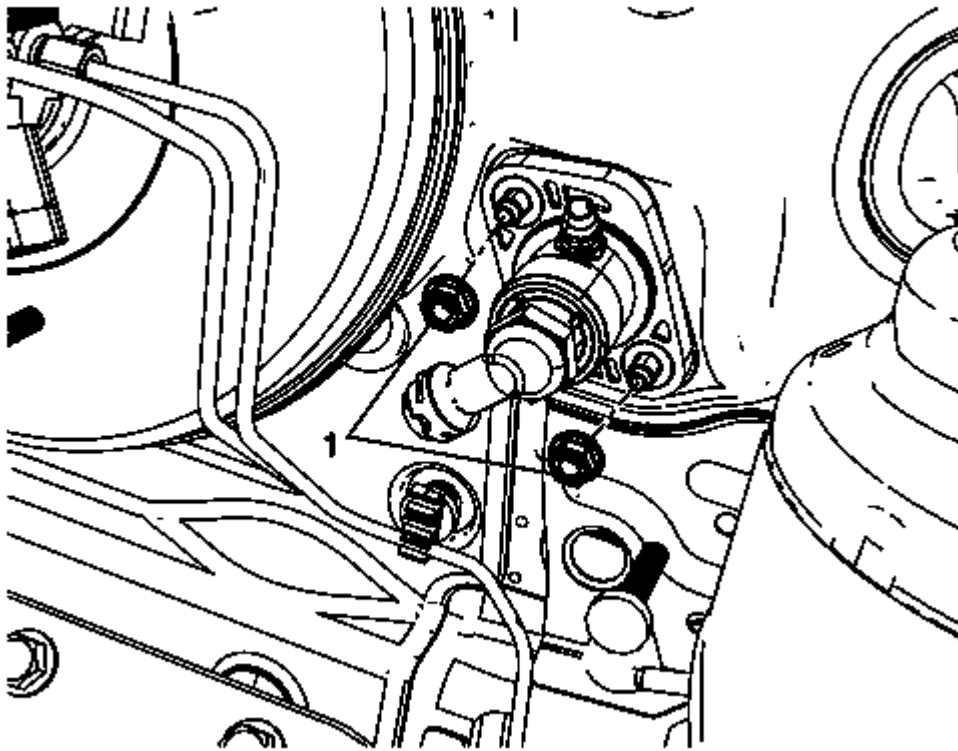


Fig. 9: 2 Clutch Master Cylinder Mount Nuts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

4. Install the 2 clutch master cylinder mount nuts (1) and tighten to 22 (16 lb ft).
5. Install the clutch master cylinder reservoir hose to the master cylinder. Refer to Clutch Master Cylinder Reservoir Hose Replacement.

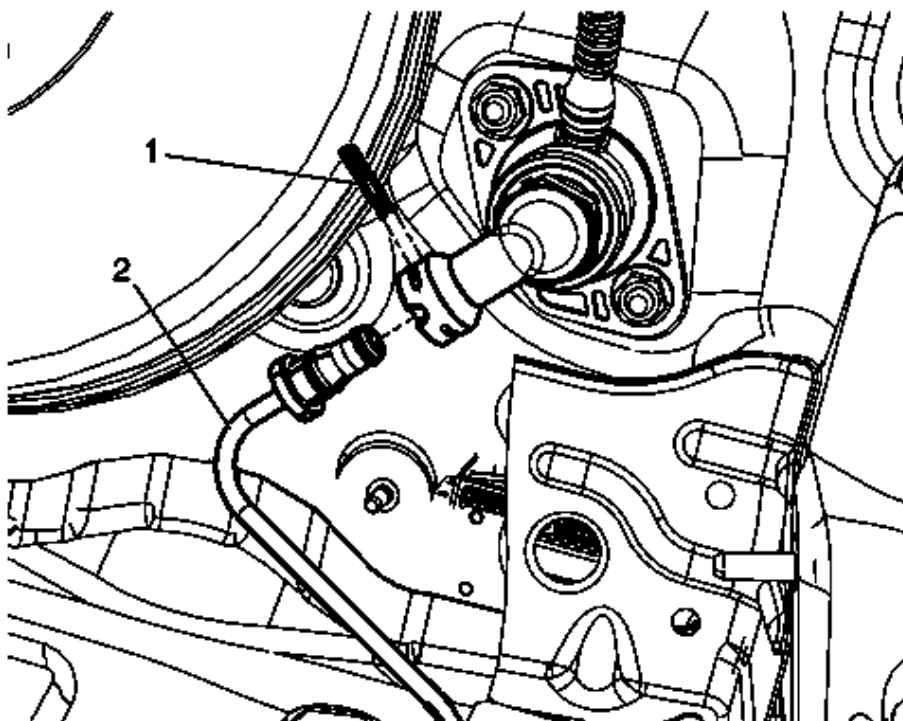


Fig. 10: Retaining Clip And Clutch Actuator Cylinder Front Pipe
Courtesy of GENERAL MOTORS COMPANY

6. Install the retaining clip (1).
7. Connect the clutch actuator cylinder front pipe (2) to the clutch master cylinder.

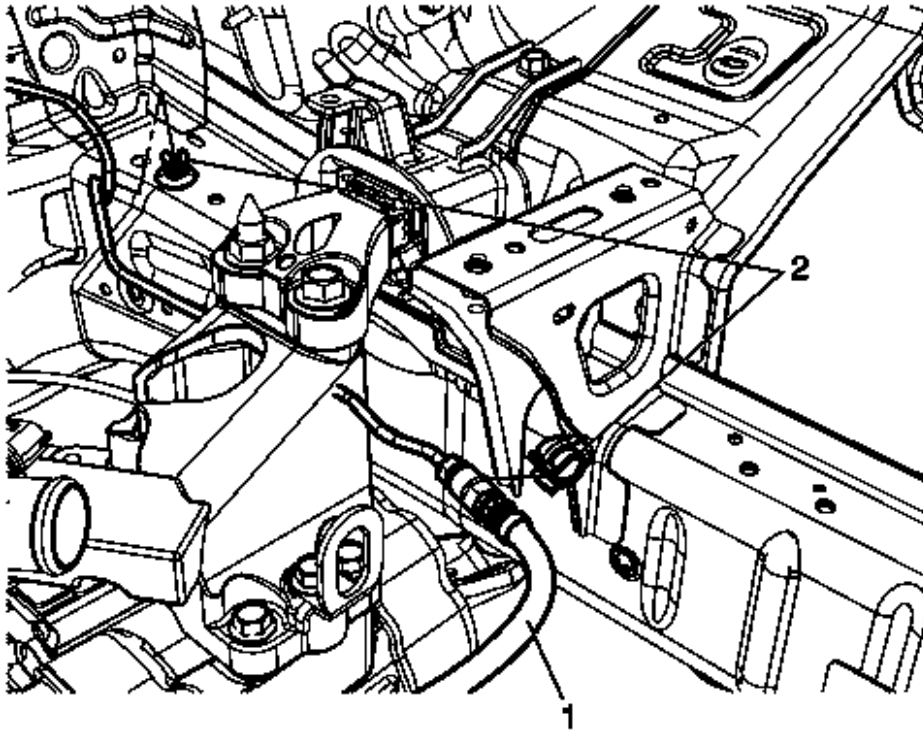


Fig. 11: Clutch Actuator Cylinder Front Pipe
Courtesy of GENERAL MOTORS COMPANY

8. Clip the clutch actuator cylinder front pipe (1) to the retainers (2).
9. Bleed the hydraulic clutch system. Refer to **Hydraulic Clutch System Bleeding**.
10. Fill the reservoir with clutch/brake fluid up to the MAX level.
11. Install the battery tray. Refer to **Battery Tray Replacement**.

CLUTCH ACTUATOR CYLINDER FRONT PIPE REPLACEMENT

Removal Procedure

1. Remove the battery tray. Refer to **Battery Tray Replacement**.
2. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement**.

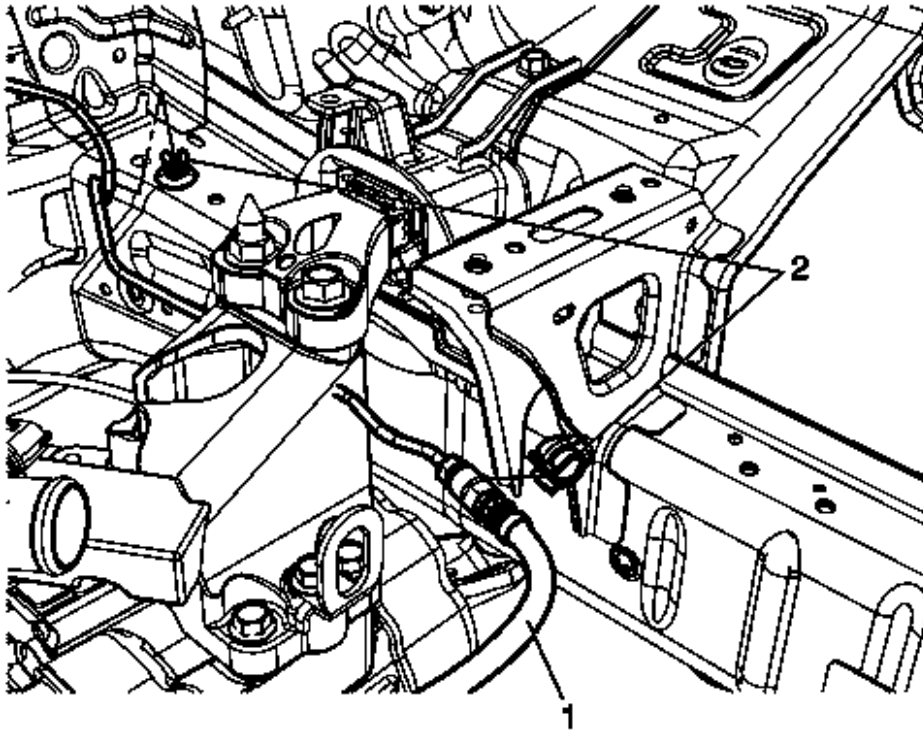


Fig. 12: Clutch Actuator Cylinder Front Pipe
Courtesy of GENERAL MOTORS COMPANY

3. Unclip the clutch actuator cylinder front pipe (1) from the retainers (2).

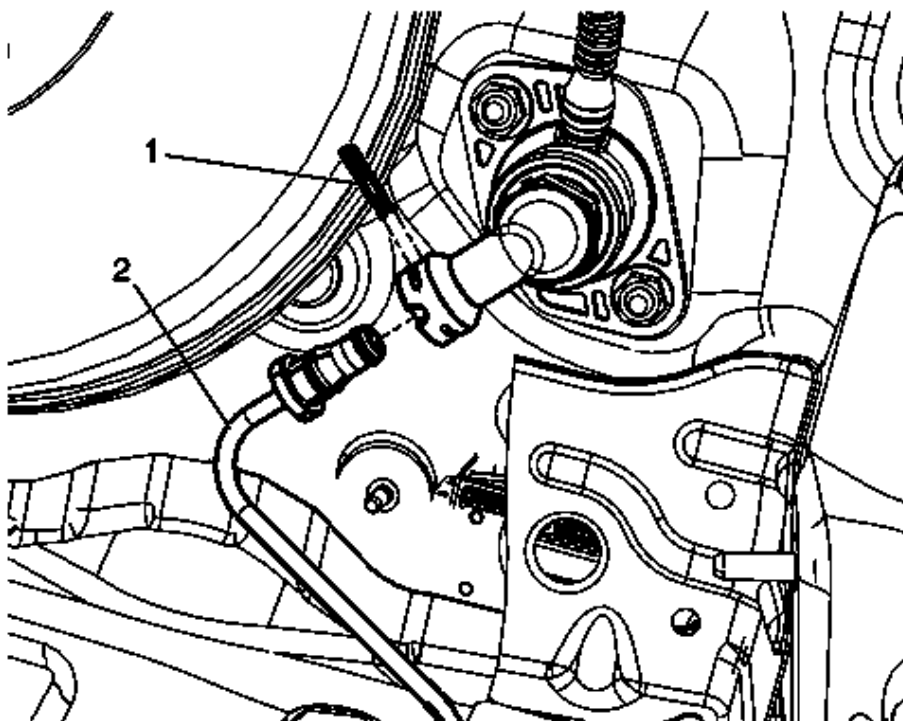


Fig. 13: Retaining Clip And Clutch Actuator Cylinder Front Pipe
Courtesy of GENERAL MOTORS COMPANY

NOTE: Before disconnecting the clutch actuator cylinder front pipe, remove the clutch/brake fluid from the reservoir tank.

4. Remove the retaining clip (1).
5. Disconnect the clutch actuator cylinder front pipe (2) from the clutch master cylinder.

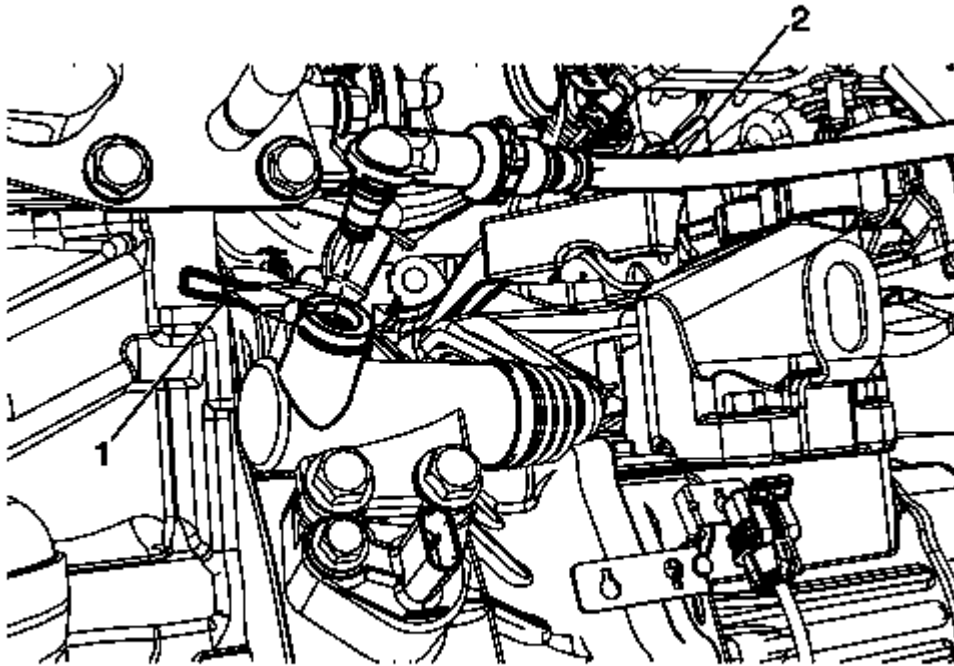


Fig. 14: Clutch Actuator Cylinder Front Pipe
Courtesy of GENERAL MOTORS COMPANY

6. Remove the retaining clip (1).
7. Disconnect the clutch actuator cylinder front pipe (2) from the clutch actuator cylinder.
8. Remove the clutch actuator cylinder front pipe.

Installation Procedure

1. Install the clutch actuator cylinder front pipe.

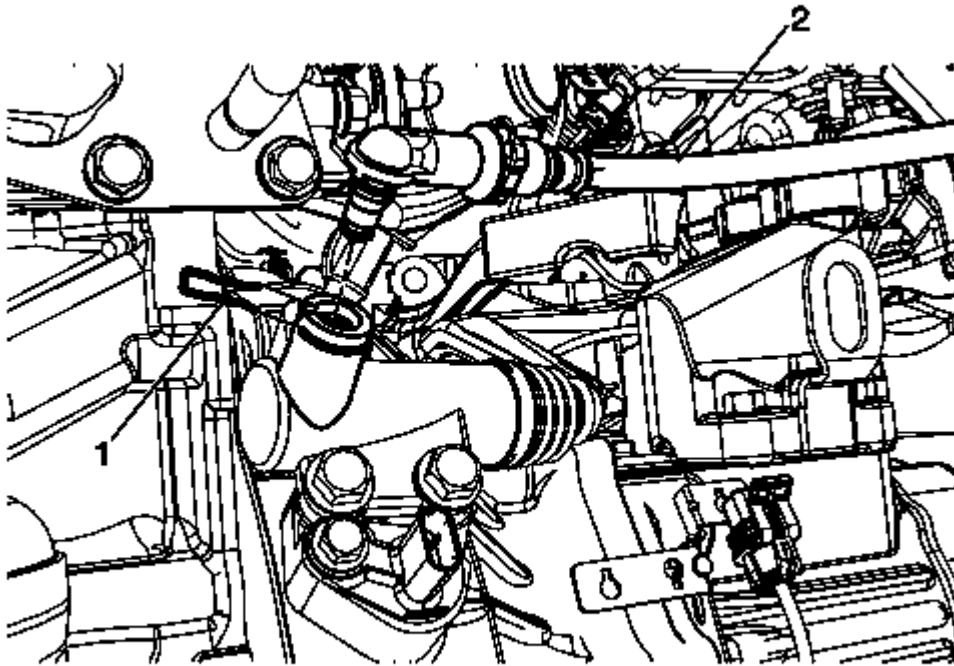


Fig. 15: Clutch Actuator Cylinder Front Pipe
Courtesy of GENERAL MOTORS COMPANY

2. Install the retaining clip (1).
3. Connect the clutch actuator cylinder front pipe (2) to the clutch actuator cylinder.

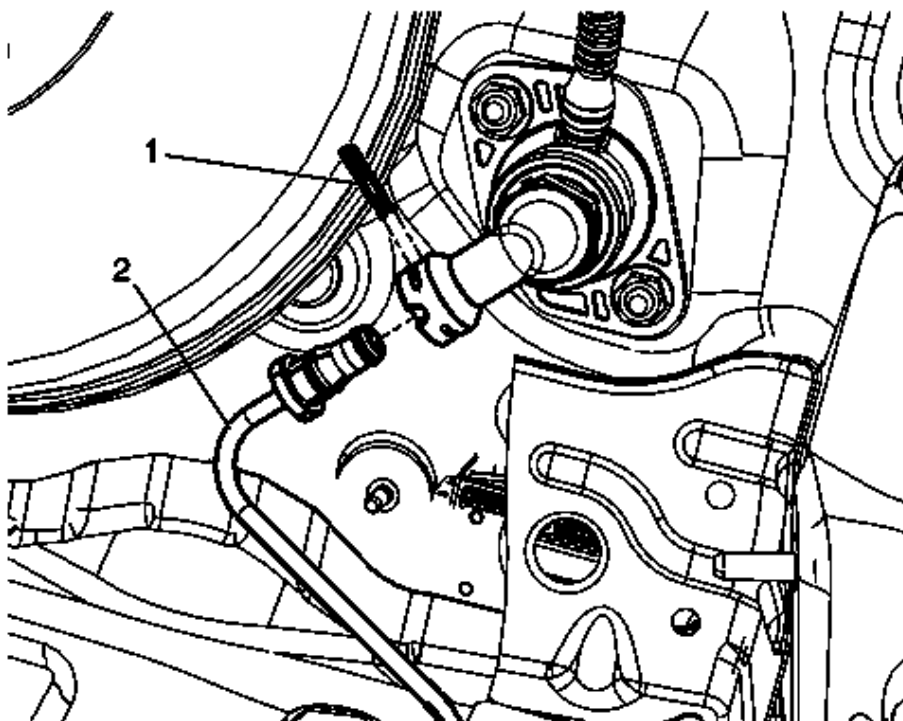


Fig. 16: Retaining Clip And Clutch Actuator Cylinder Front Pipe
Courtesy of GENERAL MOTORS COMPANY

4. Install the retaining clip (1).
5. Connect the clutch actuator cylinder front pipe (2) to the clutch master cylinder.

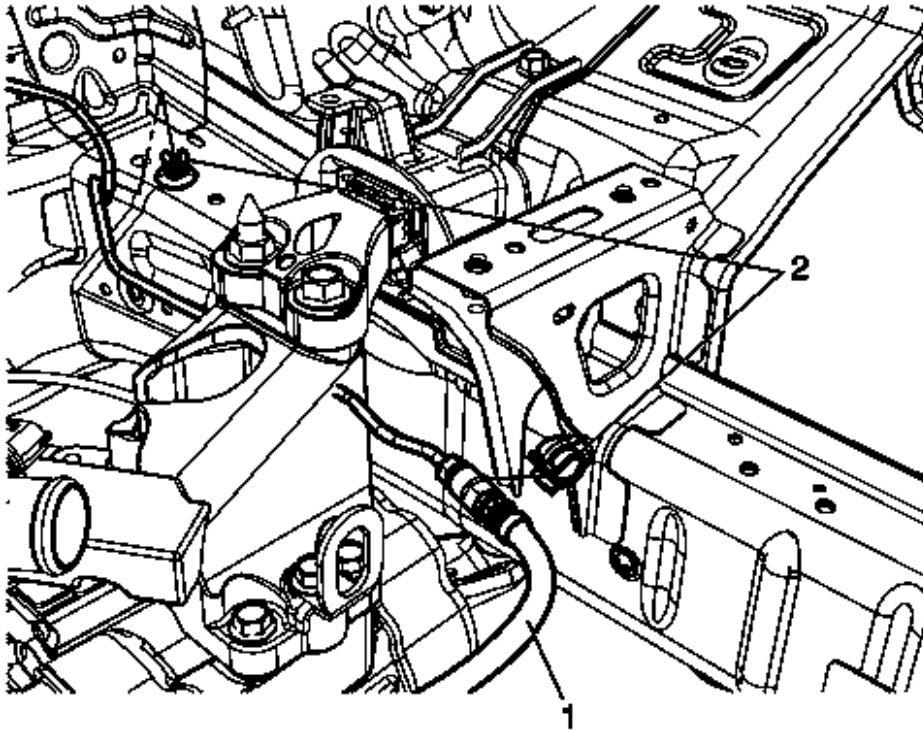


Fig. 17: Clutch Actuator Cylinder Front Pipe
Courtesy of GENERAL MOTORS COMPANY

6. Clip the clutch actuator cylinder front pipe (1) to the retainers (2).
7. Bleed the hydraulic clutch system. Refer to **Hydraulic Clutch System Bleeding**.
8. Fill the reservoir with clutch/brake fluid up to the MAX level.
9. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
10. Install battery tray. Refer to **Battery Tray Replacement** .

HYDRAULIC CLUTCH SYSTEM BLEEDING

WARNING: Refer to **Brake Fluid Irritant Warning** .

CAUTION: Refer to **Brake Fluid Effects on Paint and Electrical Components Caution** .

NOTE: Brake fluid must not come in contact with mineral oils and greases. The smallest amount of such could lead to malfunction or breakdown of the clutch.

NOTE: The hydraulic clutch actuation must only be bled from "below", i.e. from the bleeder valve.

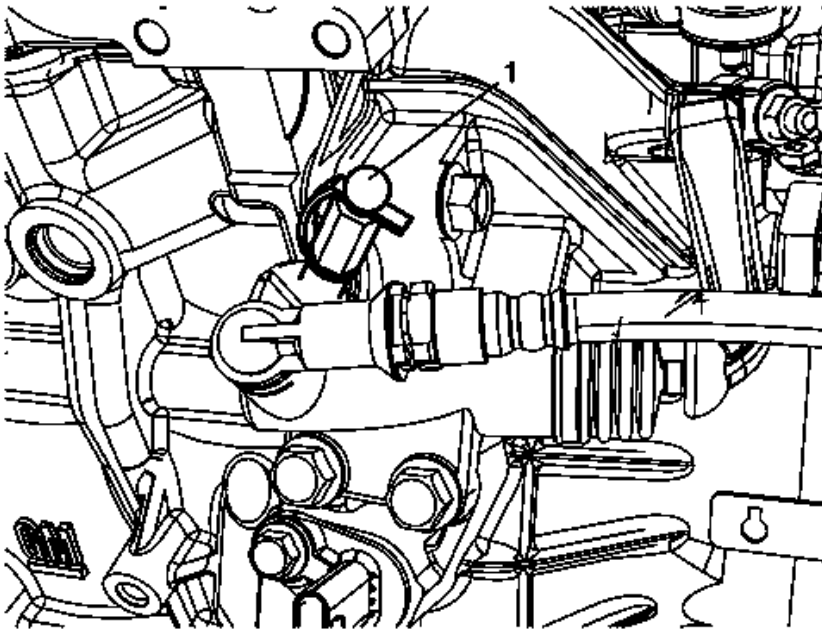


Fig. 18: Identifying Valve Cap

Courtesy of GENERAL MOTORS COMPANY

NOTE: The following operational stages must be undertaken to fill the pressure line between the master cylinder and the clutch actuator cylinder. When bleeding, ensure that the brake fluid reservoir is always full and does not run dry.

1. Bleed pressure line between the clutch master cylinder and the clutch actuator cylinder using the following procedure:
 1. Remove the valve cap (1) from the bleeder valve.
 2. Fill brake fluid reservoir up to "MAX" marking.
 3. Press and hold clutch pedal.
 4. Open bleeder valve until air or air/brake fluid mixture emerges.

NOTE: Do not close the bleeder valve too fast.

5. Close the bleeder valve.
6. Release the clutch pedal slowly.
7. Wait approximately 5 seconds.

8. Repeat this bleeding process 4 times.
9. Tighten bleeder valve.
10. Push valve cap on to bleeder valve to protect the bleeder valve.
2. Check shifting for ease of movement with vehicle stationary, with engine running and with clutch disengaged.
3. Road test the vehicle to ensure proper operation.

Undertake road test using varying RPM ranges and frequent gear changes, bring vehicle to operating temperature during this process. Ensure the brake and clutch system is operating correctly.

CLUTCH PEDAL POSITION SENSOR REPLACEMENT

Removal Procedure

1. Remove the instrument panel lower reinforcement bracket. Refer to **Instrument Panel Lower Reinforcement Bracket Replacement** .
2. Remove the intermediate steering shaft. Refer to **Intermediate Steering Shaft Replacement** .

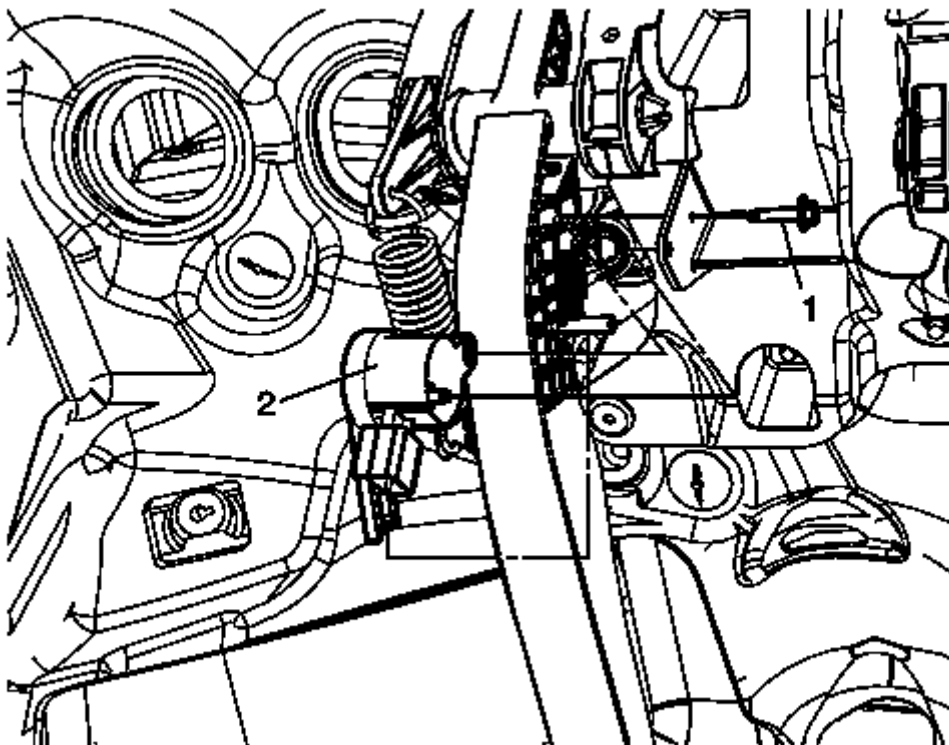


Fig. 19: Clutch Pedal Position Sensor Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the clutch pedal position sensor wiring harness connector.
4. Remove the clutch pedal position sensor bolt (1).
5. Remove the clutch pedal position sensor (2).

Installation Procedure

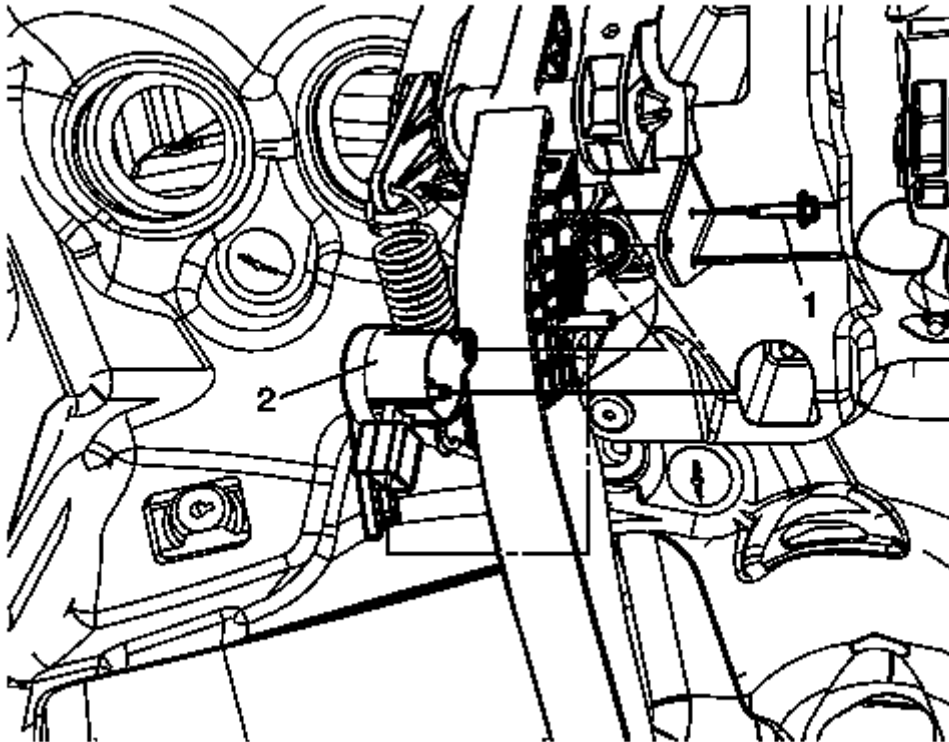


Fig. 20: Clutch Pedal Position Sensor Bolt
Courtesy of GENERAL MOTORS COMPANY

1. Install the clutch pedal position sensor (2).

CAUTION: Refer to Fastener Caution .

2. Install the clutch pedal position sensor bolt (1) and tighten to 3 (27 lb in).
3. Connect the clutch pedal position sensor wiring harness connector.
4. Install the intermediate steering shaft. Refer to **Intermediate Steering Shaft Replacement** .
5. Install the instrument panel lower reinforcement bracket. Refer to **Instrument Panel Lower Reinforcement Bracket Replacement** .

CLUTCH PRESSURE AND DRIVEN PLATE REPLACEMENT

Special Tools

- DT-6263-30 Drift
- DT-6263-23 Clutch Center Guide

For equivalent regional tools, refer to Special Tools.

Removal Procedure

1. Remove the transmission from the vehicle. Refer to Transmission Replacement (MX2, MFM) .

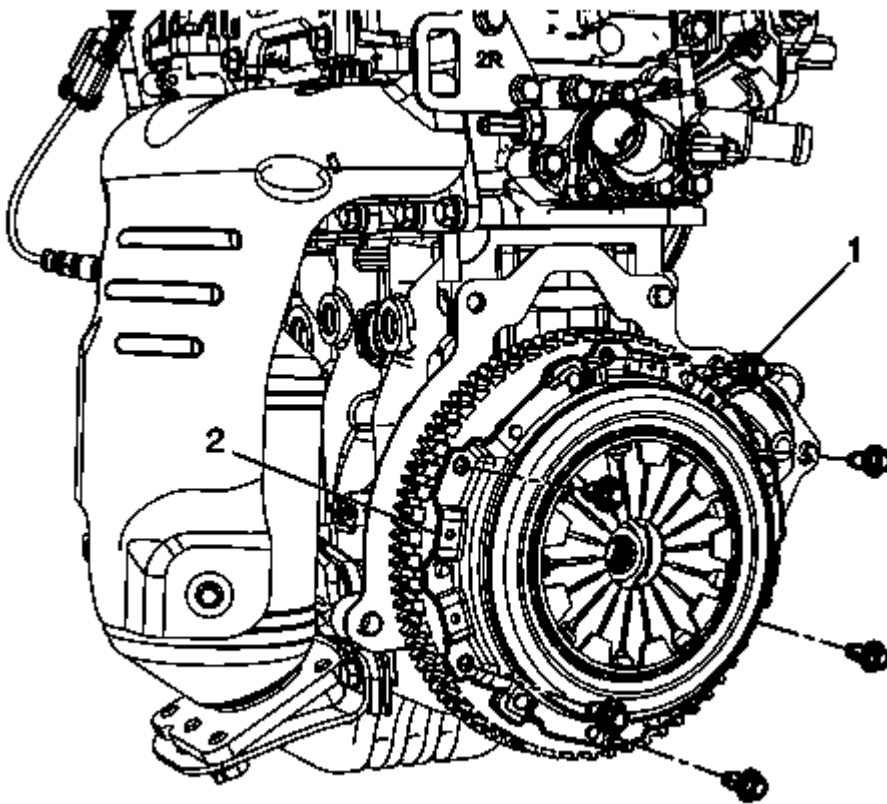


Fig. 21: Clutch Pressure Plate Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: Remove the clutch pressure plate bolts symmetrically to avoid clutch pressure plate distortion.

2. Remove and DISCARD the 6 clutch pressure plate bolts (1).
3. Remove the clutch pressure plate and clutch disc (2).

Pressure Plate Inspection Procedure

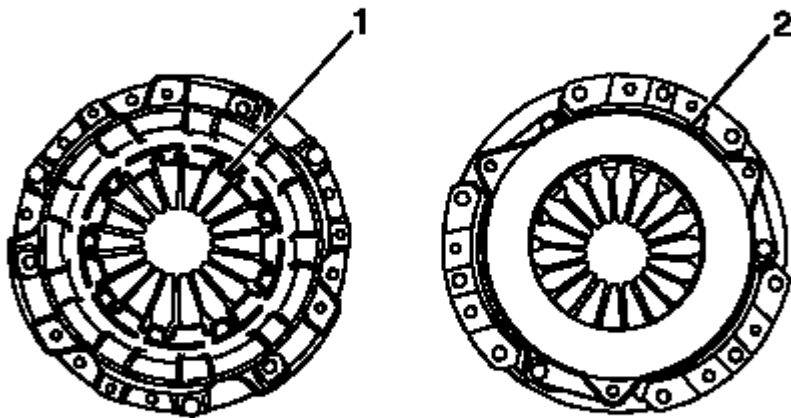


Fig. 22: Weak And Damaged Diaphragm Spring
Courtesy of GENERAL MOTORS COMPANY

1. Inspect the weak and damaged diaphragm spring (1).
2. Inspect the face that may be polluted by the oil or grease (2).

Clutch Disc Inspection Procedure

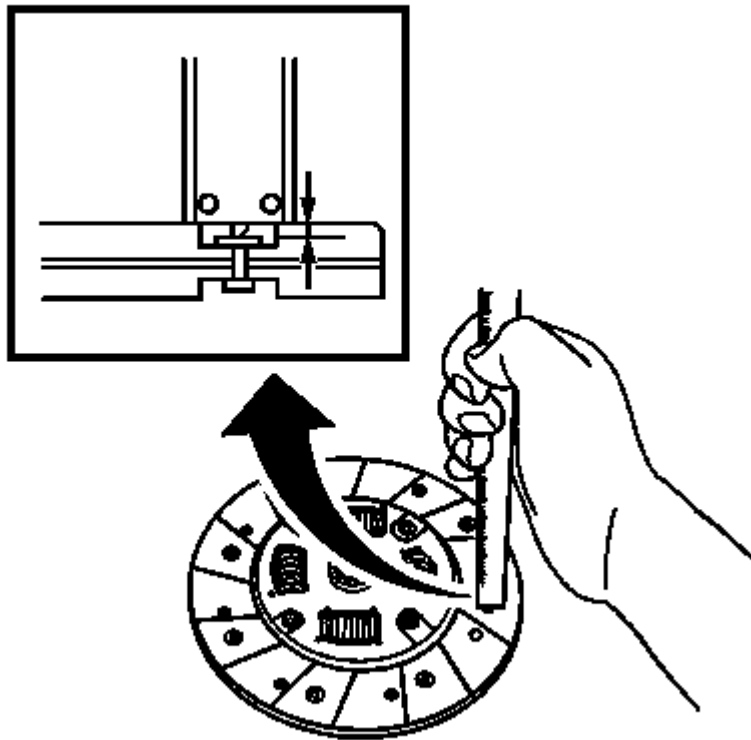


Fig. 23: Clutch Disc Inspection

Courtesy of GENERAL MOTORS COMPANY

1. Measure the rivet head depth from the clutch disc surface and replace if the depth is below the limit.

Specifications

- Rivet head depth for standard equals 1.1 mm (0.043 in).
 - Rivet head depth for limit equals 0.4 mm (0.016 in).
2. Replace the clutch disc if the clutch disc surface is contaminated or if the clutch disc rivets are loose.

Clutch Disc Runout In A Rotational Direction Inspection Procedure

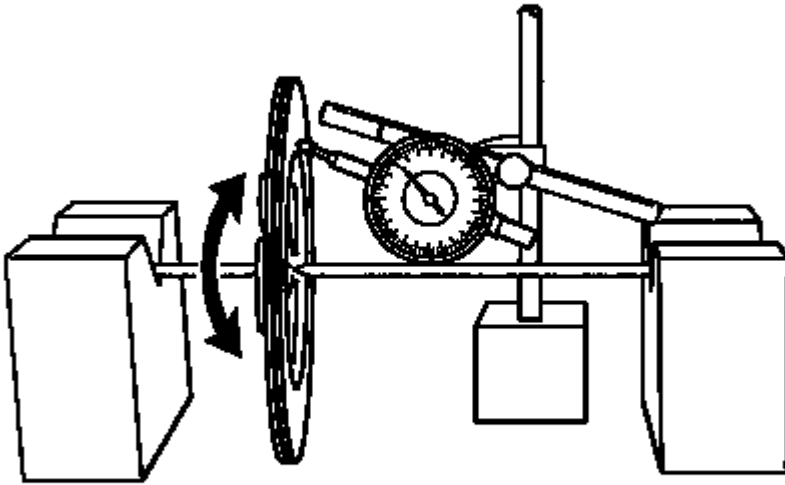


Fig. 24: Measuring Runout In Rotational Direction
Courtesy of GENERAL MOTORS COMPANY

Measure the runout in a rotational direction and replace if the runout exceeds the limit.

Specifications

The disc runout limit in a rotational direction equals 0.7 mm (0.028 in).

Installation Procedure

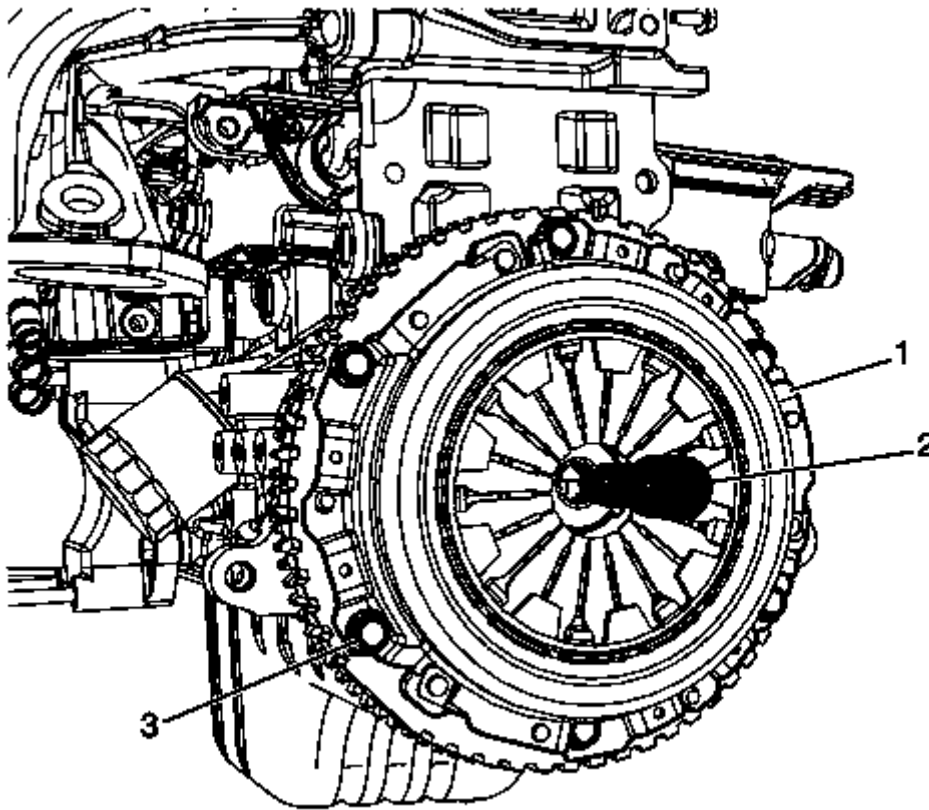


Fig. 25: Clutch Pressure Plate And Clutch Disc
Courtesy of GENERAL MOTORS COMPANY

1. Install the clutch pressure plate and clutch disc (1) to the flywheel.
2. Attach the **DT-6263-23** clutch center guide to the **DT-6263-30** drift.
3. Align the clutch pressure plate and clutch disc onto the flywheel using the **DT-6263-23** clutch center guide (2) and the **DT-6263-30** drift.

CAUTION: Refer to Fastener Caution .

4. Install the 6 NEW clutch pressure plate bolts (3) and tighten the bolts crosswise to 28 N•m (21 lb ft).
5. Remove the **DT-6263-23** clutch center guide (2) and the **DT-6263-30** drift.
6. Install the transmission to the vehicle. Refer to **Transmission Replacement (MX2, MFM)** .

CLUTCH PEDAL ARM REPLACEMENT

Removal Procedure

1. Remove the clutch actuator cylinder. Refer to **Clutch Actuator Cylinder Replacement**.

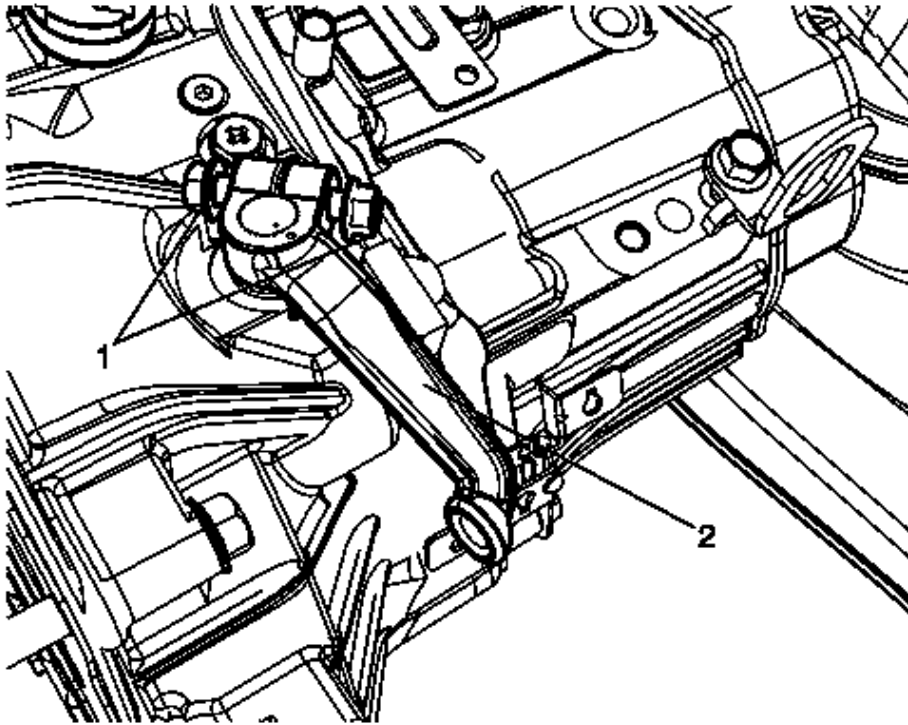


Fig. 26: Clutch Pedal Arm Bolt And Nut
Courtesy of GENERAL MOTORS COMPANY

2. Loosen the clutch pedal arm bolt and nut (1).
3. Remove the clutch release arm (2).

Installation Procedure

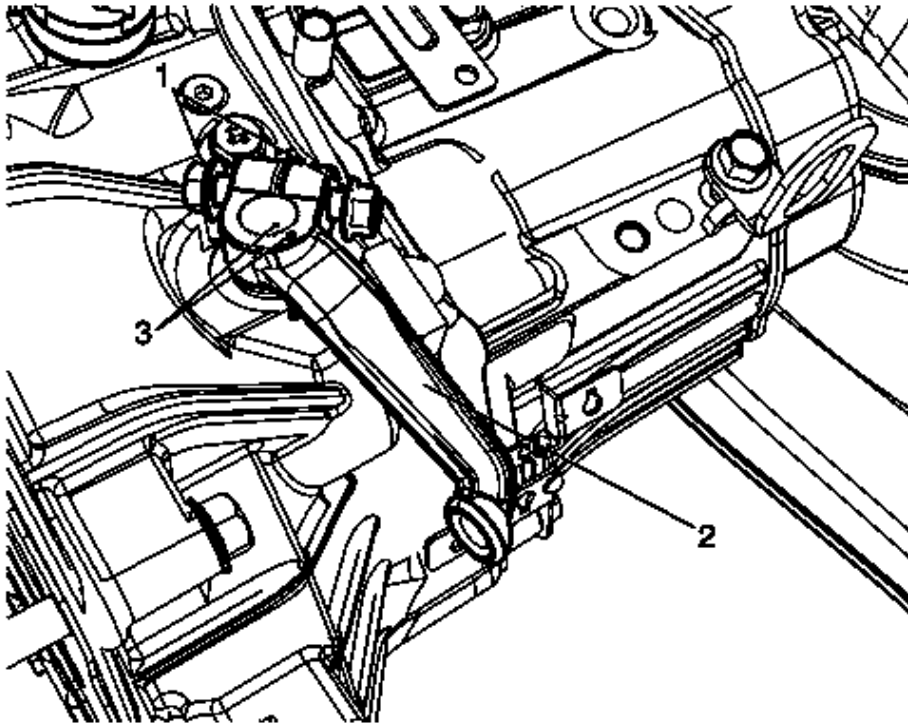


Fig. 27: Clutch Pedal Arm

Courtesy of GENERAL MOTORS COMPANY

1. Install the clutch pedal arm (2) to the clutch fork shaft and align to the marked position (3).

CAUTION: Refer to Fastener Caution .

2. Install the clutch pedal arm bolt and nut (1) and tighten to 17 (13 lb ft).
3. Install the clutch actuator cylinder. Refer to **Clutch Actuator Cylinder Replacement**.

CLUTCH RELEASE BEARING REPLACEMENT

Removal Procedure

1. Remove the transmission from the vehicle. Refer to **Transmission Replacement (MX2, MFM)** .
2. Remove the clutch pedal arm. Refer to **Clutch Pedal Arm Replacement**.

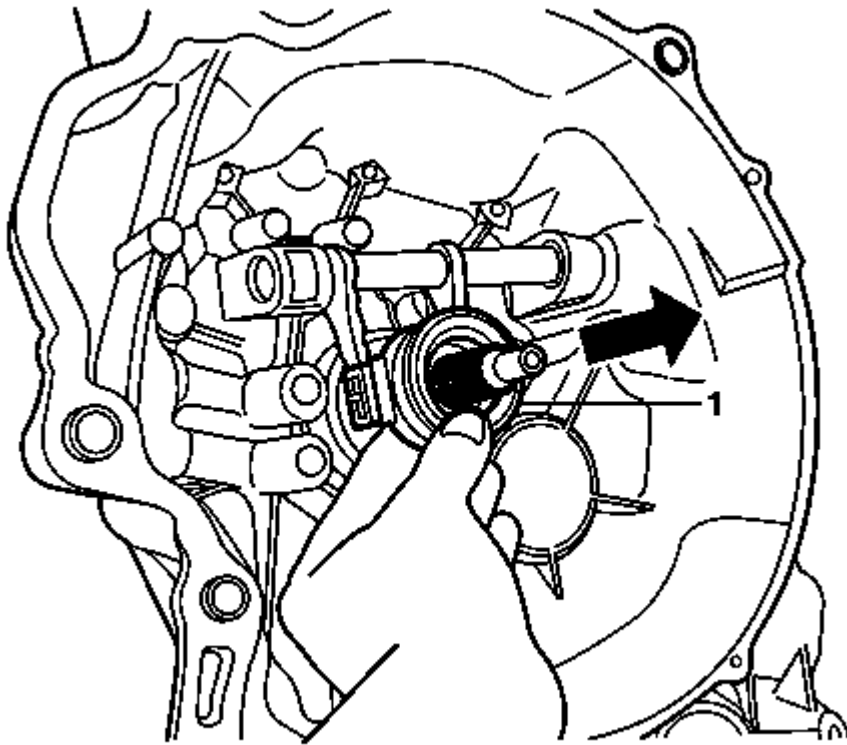


Fig. 28: Clutch Release Bearing

Courtesy of GENERAL MOTORS COMPANY

3. Remove the clutch release bearing (1).

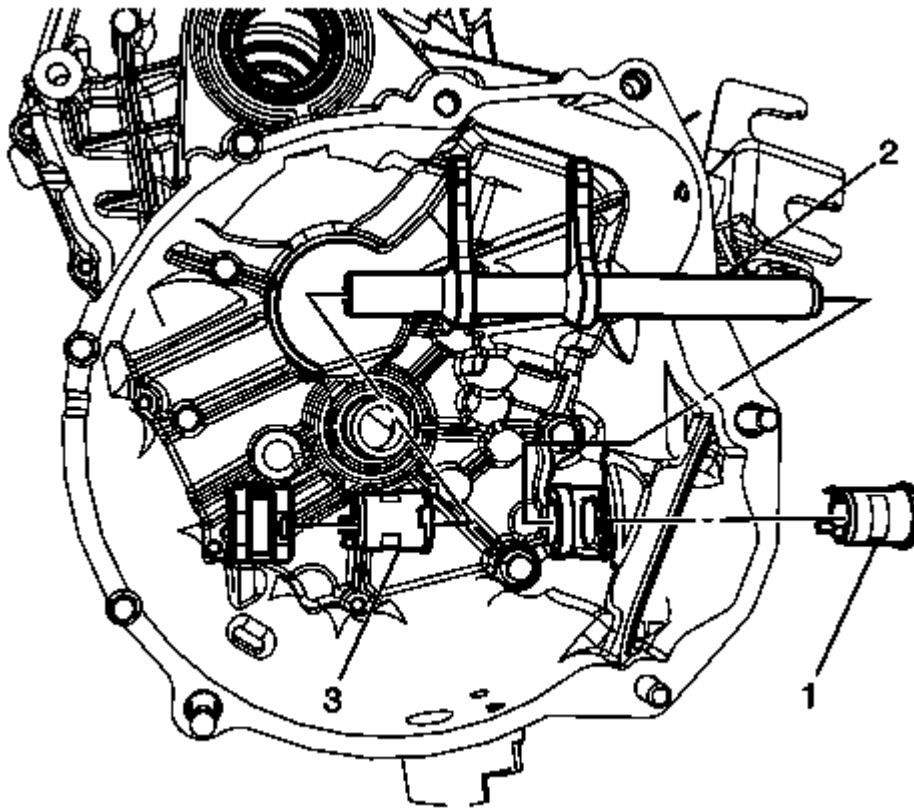


Fig. 29: Clutch Fork Shaft Bushing
Courtesy of GENERAL MOTORS COMPANY

4. Remove the clutch fork shaft bushing (1).
5. Remove the clutch fork shaft (2).
6. Remove the clutch fork shaft bushing (3).

Installation Procedure

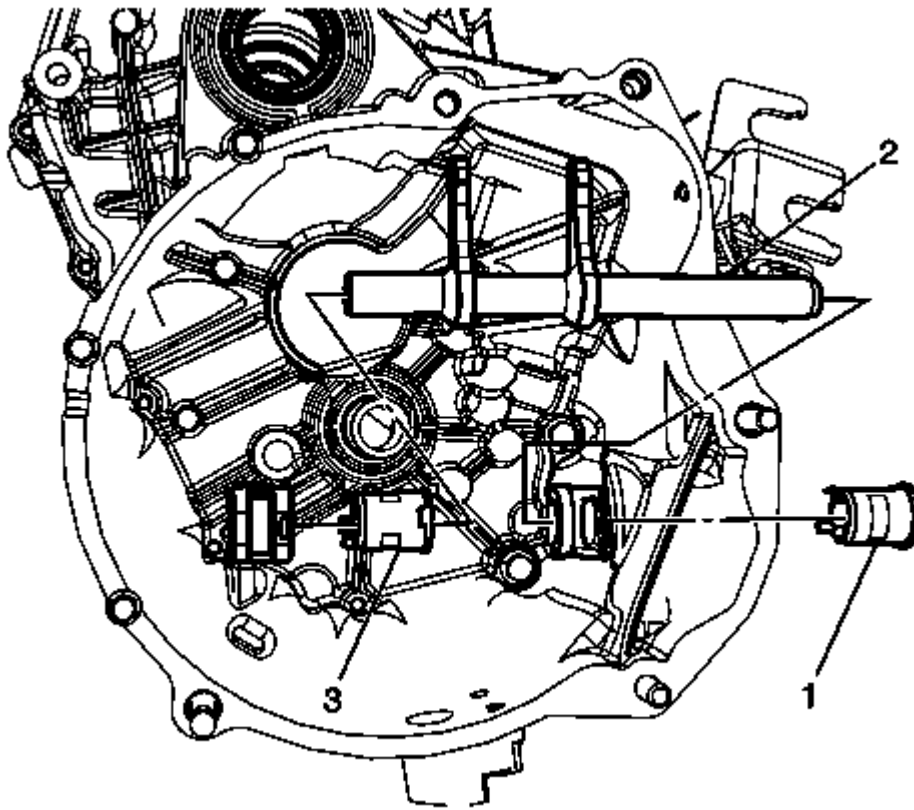


Fig. 30: Clutch Fork Shaft Bushing
Courtesy of GENERAL MOTORS COMPANY

1. Install the clutch fork shaft bushing (3).
2. Coat the clutch fork shaft and bushing with grease.
3. Install the clutch fork shaft (2).
4. Install the clutch fork shaft bushing (1).

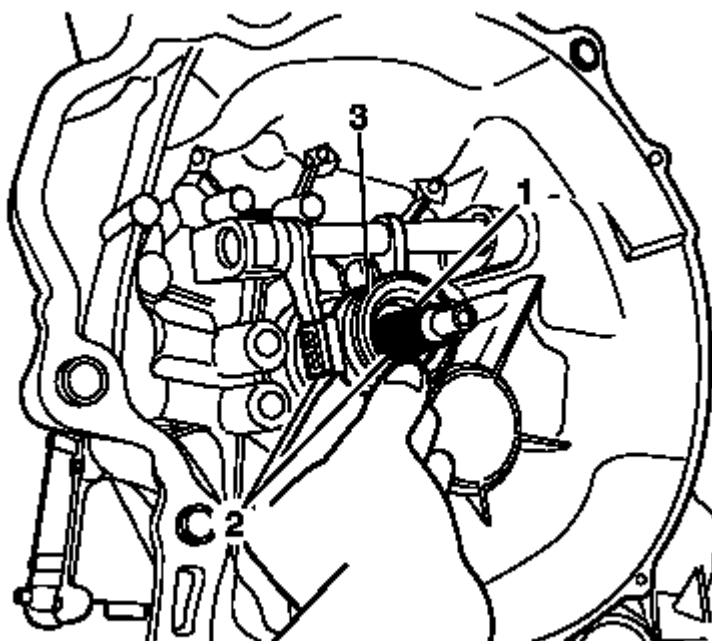


Fig. 31: Clutch Release Bearing

Courtesy of GENERAL MOTORS COMPANY

5. Coat the spline of the transmission input shaft with multi-purpose grease (1).
6. Coat the release bearing bore and the connecting of the clutch fork shaft with multi-purpose grease (2).
7. Install the clutch release bearing (3).
8. Install the clutch pedal arm. Refer to **Clutch Pedal Arm Replacement**.
9. Install the transmission to the vehicle. Refer to **Transmission Replacement (MX2, MFM)** .

CLUTCH ACTUATOR CYLINDER REPLACEMENT

Removal Procedure

1. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .

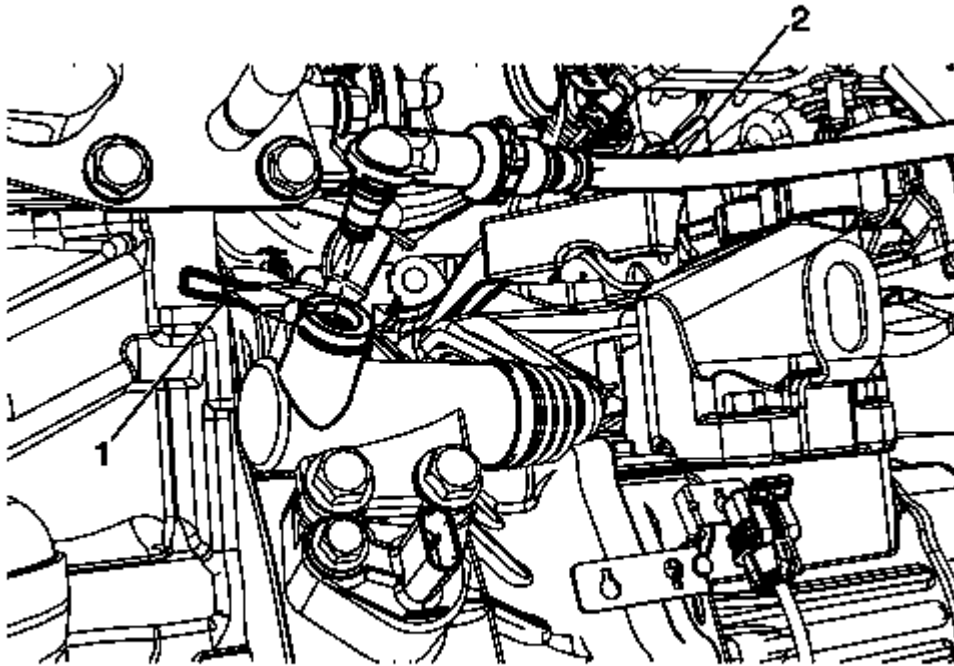


Fig. 32: Clutch Actuator Cylinder Front Pipe
Courtesy of GENERAL MOTORS COMPANY

NOTE: Before disconnecting the clutch actuator cylinder front pipe, remove the clutch/brake fluid from the reservoir tank.

2. Remove the retaining clip (1).
3. Disconnect the clutch actuator cylinder front pipe (2) from the clutch actuator cylinder.

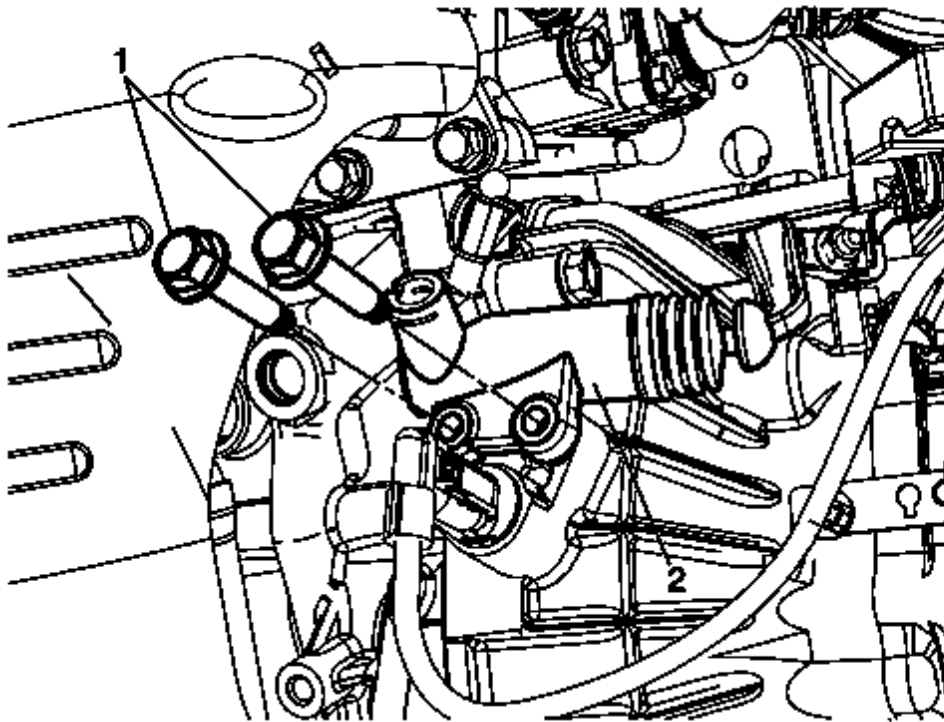


Fig. 33: Clutch Actuator Cylinder Mount Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove the clutch actuator cylinder mount bolts (1).
5. Remove the clutch actuator cylinder (2).

Installation Procedure

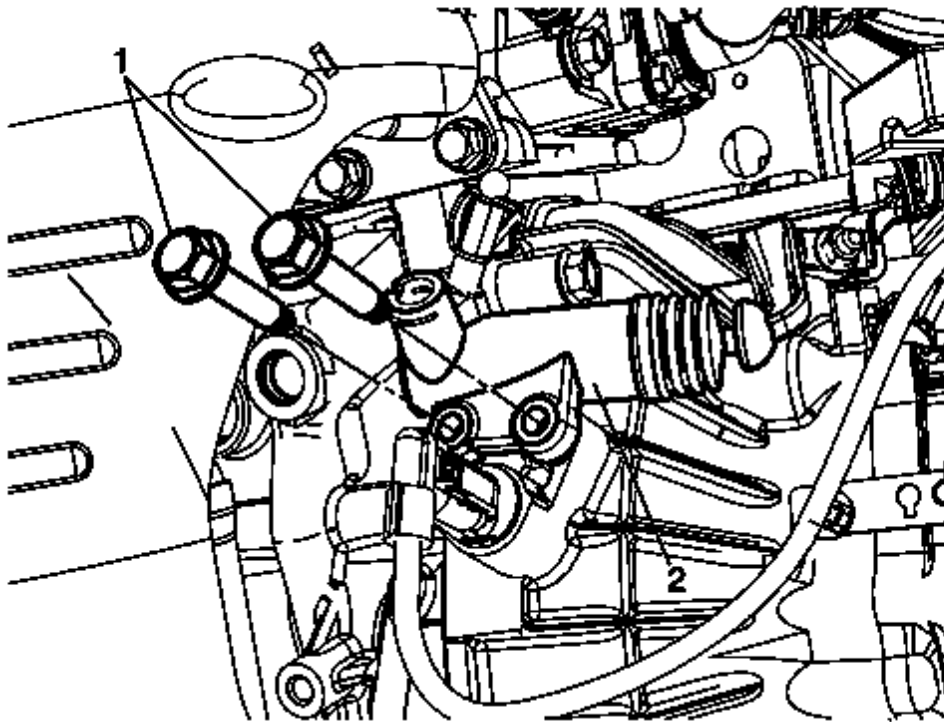


Fig. 34: Clutch Actuator Cylinder Mount Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the clutch actuator cylinder (2).

CAUTION: Refer to Fastener Caution .

2. Install the clutch actuator cylinder mount bolts (1) and tighten to 22 (16 lb ft).

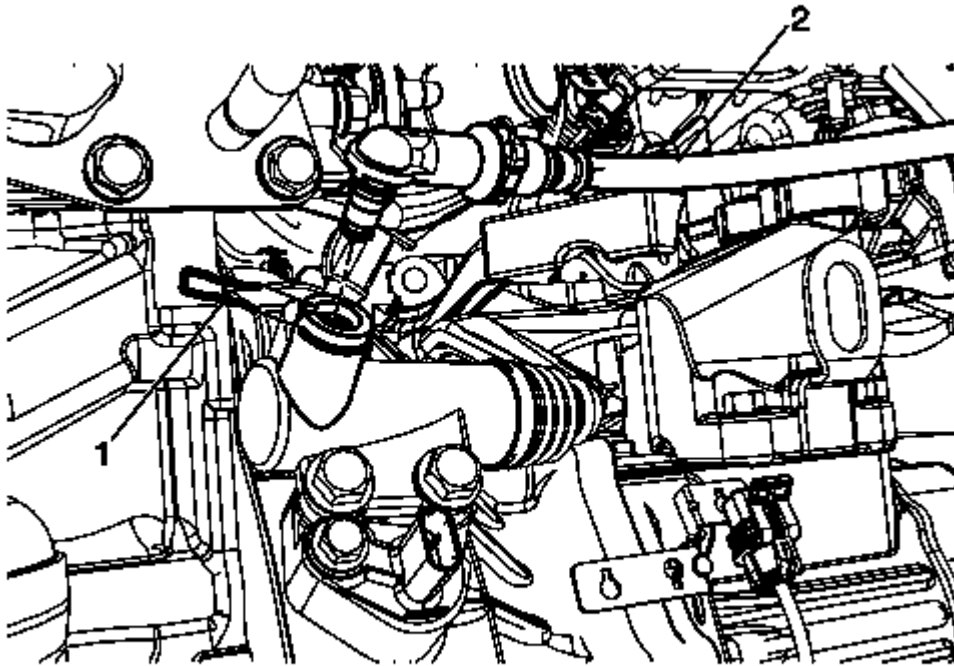


Fig. 35: Clutch Actuator Cylinder Front Pipe
Courtesy of GENERAL MOTORS COMPANY

3. Install the retaining clip (1).
4. Connect the clutch actuator cylinder front pipe (2) to the clutch actuator cylinder.
5. Bleed the hydraulic clutch system. Refer to **Hydraulic Clutch System Bleeding**.
6. Fill the reservoir with clutch/brake fluid up to the MAX level.
7. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .

CLUTCH RELEASE BEARING AND DOOR SHAFT INSPECTION

Release Bearing Inspection

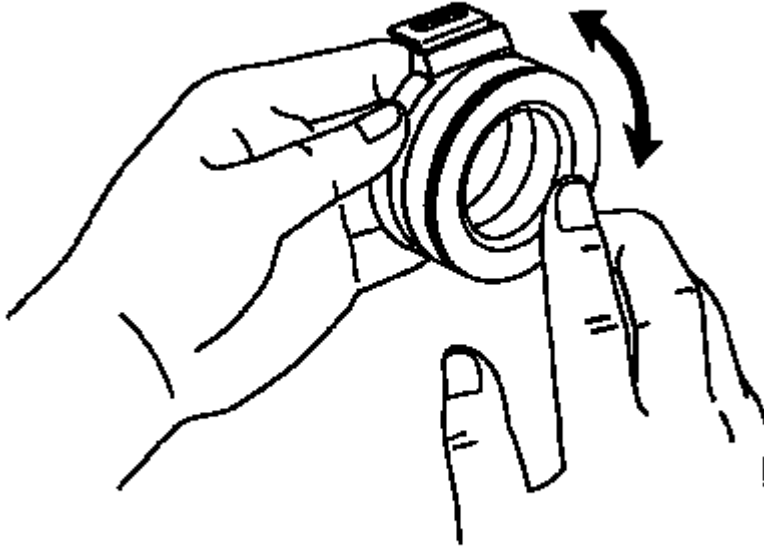


Fig. 36: Clutch Release Bearing and Door Shaft Inspection
Courtesy of GENERAL MOTORS COMPANY

1. Inspect for a noisy, worn, and damaged release bearing.
2. Inspect for a grabbing rotation of release bearing.
3. Replace the release bearing if necessary.

Release Shaft Inspection

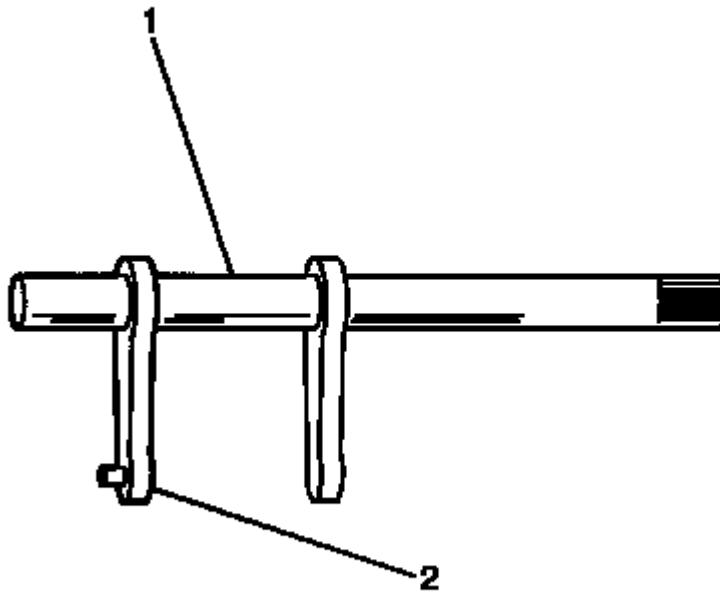


Fig. 37: Warped Shaft And Worn Fork
Courtesy of GENERAL MOTORS COMPANY

1. Inspect for a warped shaft (1).
2. Inspect for a worn fork (2).
3. Replace the shaft if necessary.

DESCRIPTION AND OPERATION

CLUTCH SYSTEM DESCRIPTION AND OPERATION

Driving Members

The driving members consist of 2 flat surfaces machined to a smooth finish. One of these is the rear face of the engine flywheel, and the other is the pressure plate. The pressure plate is fitted into a steel cover, which is bolted to the flywheel.

Driven Members

The driven member is the clutch disc with a splined hub which is free to slide lengthwise along the splines of the input shaft, but which drives the input shaft through these same splines.

The driving and driven members are held in contact by spring pressure. This pressure is exerted by a diaphragm spring in the pressure plate assembly.

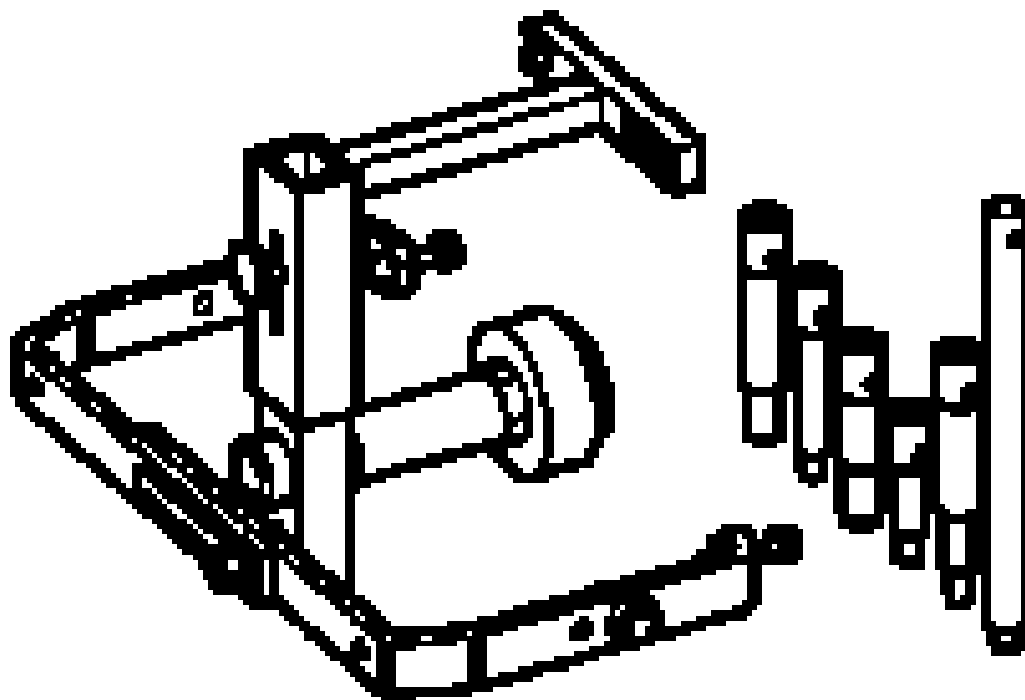
Operating Members

The clutch release system consists of the clutch pedal, the clutch fork shaft, the clutch pedal arm and the release bearing. When pressure is applied to the clutch pedal, the clutch fork shaft pushes against the release bearing by rotating. The bearing then pushes against the diaphragm spring in the pressure plate assembly, thereby releasing the clutch.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description
	DT-6263 KM-6263 Remover/Installer



KM-6263-23
Clutch Center
Guide

TRANSMISSION

Manual Transmission - Y4A/Y4M - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Backup Light Switch	17	13 lb ft
Clutch Housing Lower Plate Bolt	10	89 lb in
Countershaft 5th Gear Nut	70	52 lb ft
Left Case Bolt	19	14 lb ft
Left Case Plate Screw	9	80 lb in
Oil Drain Plug	25	18 lb ft
Oil Fill Plug	25	18 lb ft
Reverse Gear Shift Lever Bolt	23	17 lb ft
Reverse Idle Gear Shaft Bolt	33	24 lb ft
Right Case Bolt	19	14 lb ft
Shift Interlock Bolt	23	17 lb ft
Shift Lever and Selector Lever Cable Grommet Nut	6	53 lb in
Shift Lever and Selector Lever Cable Underbody Bracket Nut	6	53 lb in
Side Cover Bolt	10	89 lb in
Transmission Bracket Mount- Mount through Bolt and Nut - Rear	80	59 lb ft
Transmission Control Bolt and Nut	6	53 lb in
Transmission Lower Bolt	61	44 lb ft
Transmission Lower Nut	61	44 lb ft
Transmission Mount Body Bolt - Left	50	37 lb ft
Transmission Mount Bolt - Left	95	70 lb ft
Transmission Mount Bracket Bolt - Left	60	44 lb ft
Transmission Mount Bracket Bolt - Rear	60	44 lb ft
Transmission Mount Frame Bolt - Rear	100	74 lb ft
Transmission Mount Nut - Left	95	70 lb ft
Transmission Selector and Shift Lever Cable Bracket Bolt	23	17 lb ft
Transmission Upper Bolt	61	44 lb ft
Vehicle Speed Sensor Assembly Bolt	9	80 lb in

MANUAL TRANSMISSION SPECIFICATIONS (HD)

General Specifications

General Specifications

Application	Specification				
Transmission Type	Y4M HD				
Transmission RPO Code	MX2	MFM			
Engine Type	1.2L DOHC	1.0L DOHC		1.2L DOHC	
Final Drive RPO Code	FYB	FV5	FWL	FX2	FWL
1st Gear Ratio	3.539	3.539	3.539	3.539	3.539
2nd Gear Ratio	2.050	1.952	2.050	1.864	1.864
3rd Gear Ratio	1.323	1.242	1.323	1.242	1.242
4th Gear Ratio	0.946	0.974	0.974	0.974	0.974
5th Gear Ratio	0.756	0.781	0.781	0.781	0.781
Reverse Gear Ratio	3.385	3.385	3.385	3.385	3.385
Final Drive Ratio	4.211	4.190	4.444	3.905	4.444
Oil Capacity	2.1 Liters (2.21 quarts)				
Oil Grade	XGP SAE 75W85W				
Manufacturer	GMK				
Service Specifications					
Distance between the Synchronizer Sleeve and the Shift Fork - Limit	1.0 mm (0.039 in)				
Distance between the Synchronizer Sleeve and the Shift Fork - Standard	0.2-0.6 mm (0.008-0.024 in)				
Thickness of the Shift Fork End for the Low-Speed - 1-2 Gear - Shift Fork - Limit	8.56 mm (0.337 in)				
Thickness of the Shift Fork End for the Low-Speed - 1-2 Gear - Shift Fork - Standard	8.7 mm (0.343 in)				
Thickness of the Shift Fork End for the High-Speed - 3-4 Gear - Shift Fork - Limit	7.66 mm (0.302 in)				
Thickness of the Shift Fork End for the High-Speed - 3-4 Gear - Shift Fork - Standard	7.8 mm (0.307 in)				
Shift Fork End for the 5 Gear Shift Fork - Limit	7.66 mm (0.302 in)				
Shift Fork End for the 5 Gear Shift Fork - Standard	7.8 mm (0.307 in)				

Distance Between the Transmission Case Surface and the Bearing Outer Race

Measurement	Shim Thickness

0.33-0.37 mm (0.0130-0.0146 in)	0.55 mm (0.0217 in)
0.38-0.42 mm (0.0147-0.0165 in)	0.60 mm (0.0236 in)
0.43-0.47 mm (0.0169-0.0185 in)	0.65 mm (0.0256 in)
0.48-0.52 mm (0.0189-0.0205 in)	0.70 mm (0.0276 in)
0.53-0.57 mm (0.0209-0.0224 in)	0.75 mm (0.0295 in)
0.58-0.62 mm (0.0228-0.0244 in)	0.80 mm (0.0315 in)
0.63-0.67 mm (0.0248-0.0264 in)	0.85 mm (0.0335 in)
0.68-0.72 mm (0.0268-0.0283 in)	0.90 mm (0.0354 in)
0.73-0.77 mm (0.0287-0.0303 in)	0.95 mm (0.0374 in)
0.78-0.82 mm (0.0307-0.0323 in)	1.00 mm (0.0394 in)
0.83-0.87 mm (0.0327-0.0343 in)	1.05 mm (0.0413 in)
0.88-0.92 mm (0.0346-0.0362 in)	1.10 mm (0.0433 in)
0.93-0.97 mm (0.0366-0.0382 in)	1.15 mm (0.0453 in)
0.98-1.02 mm (0.0386-0.0402 in)	1.20 mm (0.0472 in)
1.03-1.07 mm (0.0406-0.0421 in)	1.25 mm (0.0492 in)

SCHEMATIC WIRING DIAGRAMS

MANUAL TRANSMISSION WIRING SCHEMATICS

MX2 Wiring Schematic

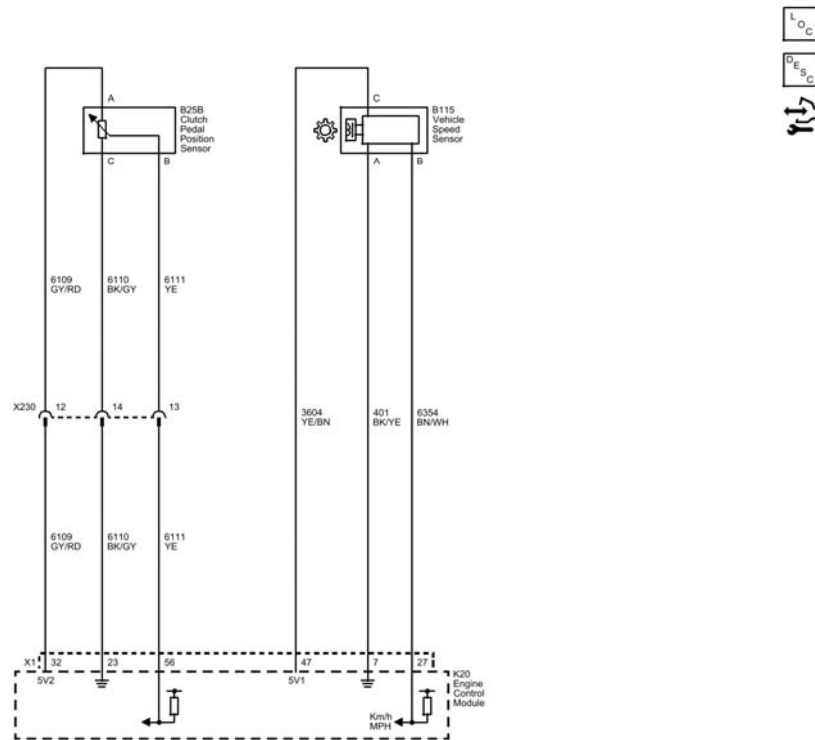


Fig. 1: MX2 Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

COMPONENT LOCATOR

MANUAL TRANSMISSION COMPONENT VIEWS

Gear Shift Control

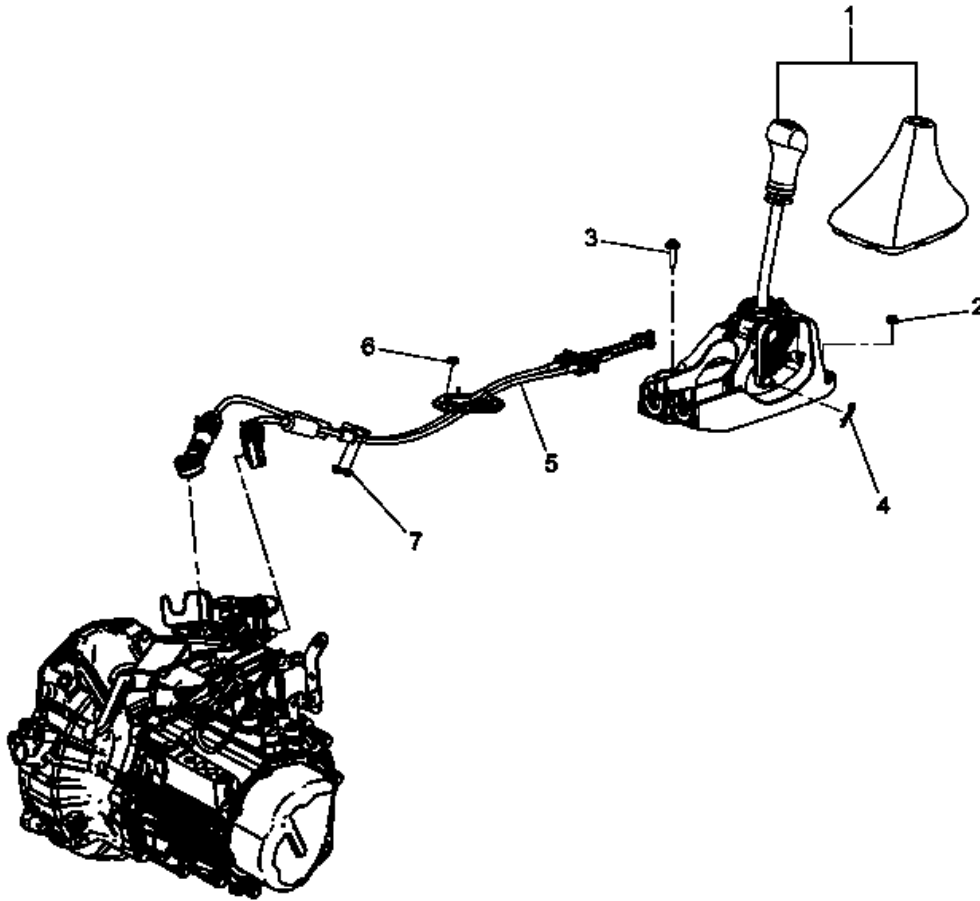


Fig. 2: Gear Shift Control Components
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Transmission Control
2	Nut
3	Bolt
4	Pin
5	Shift Lever and Selector Lever Cable
6	Nut
7	Nut

Gear Shift Fork



Callout	Component Name
1	Selector and Shift Lever Cable Bracket
2	Bolt
3	Selector Lever Bushing
4	Shift Control Lever Shaft
5	Shift Control Shaft Seal
6	Shift Control Shaft Bearing
7	Shift Shaft Detent Cam Spring
8	5th-Reverse Inhibitor Cam
9	Shift Control Shaft Detent Spring
10	Shift Interlock Plate
11	Bolt
12	Gasket

13	Shift Control Lever
14	Low-Speed Gear Shift Fork
15	Low-Speed Gear Shift Shaft
16	Low-Speed Shift Shaft Detent
17	Low-Speed Shift Yoke
18	High-Speed Shift Yoke
19	High-Speed Shift Shaft Detent
20	High-Speed Shift Shaft
21	High-Speed Shift Fork
22	Reverse Shift Arm
23	5th-Reverse Shift Ball
24	5th-Reverse Shift Shaft Detent
25	Reverse Shift Shaft Guide Spring/Ball
26	5th-Reverse Shift Shaft
27	5th-Reverse Shift Yoke
28	5th Shift Fork
29	Reverse Shift Lever
30	Bolt

Input Shaft and Countershaft Gear

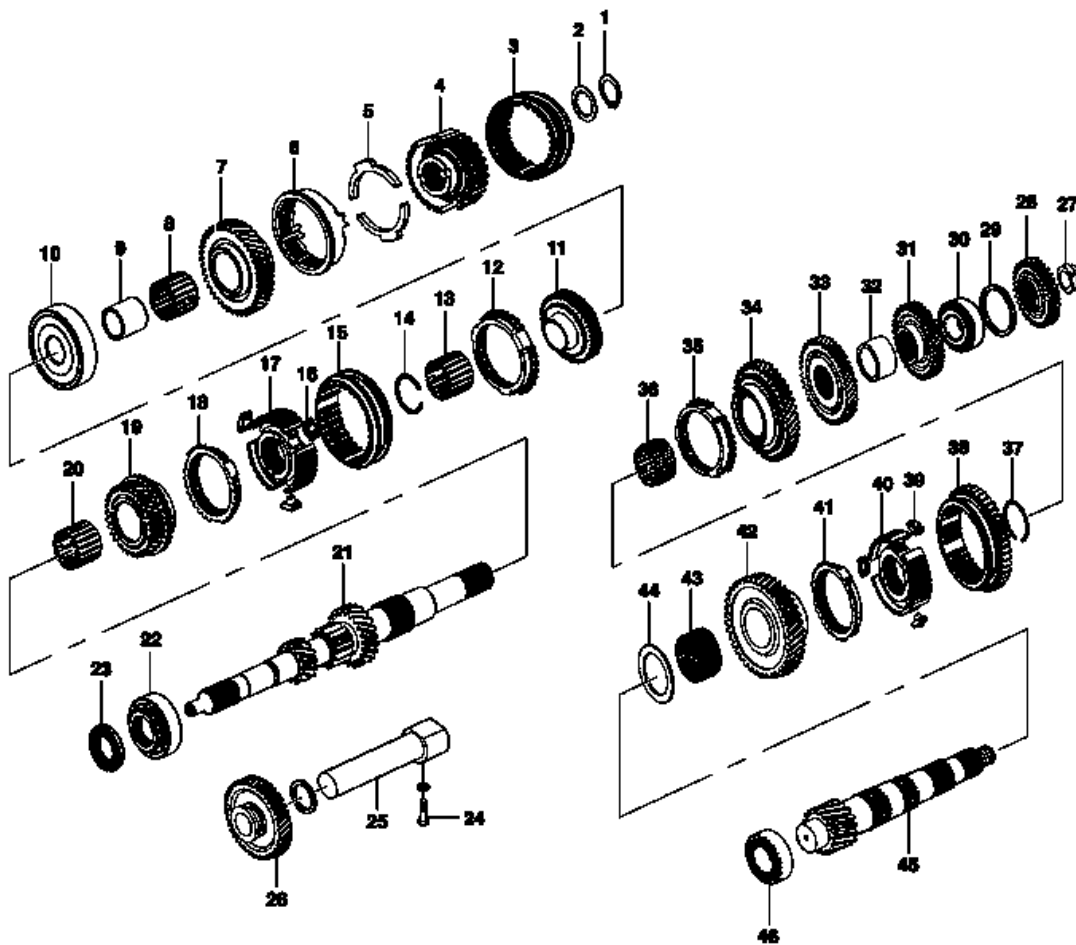


Fig. 4: Input Shaft and Countershaft Gear Components
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Input Shaft Circlip
2	5th Gear Synchronizer Hub Plate
3	5th Gear Synchronizer Sleeve
4	5th Gear Synchronizer Hub
5	5th Gear/Reverse Synchronizer Lever
6	5th Gear Synchronizer Ring
7	Input Shaft 5th Gear
8	Input Shaft 5th Gear Bearing
9	Input Shaft 5th Gear Spacer
10	Input Shaft Bearing - Left
11	Input Shaft 4th Gear
12	4th Gear Synchronizer Ring

13	Input Shaft 4th Gear Bearing
14	3rd-4th Gear Synchronizer Circlip
15	3rd-4th Gear Synchronizer Sleeve
16	3rd-4th Gear Synchronizer Key Unit
17	3rd-4th Gear Synchronizer Hub
18	3rd Gear Synchronizer Ring
19	Input Shaft 3rd Gear
20	Input Shaft 3rd Gear Bearing
21	Input Shaft
22	Input Shaft Bearing - Right
23	Input Shaft Oil Seal
24	Reverse Gear Shaft Bolt
25	Reverse Gear Shaft
26	Reverse Idle Gear
27	Countershaft Nut
28	Countershaft 5th Gear
29	Countershaft Bearing Shim
30	Countershaft Bearing - Left
31	Countershaft 4th Gear
32	Countershaft 3rd-4th Gear Spacer
33	Countershaft 3rd Gear
34	Countershaft 2nd Gear
35	2nd Gear Synchronizer Ring
36	Countershaft 2nd Gear Bearing
37	1st-2nd Gear Synchronizer Circlip
38	1st-2nd Gear Synchronizer Sleeve
39	1st-2nd Gear Synchronizer Key Unit
40	1st-2nd Gear Synchronizer Hub
41	1st Gear Synchronizer Ring
42	Countershaft 1st Gear
43	Countershaft 1st Gear Bearing
44	Countershaft 1st Gear Spacer
45	Countershaft
46	Countershaft Bearing - Right

Transmission Case and Differential

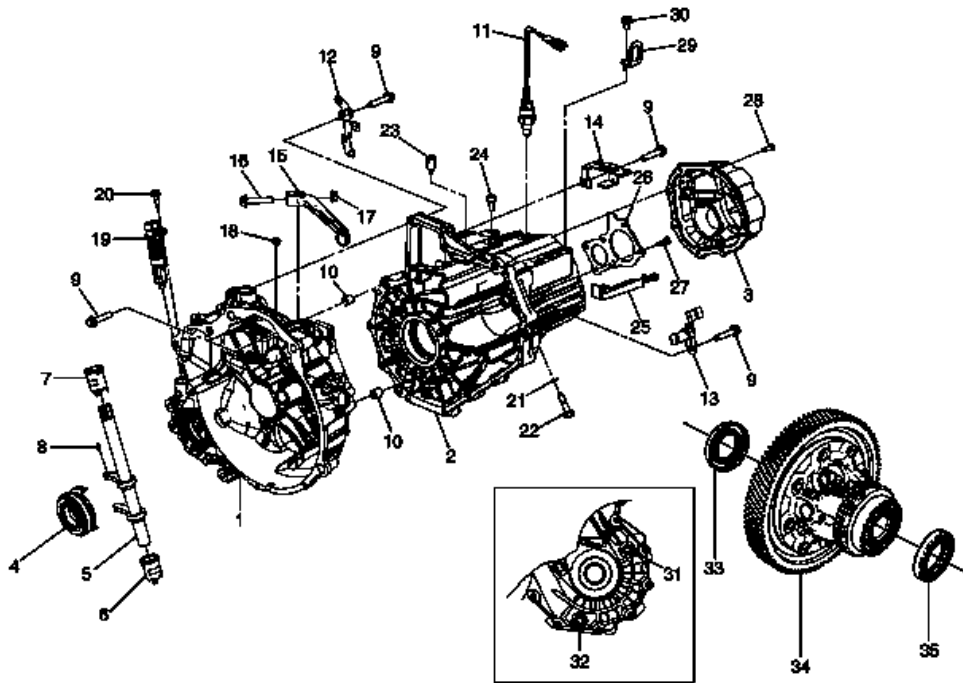


Fig. 5: Transmission Case and Differential Components
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Transmission Case - Right
2	Transmission Case - Left
3	Transmission Side Cover
4	Clutch Release Bearing
5	Clutch Fork Shaft
6	Clutch Fork Shaft Bushing
7	Clutch Fork Shaft Bushing
8	Clutch Release Bearing Pin
9	Transmission Case Bolt
10	Transmission Case Dowel Pin
11	Backup Lamp Switch
12	Engine Wiring Harness Bracket
13	Oxygen Sensor Connector Bracket
14	Engine Wiring Harness Bracket
15	Clutch Pedal Arm
16	Clutch Pedal Arm Bolt
17	Clutch Pedal Arm Nut
18	Transmission Vent Hole Plug
19	Vehicle Speed Sensor Assembly
20	Vehicle Speed Sensor Assembly Bolt

21	Gasket
22	Reverse Idle Gear Shaft Bolt
23	Transmission Vent Hole Plug
24	Fluid Baffle Bolt
25	Oil Gutter
26	Left Case Plate
27	Left Case Plate Screw
28	Transmission Side Cover Bolt
29	Transmission Lifting Eye
30	Transmission Lifting Eye Bolt
31	Oil Fill Plug
32	Oil Drain Plug
33	Differential Oil Seal - Left
34	Front Differential
35	Differential Oil Seal - Right

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC P0501</u>	DTC P0501 Vehicle Speed Sensor Performance
<u>DTC P0502 or P0503</u>	DTC P0502 Vehicle Speed Sensor Circuit Low Voltage DTC P0503 Vehicle Speed Sensor Circuit Intermittent
<u>DTC P0502 or P0503 (LL0 Engine)</u>	DTC P0502 Vehicle Speed Sensor (VSS) Circuit Low Voltage DTC P0503 Vehicle Speed Sensor (VSS) Circuit Intermittent
<u>DTC P0806-P0808 (LL0 Engine)</u>	DTC P0806 Clutch Pedal Position (CPP) Sensor Performance DTC P0807 Clutch Pedal Position (CPP) Sensor Circuit Low Voltage DTC P0808 Clutch Pedal Position (CPP) Sensor Circuit High Voltage
<u>DTC P0806-P0808 (LMT)</u>	DTC P0806 Clutch Pedal Position (CPP) Sensor Performance DTC P0807 Clutch Pedal Position (CPP) Sensor Circuit Low Voltage DTC P0808 Clutch Pedal Position (CPP) Sensor Circuit High Voltage
	DTC P080A Clutch Pedal Position (CPP) Not

DTC P080A	Learned
DTC P0812	DTC P0812 Reverse Position Switch Circuit
DTC P0812 (LL0 Engine)	DTC P0812 Reverse Position Switch Circuit

DTC P0501: VEHICLE SPEED SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0501

Vehicle Speed Sensor Performance

Circuit/System Description

The vehicle speed sensor (VSS) is a 3 wire sensor. The engine control module (ECM) provides a 5 volt reference circuit, low reference circuit and a signal circuit to the VSS. The VSS is a Hall Effect type sensor that produces a square wave output signal to the ECM. As vehicle speed increases, the output frequency of the VSS signal increases. The ECM converts the square wave output signal into km/h (MPH). The ECM supplies the VSS signal to other control modules on the vehicle through the serial data communications line.

Conditions for Running the DTC

- The engine speed is greater than 2 496 RPM.
- The mass air flow is greater than 179.75 mg/stroke.
- The engine coolant temperature is greater than 70°C (158°F).
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

The ECM detects that the vehicle speed parameter is 0 km/h (0 MPH) for 25 s.

Action Taken When the DTC Sets

DTC P0501 is a Type B DTC.

Conditions for Clearing the DTC

DTC P0501 is a Type B DTC.

Reference Information

Schematic Reference

Manual Transmission Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Operate the vehicle while observing the scan tool Output Speed Sensor parameter. It should vary with the vehicle speed and match the speedometer indicator.
 - **If the vehicle speed does not match with the speedometer indicator**

Refer to Circuit/System Testing.
 - **If the vehicle speed does match the speedometer indicator**
2. Operate the vehicle within the conditions for running the DTC to verify the DTC does not set. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records.
3. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.
 - **If the DTC does not set**
4. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the Transmission Output Shaft Speed Sensor harness connector.

2. Test for less than 5 ohms between the low reference circuit terminal A and ground.
 - **If 5 ohms or greater**
 1. Disconnect the X1 harness connector at the Engine Control Module.
 2. Test for less than 2 ohms in the circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the Engine Control Module.
 - **If less than 5 ohms**
3. Ignition ON.
4. Test for 4.8-5.2 V between the 5 V reference circuit terminal C and ground.
 - **If less than 4.8 V**
 1. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 1. Disconnect the X1 harness connector at the Engine Control Module.
 2. Test for less than 2 ohms in the 5 V reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the Engine Control Module.
 - **If greater than 5.2 V**
 1. Disconnect the X1 harness connector at the Engine Control Module.
 2. Test for less than 0.3 V between the 5 V reference circuit terminal 47 and ground.
 - If 0.3 V or greater, repair the short to voltage on the circuit.
 - If less than 0.3 V, replace the Engine Control Module.
 - **If between 4.8-5.2 V**
 - 5. Ignition OFF.
 - 6. Test for less than 1 V between the signal circuit terminal B and ground.
 - **If 1 V or greater**
 1. Disconnect the X1 harness connector at the Engine Control Module.
 2. Test for less than 0.3 V between the signal circuit terminal 27 and ground.
 - If 0.3 V or greater, repair the short to voltage on the circuit.
 - If less than 0.3 V, replace the Engine Control Module.
 - **If less than 1 V**
 - 7. Ignition OFF, disconnect the X1 harness connector at the Engine Control Module.
 - 8. Test for less than 2 ohms between the signal circuit terminal 27 at the Engine Control Module and the signal circuit terminal B at the Transmission Output Shaft Speed Sensor.
 - **If 2 ohms or greater**

Repair the open/high resistance in the circuit.
 - **If less than 2 ohms**

9. Test for infinite resistance between the signal circuit terminal B and ground at the Transmission Output Shaft Speed Sensor.

- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

10. Replace the Transmission Output Shaft Speed Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Control Module References** for ECM replacement, programming and setup.
- **Vehicle Speed Sensor Replacement (MX2, MFM)**

DTC P0502 OR P0503: VEHICLE SPEED SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0502

Vehicle Speed Sensor Circuit Low Voltage

DTC P0503

Vehicle Speed Sensor Circuit Intermittent

Circuit/System Description

Vehicle speed information is provided to the engine control module (ECM) by the transmission output shaft speed (TOSS) sensor. The TOSS Sensor consists of a magneto-resistive (MR) sensor mounted to the transmission case which interfaces with a rotor pressed onto the transmission output shaft. The MR sensor contains a permanent magnet and a semiconductor plate to which reference voltage is applied. As the output shaft spins, the rotor directs the field of the permanent magnet either toward or away from the plate. The TOSS Sensor produces a frequency signal that is proportional to vehicle speed. The ECM converts the TOSS signal to vehicle speed, displayed on the scan tool in kilometers per hour or miles per hour. The TOSS Sensor also sends signal to some modules such as instrument panel cluster (IPC), radio, HVAC control module or telematics communication interface control module if equipped.

Conditions for Running the DTC

P0502

- The engine torque is between 90-8192.
- The minimum throttle is greater than 8%.
- The engine speed is between 1500-6500 RPM.
- The ignition voltage is between 11-32 V.

P0503

- The transmission output shaft speed is greater than 200 RPM.
- The change in transmission output shaft speed is less than 150 RPM.
- The ignition voltage is between 11-32 V.
- The engine speed is between 200-7500 RPM.
- The vehicle speed is less than 200 km/h (124 mph).

Conditions for Setting the DTC

P0502

The ECM detects that the transmission output shaft speed signal is less than 60 RPM for 4.5 s.

P0503

The ECM detects that the loop-to-loop change in transmission output shaft speed signal is greater than 350 RPM for 3.3 s.

Action Taken When the DTC Sets

DTCs P0502 and P0503 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P0502 and P0503 are Type B DTCs.

Reference Information

Schematic Reference

Manual Transmission Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Transmission System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Operate the vehicle at 16-32 km/h (10-20 mph) while observing the scan tool VSS parameter. The reading should vary with the vehicle speed and match the instrument panel speedometer indicator.
2. Operate the vehicle within the Conditions For Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the B14A Transmission Output Shaft Speed Sensor.
2. Ignition ON, test for 4.8-5.2 V between the 5V reference circuit terminal C and ground.
 - If greater than the specified range, test the 5V reference circuit for a short to voltage. If the circuit tests normal, replace the K20 ECM.
 - If less than the specified range, test the 5V reference circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the K20 ECM.
3. Ignition OFF, test for less than 5ohms between the low reference circuit terminal A and ground.
 - If greater than the specified range, test the low reference circuit for an open/high resistance. If the circuit tests normal, replace the K20 ECM.

NOTE: **You may need to disconnect all the modules that share the signal circuit in order to isolate the condition. Refer to Manual Transmission Schematics to identify the modules that share the signal circuit.**

4. Ignition OFF, test for greater than 10ohms between the signal circuit terminal B and ground.
 - If less than the specified range, test the signal circuit for a short to ground. If the circuit tests

normal, replace the K20 ECM.

5. Ignition OFF, disconnect the harness connector at the K20 ECM.
6. Ignition OFF, test for less than 50hms in the signal circuit end to end.
 - If greater than the specified range, test the signal circuit for an open/high resistance.
7. Ignition ON, test for less than 10 V between the signal circuit terminal B and ground.
 - If greater than the specified value, test the signal circuit for a short to voltage.
8. If all circuits test normal, replace the B14A Transmission Output Shaft Speed Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for ECM replacement, setup and programming

DTC P0502 OR P0503: VEHICLE SPEED SENSOR (LL0 ENGINE)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0502

Vehicle Speed Sensor (VSS) Circuit Low Voltage

DTC P0503

Vehicle Speed Sensor (VSS) Circuit Intermittent

Circuit/System Description

The vehicle speed sensor (VSS) is a 3 wire sensor. The engine control module (ECM) provides a 5 volt reference circuit, low reference circuit and a signal circuit to the VSS. The VSS is a Hall Effect type sensor that produces a square wave output signal to the ECM. As vehicle speed increases, the output frequency of the VSS signal increases. The ECM converts the square wave output signal into vehicle speed shown as km/h (MPH). The ECM supplies the VSS signal to other control modules on the vehicle through the serial data communications line.

Conditions for Running the DTC

P0502

- DTC P0101, P0102, P0103, P0106, P0107, P0108, P0300, P0301, P0302, P0303, P0304, P0305, P0306

or P0503 is not set.

- Ignition voltage is between 11-32 V.
- Throttle position is 8 % or greater.
- Engine speed is between 1, 500-6, 500 RPM.

P0503

- Ignition voltage is between 11-32 V.
- Engine speed is between 200-7, 500 RPM for 5 s or greater.
- VSS signal is 200 RPM or greater for 2 s or greater.
- Change in VSS signal is 150 RPM or less for 2 s or greater.

Conditions for Setting the DTC

P0502

VSS signal is less than 60 RPM for 4.5 s.

P0503

Change in VSS signal is 350 RPM or greater for 3.3 s.

Action Taken When the DTC Sets

P0502 and P0503 are Type B DTCs.

Conditions for Clearing the DTC

P0502 and P0503 are Type B DTCs.

Diagnostic Aids

The battery must be fully charged. Refer to **Battery Inspection/Test** .

Reference Information

Schematic Reference

Manual Transmission Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Transmission System Description and Operation

Electrical Information Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

K20 Engine Control Module: Scan Tool Information (LEB) , **K20 Engine Control Module: Scan Tool Information (Without FX3)** , **K20 Engine Control Module: Scan Tool Information (FX3)** , **K20 Engine Control Module: Scan Tool Information (LL0)**

Special Tools

J-38522-A Vehicle Signal Generator

For equivalent regional tools, refer to **Special Tools**.

Circuit/System Verification

CAUTION: Support the lower control arms in the normal horizontal position in order to avoid damage to the drive axles. Do not operate the vehicle in gear with the wheels hanging down at full travel.

1. Raise and support the drive wheels in a horizontal position.
2. Start and idle the engine.
3. Place the transmission in second gear and release the clutch pedal.
4. Verify the scan tool Vehicle Speed Sensor parameter increases as the drive wheel speed increases.
 - **If the Vehicle Speed Sensor parameter does not increase**

Refer to Circuit/System Testing.

- **If the Vehicle Speed Sensor parameter does increase**
5. Operate the vehicle within the conditions for running the DTC to verify the DTC does not set. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records.
 - **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

6. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF. Disconnect the harness connector at the B115 Vehicle Speed Sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the low reference circuit terminal 2 and ground.
 - **If 10 ohms or greater**
 1. Disconnect the X3 harness connector at the K20 Engine Control Module.
 2. Test for less than 2 ohms in the circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If less than 10 ohms**
3. Ignition ON.
4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 1 and ground.
 - **If less than 4.8 V**
 1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the 5 V reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If greater than 5.2 V**
 1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module, Ignition ON.
 2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If between 4.8-5.2 V**
5. Ignition OFF, connect the test leads of the J-38522-A vehicle signal generator as follows:
 - Red test lead to the signal circuit terminal 3 at the B115 Vehicle Speed Sensor wire harness connector.
 - Black test lead to ground at the transmission case.
 - Double black power and ground lead wire to B+ and ground.
6. Set and adjust the J-38522-A vehicle signal generator to the following switch positions:
 - Signal switch to 5 V.
 - Frequency switch to 600 Hz.

- Duty cycle switch to 50% or normal position.
7. Ignition ON.
 8. Verify the scan tool Vehicle Speed Sensor parameter displays between 41-51 km/h (25.5-31.5 mph).
 - **If the vehicle speed sensor parameter is not within the specified range**
 1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal 3 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If the vehicle speed sensor parameter is within the specified range**
 9. Replace the B115 Vehicle Speed Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Vehicle Speed Sensor Replacement (MX2, MFM)**
- **Control Module References** for ECM replacement, programming and setup.

DTC P0806-P0808: CLUTCH PEDAL POSITION (CPP) SENSOR (LL0 ENGINE)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0806

Clutch Pedal Position (CPP) Sensor Performance

DTC P0807

Clutch Pedal Position (CPP) Sensor Circuit Low Voltage

DTC P0808

Clutch Pedal Position (CPP) Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0642, P0807	P0807	P0642, P0808	-
Signal	P0807	P0807	P0808	P0806
Low Reference	-	P0808	P0808	-

Typical Scan Tool Data

CPP Sensor Voltage

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON. CPP Sensor Voltage Parameter Normal Range: 0 V with clutch pedal applied to 5 V when clutch pedal is released.			
5 V Reference	0 V	0 V	5 V
Signal	0 V	0 V	5 V
Low Reference	-	5 V	-

CPP Sensor Percentage

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON. CPP Sensor Percent Parameter Normal Range: 0% with clutch pedal released to 100% when clutch pedal is applied.			
5 V Reference	100%	100%	0-100%
Signal	100%	100%	100%
Low Reference	-	0%	-

Circuit/System Description

The clutch pedal position (CPP) sensor is a three wire sensor, connected to a 5 V reference circuit, a low reference circuit and a signal circuit. The engine control module supplies 5 V to the CPP sensor and also provides a sensor ground path on the low reference circuit. The CPP sensor sends a voltage signal to the ECM on the signal circuit. The voltage on the signal circuit will vary from a voltage less than or equal to 5 V when the clutch pedal is released, to a voltage less than or equal to 1.5 V when the clutch pedal is applied.

Conditions for Running the DTC

P0806

- DTC P0335, P0336, P0502, P0503, P0807 or P0808 is not set.
- The vehicle speed is greater than 8 kmh (5 mph).
- The ignition is ON.

P0807 and P0808

- DTC P0651 is not set.
- The system voltage is more than 9 V.
- The ignition is ON.

Conditions for Setting the DTC

P0806

The CPP sensor is stuck in range.

P0807

The CPP sensor voltage is less than 0.1 V for more than 1 s.

P0808

The CPP sensor voltage is more than 5.2 V for more than 1 s.

Action Taken When the DTC Sets

DTC P0806 - P0808 are Type A DTCs.

Conditions for Clearing the DTC

DTC P0806 - P0808 are Type A DTCs.

Reference Information

Schematic Reference

Manual Transmission Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Transmission System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

K20 Engine Control Module: Scan Tool Information (LEB) , **K20 Engine Control Module: Scan Tool Information (Without FX3)** , **K20 Engine Control Module: Scan Tool Information (FX3)** , **K20 Engine Control Module: Scan Tool Information (LL0)** for scan tool information

Circuit/System Verification

1. If DTC P0651 or P080A is set, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
2. Ignition ON.
3. Verify the scan tool CPP Sensor percent parameter varies from 0% when the clutch pedal is released, to 100% when the clutch pedal is in the apply position.

- **If the percentage does not vary from 0% to 100%**

Refer to Circuit/System Testing.

- **If the percentage varies from 0% to 100%**

4. Perform the CPP learn procedure.
5. Operate the vehicle within the conditions for running the DTC to verify the DTC does not set. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

6. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector of the B25B Clutch Pedal Position Sensor.
2. Test for less than 5 ohms between the low reference circuit terminal A and ground:

- **If 5 ohms or greater**

1. Disconnect the X3 harness connector at the K20 Engine Control Module.
2. Test for less than 2 ohms in the circuit end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, replace the K20 Engine Control Module.

- **If less than 5 ohms**

3. Ignition ON.

4. Test for 4.8-5.2 V between the 5 V reference circuit terminal C and ground:
 - **If less than 4.8 V**
 1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the 5 V reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If greater than 5.2 V**
 1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module.
 2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If between 4.8-5.2 V**
5. Verify the scan tool CPP Sensor voltage parameter is less than 0.1 V.
 - **If 0.1 V or greater**
 1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module, Ignition ON.
 2. Test for less than 1 V between the signal circuit terminal B and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If less than 0.1 V**
6. Install a 3 A fused jumper wire between the signal circuit terminal B and the 5 V reference circuit terminal C.
7. Verify the scan tool CPP Sensor voltage parameter is greater than 4.9 V.
 - **If 4.9 V or less**
 1. Ignition OFF, remove the jumper wire, disconnect the X3 harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal B and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If greater than 4.9 V**
8. Test or replace the B25B Clutch Pedal Position Sensor.

Component Testing

Static Test

- 1. Ignition OFF, disconnect the harness connector of the B25B Clutch Pedal Position Sensor.
- 2. Measure the resistance between the signal terminal B and the low reference terminal A at the B25B Clutch Pedal Position Sensor. Depress the clutch pedal through the entire range. The resistance should vary from low to high and vice versa without any spikes or dropouts.
 - o **If the resistance is erratic with spikes or dropouts**

Replace the B25B Clutch Pedal Position Sensor.

- o **If the resistance is not erratic without spikes or dropouts**
- 3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Clutch Pedal Position Sensor Learn
- Clutch Pedal Position Sensor Replacement
- Control Module References for ECM replacement, programming and setup.

DTC P0806-P0808: CLUTCH PEDAL POSITION (CPP) SENSOR (LMT)

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptors

DTC P0806

Clutch Pedal Position (CPP) Sensor Performance

DTC P0807

Clutch Pedal Position (CPP) Sensor Circuit Low Voltage

DTC P0808

Clutch Pedal Position (CPP) Sensor Circuit High Voltage

Diagnostic Fault Information

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Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0807	P0807	P0808	P0806
5 V Reference	P0807	P0807	P0808	P0808
Low Reference	-	P0808	-	P0808

Typical Scan Tool Data

CPP Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON			
Clutch Pedal Position Sensor Parameter Normal Range: 0.2-4.8 V			
5 V Reference	0.06 V	0 V	5 V
Signal	0 V	0 V	5 V
Low Reference	-	4.94 V	-

Circuit/System Description

The clutch pedal position (CPP) sensor is a 3 wire sensor, connected to a 5 V reference circuit, a low reference circuit and a signal circuit. The engine control module (ECM) supplies 5 V to the CPP sensor and also provides a sensor ground path on the low reference circuit. The CPP sensor sends a voltage signal to the ECM on the signal circuit. The voltage on the signal circuit will vary from a voltage less than or equal to 5 V when the clutch pedal is released, to a voltage less than or equal to 1.5 V when the clutch pedal is applied.

Conditions for Running the DTC

Ignition voltage is greater than 9 V.

Conditions for Setting the DTC

P0806

The ECM detects that the CPP sensor signal is stuck in a range.

P0807

CPP sensor voltage is less than 0.2 V for 5 second.

P0808

CPP sensor voltage is greater than 4.8 V for 5 second.

Action Taken When the DTC Sets

DTCs P0806, P0807 and P0808 are Type A DTCs.

Conditions for Clearing the MIL/DTC

DTCs P0806, P0807 and P0808 are Type A DTCs.

Reference Information

Schematic Reference

Manual Transmission Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool CPP Sensor parameter in the Manual Transmission Data of the ECM data list is between 0.2-4.8 V and changes smoothly without any spikes or dropouts when slowly applying and releasing the clutch pedal.
 - **If not between 0.2-4.8 V, does not change or has spikes or dropouts**

Refer to Circuit/System Testing.
 - **If between 0.2-4.8 V and changes smoothly without any spikes or dropouts**
3. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B25B Clutch Pedal Position Sensor. It may take up to 2 minutes for all vehicle systems to power down.

2. Test for less than 10 ohms between the low reference circuit terminal C and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 ECM.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 ECM.
 - **If less than 10 ohms**
3. Ignition ON.
4. Test for 4.8-5.2 V between the 5 V reference circuit terminal A and ground.
 - **If less than 4.8 V**
 1. Ignition OFF, disconnect the harness connector at the K20 ECM.
 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the 5 V reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 ECM.
 - **If greater than 5.2 V**
 1. Ignition OFF, disconnect the harness connector at the K20 ECM, ignition ON.
 2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 ECM.
 - **If between 4.8-5.2 V**
5. Verify the scan tool CPP Sensor parameter is less than 0.2 V.
 - **If 0.2 V or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 ECM, ignition ON.
 2. Test for less than 1 V between the signal circuit terminal B and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 ECM.
 - **If less than 0.2 V**
6. Install a 3 A fused jumper wire between the signal circuit terminal B and the 5 V reference circuit terminal A.
7. Verify the scan tool CPP Sensor parameter is greater than 4.8 V.
 - **If 4.8 V or less**
 1. Ignition OFF, disconnect the harness connector at the K20 ECM.
 2. Test for infinite resistance between the signal circuit terminal B and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance

3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 ECM.

- **If greater than 4.8 V**

8. Test or replace the B25B Clutch Pedal Position Sensor.

Component Testing

Static Test

1. Ignition OFF, disconnect the harness connector at the B25B Clutch Pedal Position Sensor.
2. Test for 2.1-3.9 Kohms between the 5 V reference terminal A and the low reference terminal C.
 - **If not between 2.1-3.9 Kohms**

Replace the B25B Clutch Pedal Position Sensor.

- **If between 2.1-3.9 Kohms**

3. Test for 2.1-3.9 Kohms without any spikes or dropouts between the signal terminal B and the low reference terminal C while moving the sensor through the entire range.

- **If not between 2.1-3.9 Kohms or has spikes or dropouts**

Replace the B25B Clutch Pedal Position Sensor.

- **If between 2.1-3.9 Kohms and there are no spikes or dropouts**

4. All OK

Dynamic Test

1. Install a 3 A fused jumper wire between the 5 V reference terminal A and 5 V. Install a jumper wire between the low reference terminal C and ground.
2. Test for 0.25-4.75 V without any spikes or dropouts between the signal terminal B and the low reference terminal C while moving the sensor through the entire range.
 - **If not between 0.25-4.75 V or has spikes or dropouts**

Replace the B25B Clutch Pedal Position Sensor.

- **If between 0.25-4.75 V and there are no spikes or dropouts**

3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- Refer to **Control Module References** for control solenoid valve assembly replacement, setup and

programming.

- Perform the **Clutch Pedal Position Sensor Learn** following the replacement of the ECM or CPP sensor or any repair that affects the CPP sensor alignment.

DTC P080A: CLUTCH PEDAL POSITION (CPP) SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P080A

Clutch Pedal Position (CPP) Not Learned

Circuit/System Description

The clutch pedal position (CPP) is a three wire sensor, connected to a 5 V reference circuit, a low reference circuit and a signal circuit. The engine control module (ECM) supplies 5 V to the CPP sensor and also provides a sensor ground path on the low reference circuit. The CPP sensor sends a voltage signal to the ECM on the signal circuit. The voltage on the signal circuit will vary from a voltage less than or equal to 5 V when the clutch pedal is released to a voltage less than or equal to 1.5 V when the clutch pedal is applied.

Conditions for Running the DTC

Clutch pedal fully applied.

Conditions for Setting the DTC

Clutch pedal position not learned.

Action Taken When the DTC Sets

P080A is a Type C DTC.

Conditions for Clearing the DTC

P080A is a Type C DTC.

Reference Information

Schematic Reference

Manual Transmission Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Transmission System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

K20 Engine Control Module: Scan Tool Information (LEB) , **K20 Engine Control Module: Scan Tool Information (Without FX3)** , **K20 Engine Control Module: Scan Tool Information (FX3)** , **K20 Engine Control Module: Scan Tool Information (LL0)** for scan tool information

Circuit/System Verification

Perform the clutch pedal position sensor learn procedure. Refer to **Clutch Pedal Position Sensor Learn**.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Clutch Pedal Position Sensor Learn**
- **Control Module References**

DTC P0812: REVERSE POSITION SWITCH

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0812

Reverse Position Switch Circuit

Circuit/System Description

The reverse gear switch is a normally open switch that closes with the reverse gear engagement. When the switch is open, the engine control module (ECM) should detect a high signal voltage input. When the switch is closed, the ECM should detect a low signal voltage input.

Conditions for Running the DTC

- No vehicle speed sensor faults exist.
- Reverse switch is ON.

Conditions for Setting the DTC

The ECM detects circuit failure of the reverse input switch.

Action Taken When the DTC Sets

DTC P0812 is a Type C DTC.

Conditions for Clearing the DTC

DTC P0812 is a Type C DTC.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Ignition ON, observe the scan tool Reverse Position Switch parameter. The reading should be Off and change to On when the transmission is shifted into reverse.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the B16 Backup Lamp Switch.
2. Ignition OFF, test for less than 1 ohms between the ground circuit terminal 2 and ground.
 - If greater than the specified value, test the ground circuit for an open/high resistance.
3. Ignition ON, verify the scan tool Reverse Position Switch parameter is Off.
 - If not the specified value, test the signal circuit terminal 1 for a short to ground. If the circuit tests normal, replace the K20 Engine Control Module.
4. Ignition ON, install a 3 A fused jumper wire between the signal circuit terminal 1 and ground. Verify the scan tool Reverse Position Switch parameter is On.
 - If not the specified value, test the signal circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the K20 Engine Control Module.
5. If all circuits test normal, test or replace the B16 Backup Lamp Switch.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Backup Lamp Switch Replacement (MX2, MFM)**
- **Control Module References** for ECM replacement, setup and programming

DTC P0812: REVERSE POSITION SWITCH (LL0 ENGINE)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0812

Reverse Position Switch Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Reverse Switch Signal	P0812	1	-	-
Ground	-	1	-	-
1. Backup Lamps Malfunction				

Circuit/System Description

The reverse gear switch is a normally open switch that closes with the reverse gear engagement. When the switch is open the engine control module should detect a high signal voltage input. When the switch is closed the ECM should detect a low signal voltage input.

Conditions for Running the DTC

- No vehicle speed sensor faults exist.
- Reverse switch is ON.

Conditions for Setting the DTC

The ECM detects circuit malfunction of the reverse input switch.

Action Taken When the DTC Sets

DTC P0812 is a Type C DTC.

Conditions for Clearing the DTC

DTC P0812 is a Type C DTC.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Reverse Position Switch parameter should be Off and change to On when the transmission is shifted into reverse.
 - **If the parameter does not change from Off to On**

Refer to Circuit/System Testing.
 - **If the parameter changes from Off to On**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.
 - **If the DTC does not set**
5. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the B16 Backup Lamp Switch.
2. Test for less than 5 ohms between the ground circuit terminal 2 and ground.
 - **If 5 ohms or greater**
 1. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
3. Ignition ON, transmission in neutral position.
4. Verify the scan tool Reverse Position Switch parameter is Off.
 - **If the parameter ON**
 1. Disconnect the X1 harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance, replace the K20 Engine Control Module.
- **If the parameter is OFF**
- 5. Ignition ON, install a 3 A fused jumper wire between the signal circuit terminal 1 at the B16 Backup Lamp Switch harness connector and ground.
- 6. Verify the scan tool Reverse Position Switch parameter is On.
 - **If the parameter is Off**
 1. Disconnect the X1 harness connector at the K20 Engine Control Module.
 2. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If the parameter is On**
- 7. Test or replace the B16 Backup Lamp Switch.

Component Testing

1. Ignition OFF, disconnect the harness connector at the B16 Backup Lamp Switch.
2. Place the transmission in Reverse position.
3. Test for less than 5 ohms between the signal terminal 1 and the ground terminal 2 at the B16 Backup Lamp Switch.
 - **If 5 ohms or greater**

Replace the B16 Backup Lamp Switch.
 - **If less than 5 ohms**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Backup Lamp Switch Replacement (MX2, MFM)**
- **Control Module References** for ECM replacement, programming and setup.

SYMPTOMS - MANUAL TRANSMISSION

Symptom List

In order to troubleshoot problems, refer to the troubleshooting procedures in the following list.

- **Transmission Shifts Hard**
- **Transmission Gear Clash When Shifting Gears**
- **Transmission Noisy**
- **Transmission Jumps Out of Gear**

- **Transmission Fluid Leak Diagnosis**

CLUTCH PEDAL POSITION SENSOR LEARN

NOTE: The clutch pedal position (CPP) sensor learn procedure is required when the following service procedures have been performed regardless of whether DTC P080A is set:

- An engine control module (ECM) replacement
- A CPP sensor replacement
- Any repairs which affect the CPP sensor relationship

1. Install a scan tool.
2. Monitor the ECM for DTCs with a scan tool. If other DTCs are set, except DTC P080A, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** for the applicable DTC that set.
3. With a scan tool, select Clutch Pedal Position Learn under Module Setup in Engine Control Module and perform the following instructions displayed on the scan tool screen.

NOTE: The CPP sensor learn procedure cannot be performed more than once per ignition cycle. The clutch pedal needs to be fully depressed and held steady throughout this procedure in order to perform a correct learning.

4. The scan tool will display under CPP Learn Status: Not Learned, In Process, Complete, Fail - Low Volt, Fail - High Volt or Fail Moving. The scan tool will display under CPP Learn Status Complete if the process was successful.
5. If the scan tool indicates that DTC P080A ran and passed this ignition the CPP sensor learn procedure is complete. If the scan tool indicates DTC P080A failed or did not run this ignition, refer to **DTC P080A**. If any other DTC is set, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** for the applicable DTC.
6. Turn OFF the ignition for 30 s after the learn procedure has successfully completed in order to store the CPP sensor variation values in ECM history.

TRANSMISSION SHIFTS HARD

Transmission Shifts Hard

Possible Cause	Action
Worn synchronizer ring	Replace the synchronizer ring.
Worn synchronizer sleeve or gear	Replace the sleeve or gear.
Bent or deformed shift shaft	Replace the shift shaft.
Excessive free travel of all gears in axial direction	Replace the gear.
Worn bearings on input shaft or counter shaft	Replace the bearing.
Distorted or broken clutch disc	Replace the clutch disc.
Damaged pressure plate	Replace the pressure plate.

TRANSMISSION GEAR CLASH WHEN SHIFTING GEARS

Transmission Gear Clash When Shifting Gears

Cause	Actions
Bent or distorted shift shaft or shift fork	Replace the shift shaft or shift fork.

TRANSMISSION NOISY

Many noises that appear to come from the transmission may actually originate with other sources such as the tires, road surfaces, wheel bearings or the engine and exhaust system.

Identify the cause of any noise before attempting to repair the clutch, the transmission or their related linkages.

To verify suspected transmission noises:

1. Select a smooth, level asphalt road to reduce tire and resonant body noise.
2. Drive the vehicle far enough to warm up all the lubricants thoroughly.
3. Record the speed and the gear range of the transmission when the noise occurs.
4. Check for noises with the vehicle stopped, but with the engine running.
5. Determine if the noise occurs while the vehicle operates in the following:
 - Drive-Under a light acceleration or a heavy pull.
 - Float-Maintaining a constant speed with a light throttle on a level road.
 - Coast-With the transmission in gear and the throttle partly or fully closed.
 - All of the above

Checking Bearing Noise

Differential Side Bearing Noise

Differential side bearing noise and wheel bearing noise can be confused easily. Since side bearings are pre-loaded, a differential side bearing noise should not diminish much when the differential/transmission is run with the wheels off the ground.

Wheel Bearing Noise

Wheel bearings produce a rough growl or grating sound that will continue when the vehicle is coasting and the transmission is in NEUTRAL. Since wheel bearings are not pre-loaded, a wheel bearing noise should diminish considerably when the wheels are off the ground.

Transmission Noisy

Checks	Actions
Insufficient Lubricant	Supply the lubricant.
Worn Input Shaft Gear	Replace the gear.
Worn Bearings on the Input Shaft Gears	Replace the bearing.
Worn Clutch Release Bearing	Replace the clutch release bearing.
Worn Bearings on the Input Shaft or Counter Shaft	Replace the bearing.

Worn Input Shaft or Counter Shaft Gear	Replace the gear.
Worn or Damaged Synchronizer Ring	Replace the synchronizer ring.
Worn or Damaged Synchronizer Sleeve	Replace the synchronizer sleeve.
Worn Differential Gear or Bearing	Replace the gear or bearing.
Worn or Damaged Synchronizer Ring in the selected GearRange	Replace the synchronizer ring.
Worn or Damaged Gear in the selected Gear Range	Replace the gear.
Worn or Damaged Bearing in the selected Gear Range	Replace the bearing.

TRANSMISSION JUMPS OUT OF GEAR

Transmission Jumps Out of Gear

Checks	Actions
Worn Shift Fork	Replace the shift fork.
Worn Synchronizer Sleeve or Gear	Replace the sleeve or gear.
Worn Bearings on Input Shaft or Counter Shaft	Replace the bearing.
Excessive Back-Lash of Gear	Adjust the back-lash of gear.

TRANSMISSION FLUID LEAK DIAGNOSIS

Transmission Fluid Leak Diagnosis

Checks	Actions
Damaged Gasket, Oil Seal or O-ring	Replace the gasket, oil seal or O-ring.
Worn or Damaged Gear in the Selected Gear Range	Replace the gear.
Worn or Damaged Bearing in the Selected Gear Range	Replace the synchronizer ring and related components.

REPAIR INSTRUCTIONS - ON VEHICLE

TRANSMISSION REAR MOUNT BRACKET REPLACEMENT (MX2, MFM)

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Using a suitable jack stand, support the rear of the powertrain.

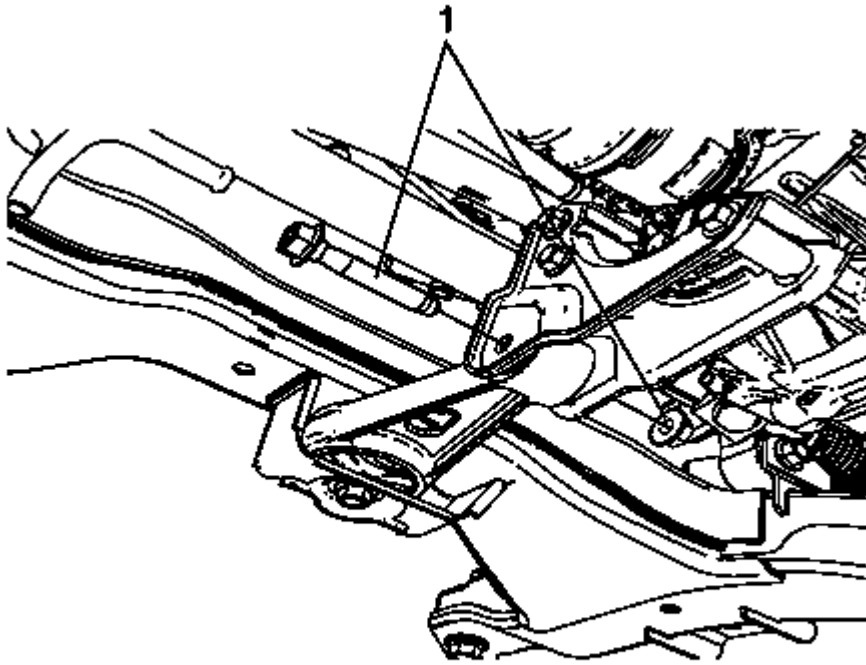


Fig. 6: Transmission Bracket Mount
Courtesy of GENERAL MOTORS COMPANY

3. Remove the transmission bracket mount to mount through bolt and nut (1).

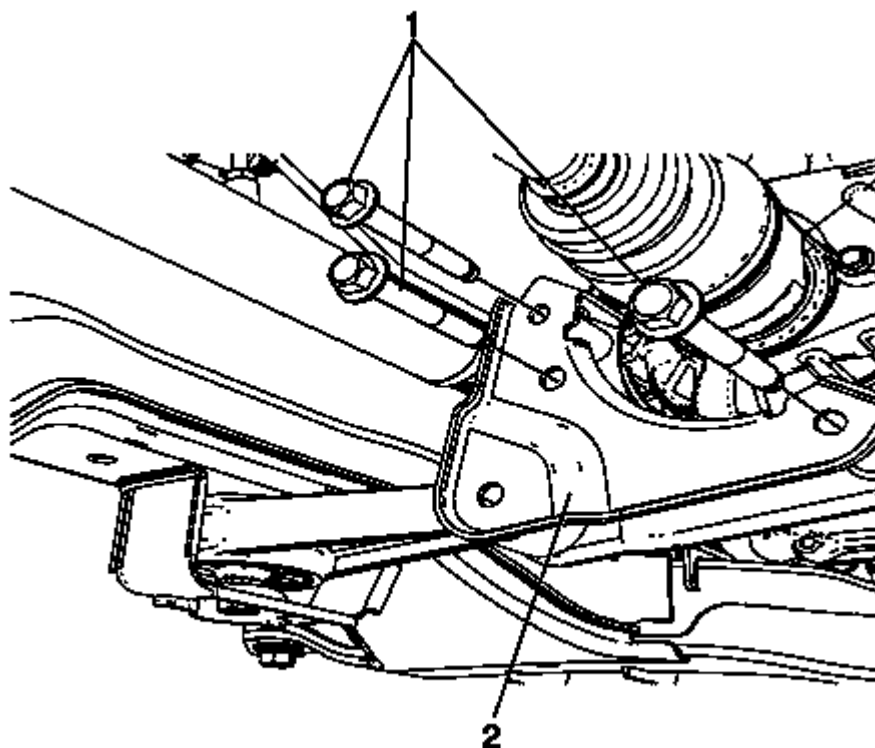


Fig. 7: Transmission Mount Brackets
Courtesy of GENERAL MOTORS COMPANY

4. Remove the transmission mount bracket bolts (1).
5. Remove the transmission mount bracket (2).

Installation Procedure

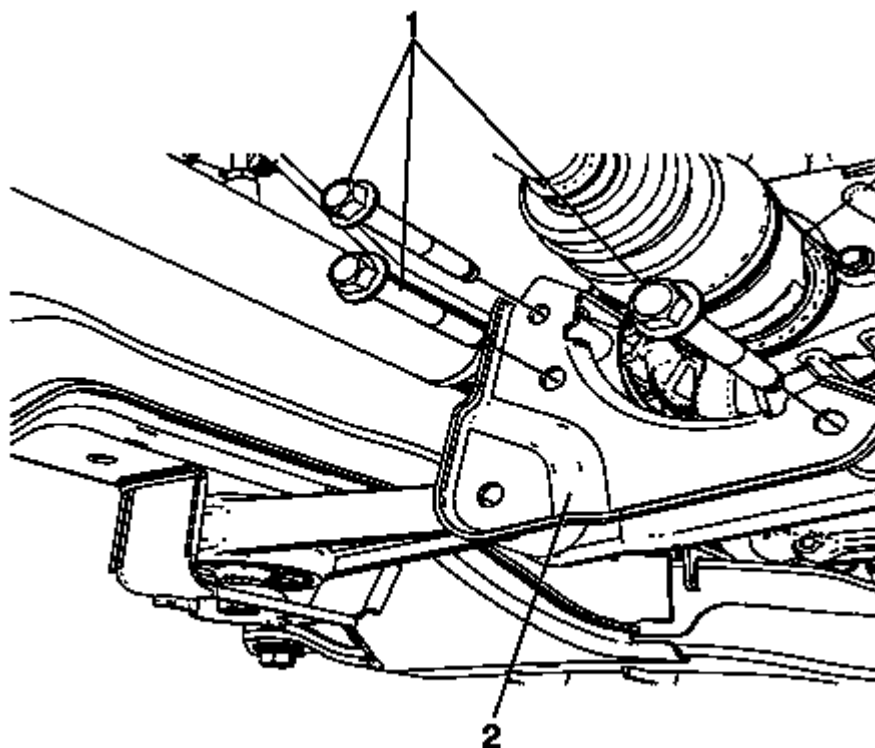


Fig. 8: Transmission Mount Brackets
Courtesy of GENERAL MOTORS COMPANY

1. Install the transmission mount bracket (2).

CAUTION: Refer to Fastener Caution .

2. Install the transmission mount bracket bolts (1) and tighten to 60 (44 lb ft).

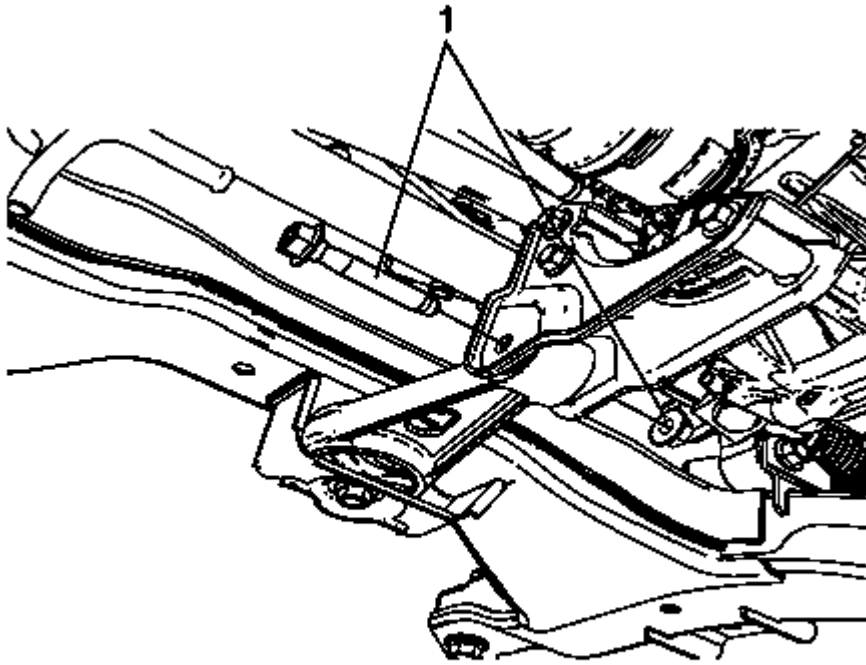


Fig. 9: Transmission Bracket Mount
Courtesy of GENERAL MOTORS COMPANY

3. Install the transmission bracket mount to mount through bolt and nut (1) and tighten to 80 (59 lb ft).
4. Remove the jack stand.
5. Lower the vehicle.

TRANSMISSION REAR MOUNT REPLACEMENT (MX2, MFM)

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Using a suitable jack stand, support the rear of the powertrain.

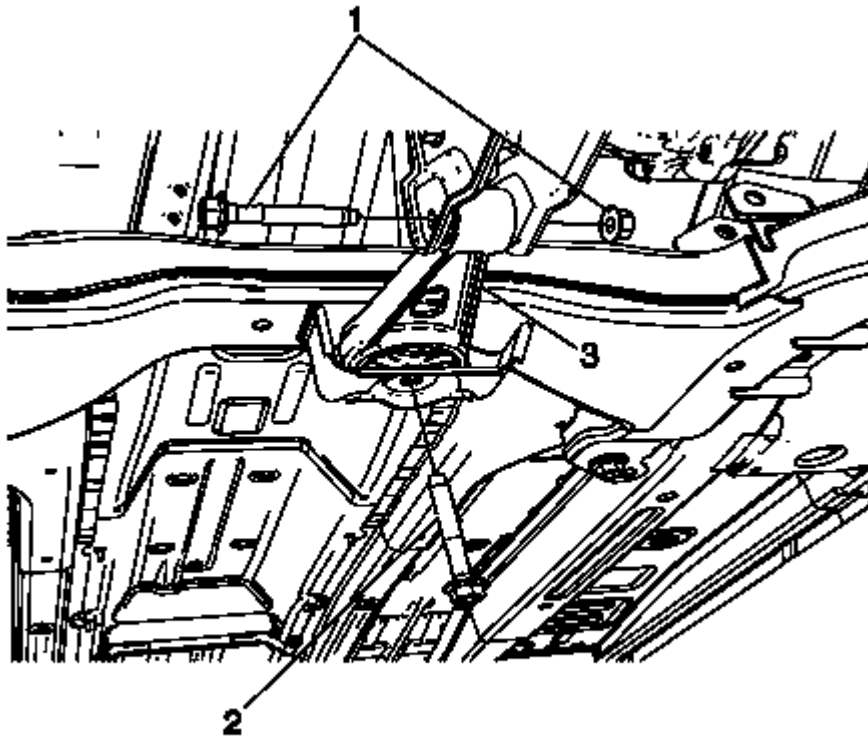


Fig. 10: Transmission Mount And Frame Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Remove the transmission bracket mount to mount through bolt and nut (1).
4. Remove the transmission mount to frame bolt (2).
5. Remove the transmission mount (3).

Installation Procedure

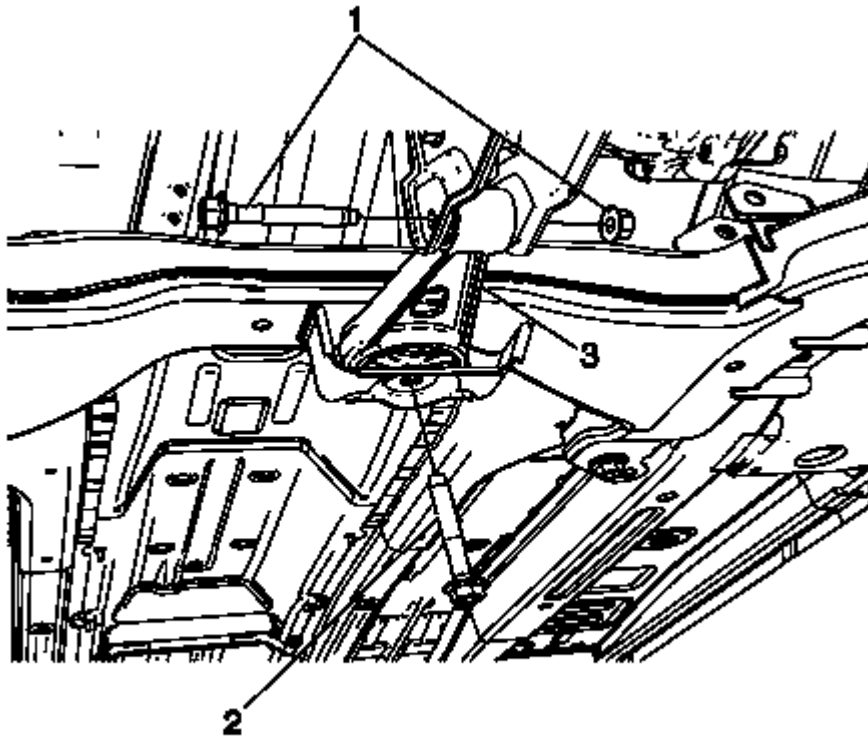


Fig. 11: Transmission Mount And Frame Bolt
Courtesy of GENERAL MOTORS COMPANY

1. Install the transmission mount (3).

CAUTION: Refer to Fastener Caution .

2. Install the transmission mount to frame bolt (2) and tighten to 100 (74 lb ft).
3. Install the transmission bracket mount to mount through bolt and nut (1) and tighten to 80 (59 lb ft).
4. Remove the jack stand.
5. Lower the vehicle.

TRANSMISSION MOUNT REPLACEMENT - LEFT SIDE (MX2, MFM)

Removal Procedure

1. Remove the battery tray. Refer to **Battery Tray Replacement** .
2. Install the engine support fixture. Refer to **Engine Support Fixture** .

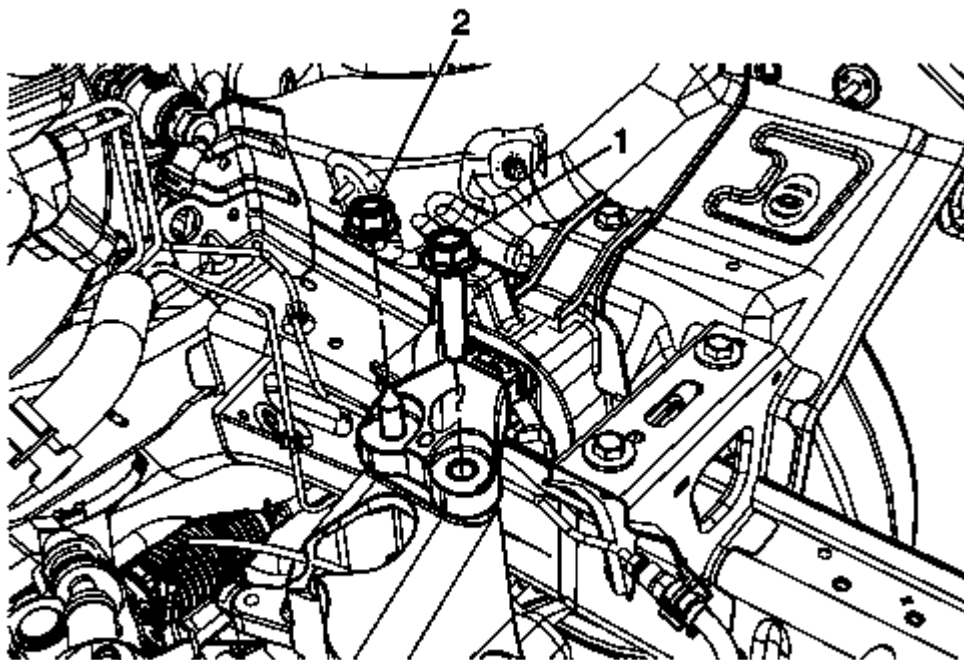


Fig. 12: Left Transmission Mount Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Remove the left transmission mount bolt (1) and nut (2) from the transmission mount bracket.

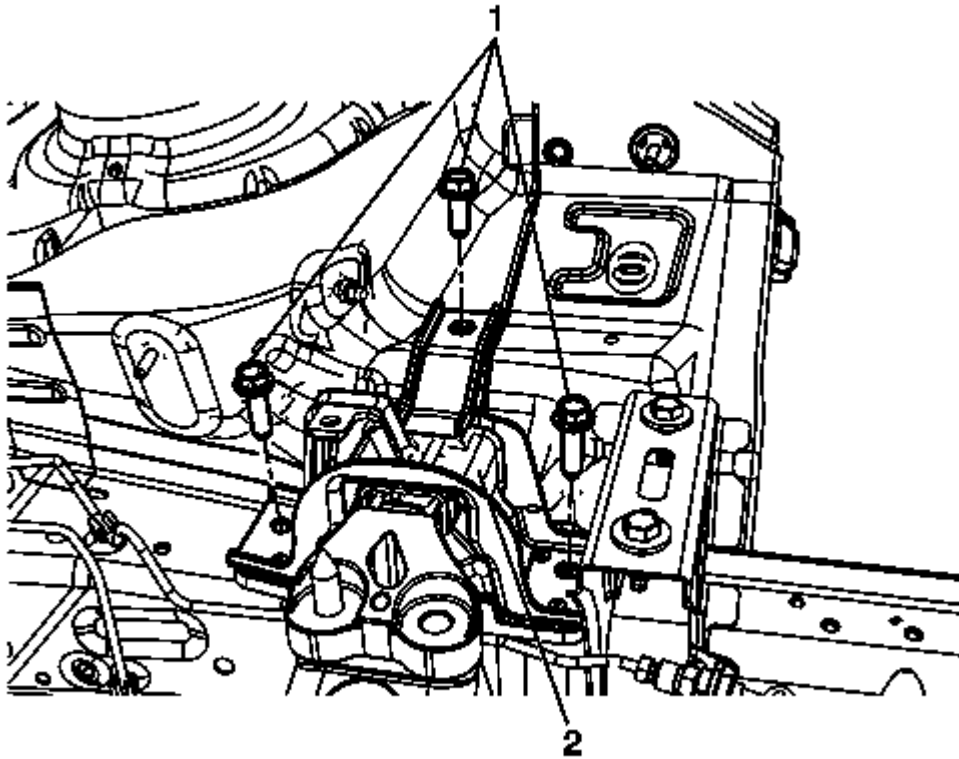


Fig. 13: Left Transmission Mount And Body Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove the left transmission mount to body bolts (1).
5. Remove the transmission mount (2) from the vehicle.

Installation Procedure

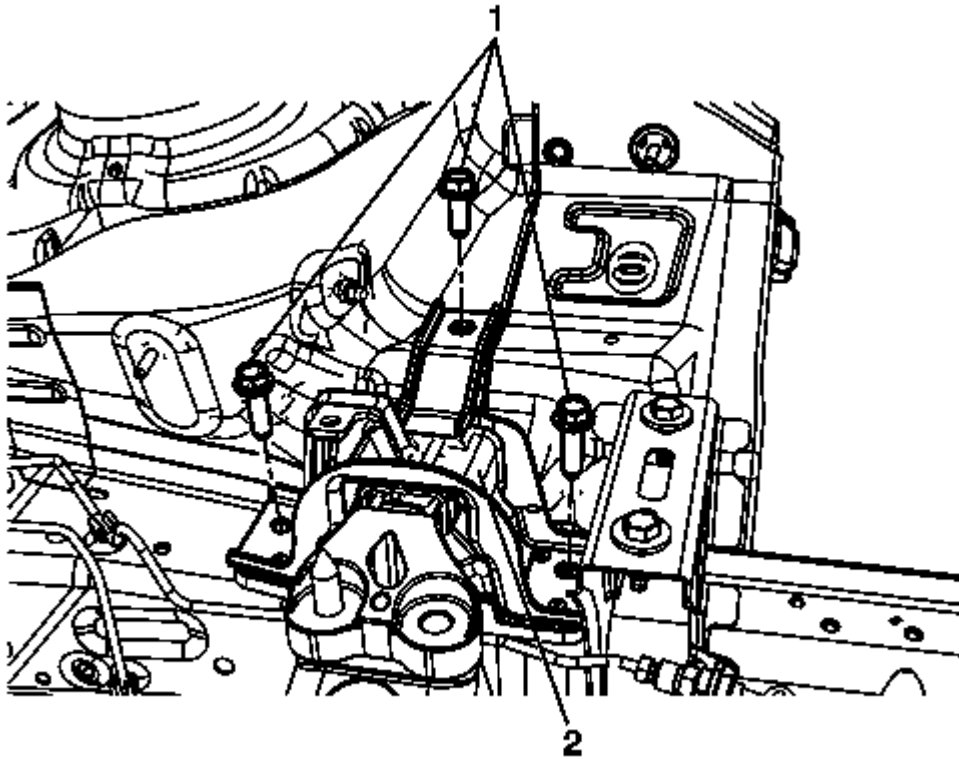


Fig. 14: Left Transmission Mount And Body Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the transmission mount (2) to the vehicle.

CAUTION: Refer to Fastener Caution .

2. Install the transmission mount to body bolts (1) and tighten to 50 (37 lb ft).

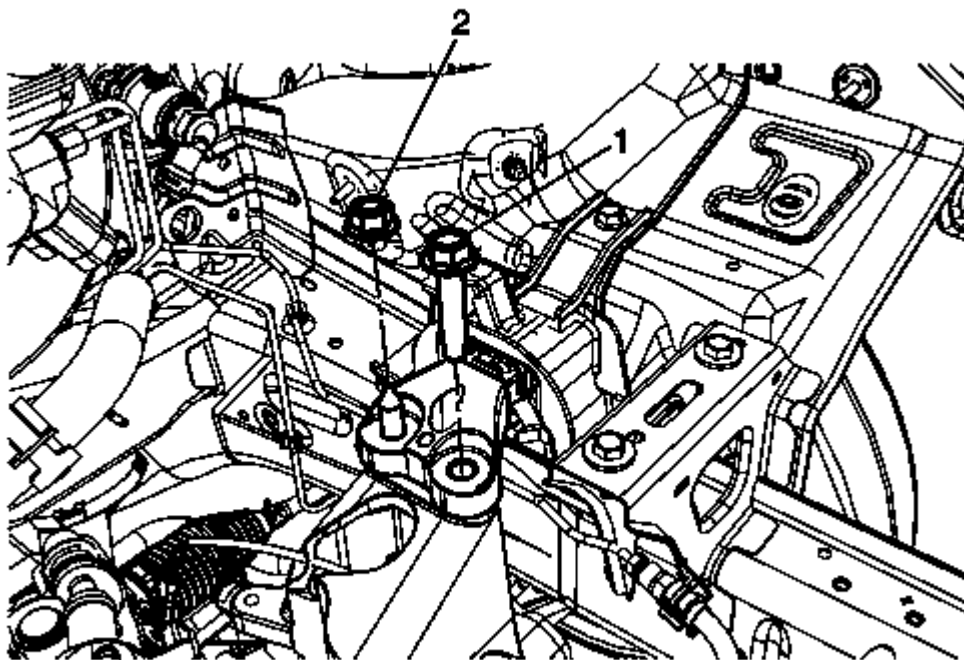


Fig. 15: Left Transmission Mount Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Install the left transmission mount bolt (1) and nut (2) to transmission mount bracket and tighten to 95 (70 lb ft).
4. Remove the engine support fixture. Refer to **Engine Support Fixture** .
5. Install the battery tray. Refer to **Battery Tray Replacement** .

TRANSMISSION REPLACEMENT (MX2, MFM)

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Drain the transmission fluid. Refer to **Transmission Fluid Drain and Fill**.

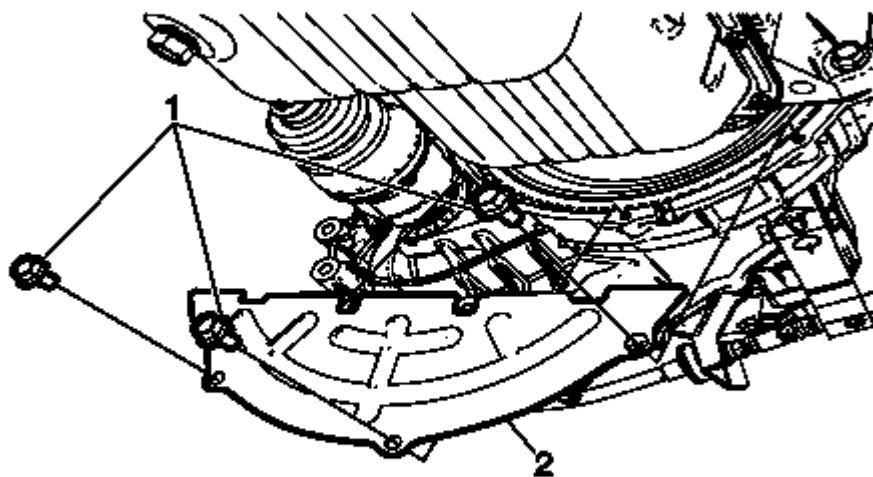


Fig. 16: Clutch Housing Lower Plate Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Remove the clutch housing lower plate bolt (1) and clutch housing lower plate (2).
4. After removing the related parts for the powertrain assembly removal, remove the powertrain assembly from the vehicle. Refer to **Engine Replacement (LFM)** , **Engine Replacement (LL0)** .

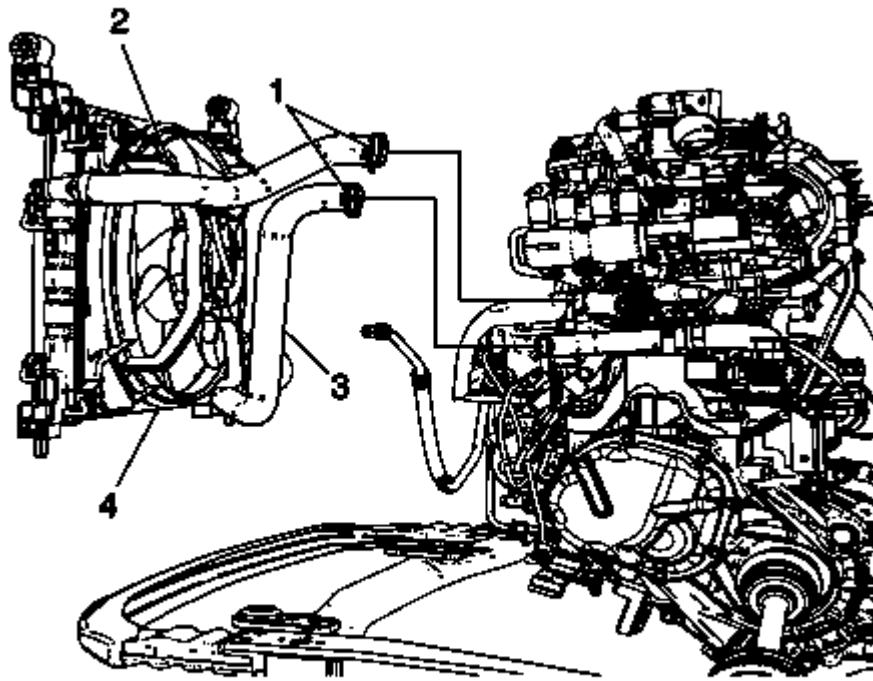


Fig. 17: Radiator Inlet And Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

5. Loosen the radiator inlet and outlet hose clamp (1).
6. Disconnect the radiator inlet and outlet hoses (2, 3) and remove the radiator and condenser assembly (4).

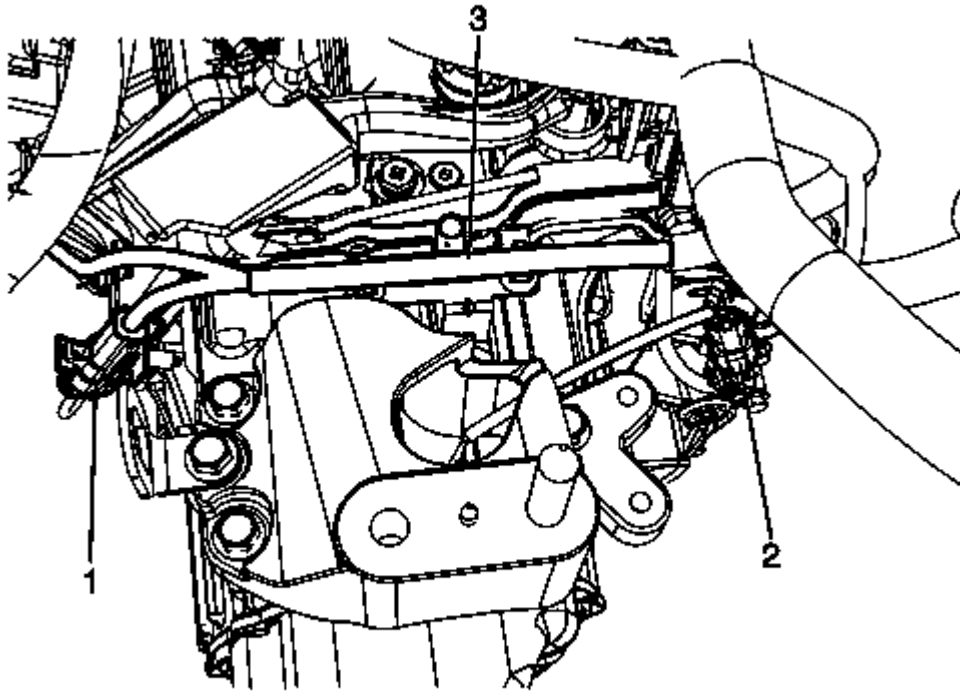


Fig. 18: Oxygen Sensor Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

7. Disconnect the oxygen sensor electrical connector (1).
8. Remove the crankshaft position sensor. Refer to **Crankshaft Position Sensor Replacement** .
9. Disconnect the electrical connector (2) from the backup light switch.
10. Unclip the engine wiring harness (3) from the oxygen sensor connector bracket and engine wiring harness brackets.

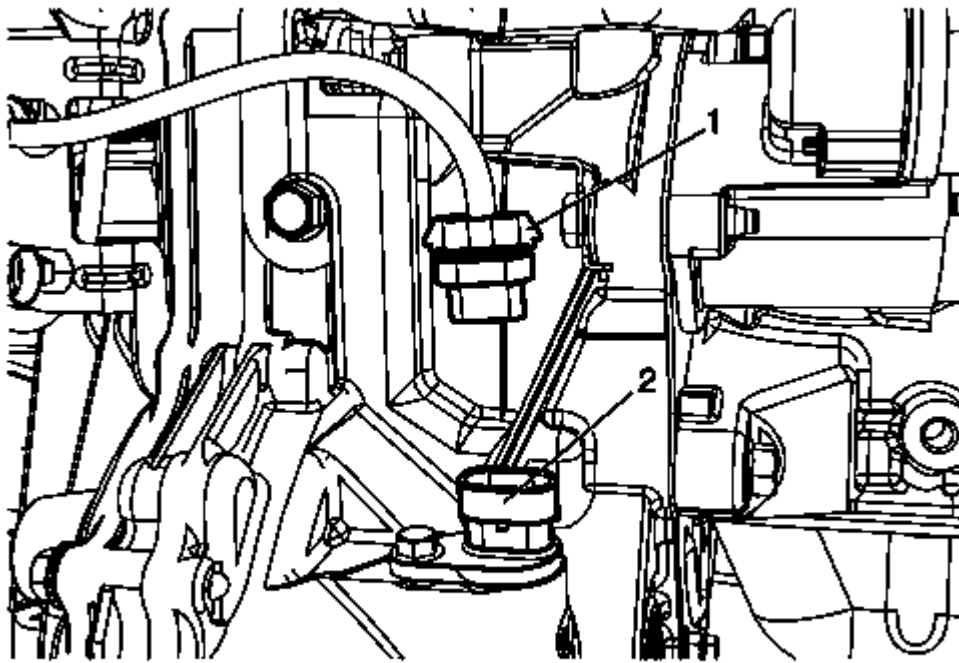


Fig. 19: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

11. Disconnect the electrical connector (1) from the vehicle speed sensor (2).
12. Separate the wiring harness from the transmission.
13. Remove the transmission mount bracket - left side. Refer to **Transmission Mount Bracket Replacement - Left Side (MX2, MFM)**.
14. Remove the transmission rear mount bracket. Refer to **Transmission Rear Mount Bracket Replacement (MX2, MFM)**.
15. Remove the front wheel drive shaft from the transmission. Refer to **Front Wheel Drive Shaft Replacement** .
16. Remove the starter. Refer to **Starter Replacement** .

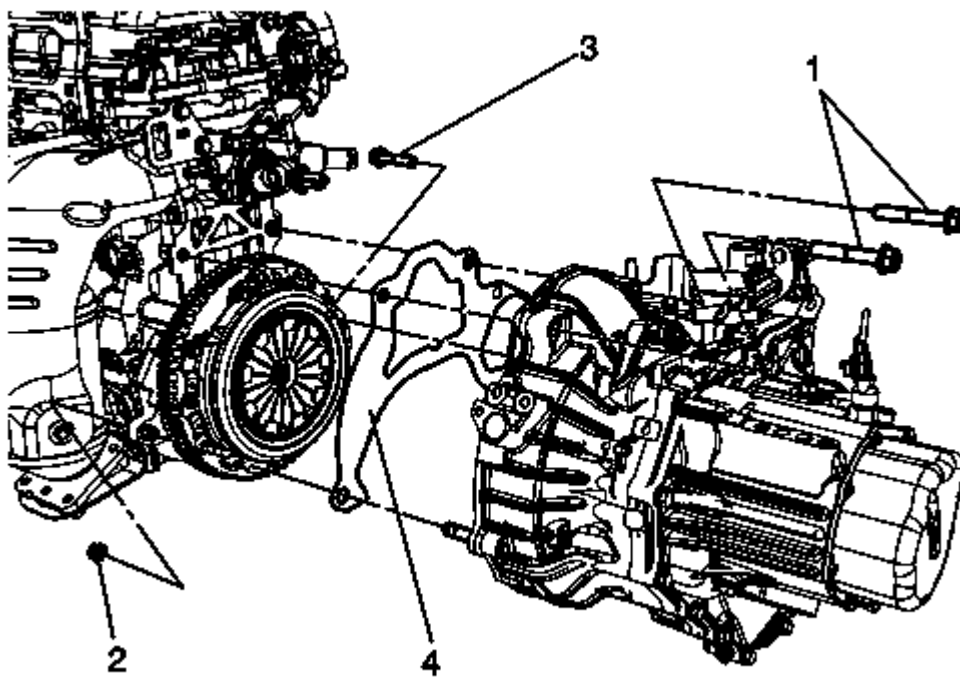


Fig. 20: Transmission Upper Bolts
Courtesy of GENERAL MOTORS COMPANY

17. Remove the transmission upper bolts (1).
18. Remove the transmission lower nut (2).
19. Remove the transmission lower bolt (3).
20. Remove the clutch housing upper plate (4).
21. Separate the transmission from the engine.

Installation Procedure

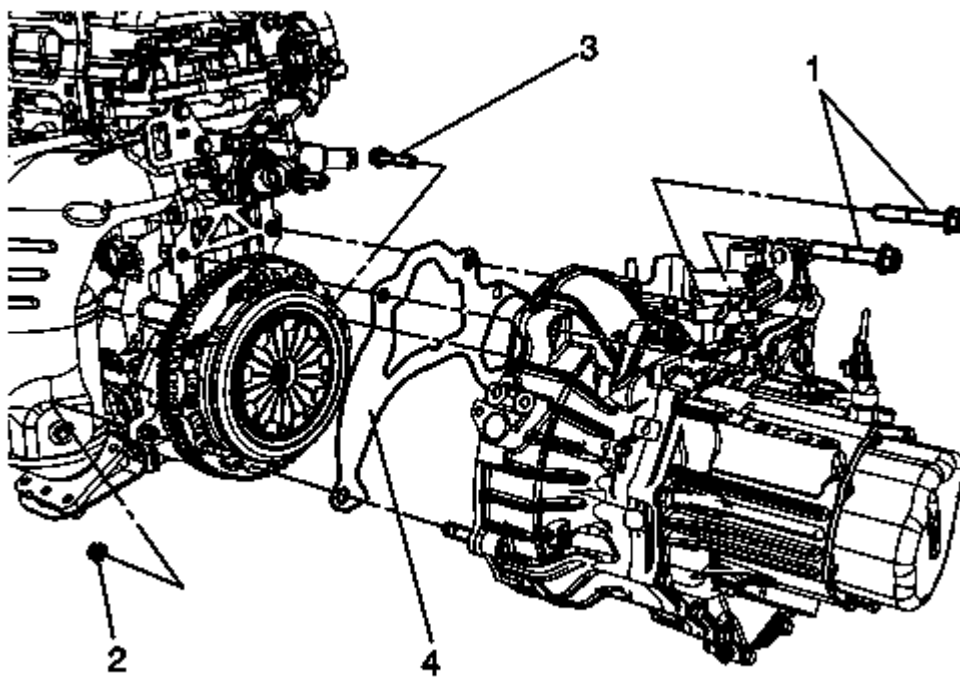


Fig. 21: Transmission Upper Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the transmission to the engine.

CAUTION: Refer to Fastener Caution .

2. Install the clutch housing upper plate (4).
3. Install the transmission lower bolt (3) and tighten to 61 (44 lb ft).
4. Install the transmission lower nut (2) and tighten to 61 (44 lb ft).
5. Install the transmission upper bolts (1) and tighten to 61 (44 lb ft).
6. Install the starter. Refer to **Starter Replacement** .
7. Install the front wheel drive shaft to the transmission. Refer to **Front Wheel Drive Shaft Replacement** .
8. Install the transmission rear mount bracket. Refer to **Transmission Rear Mount Bracket Replacement (MX2, MFM)**.
9. Install the transmission mount bracket - left side. Refer to **Transmission Mount Bracket Replacement - Left Side (MX2, MFM)**.

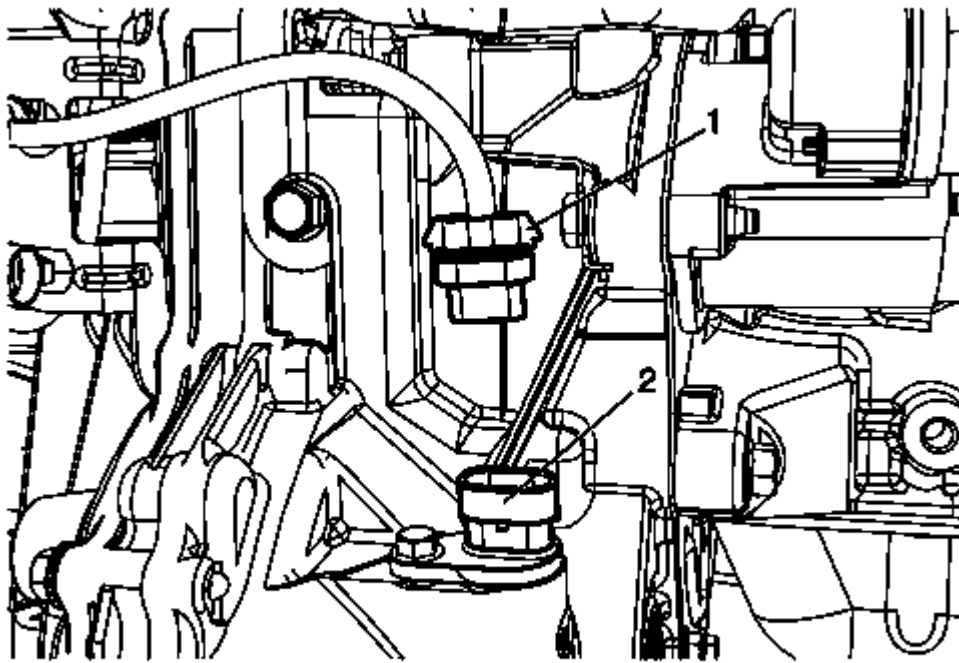


Fig. 22: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

10. Position the wiring harness into the transmission.
11. Connect the electrical connector (1) to the vehicle speed sensor (2).

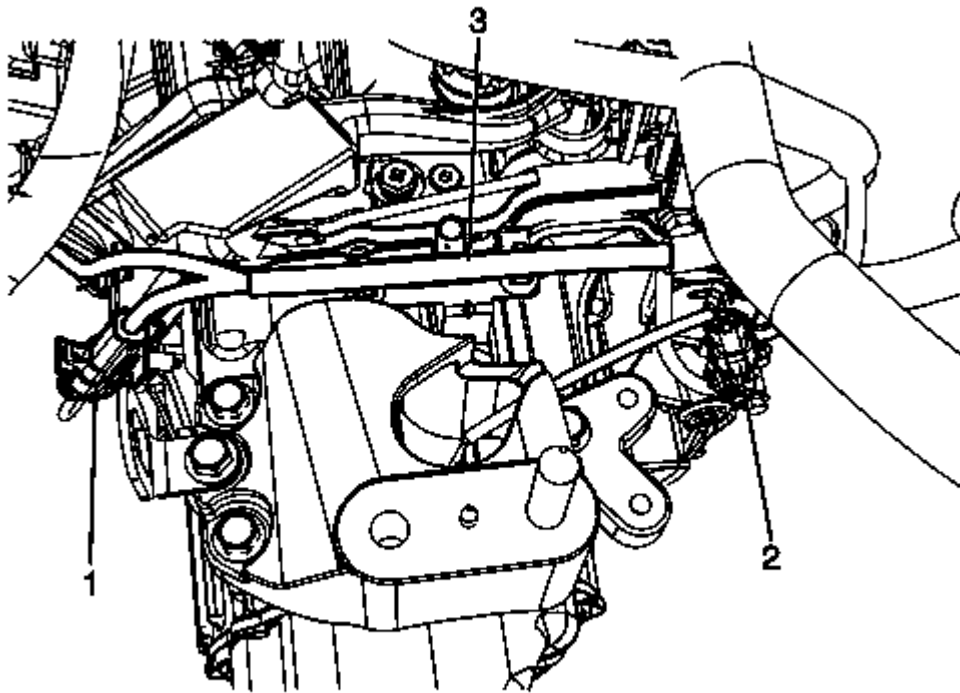


Fig. 23: Oxygen Sensor Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

12. Clip in the engine wiring harness (3) to the oxygen sensor connector bracket and engine wiring harness brackets.
13. Connect the electrical connector (2) to the backup lamp switch.
14. Install the crankshaft position sensor. Refer to **Crankshaft Position Sensor Replacement** .
15. Connect the oxygen sensor electrical connector (1).

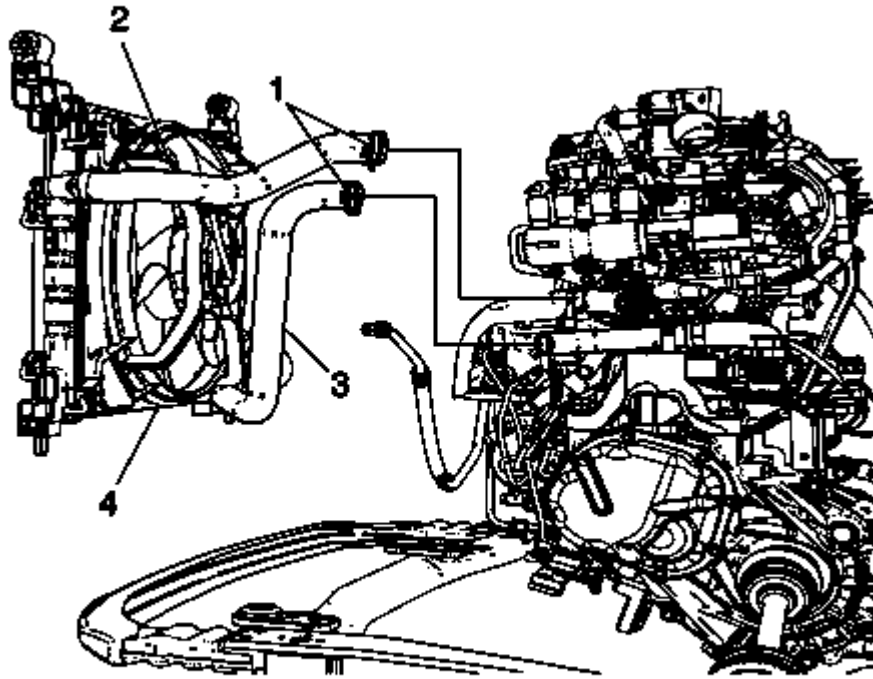


Fig. 24: Radiator Inlet And Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

16. Install the radiator and condenser assembly (4) and connect the radiator inlet and outlet hoses (2, 3).
17. Install the radiator inlet and outlet hose clamp (1).
18. Install the powertrain assembly to the vehicle and then install the related parts. Refer to **Engine Replacement (LFM)** , **Engine Replacement (LL0)** .

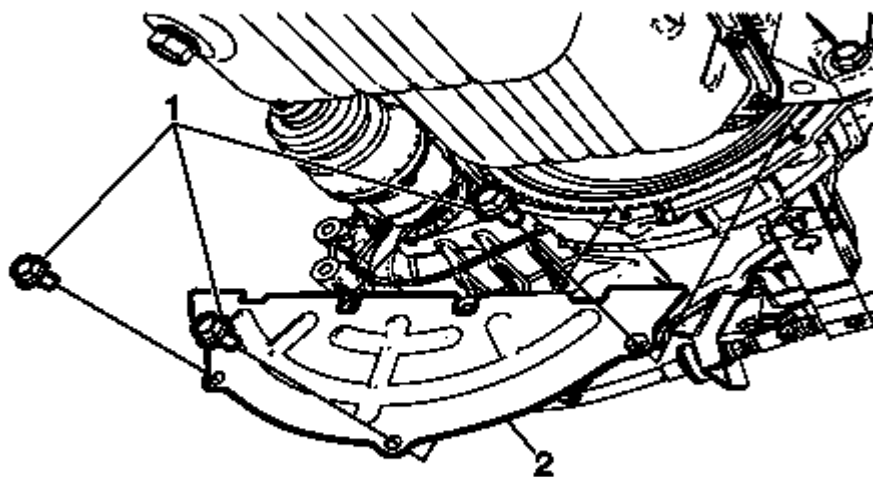


Fig. 25: Clutch Housing Lower Plate Bolt
Courtesy of GENERAL MOTORS COMPANY

19. Install the clutch housing lower plate (2) and clutch housing lower plate bolts (1) and tighten to 10 (89 lb in).
20. Fill the transmission with fluid. Refer to **Transmission Fluid Drain and Fill**.
21. Bleed the hydraulic clutch system. Refer to **Hydraulic Clutch System Bleeding**.
22. Fill the reservoir with clutch/brake fluid up to the MAX level.

MANUAL TRANSMISSION SHIFT LEVER AND SELECTOR LEVER CABLE REPLACEMENT (MX2, MFM)

Removal Procedure

1. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement**.

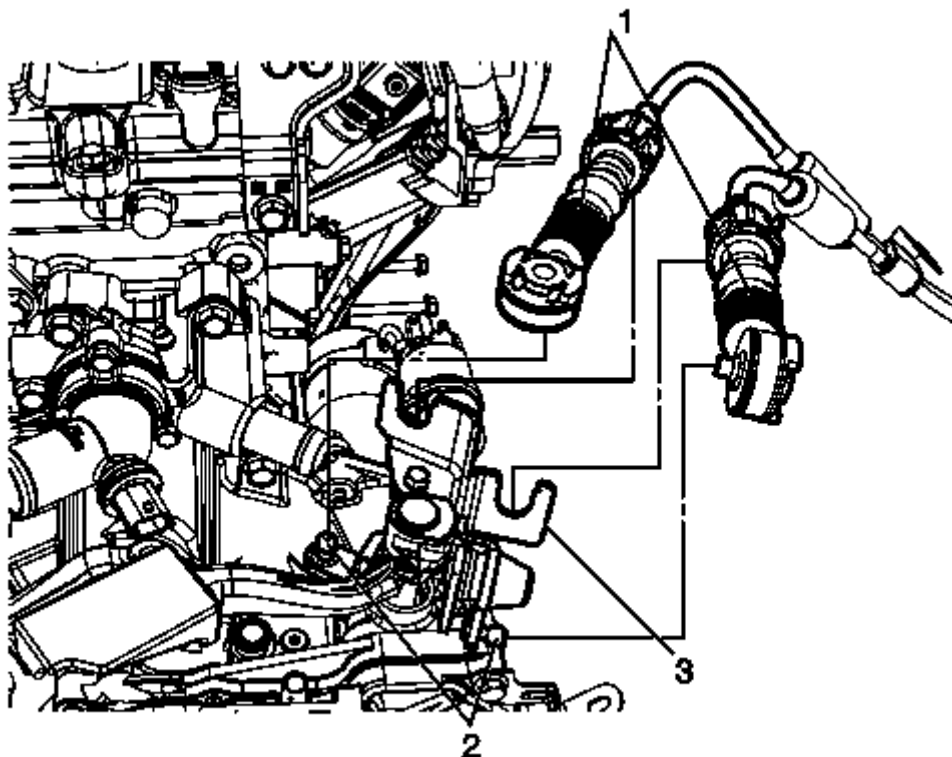


Fig. 26: Shift Lever And Selector Lever Cable
Courtesy of GENERAL MOTORS COMPANY

2. Remove the shift lever and selector lever cable (1) from the transmission control lever (2).
3. Remove the shift lever and selector lever cable from the shift lever and selector lever cable bracket (3).
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

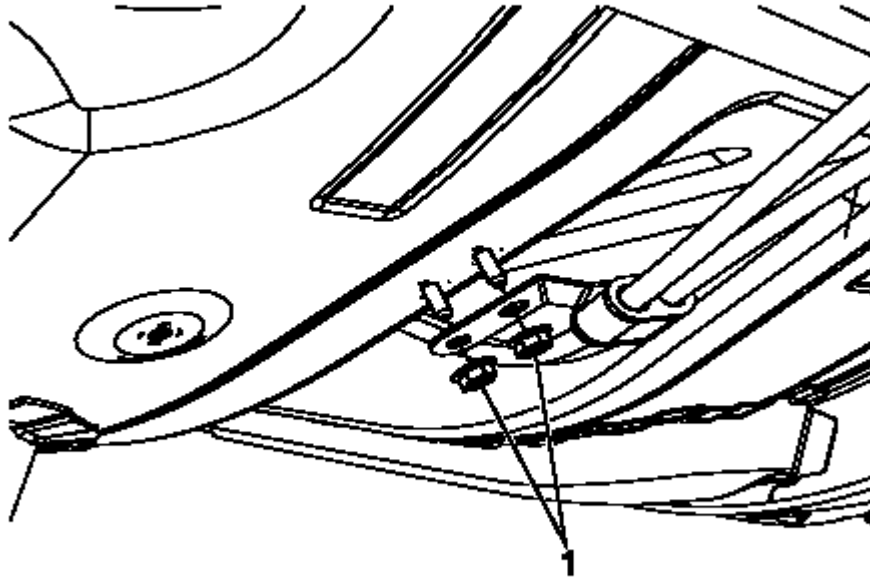


Fig. 27: Shift Lever And Selector Lever Cable Bracket Nuts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the shift lever and selector lever cable bracket nuts (1) from the underbody.
6. Lower the vehicle.
7. Remove the front floor console. Refer to **Front Floor Console Replacement** .

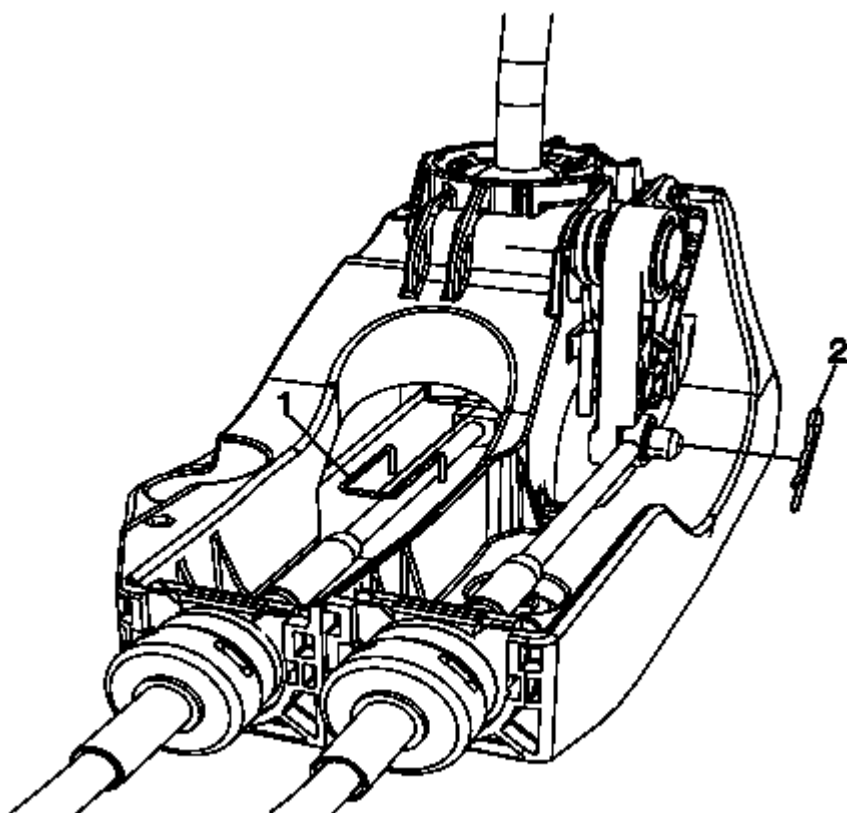


Fig. 28: Shift Lever And Selector Lever Cable U-clip
Courtesy of GENERAL MOTORS COMPANY

8. Remove the shift lever and selector lever cable U-clip (1).
9. Remove the shift lever and selector lever cable pin (2).

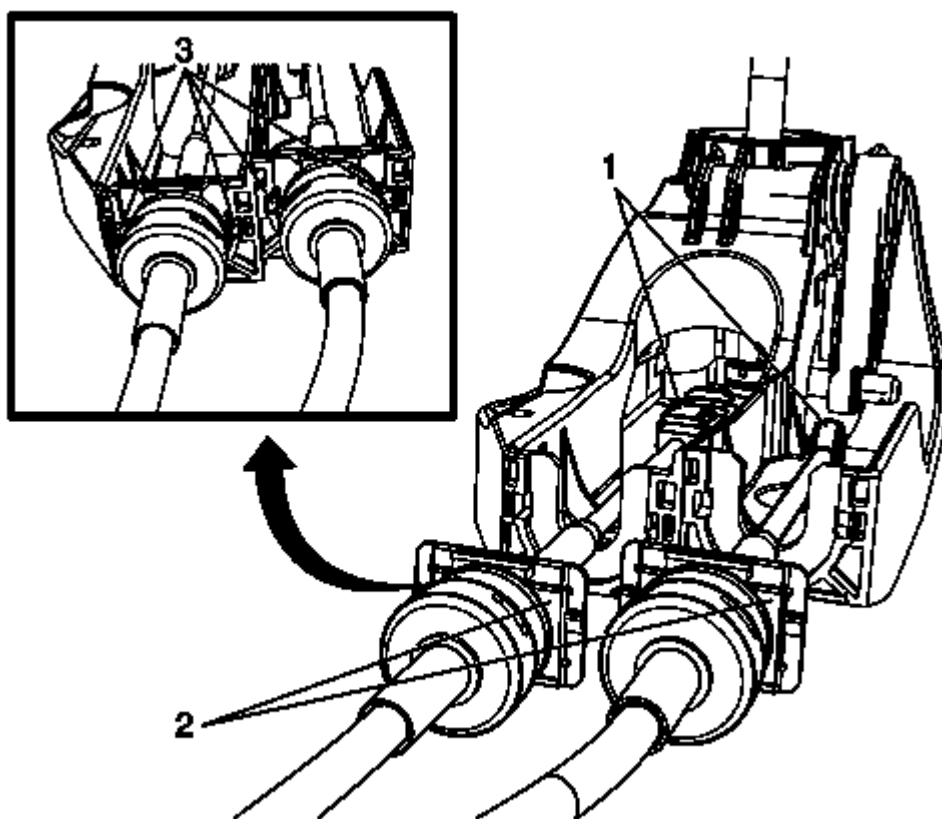


Fig. 29: Shift Lever And Selector Lever Cable Ends
Courtesy of GENERAL MOTORS COMPANY

10. Disconnect the shift lever and selector lever cable ends (1).
11. Push the cable socket tabs (3) in order to release the shift lever and selector lever cable.
12. Remove the shift lever and selector lever cable socket (2) from the transmission control housing.

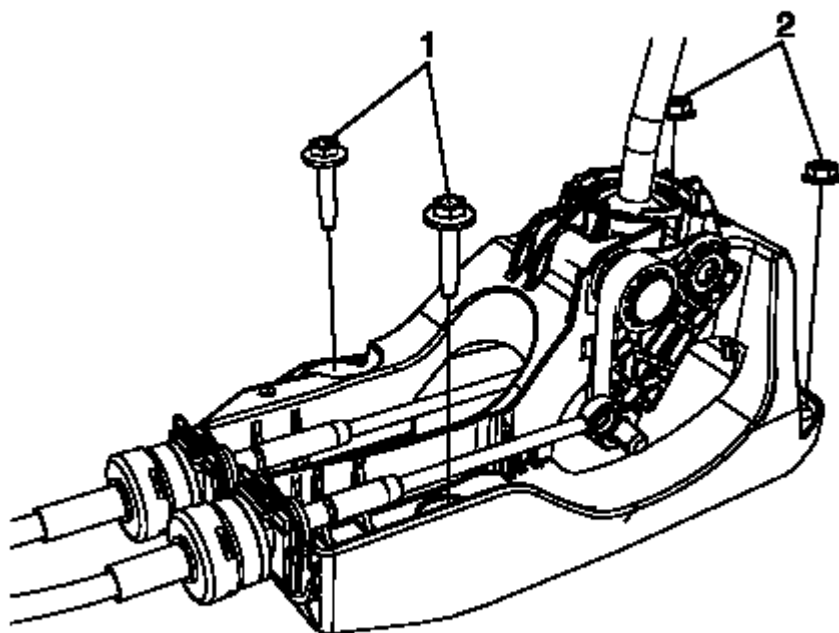


Fig. 30: Transmission Control Bolts
Courtesy of GENERAL MOTORS COMPANY

13. Remove the transmission control bolts (1) and nuts (2).
14. Remove the transmission control.

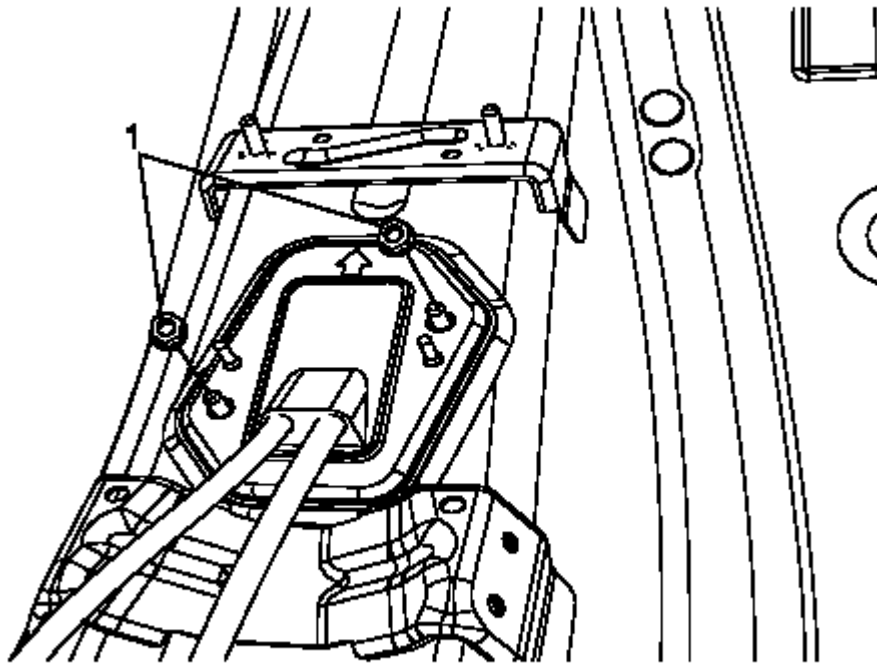


Fig. 31: Shift Lever And Selector Lever Cable Grommet Nuts
Courtesy of GENERAL MOTORS COMPANY

15. Remove the shift lever and selector lever cable grommet nuts (1).
16. Remove the shift lever and selector lever cable from the vehicle.

Installation Procedure

1. Install the shift lever and selector lever cables to the vehicle.

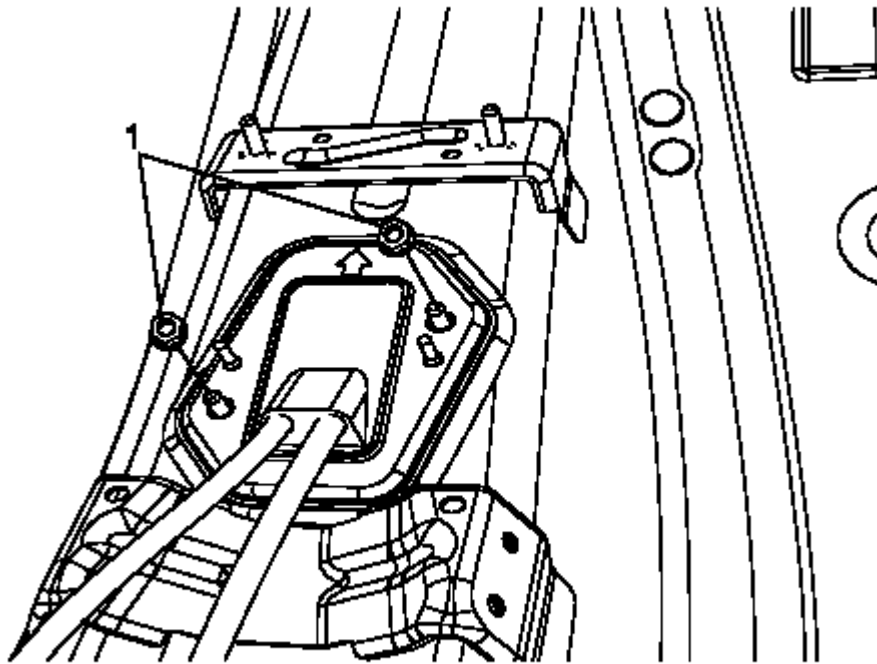


Fig. 32: Shift Lever And Selector Lever Cable Grommet Nuts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

2. Install the shift lever and selector lever cable grommet nut (1) and tighten to 6 (53 lb in).

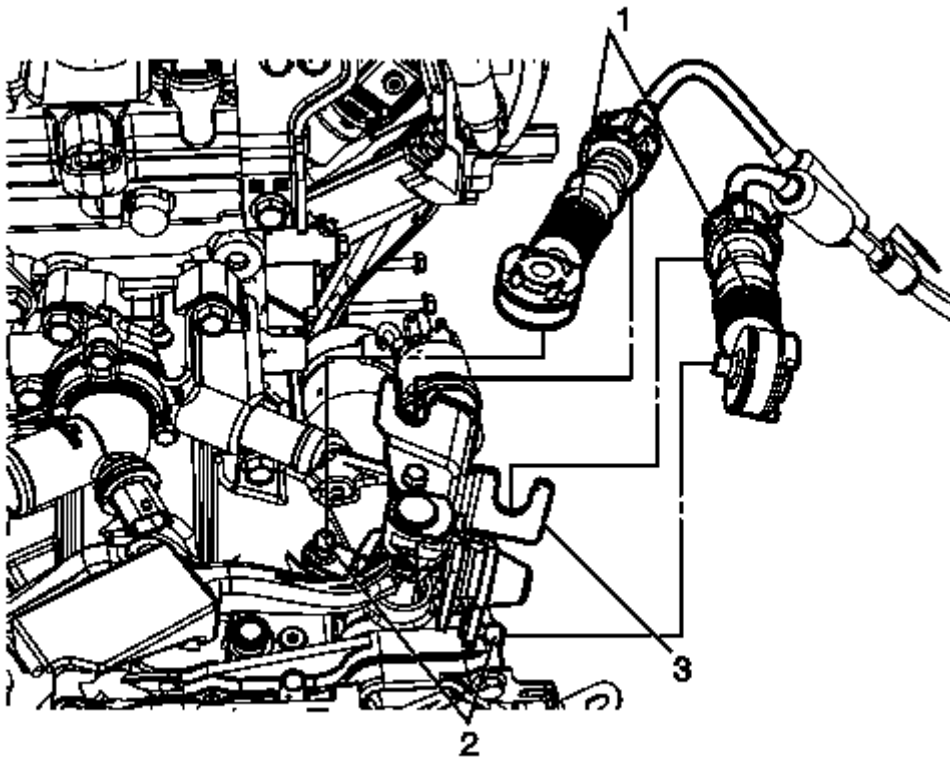


Fig. 33: Shift Lever And Selector Lever Cable
Courtesy of GENERAL MOTORS COMPANY

3. Install the shift lever and selector lever cable (1) to shift lever and selector lever cable bracket (3).
4. Install the shift lever and selector lever cable to transmission control lever (2).
5. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

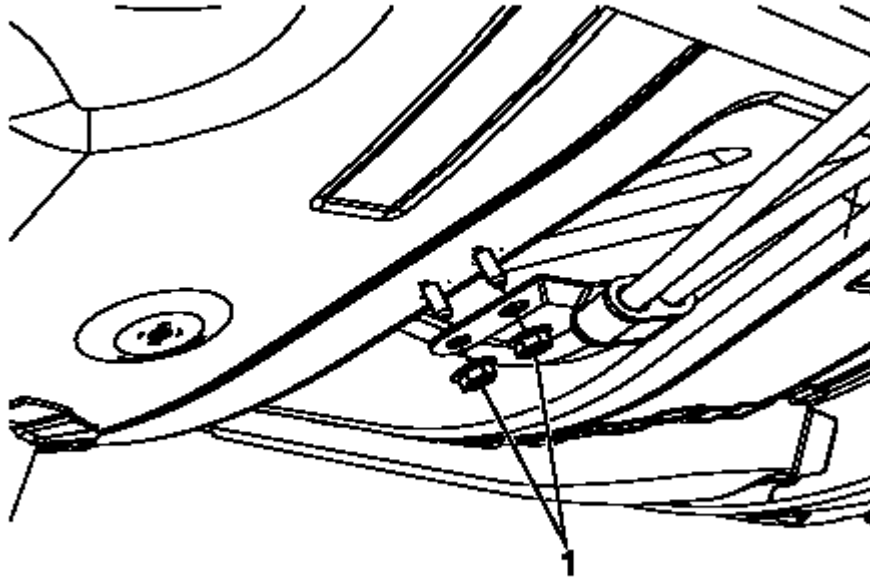


Fig. 34: Shift Lever And Selector Lever Cable Bracket Nuts
Courtesy of GENERAL MOTORS COMPANY

6. Install the shift lever and selector lever cable bracket nuts (1) to the underbody and tighten to 6 (53 lb in).
7. Lower the vehicle.

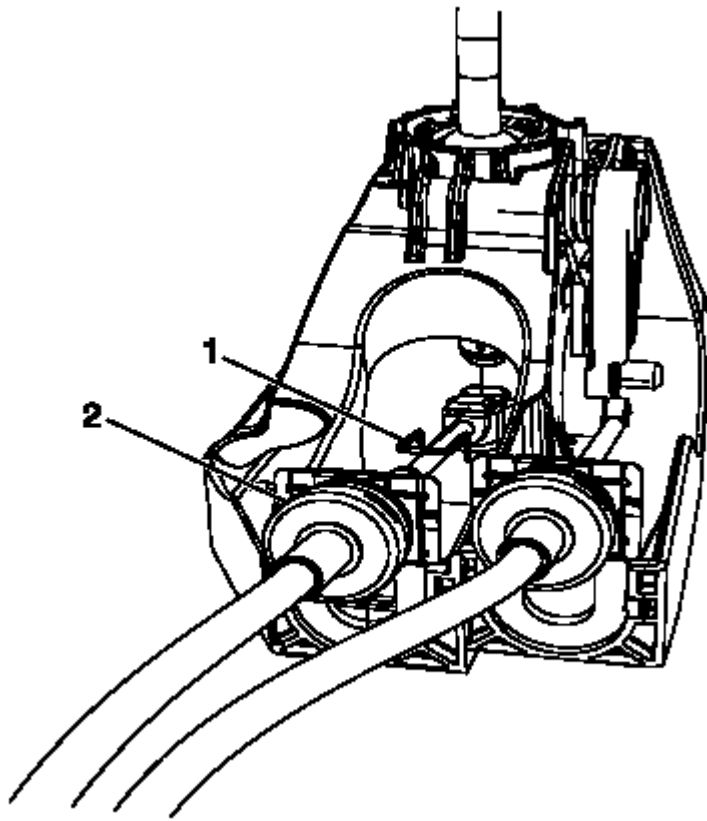


Fig. 35: Shift Lever Cable U-Clip

Courtesy of GENERAL MOTORS COMPANY

8. Position the transmission control in the vehicle.
9. Connect the shift lever cable end.
10. Install the shift lever cable U-clip (1).
11. Install the shift lever cable socket (2) to the transmission control housing.

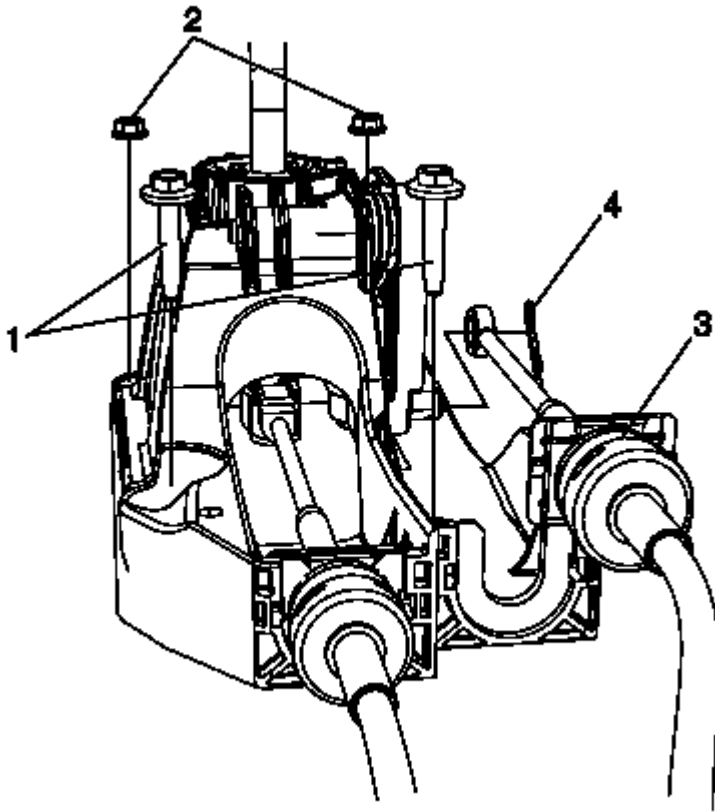


Fig. 36: Transmission Control Bolts
Courtesy of GENERAL MOTORS COMPANY

12. Install the transmission control bolts (1) and nuts (2) and tighten to 6 (53 lb in)
13. Install the selector lever cable socket (3) to the transmission control housing.
14. Connect the selector lever cable end.
15. Install the selector lever cable pin (4).
16. Install the front floor console. Refer to **Front Floor Console Replacement** .
17. Install the air cleaner. Refer to **Air Cleaner Assembly Replacement** .

TRANSMISSION CONTROL REPLACEMENT

Removal Procedure

1. Remove the front floor console. Refer to **Front Floor Console Replacement** .

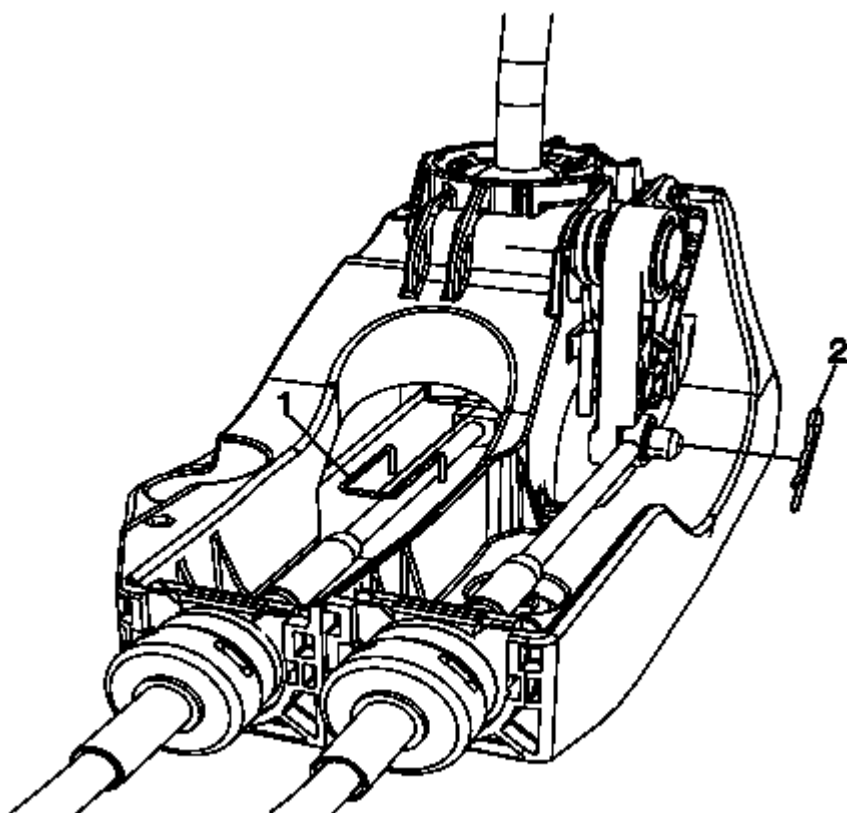


Fig. 37: Shift Lever And Selector Lever Cable U-clip
Courtesy of GENERAL MOTORS COMPANY

2. Remove the shift lever and selector lever cable U-clip (1).
3. Remove the shift lever and selector lever cable pin (2).

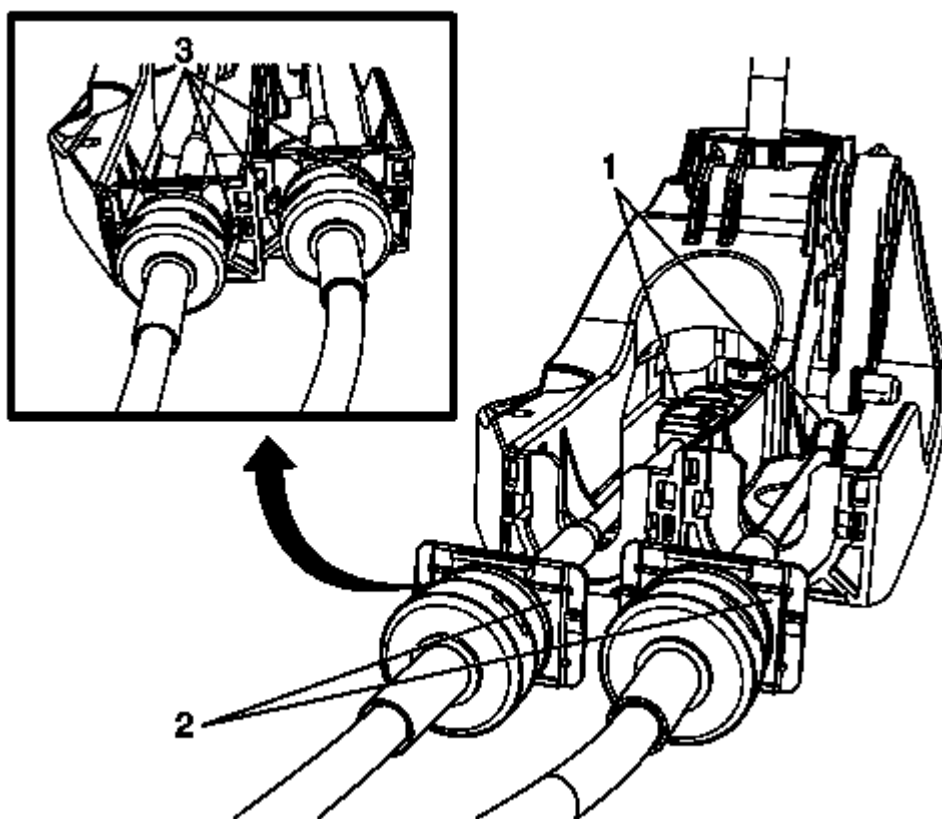


Fig. 38: Shift Lever And Selector Lever Cable Ends
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the shift lever and selector lever cable ends (1).
5. Push the cable socket tabs (3) in order to release the shift lever and selector lever cable.
6. Remove the shift lever and selector lever cable socket (2) from the transmission control housing.

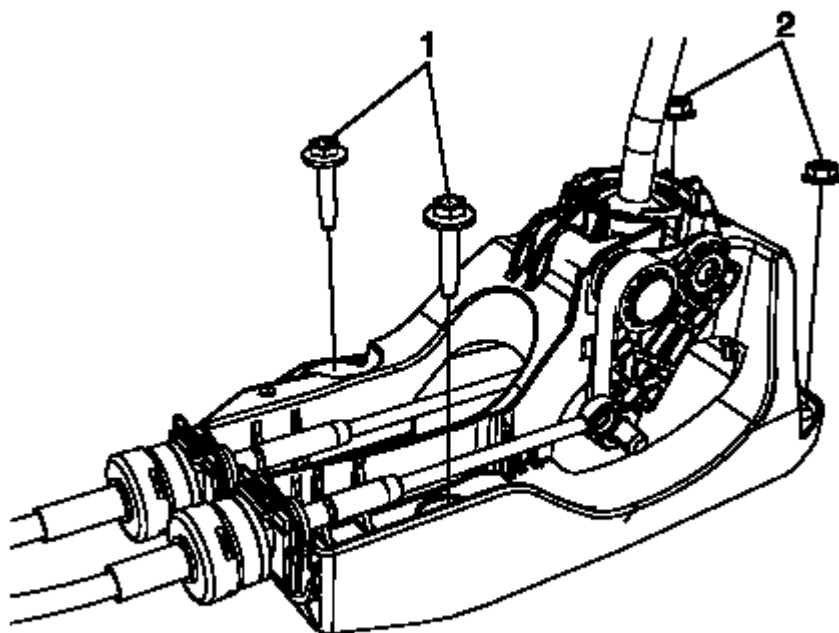


Fig. 39: Transmission Control Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Remove the transmission control bolts (1) and nuts (2).
8. Remove the transmission control from the vehicle.

Installation Procedure

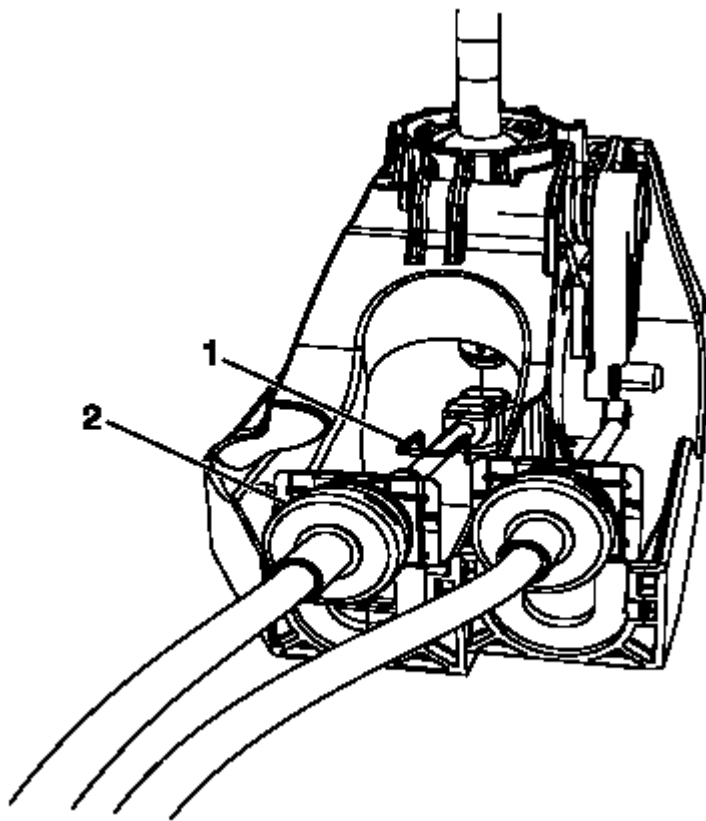


Fig. 40: Shift Lever Cable U-Clip

Courtesy of GENERAL MOTORS COMPANY

1. Position the transmission control in the vehicle.
2. Connect the shift lever cable end.
3. Install the shift lever cable U-clip (1).
4. Install the shift lever cable socket (2) to the transmission control housing.

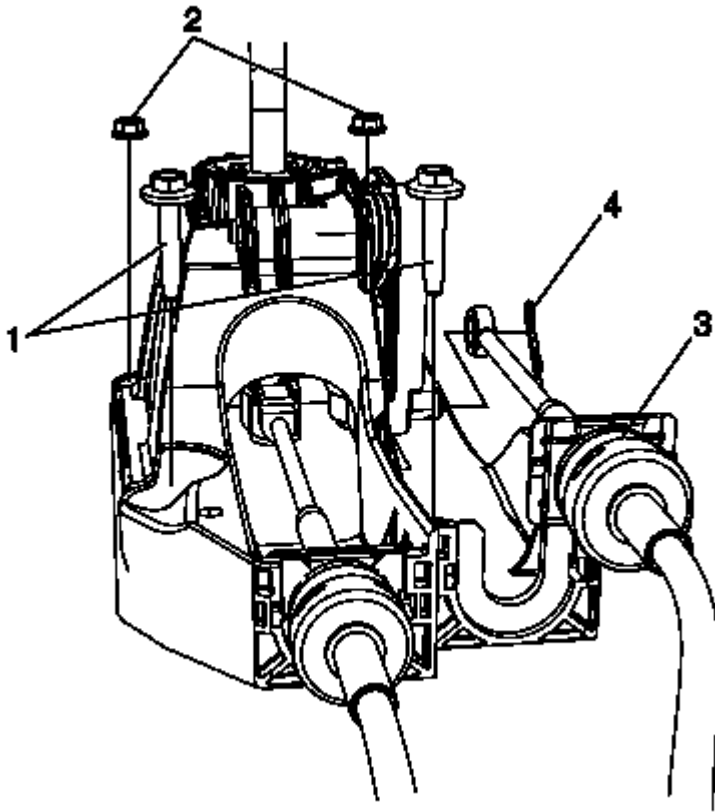


Fig. 41: Transmission Control Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

5. Install the transmission control bolts (1) and nuts (2) and tighten to 6 (53 lb in).
6. Install the selector lever cable socket (3) to the transmission control housing.
7. Connect the selector lever cable end.
8. Install the selector lever cable pin (4).
9. Install the front floor console. Refer to Front Floor Console Replacement .

SELECTOR AND SHIFT LEVER CABLE BRACKET REPLACEMENT

Removal Procedure

1. Remove the air cleaner assembly. Refer to Air Cleaner Assembly Replacement .

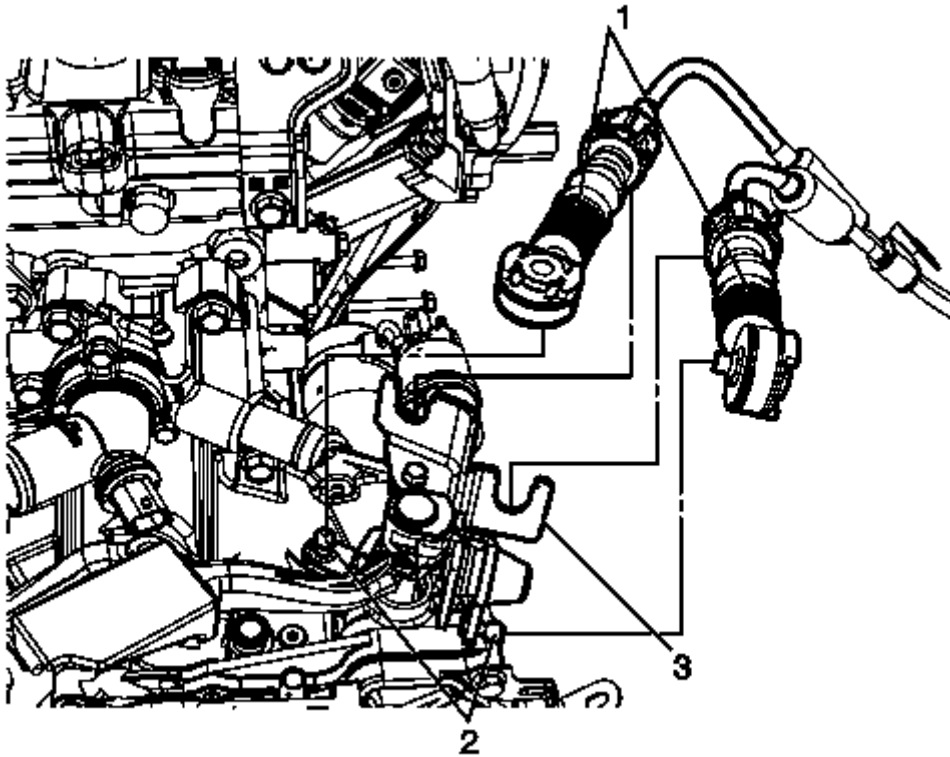


Fig. 42: Shift Lever And Selector Lever Cable
Courtesy of GENERAL MOTORS COMPANY

2. Remove the shift lever and selector lever cable (1) from the transmission control lever (2).
3. Remove the shift lever and selector lever cable from the shift lever and selector lever cable bracket (3).

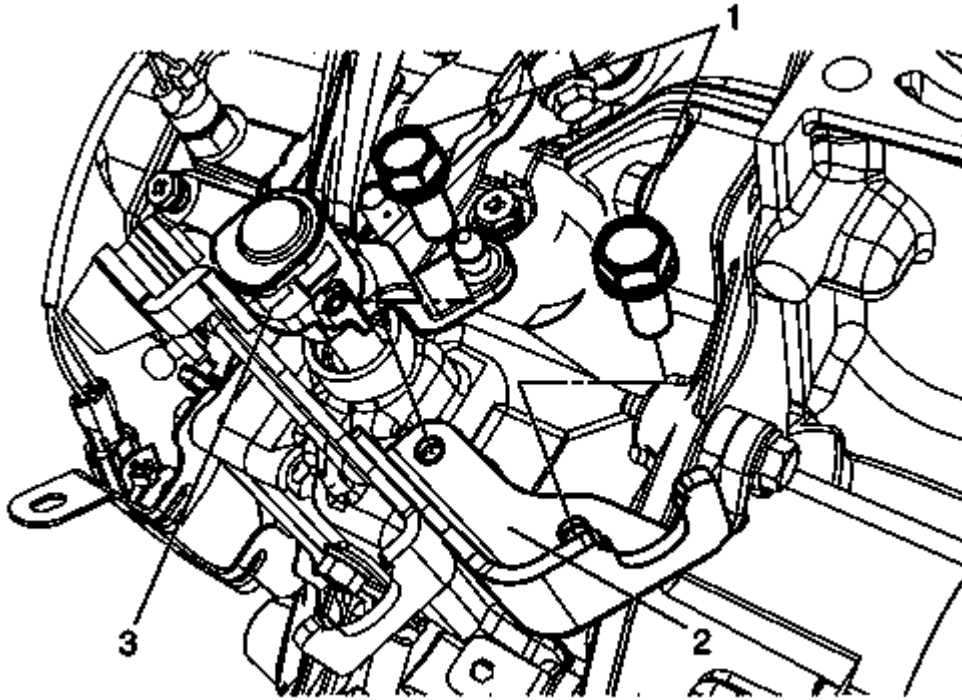


Fig. 43: Selector And Shift Lever Cable Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove the selector and shift lever cable bracket bolts (1) from the transmission.
5. Remove the selector and shift lever cable bracket (2) and bushing (3) from the transmission.

Installation Procedure

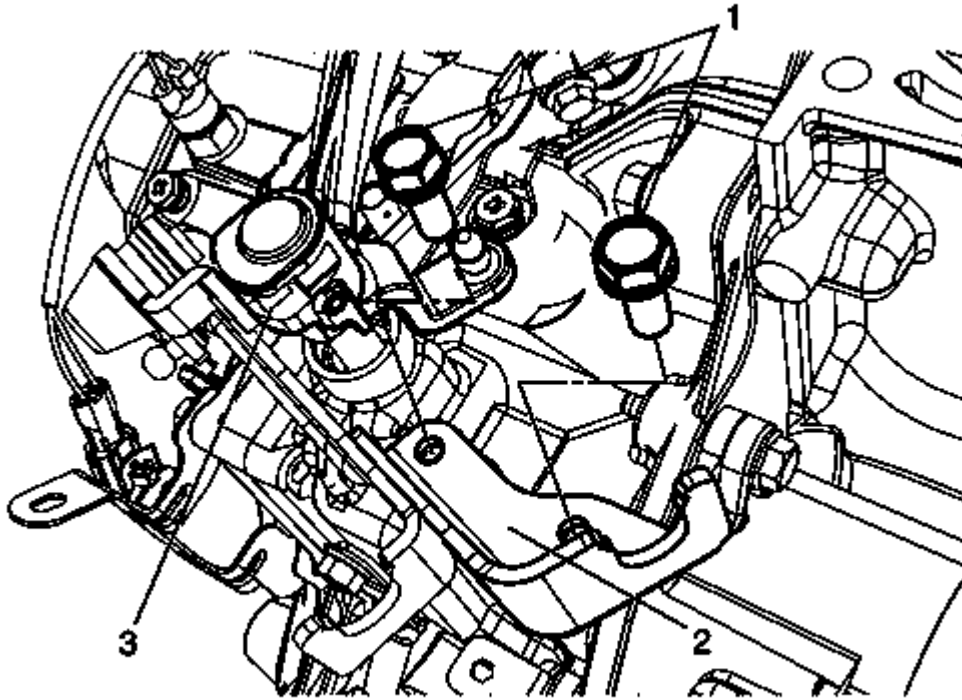


Fig. 44: Selector And Shift Lever Cable Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the selector and shift lever cable bracket (2) and bushing (3) to the transmission.

CAUTION: Refer to Fastener Caution .

2. Install the selector and shift lever cable bracket bolts (1) to the transmission and tighten to 23 (17 lb ft).

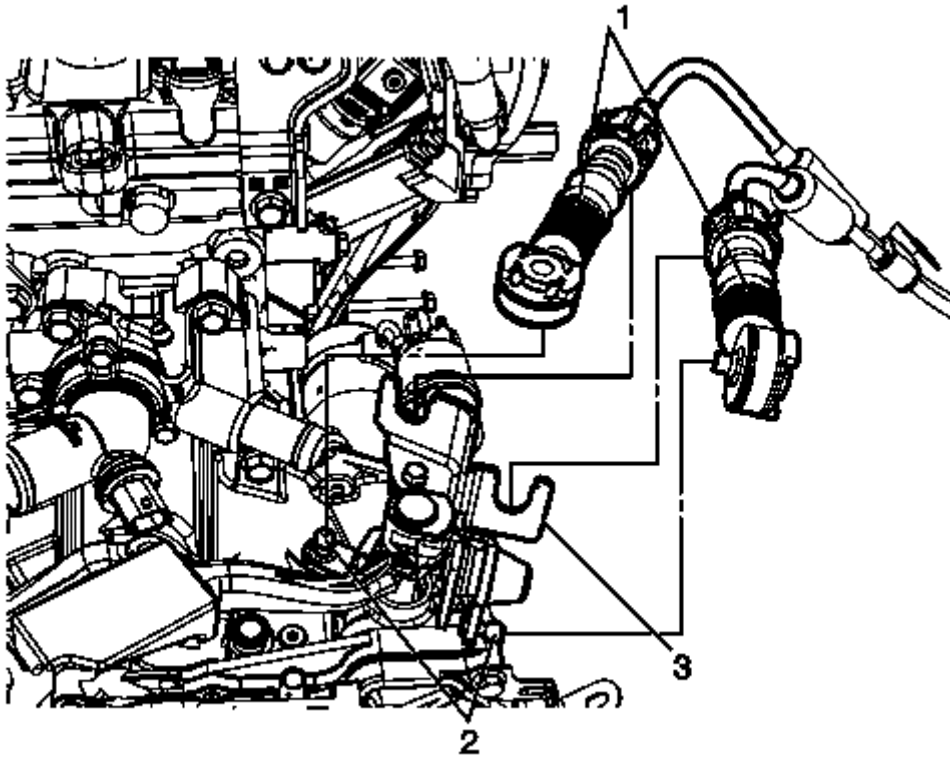


Fig. 45: Shift Lever And Selector Lever Cable
Courtesy of GENERAL MOTORS COMPANY

3. Install the shift lever and selector lever cable (1) to the shift lever and selector lever cable bracket (3).
4. Install the shift lever and selector lever cable to transmission control lever (2).
5. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .

BACKUP LAMP SWITCH REPLACEMENT (MX2, MFM)

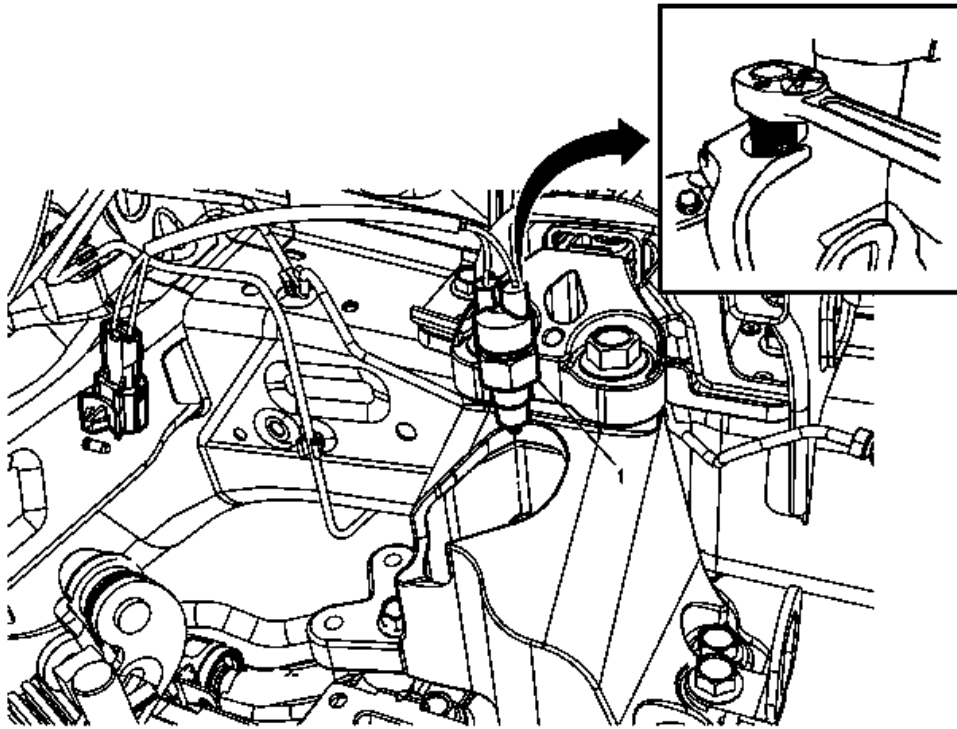


Fig. 46: Backup Lamp Switch
 Courtesy of GENERAL MOTORS COMPANY

Backup Lamp Switch Replacement (MX2, MFM)

Callout	Component Name
Preliminary Procedures	
Remove the air cleaner assembly. Refer to <u>Air Cleaner Assembly Replacement</u> .	
1	Backup Lamp Switch CAUTION: Refer to <u>Component Fastener Tightening Caution</u> . Procedure Disconnect the electrical connector. Tighten 17 (13 lb ft) Special Tools DT-50182 Backup Lamp Switch Remover/Installer For equivalent regional tools, refer to <u>Special Tools</u>

VEHICLE SPEED SENSOR REPLACEMENT (MX2, MFM)

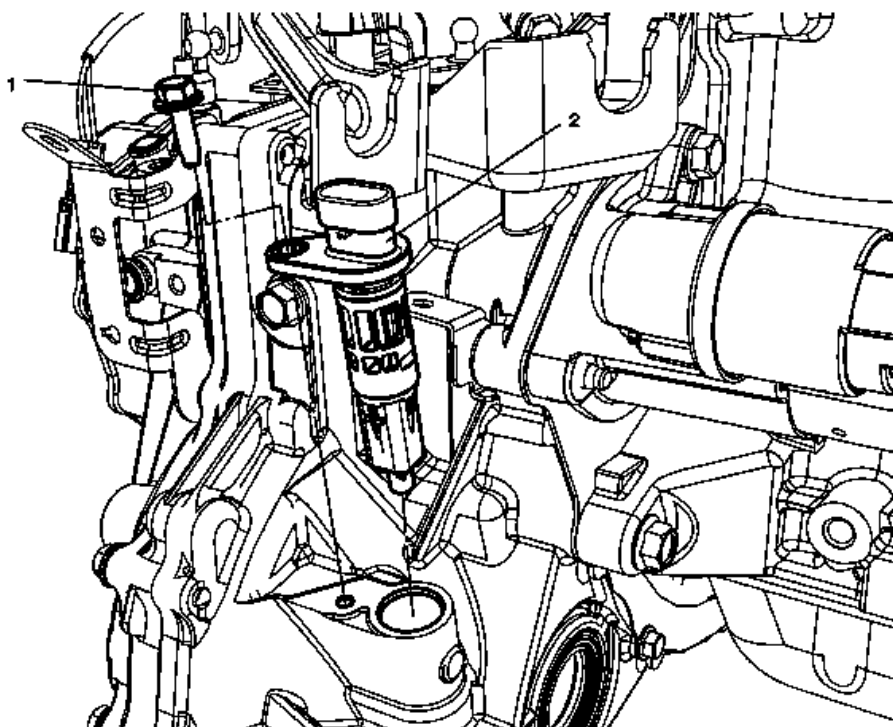


Fig. 47: Vehicle Speed Sensor

Courtesy of GENERAL MOTORS COMPANY

Vehicle Speed Sensor Replacement (MX2, MFM)

Callout	Component Name
Preliminary Procedure Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> .	
1	Vehicle Speed Sensor Mount Bolt (Qty: 1) CAUTION: Refer to <u>Fastener Caution</u> . Procedure Disconnect the electrical connector. Tighten 9 (80 lb in)
2	Vehicle Speed Sensor Assembly

FRONT WHEEL DRIVE SHAFT SEAL REPLACEMENT - LEFT SIDE (MX2, MFM)

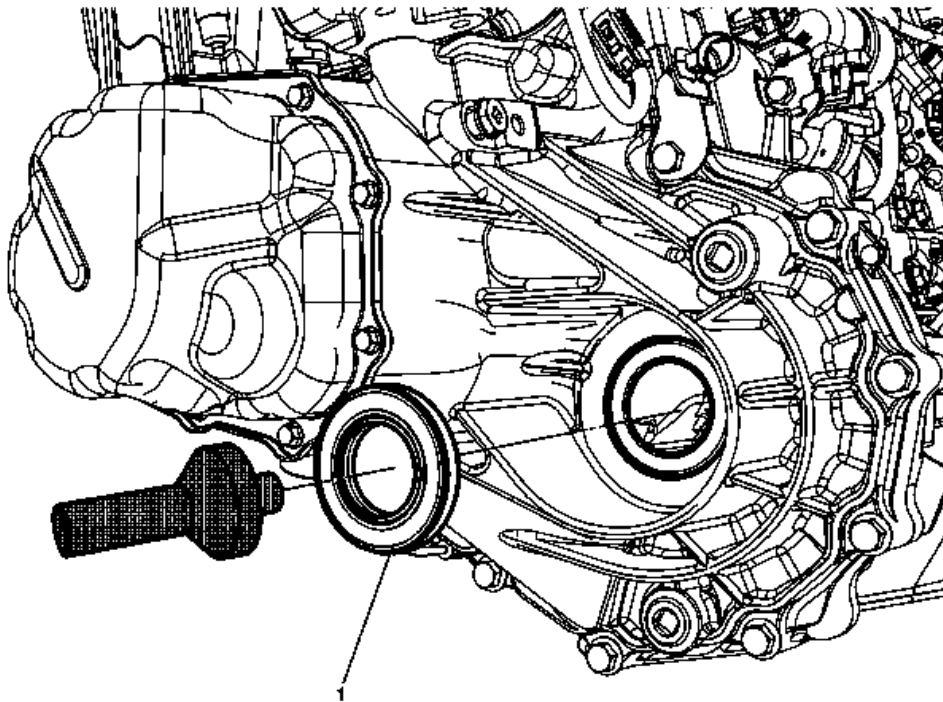


Fig. 48: Front Wheel Drive Shaft Seal - Left Side (MX2, MFM)
 Courtesy of GENERAL MOTORS COMPANY

Front Wheel Drive Shaft Seal Replacement - Left Side (MX2, MFM)

Callout	Component Name
Preliminary Procedures	
1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Remove the front wheel drive shaft from the transmission. Refer to <u>Front Wheel Drive Shaft Replacement</u> .	
1	Left Front Wheel Drive Shaft Oil Seal Procedure 1. Remove the left wheel drive shaft oil seal using the DT-7004 slide hammer and the DT-586 universal seal remover. 2. Coat NEW left front wheel drive shaft oil seal with transmission fluid. 3. Install the NEW left front wheel drive shaft oil seal using the DT-50181 oil seal installer and hammer. TIP: Do not reuse the wheel drive shaft oil seal. Special Tools

- **DT-586** Universal Seal Remover
- **DT-7004** Slide Hammer
- **DT-50181** Oil Seal Installer

For equivalent regional tools, refer to **Special Tools**.

FRONT WHEEL DRIVE SHAFT SEAL REPLACEMENT - RIGHT SIDE (MX2, MFM)

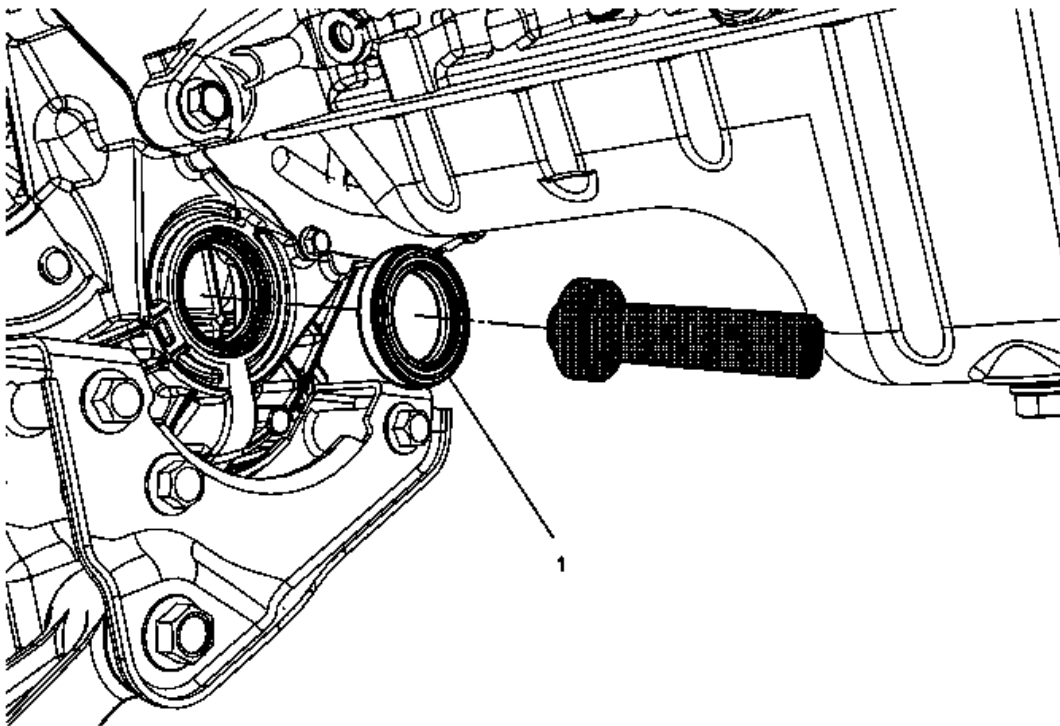


Fig. 49: Front Wheel Drive Shaft Seal - Right Side (MX2, MFM)

Courtesy of GENERAL MOTORS COMPANY

Front Wheel Drive Shaft Seal Replacement - Right Side (MX2, MFM)

Callout	Component Name
Preliminary Procedures	
1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle . 2. Remove the front wheel drive shaft from the transmission. Refer to Front Wheel Drive Shaft Replacement .	
	Right Front Wheel Drive Shaft Oil Seal
	Procedure
	1. Remove the right wheel drive shaft oil seal using the DT-7004 slide hammer with the

1

DT-586 universal seal remover.

2. Coat the NEW right front wheel drive shaft oil seal with transmission fluid.
3. Install the NEW right front wheel drive shaft oil seal using the **DT-49088** oil seal installer and hammer.

TIP: Do NOT reuse the front wheel drive shaft oil seal.

Special Tools

- **DT-586** Universal Seal Remover
- **DT-7004** Slide Hammer
- **DT-49088** Oil Seal Installer

For equivalent regional tools, refer to **Special Tools**.

TRANSMISSION FLUID LEVEL INSPECTION

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

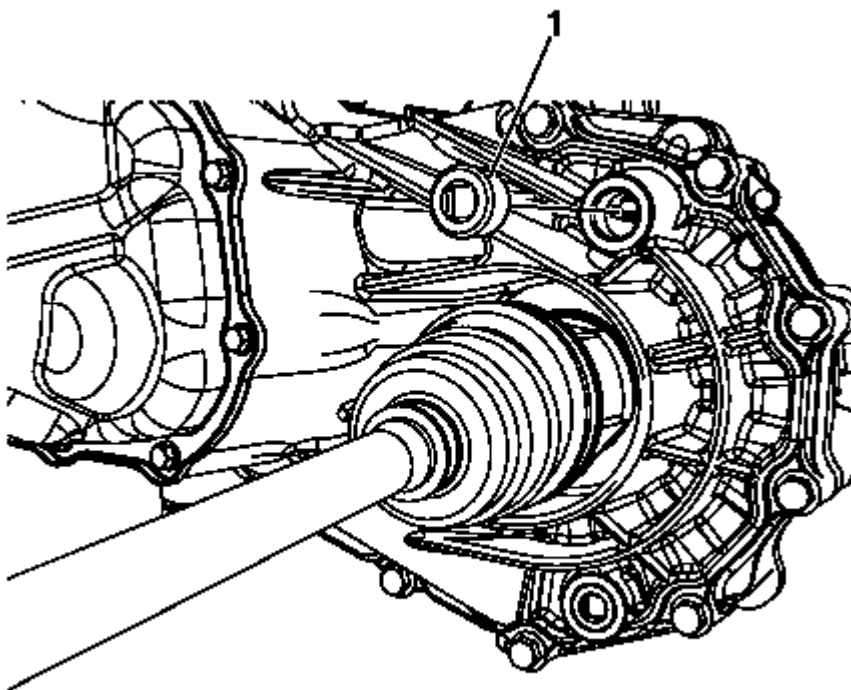


Fig. 50: Transmission Case Oil Fill Plug
Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to Checking Hot Transmission Fluid through Drain Plug Hole
Warning .

2. Clean away all dirt and debris from the transmission case plug area.

NOTE: It is not necessary to check the fluid level unless oil discoloration occurs or leakage is suspected. Make sure to check the fluid level with the engine stopped. Check if the vehicle is level.

3. Remove and discard the transmission case oil fill plug (1) and check the oil level. The fluid level should be up to the bottom edge of the fluid plug hole.
4. If the level is low, add manual transmission fluid through the fill plug hole until the fluid begins to run out.

Installation Procedure

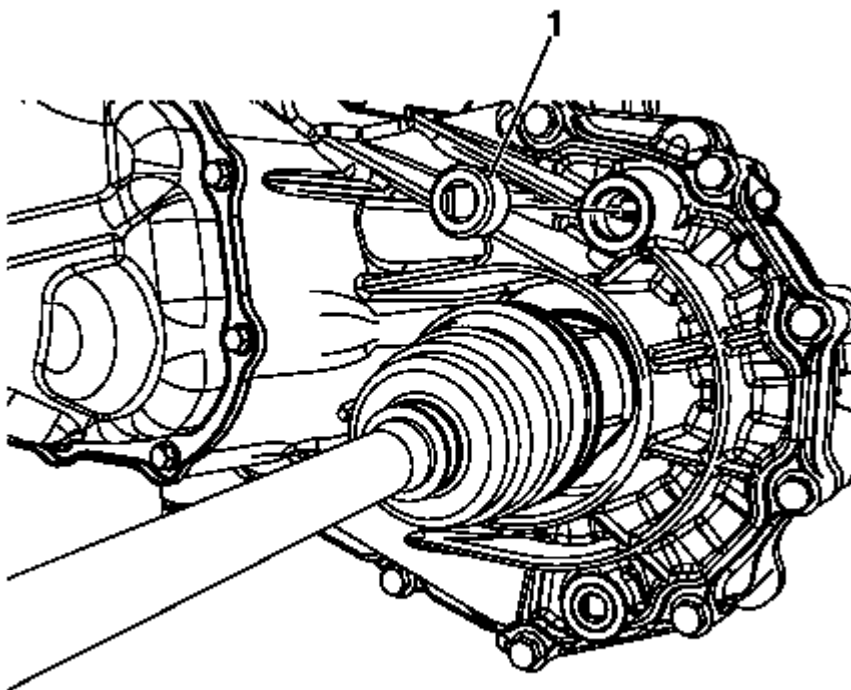


Fig. 51: Transmission Case Oil Fill Plug
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Component Fastener Tightening Caution .

1. Install the NEW transmission case oil fill plug (1) and tighten to 25 (18 lb ft).
2. Lower the vehicle.

TRANSMISSION FLUID DRAIN AND FILL

Removal Procedure

WARNING: The transmission fluid is hot. Caution must be taken to prevent personal injury when the transmission fluid drains from the transmission.

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .

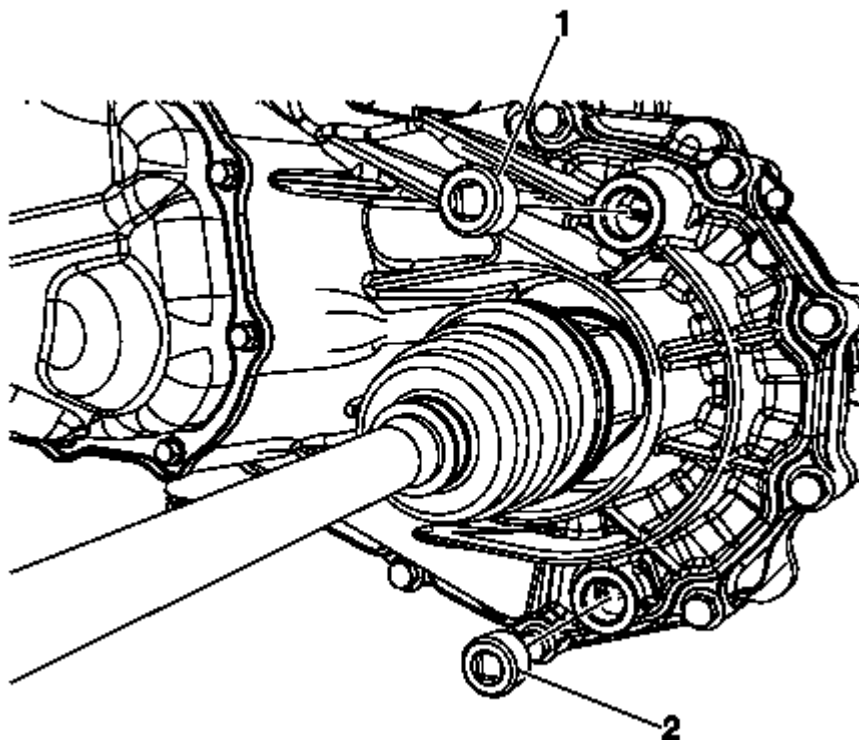


Fig. 52: Transmission Case Oil Fill Plug
Courtesy of GENERAL MOTORS COMPANY

2. Clean away all dirt and debris from the transmission case plug area.
3. Remove and discard the transmission case oil drain plug (2).
4. Drain transmission fluid into a suitable container.
5. Remove and discard the transmission case oil fill plug (1).

Installation Procedure

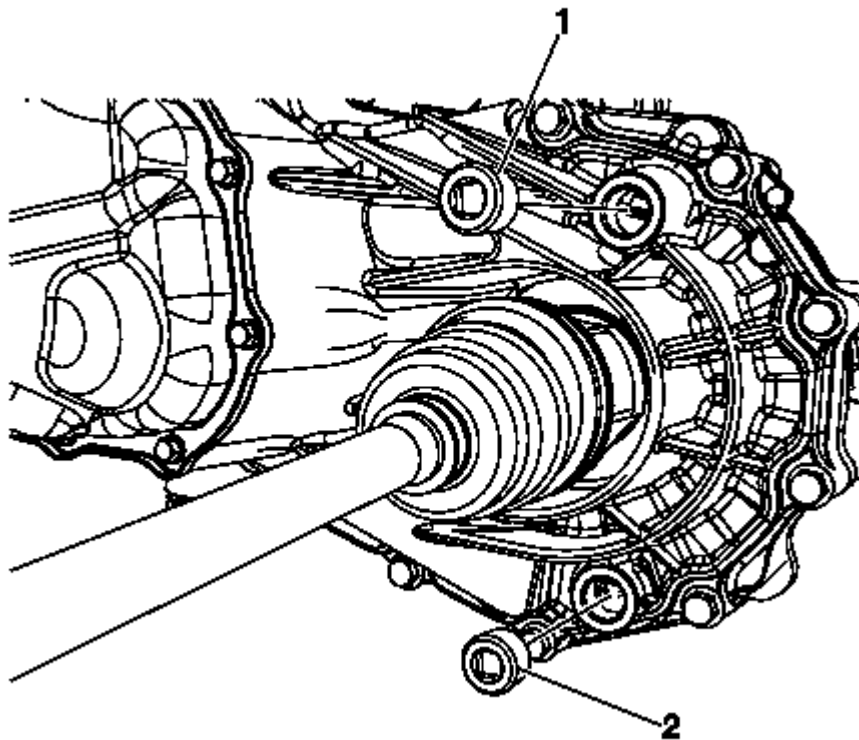


Fig. 53: Transmission Case Oil Fill Plug
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Component Fastener Tightening Caution .

1. Install the NEW transmission case oil drain plug (2) and tighten to 25 (18 lb ft).
2. Add transmission fluid until it seeps out of the fluid level check plug hole.
3. Install the NEW transmission case oil fill plug (1) and tighten to 25 (18 lb ft).
4. Lower the vehicle.

TRANSMISSION MOUNT BRACKET REPLACEMENT - LEFT SIDE (MX2, MFM)

Removal Procedure

1. Remove the left transmission mount. Refer to Transmission Mount Replacement - Left Side (MX2, MFM).
2. Remove the power brake booster pump bracket from left transmission mount bracket. Refer to Power Brake Booster Pump Replacement (Manual Transmission) .

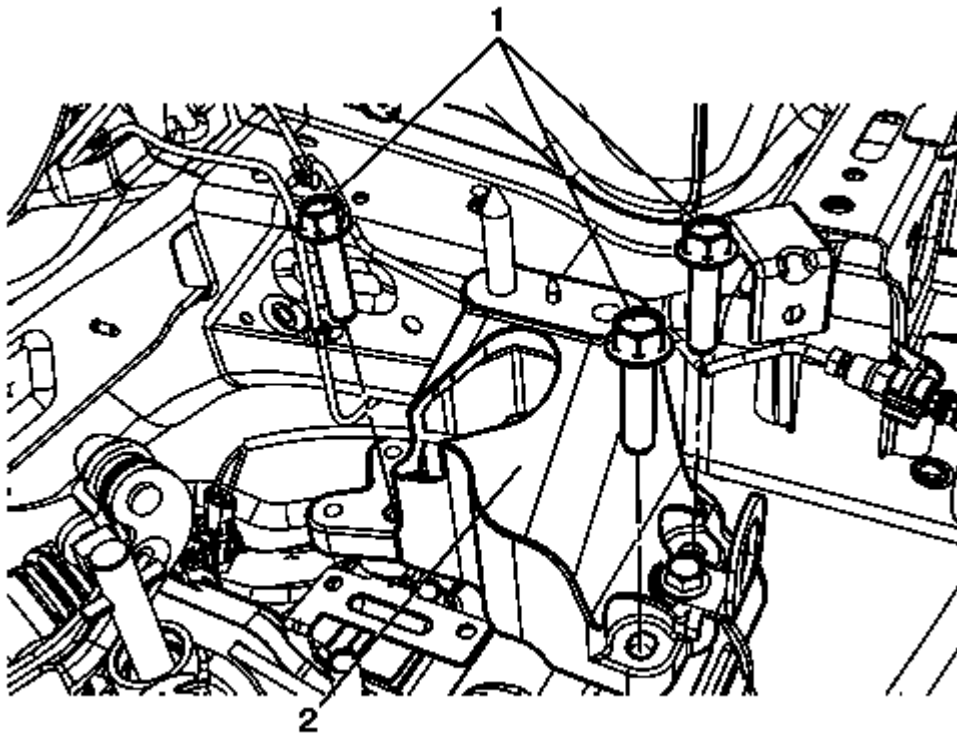


Fig. 54: Left Transmission Mount Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the backup lamp switch connector.
4. Remove the left transmission mount bracket bolts (1).
5. Remove the left transmission mount bracket (2).

Installation Procedure

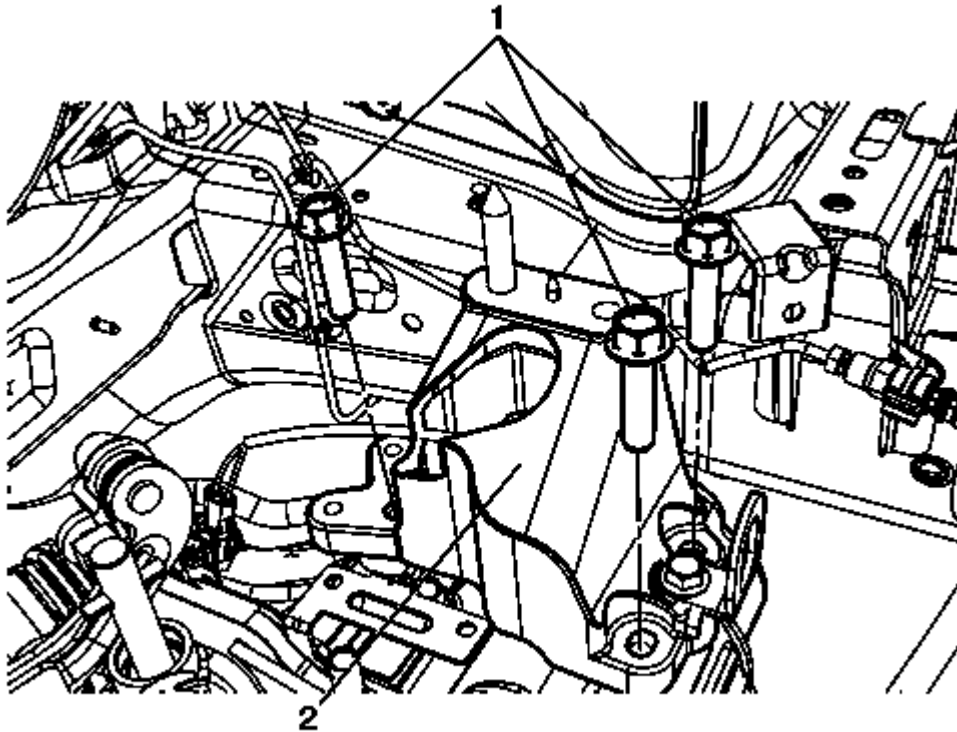


Fig. 55: Left Transmission Mount Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the left transmission mount bracket (2).

CAUTION: Refer to Fastener Caution .

2. Install the left transmission mount bracket bolts (1) and tighten to 60 (44 lb ft).
3. Connect the backup lamp switch connector.
4. Install the power brake booster pump bracket to left transmission mount bracket. Refer to **Power Brake Booster Pump Replacement (Manual Transmission)** .
5. Install the left transmission mount. Refer to **Transmission Mount Replacement - Left Side (MX2, MFM)**.

REPAIR INSTRUCTIONS - OFF VEHICLE

TRANSMISSION DISASSEMBLE (HD)

Special Tools

- **DT-7004** Sliding Hammer
- **DT-46496** Gear, Bearing Installer
- **DT-49082** Needle Bearing Remover/installer
- **DT-49084** Input Shaft Holder
- **DT-46554** Differential Bearing Puller and Plate Adapter Kit
- **DT-50511** Shift Detent Remover

For equivalent regional tools, refer to **Special Tools**.

1. Remove the manual transmission. Refer to **Transmission Replacement (MX2, MFM)**.
2. Remove the clutch pedal arm. Refer to **Clutch Pedal Arm Replacement**.
3. Remove the clutch release bearing, shaft and bushing. Refer to **Clutch Release Bearing Replacement**.

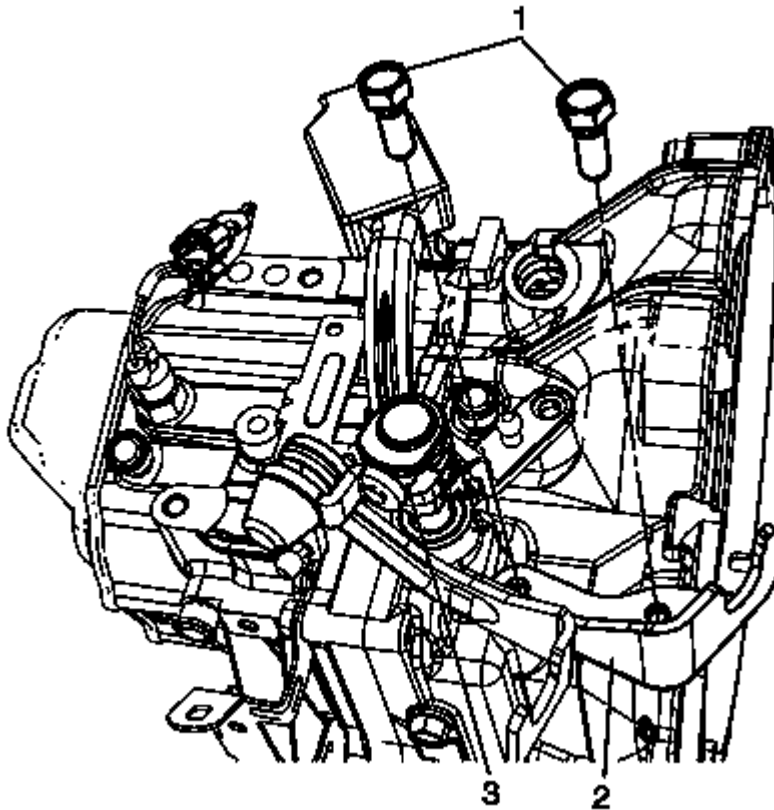


Fig. 56: Selector And Shift Lever Cable Bracket Bolts
 Courtesy of GENERAL MOTORS COMPANY

4. Remove the selector and shift lever cable bracket bolts (1).
5. Remove the selector and shift lever cable bracket (2) and bushing (3).

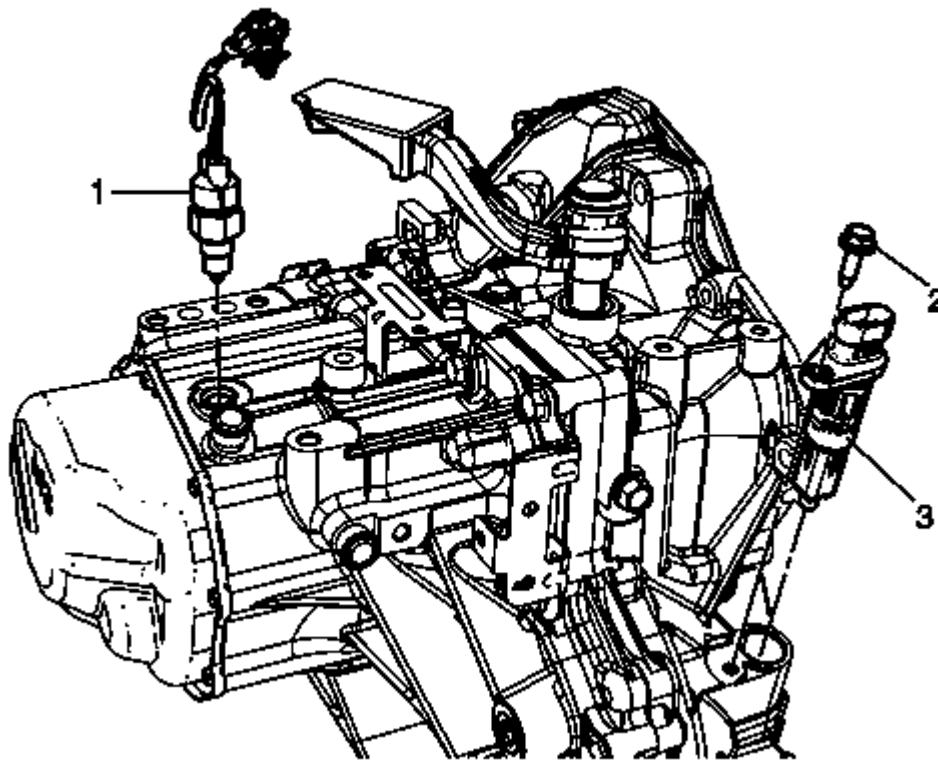


Fig. 57: Backup Light Switch

Courtesy of GENERAL MOTORS COMPANY

6. Remove the backup light switch (1).
7. Remove the vehicle speed sensor assembly bolt (2).
8. Remove the vehicle speed sensor assembly (3).

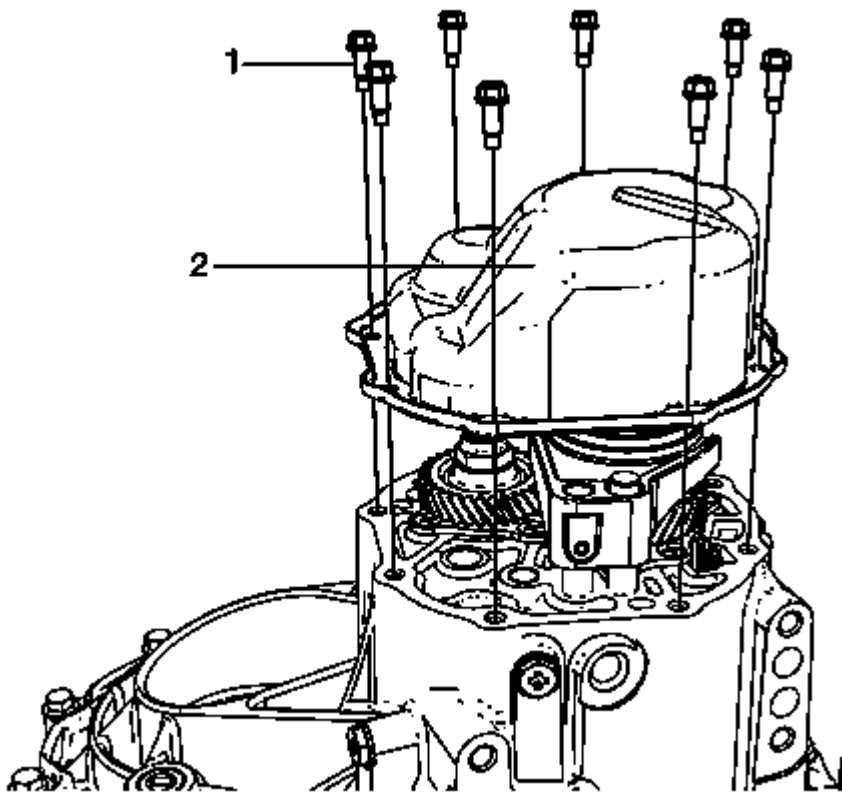


Fig. 58: Side Cover Bolts

Courtesy of GENERAL MOTORS COMPANY

9. Remove 8 side cover bolts (1).
10. Remove side cover (2) using a rubber hammer.
11. Remove the sealant on the side cover and the transmission case.

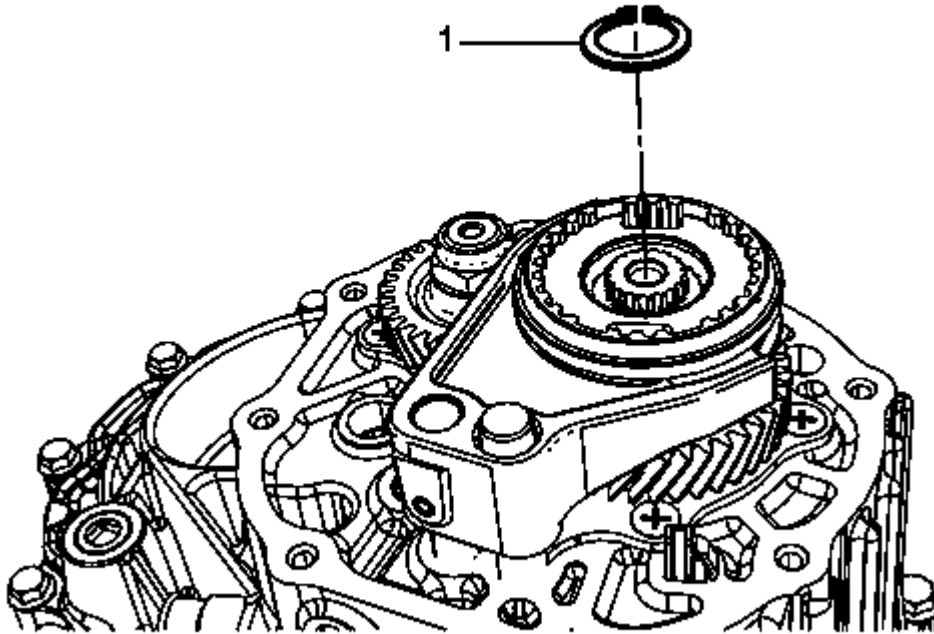


Fig. 59: Input Shaft Circlip

Courtesy of GENERAL MOTORS COMPANY

12. Remove the input shaft circlip (1).

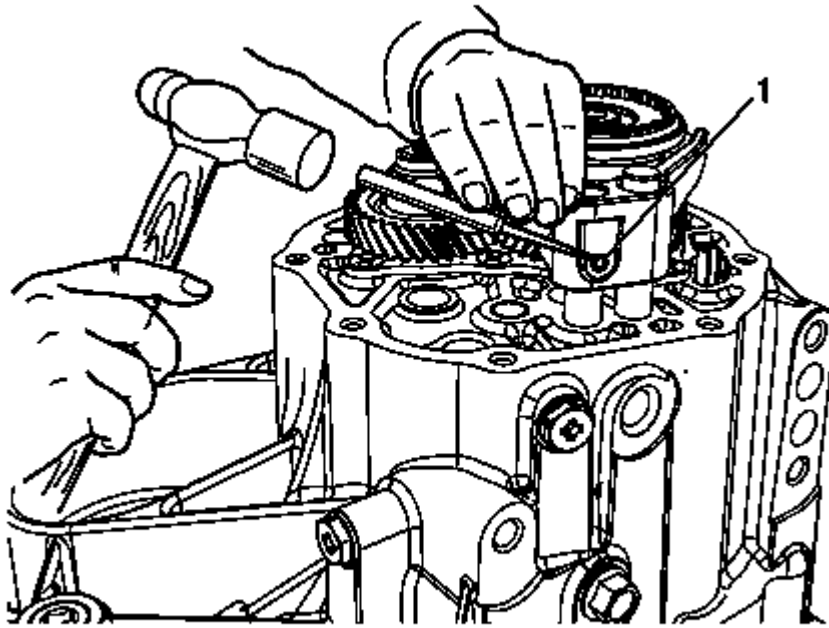


Fig. 60: Gear Shift Fork Pin

Courtesy of GENERAL MOTORS COMPANY

13. Remove the 5th gear shift fork pin (1) using a pin punch and a hammer.

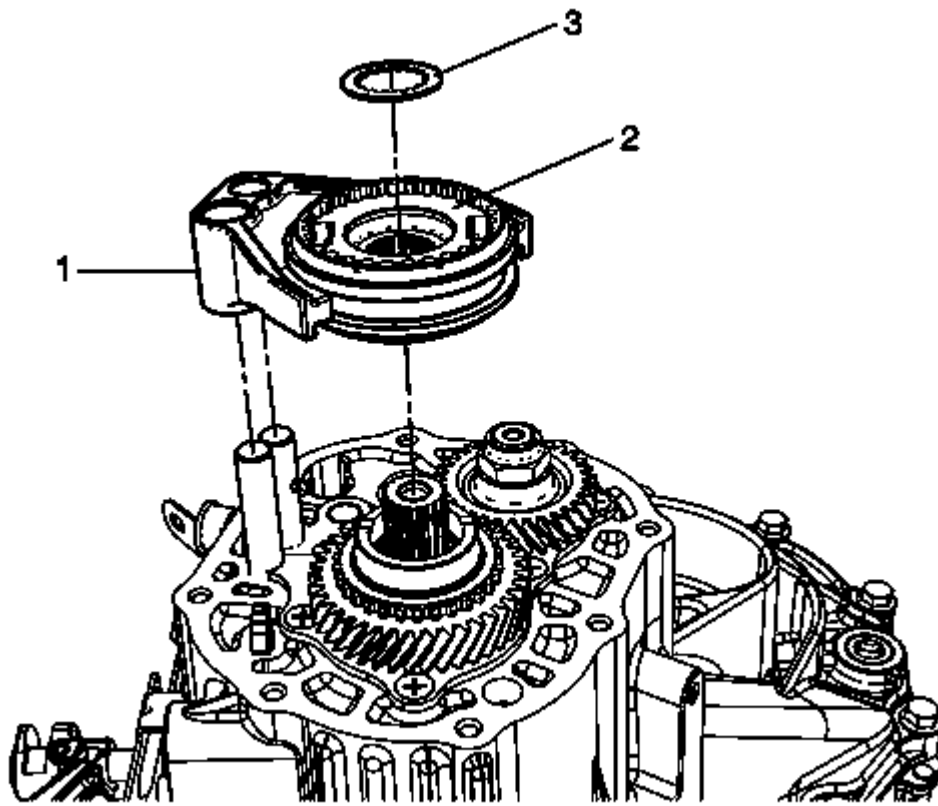


Fig. 61: Input Shaft 5th Gear Fork
Courtesy of GENERAL MOTORS COMPANY

14. Pull and remove the input shaft 5th gear fork (1) and the synchronizer hub assembly (2) together.
15. Remove the 5th gear synchronizer hub plate (3).
16. Remove the synchronizer ring, levers and sleeve from the 5th synchronizer hub assembly.

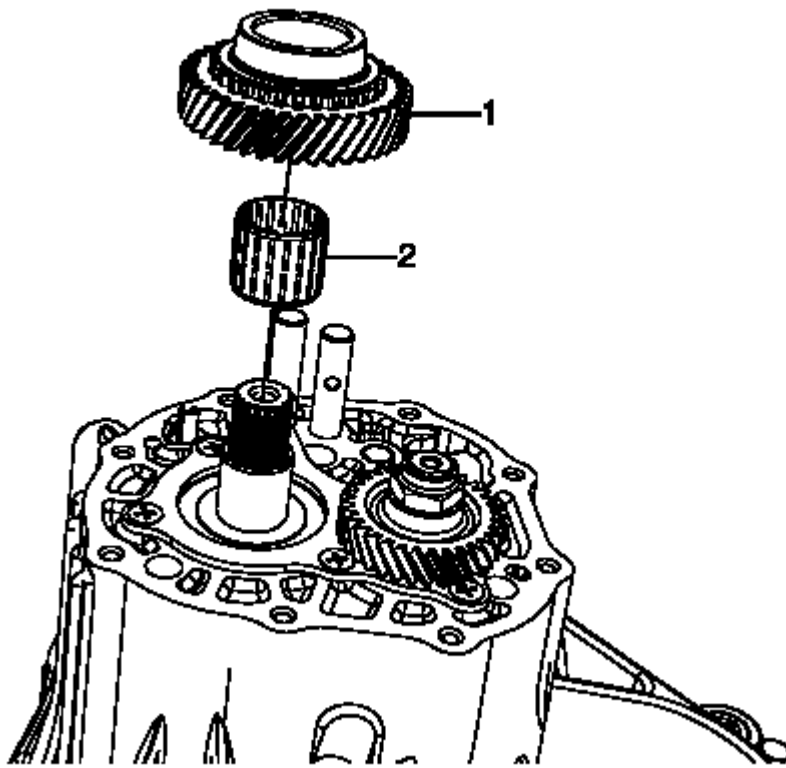


Fig. 62: Input Shaft 5th Gear

Courtesy of GENERAL MOTORS COMPANY

17. Pull and remove the input shaft 5th gear (1).
18. Remove the input shaft 5th gear bearing (2).

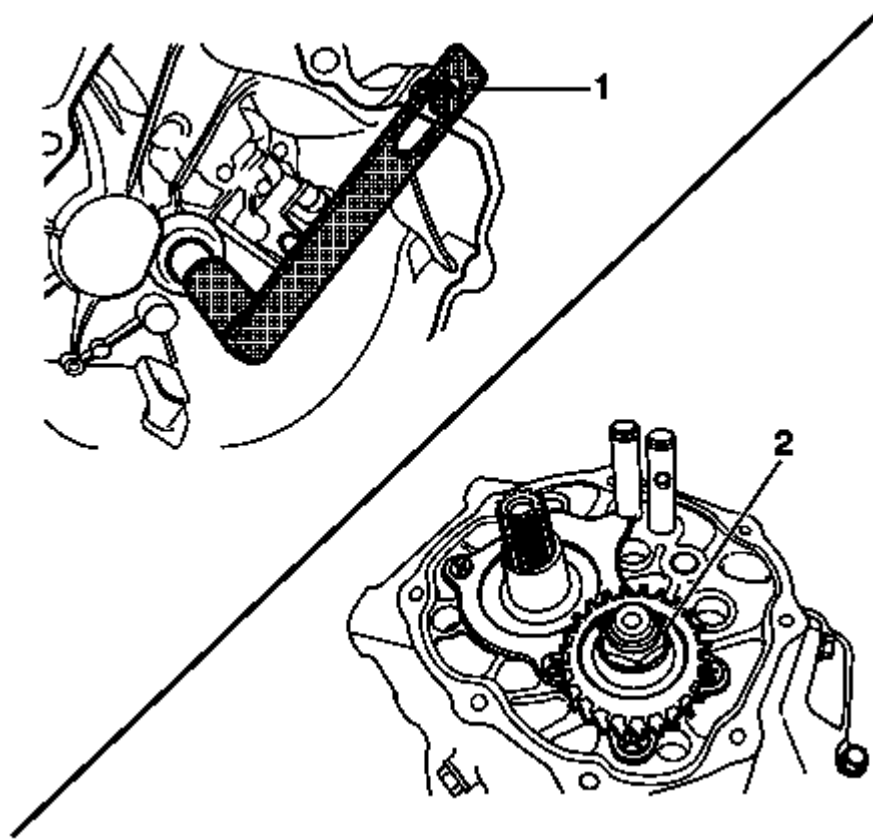


Fig. 63: View Of DT-49084 Input Shaft Holder
Courtesy of GENERAL MOTORS COMPANY

19. Move the shift shaft lever into the 4th gear position.
20. Hold the input shaft using the **DT-49084** input shaft holder (1).
21. Remove the caulking and the counter shaft 5th gear nut (2).

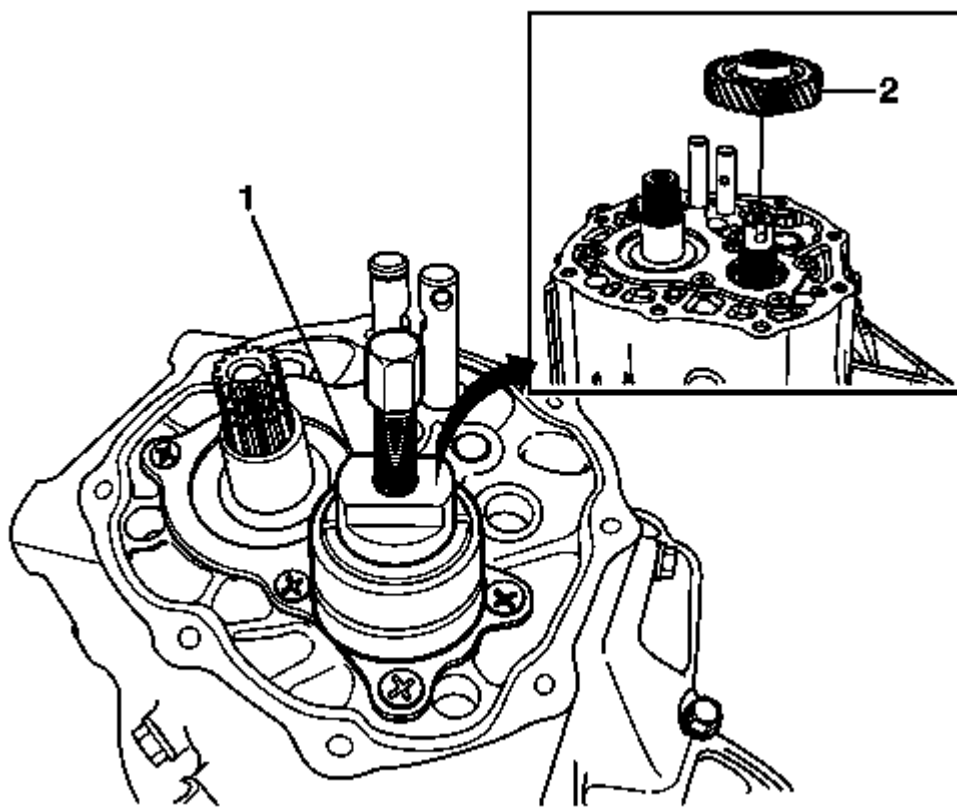


Fig. 64: View Of DT-46554 differential bearing puller and plate adapter kit
Courtesy of GENERAL MOTORS COMPANY

22. Remove the counter shaft 5th gear (2) using the **DT-46554** differential bearing puller and plate adapter kit (1).

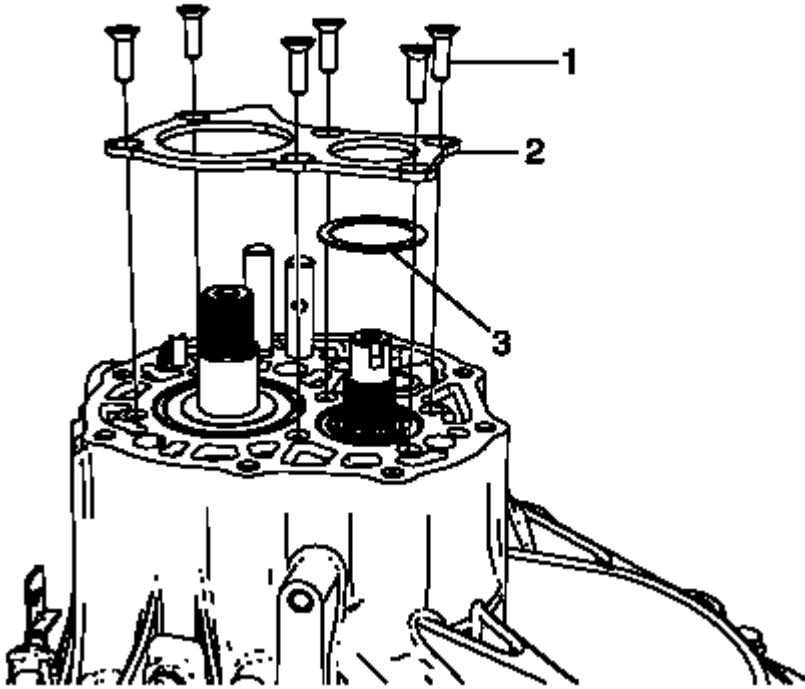


Fig. 65: Left Case Plate Screws And Plate
Courtesy of GENERAL MOTORS COMPANY

23. Remove 6 left case plate screws (1).
24. Remove the left case plate (2).
25. Remove the countershaft bearing shim (3).

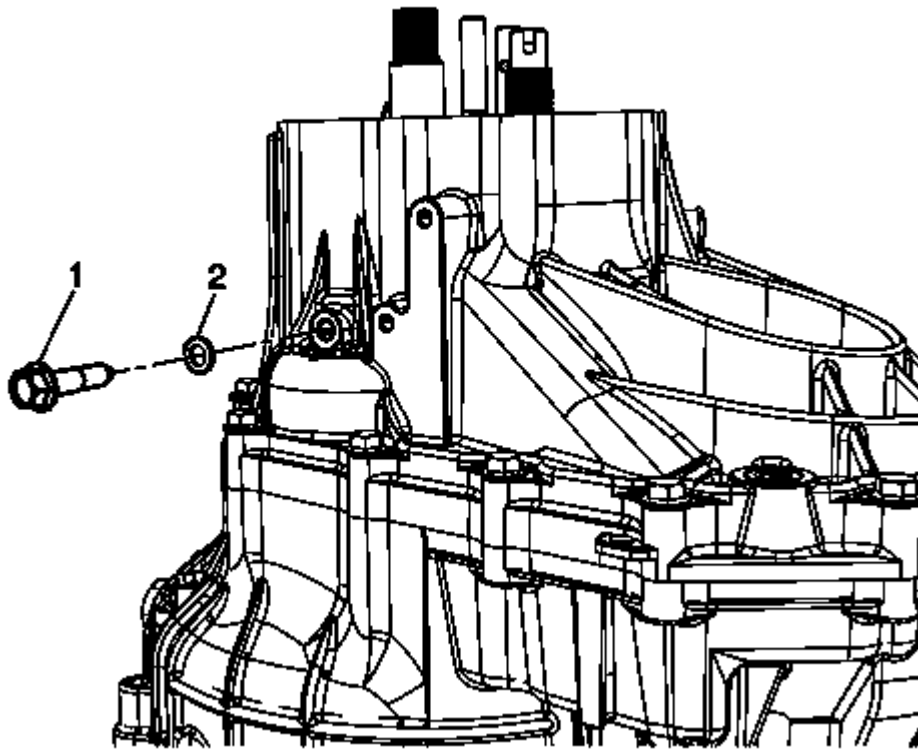


Fig. 66: Reverse Idle Gear Shaft Bolt And Gasket
Courtesy of GENERAL MOTORS COMPANY

NOTE: The case (Left) can not be removed without removing the reverse idle gear shaft bolt.

26. Remove the reverse idle gear shaft bolt (1) and gasket (2).

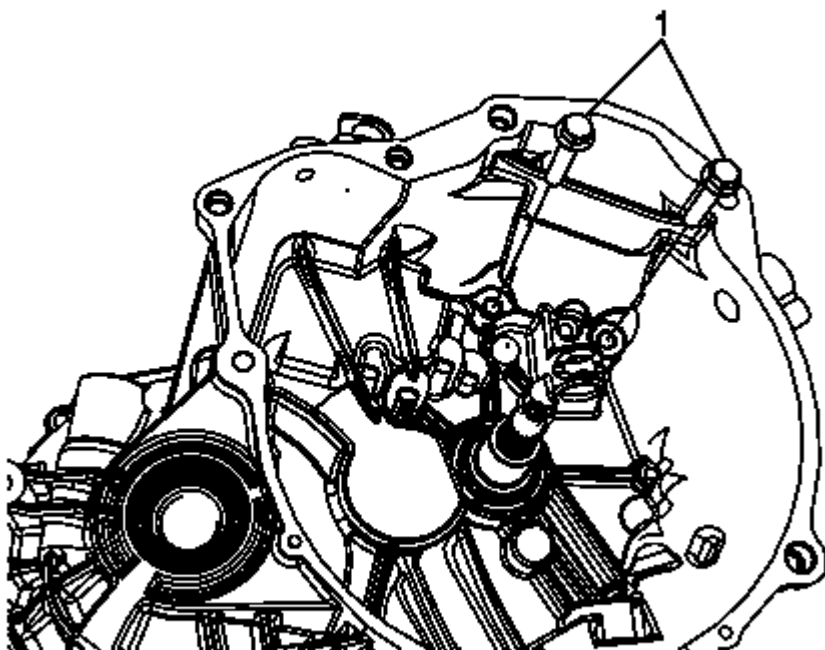


Fig. 67: Right Case Side Bolts

Courtesy of GENERAL MOTORS COMPANY

27. Remove the bolts (1) from the right case side.

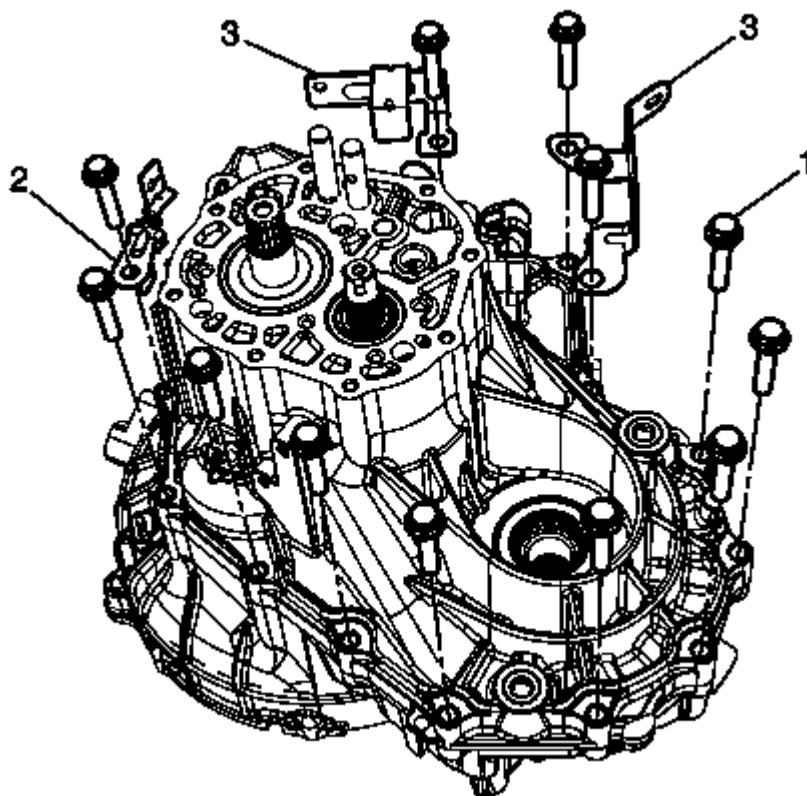


Fig. 68: Left Case Side Bolts

Courtesy of GENERAL MOTORS COMPANY

28. Remove 12 bolts (1) from the left case side.
29. Remove the sensor connector bracket (2) and the two wiring harness brackets (3) from the left case side.
30. Remove the left side case by hitting with a rubber hammer lightly.
31. Remove the sealant on the case.

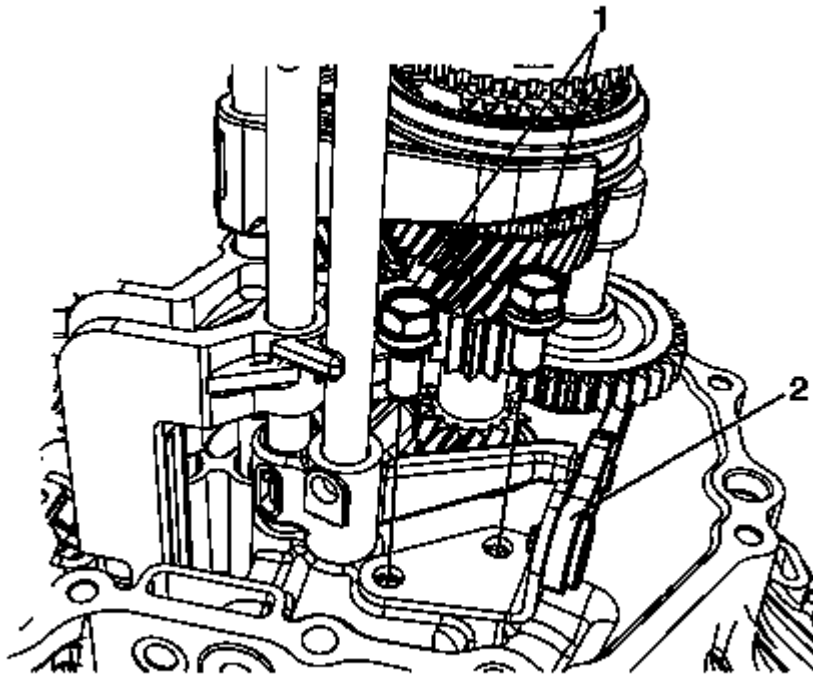


Fig. 69: Reverse Gear Shift Lever Bolts
Courtesy of GENERAL MOTORS COMPANY

32. Remove the reverse gear shift lever bolts (1).
33. Remove the reverse gear shift lever (2).

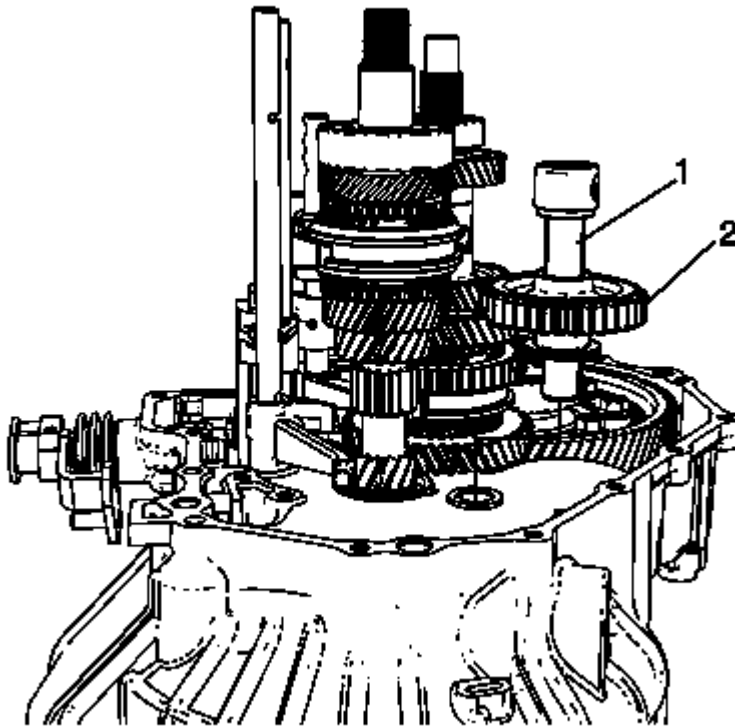


Fig. 70: Reverse Idle Gear And Shaft
Courtesy of GENERAL MOTORS COMPANY

34. Push the reverse idle gear toward the inner case.
35. Pulling shaft and remove the reverse idle gear (2) and shaft (1).
36. Remove the reverse idle gear (2) from the shaft assembly.

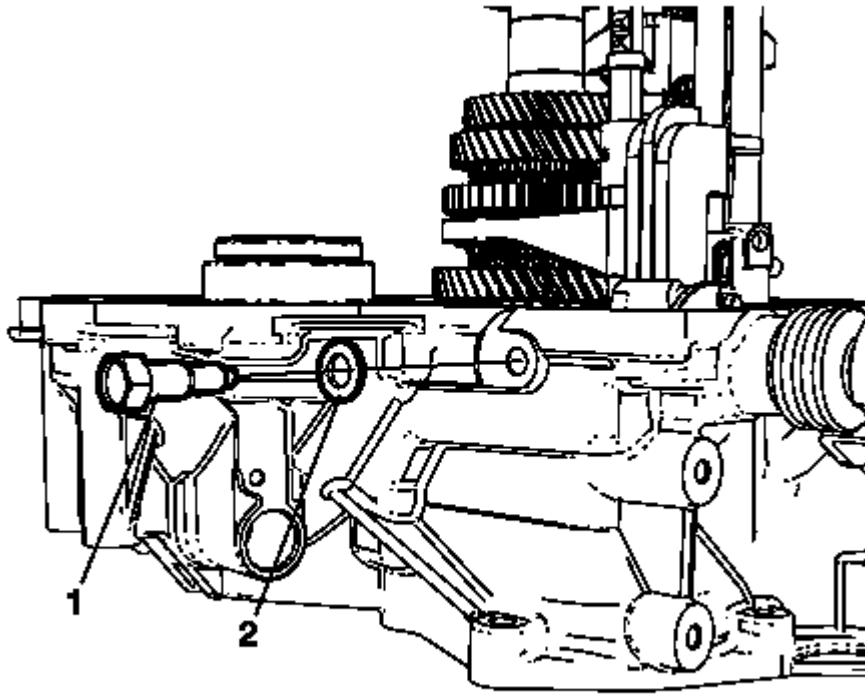


Fig. 71: Shift Interlock Bolt And Washer
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Certainly remove the shift interlock bolt. Otherwise, gear shift and shaft assembly can not be removed.**

37. Remove the shift interlock bolt (1) and washer (2).

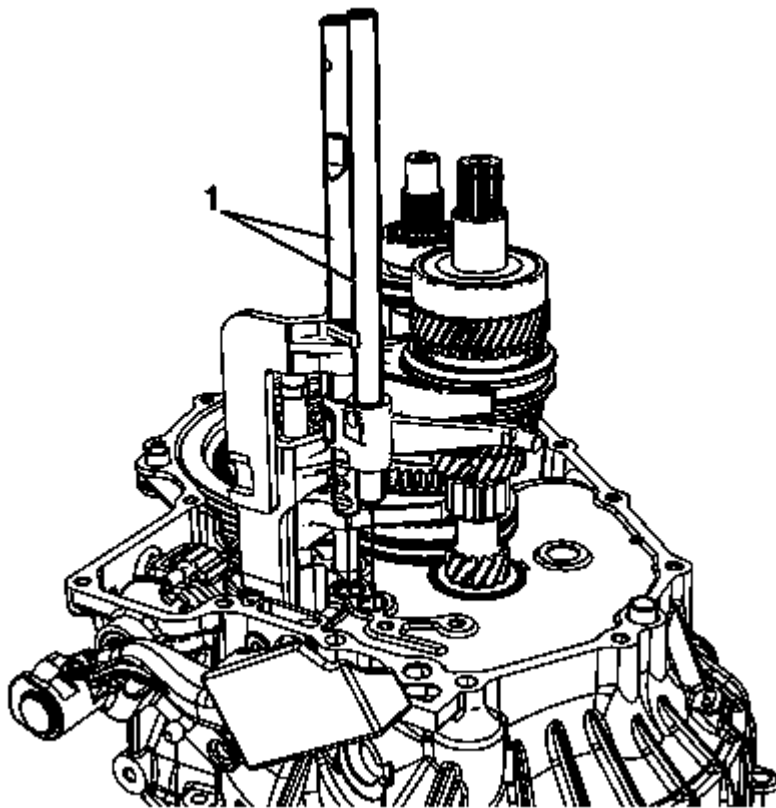


Fig. 72: 5Th And Reverse Gear Shift Shaft
Courtesy of GENERAL MOTORS COMPANY

38. Remove the 5th and reverse gear shift shaft (1)

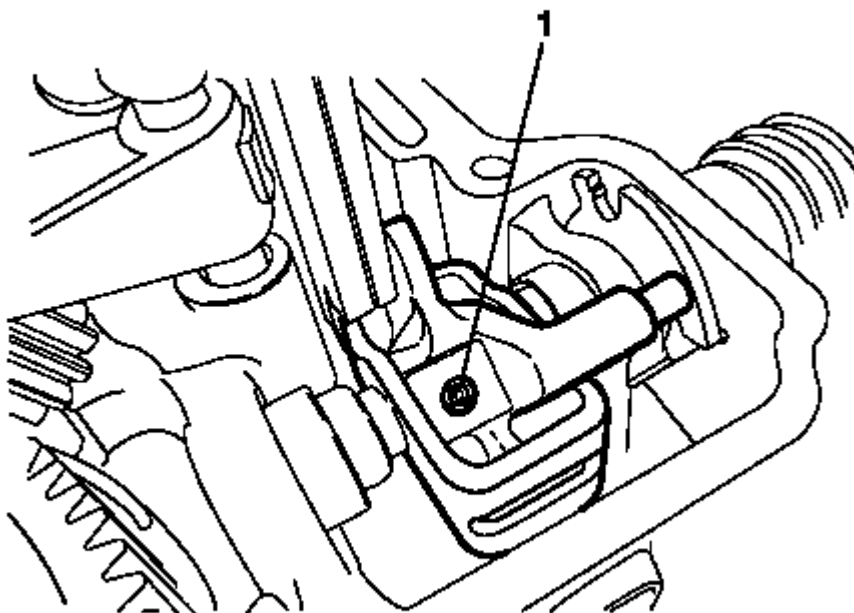


Fig. 73: Shift Control Lever Inner And Outer Pins
Courtesy of GENERAL MOTORS COMPANY

39. Remove the shift control lever inner and outer pins (1).

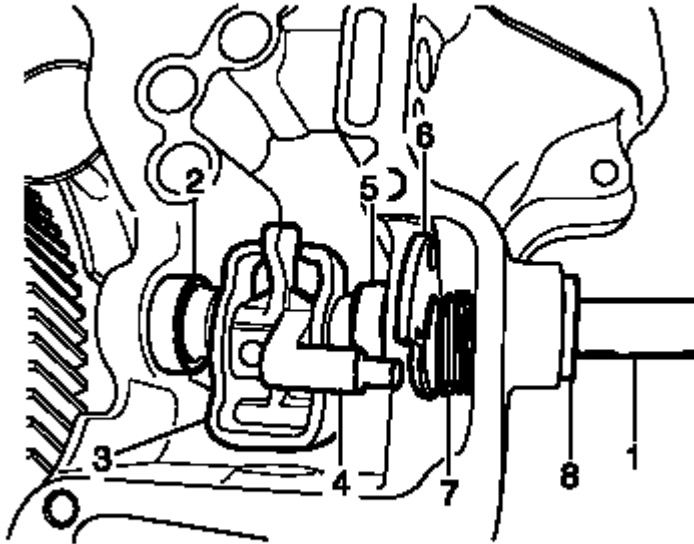


Fig. 74: Shift Control Lever

Courtesy of GENERAL MOTORS COMPANY

40. Remove the shift control lever shaft (1).
41. Remove the shift control shaft detent spring (2).
42. Remove the shift interlock plate (3).
43. Remove the shift control lever (4).
44. Remove the shift control shaft detent spring (5).
45. Remove the 5th and reverse gear inhibitor cam (6).
46. Remove the shift shaft detent cam spring (7).
47. Remove the shift control shaft seal using a screwdriver (8)..

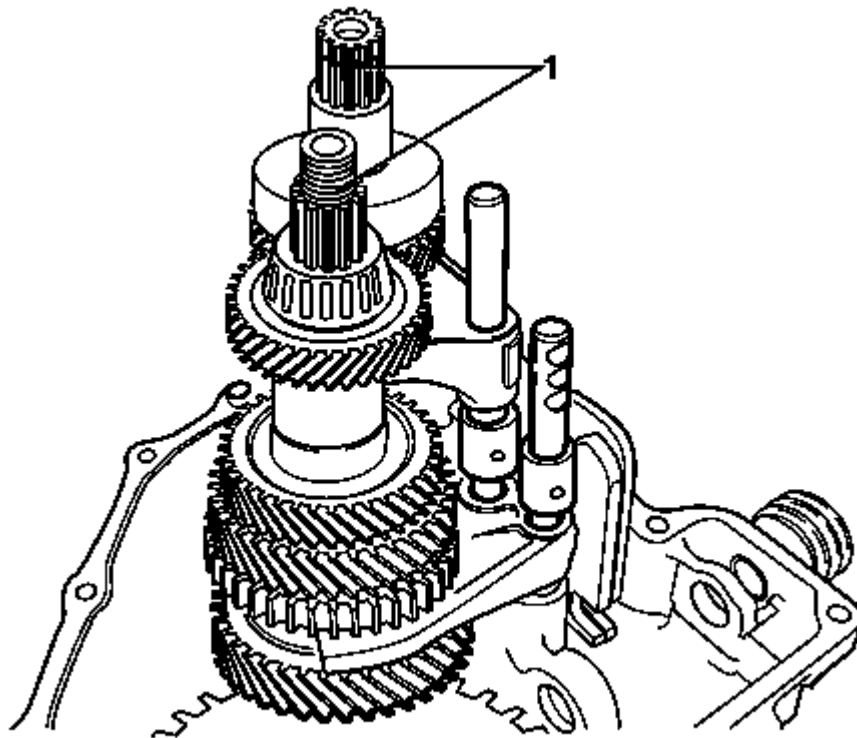


Fig. 75: Gear Unit And Shift Shaft Assembly
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Be careful not to damage the teeth of the countershaft pinion and differential ring gear.**

48. Remove the gear unit and the shift shaft assembly (1) together.
49. Remove the high and the low speed shift shaft assembly from the gear unit.

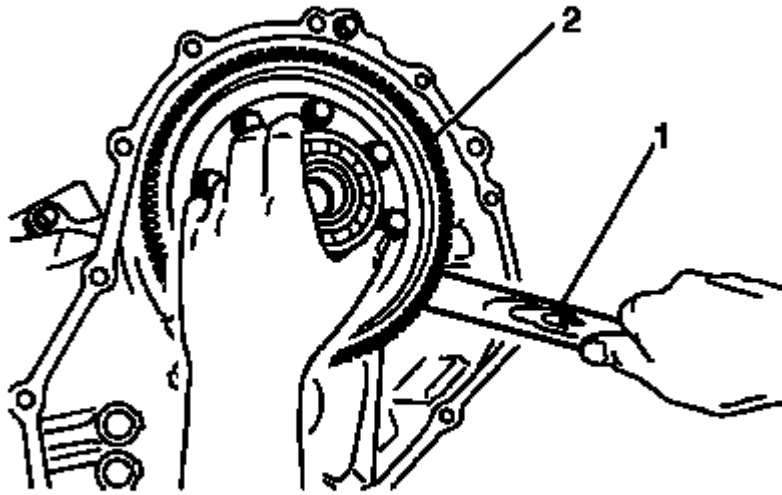


Fig. 76: Wooden Prying Device

Courtesy of GENERAL MOTORS COMPANY

50. Insert a wooden prying device (1) into the lower side of the differential.
51. Remove the differential assembly (2) by moving it right and left.

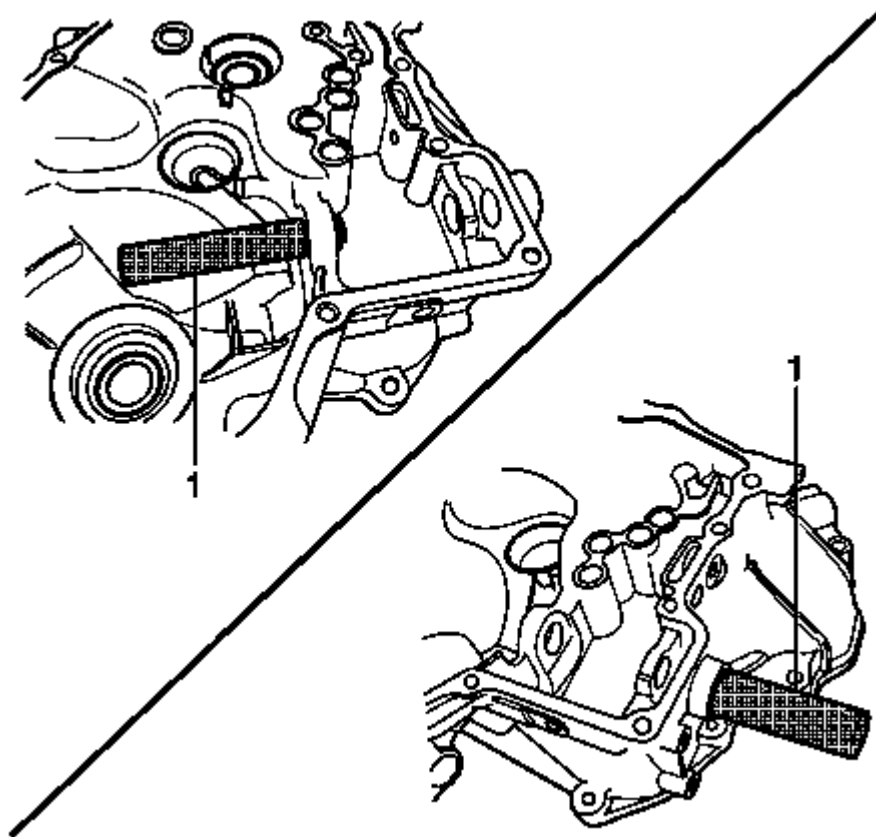


Fig. 77: DT-49082 Needle Bearing Remover/Installer
Courtesy of GENERAL MOTORS COMPANY

52. Remove the shift and select shaft needle bearings using the **DT-49082** needle bearing remover/installer (1).

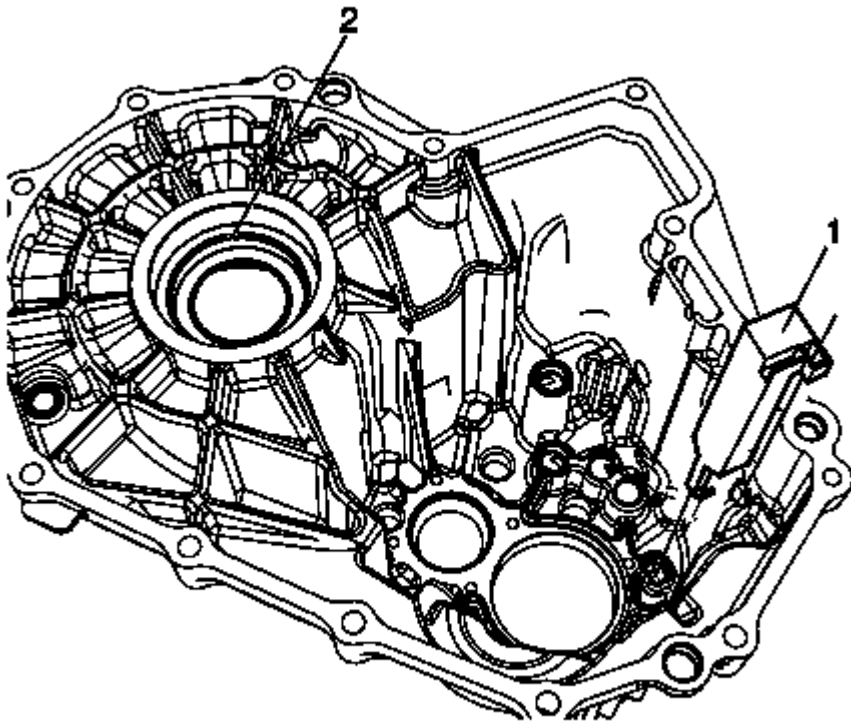


Fig. 78: Oil Gutter

Courtesy of GENERAL MOTORS COMPANY

53. Remove the oil gutter (1).
54. Remove the differential left side oil seal (2) using a hammer and a copper chisel.

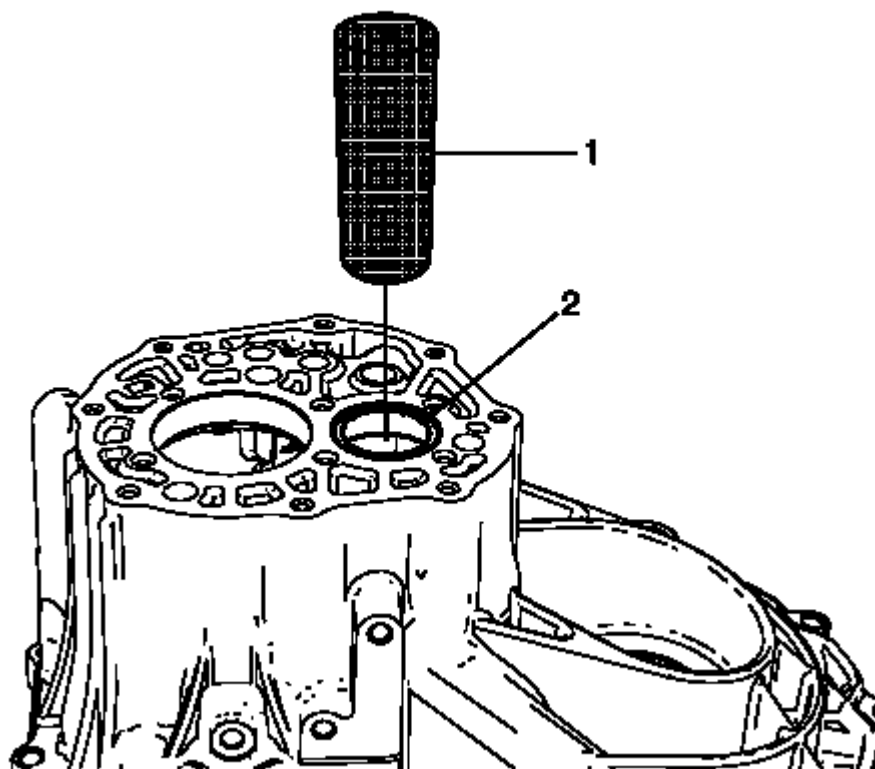


Fig. 79: Countershaft Bearing Outer Race
Courtesy of GENERAL MOTORS COMPANY

55. Remove the countershaft bearing outer race (2) using the **DT-46496** gear, bearing installer (1) and hammer.

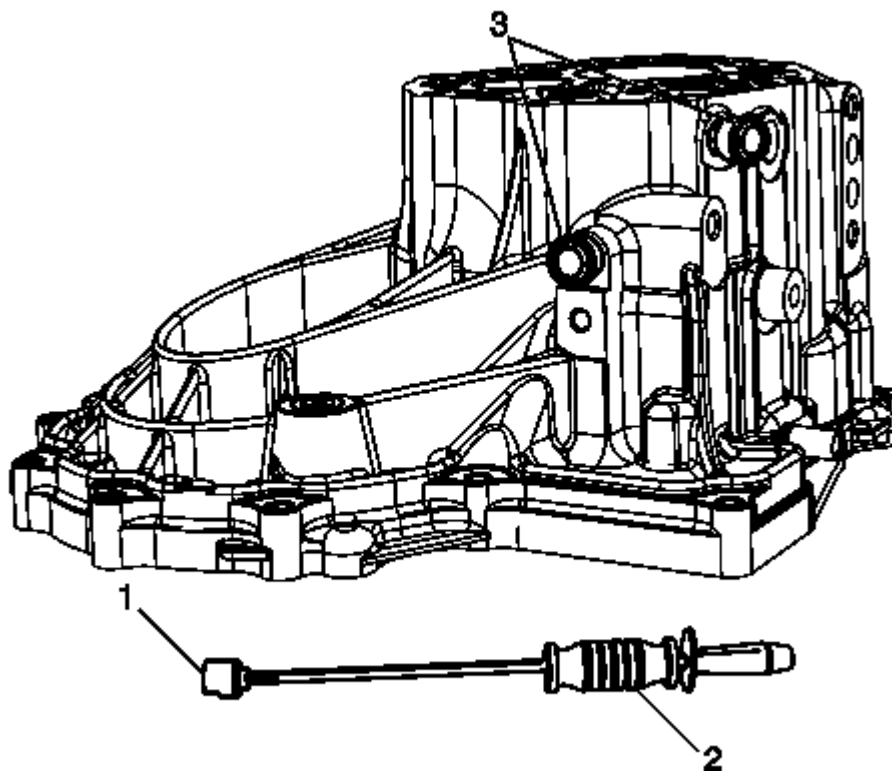


Fig. 80: Shift Shaft Detent

Courtesy of GENERAL MOTORS COMPANY

NOTE: **Inspect the detent for damage. If the detent is damaged, remove and discard the detent.**

56. Remove the shift shaft detent (3) using the **DT-50511** shift detent remover (1) and **DT-7004** sliding hammer (2).

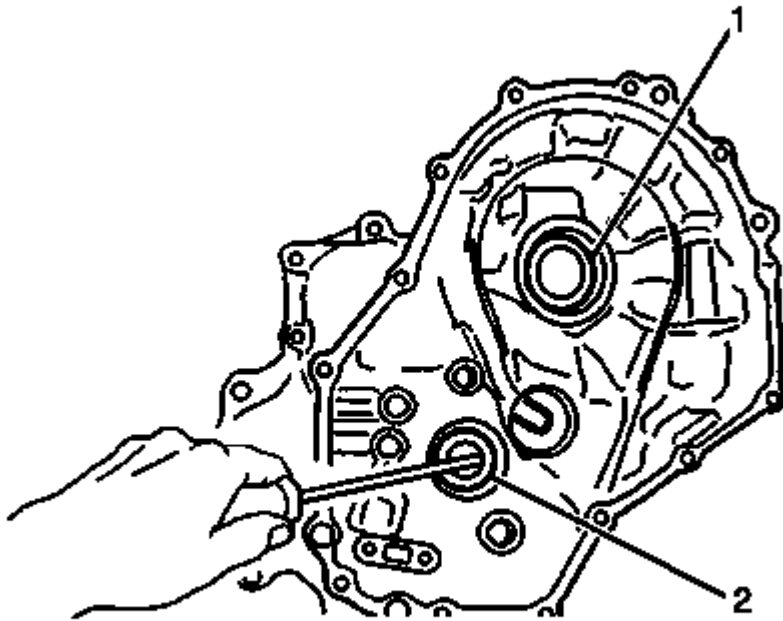


Fig. 81: Differential Right Side Oil Seal

Courtesy of GENERAL MOTORS COMPANY

- 57. Remove the differential right side oil seal (1) using a hammer and a copper chisel.
- 58. Remove the input shaft oil seal (2) using a screwdriver.

SYNCHRONIZERS CLEANING AND INSPECTION (HD)

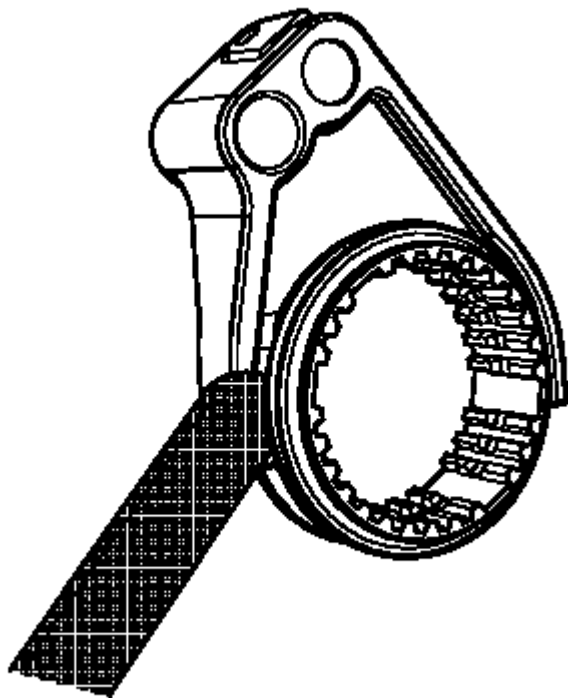


Fig. 82: Synchronizers Cleaning And Inspection (HD)
Courtesy of GENERAL MOTORS COMPANY

Measure the distance between the synchronizer sleeve and the shift fork. If the distance is over the limit, replace the shift fork.

Specification

- The standard distance between the synchronizer sleeve and the shift fork is 0.2-0.6 mm (0.008-0.024 in).
- The allowable distance limit between the synchronizer sleeve and the shift fork is 1.0 mm (0.039 in).

TRANSMISSION ASSEMBLE (HD)

Special Tools

- **DT-46496** Gear, Bearing Installer
- **DT-49080** Gear, Bearing Installer
- **DT-49082** Needle Bearing Remover/Installer
- **DT-49083** Needle Bearing Installer
- **DT-49084** Input Shaft Holder
- **DT-49088** Oil Seal Installer

- **DT-50179** Input Shaft Seal Installer
- **DT-50181** Oil Seal Installer

For equivalent regional tools, refer to **Special Tools**.

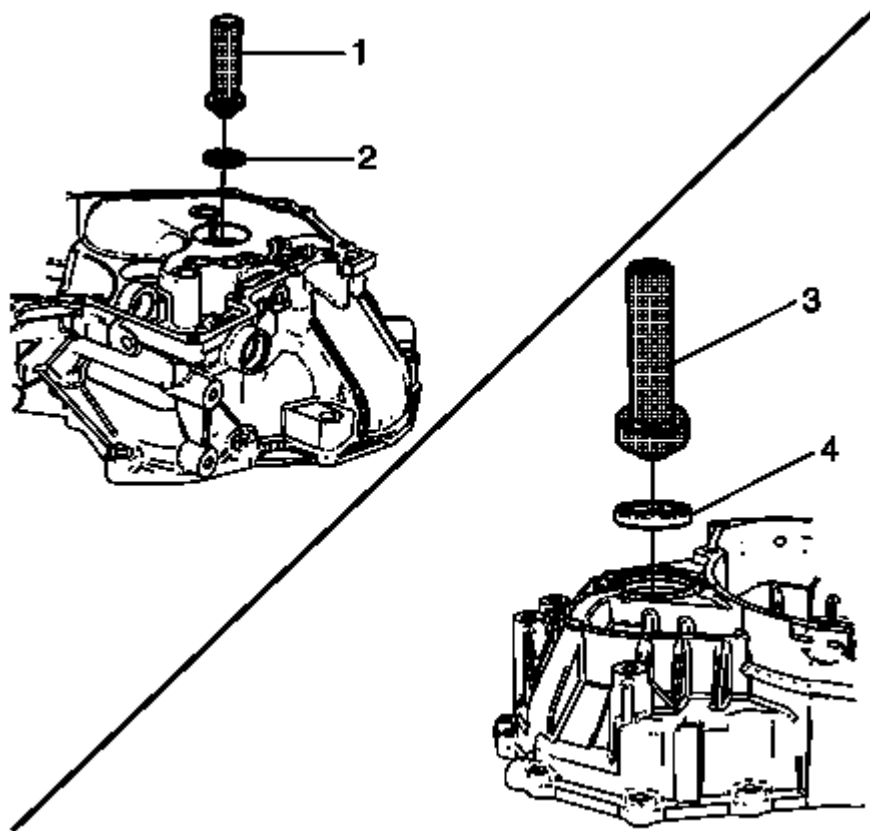


Fig. 83: Input Shaft Oil Seal And Differential Right Side Oil Seal
Courtesy of GENERAL MOTORS COMPANY

NOTE: Coat the transmission inner parts with gear fluid when installing.

1. Install the new input shaft oil seal (2) using the **DT-50179** input shaft seal installer (1).
2. Install the new differential right side oil seal (4) using the **DT-49088** oil seal installer (3).

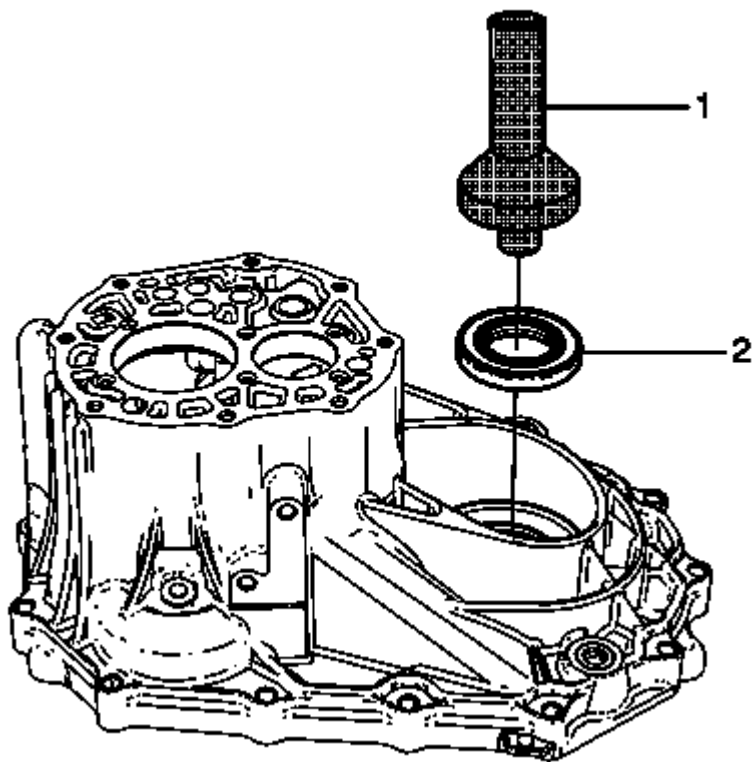


Fig. 84: Differential Right Side Oil Seal

Courtesy of GENERAL MOTORS COMPANY

3. Install the new differential left side oil seal (2) using the **DT-50181** oil seal installer (1).

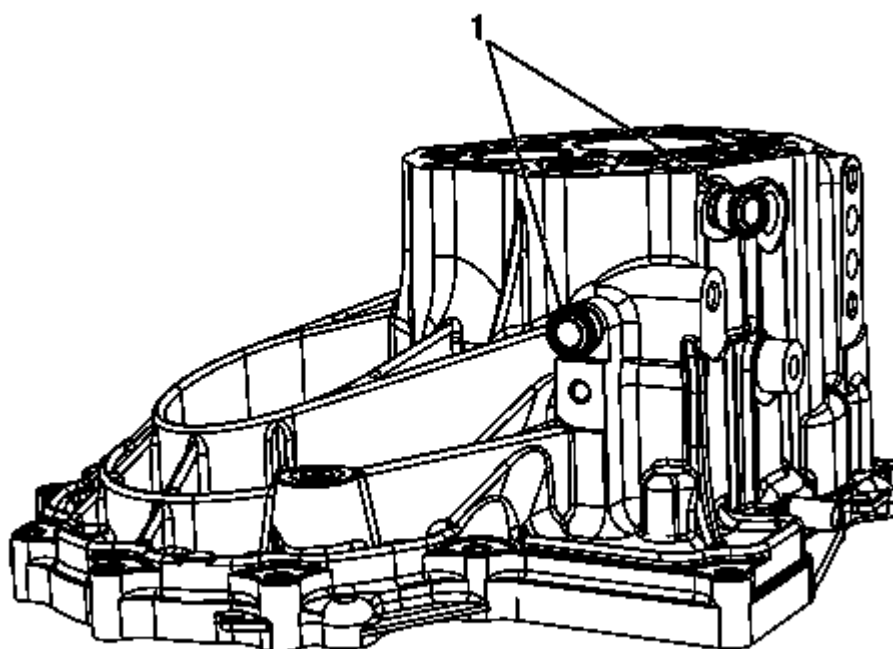


Fig. 85: Shift Shaft Detent

Courtesy of GENERAL MOTORS COMPANY

4. Install the new shift shaft detent (1) using a hammer.

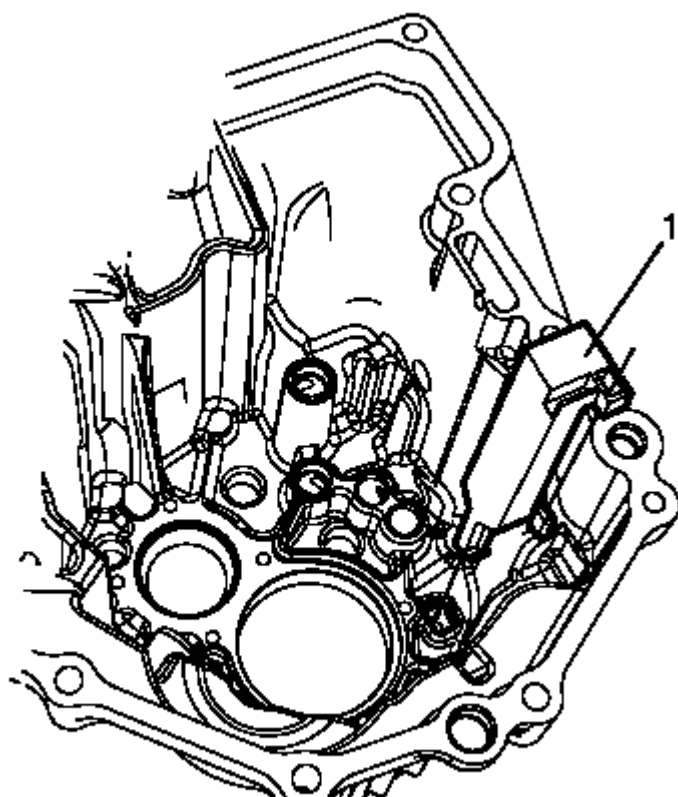


Fig. 86: Oil Gutter

Courtesy of GENERAL MOTORS COMPANY

5. Install the oil gutter (1).

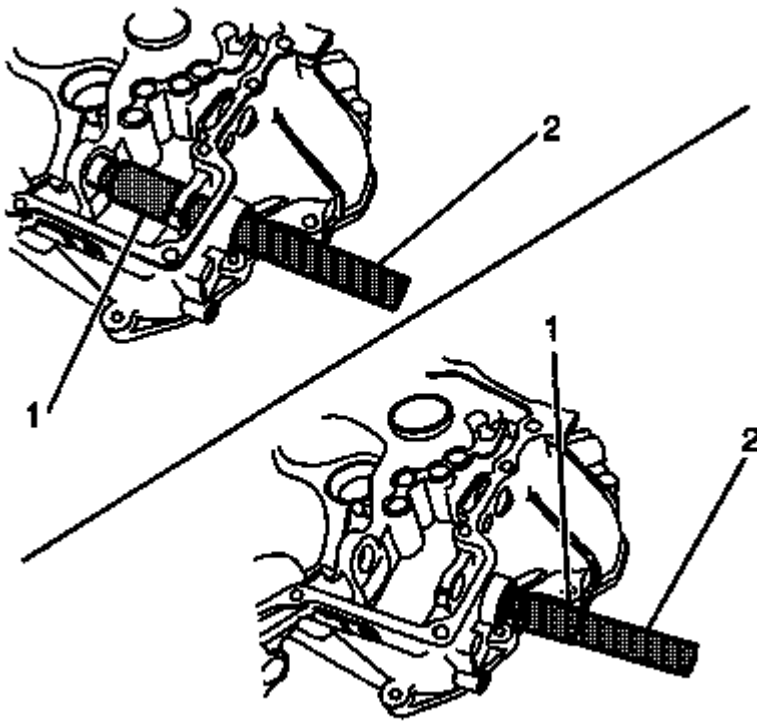


Fig. 87: Shift And Selector Shaft Needle Bearing
Courtesy of GENERAL MOTORS COMPANY

6. Install the shift and selector shaft needle bearing using the **DT-49083** needle bearing installer (1) and **DT-49082** needle bearing remover/installer (2).

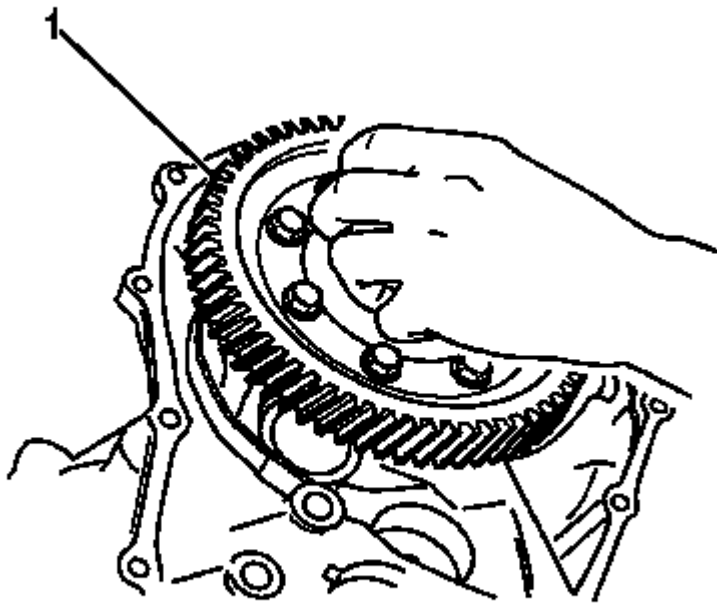


Fig. 88: Differential Assembly

Courtesy of GENERAL MOTORS COMPANY

7. Install the differential assembly (1) to the right side of the transmission case. Position the differential ring gear surface lower than the right side of the transmission case surface.

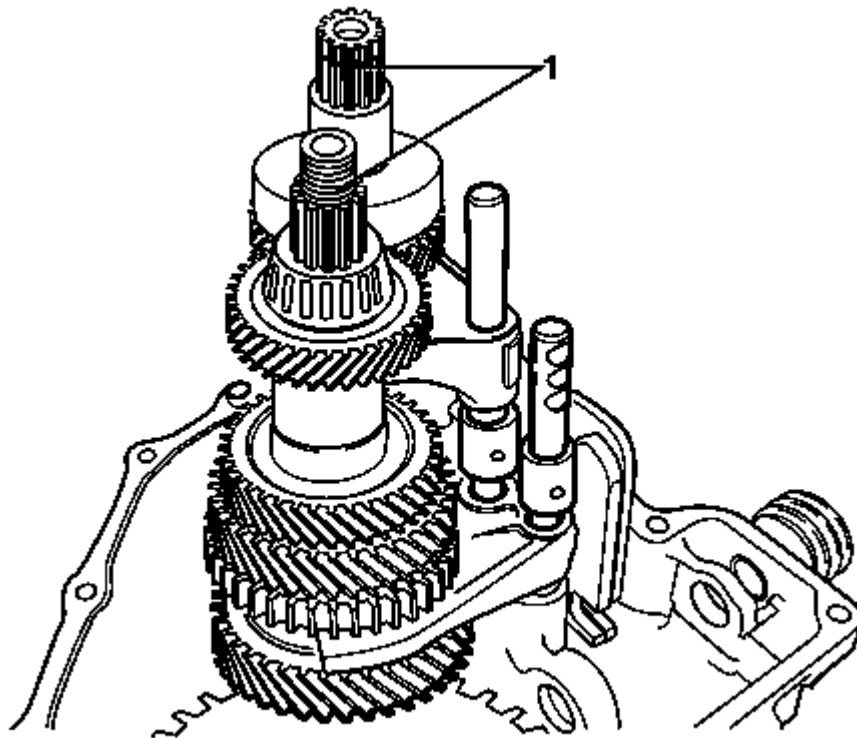


Fig. 89: Gear Unit And Shift Shaft Assembly
Courtesy of GENERAL MOTORS COMPANY

8. Install the low- and high-speed shift shaft assembly onto the gear unit.

NOTE: **Do NOT damage the teeth of the counter shaft pinion and the differential ring gear.**

9. Push the gear unit (1) by matching the unit with the input and the counter shaft hole.

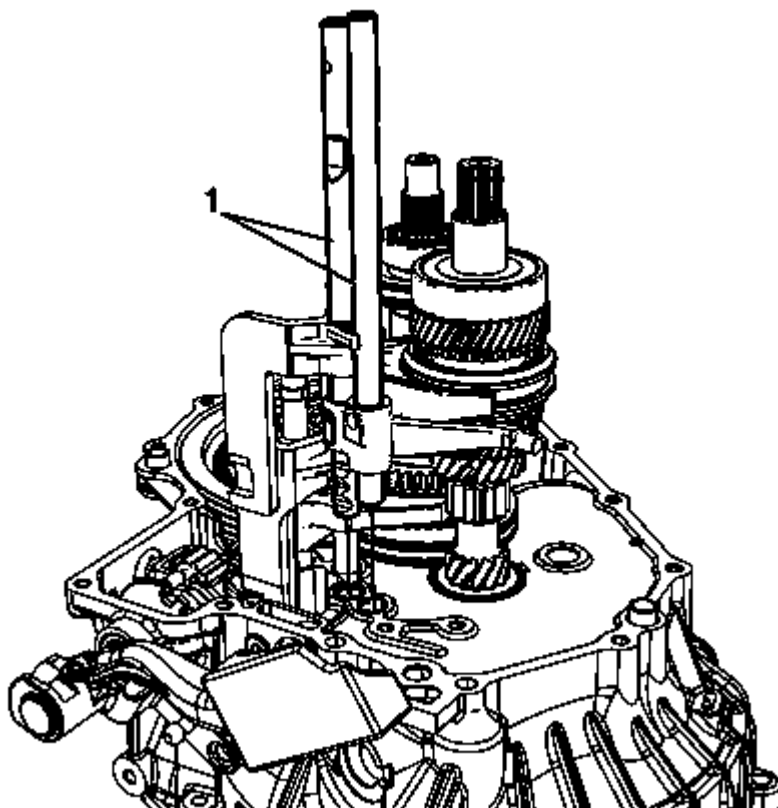


Fig. 90: 5Th And Reverse Gear Shift Shaft
Courtesy of GENERAL MOTORS COMPANY

10. Install the 5th and reverse gear shift shaft (1).

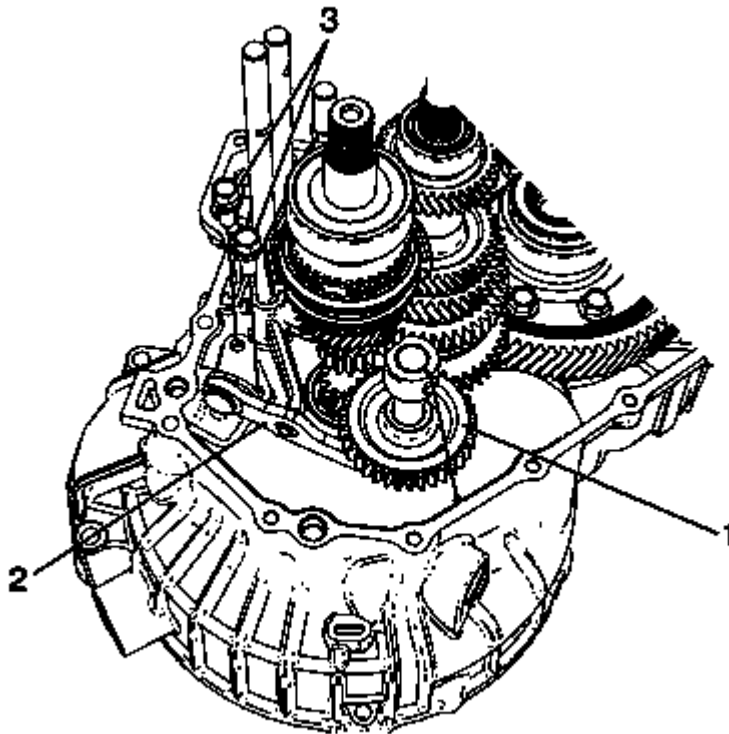


Fig. 91: Reverse Idle Gear Shaft Assembly
Courtesy of GENERAL MOTORS COMPANY

NOTE: Match the marking of the reverse idle gear shaft bolt hole with the protrusion of the transmission case - right side.

11. Install the reverse idle gear shaft assembly (1).
12. Install the reverse gear shift lever (2).

CAUTION: Refer to Fastener Caution .

13. Install the reverse gear shift lever bolts (3) and tighten to 23 (17 lb ft).

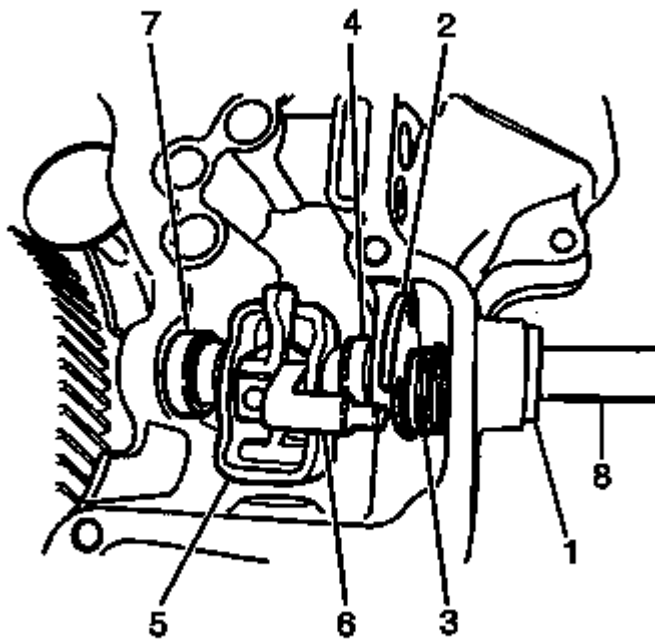


Fig. 92: NEW shift control shaft seal
Courtesy of GENERAL MOTORS COMPANY

14. Install the NEW shift control shaft seal (1).
15. Install the 5th and reverse gear inhibitor cam (2).
16. Install the shift shaft detent cam spring (3).
17. Install the shift control shaft detent spring (4).
18. Install the shift interlock plate (5).
19. Install the shift control lever (6).
20. Install the shift control shaft detent spring (7).
21. Install the shift control lever shaft (8).

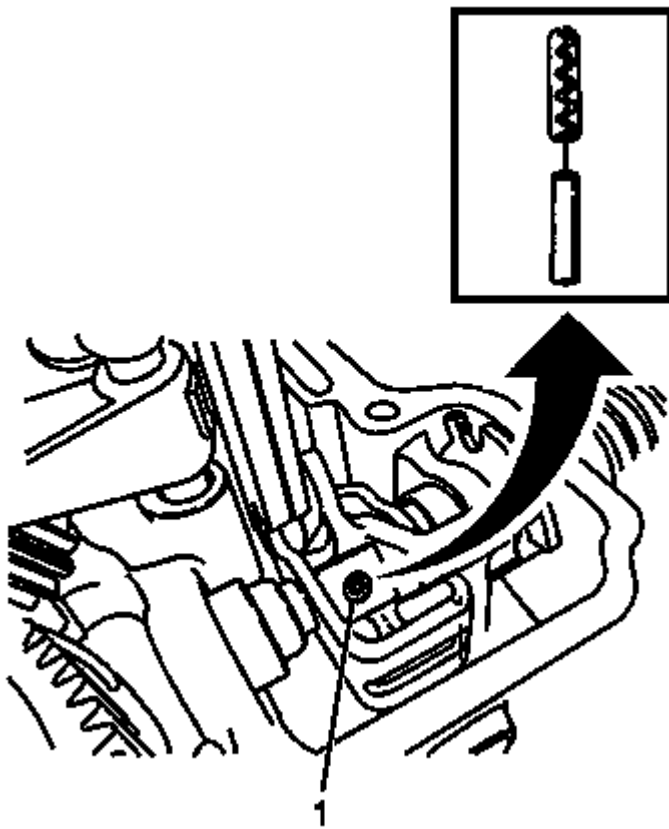


Fig. 93: Shift Control Lever Inner And Outer Pins
Courtesy of GENERAL MOTORS COMPANY

NOTE: When installing the inner and outer pins, make the crevices of 2 pins symmetric to each other.

22. Install the new shift control lever inner and outer pins (1).

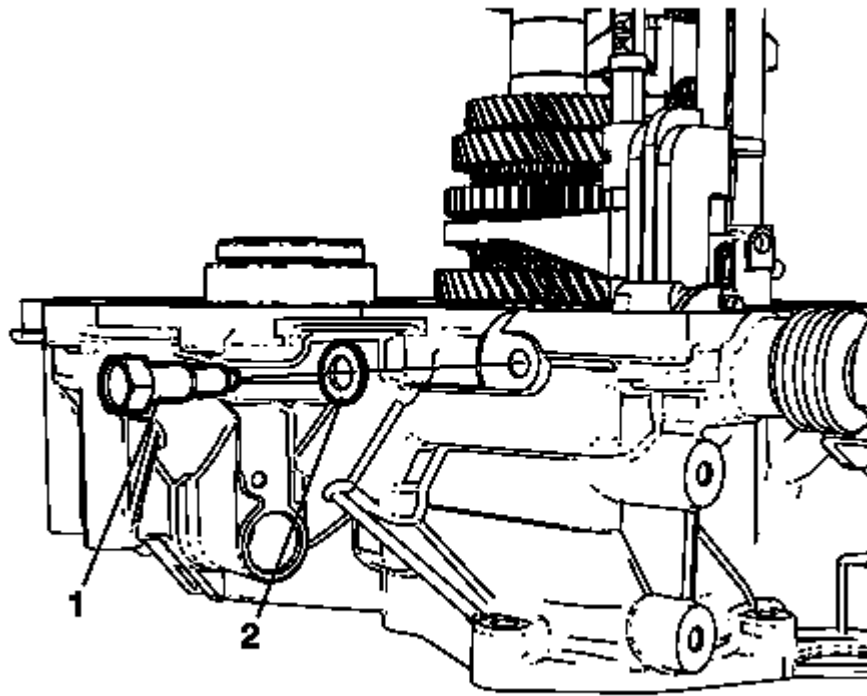


Fig. 94: Shift Interlock Bolt And Washer
Courtesy of GENERAL MOTORS COMPANY

23. Install the shift interlock washer (2) and bolt (1) and tighten to 23 (17 lb ft).

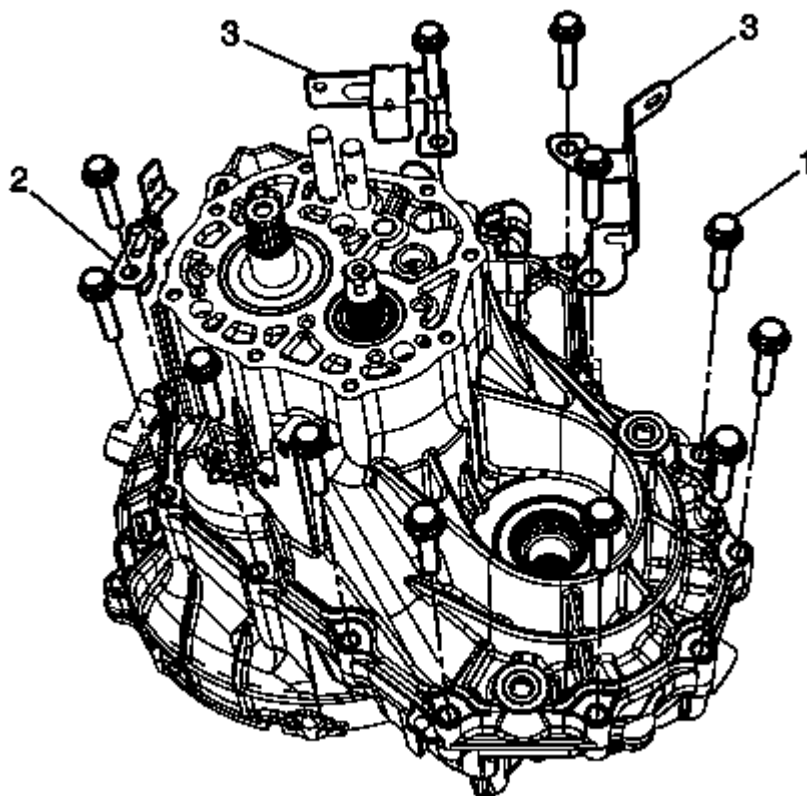


Fig. 95: Left Case Side Bolts

Courtesy of GENERAL MOTORS COMPANY

24. Coat the transmission case with recommended transmission case sealant - THREE BOND 1215 or LOCTITE 5702.
25. Install the transmission left side case to the transmission right side case.
26. Install the sensor connector bracket (2) and two wiring harness brackets (3) to the left case side.
27. Install 12 bolts (1) onto the left side case and tighten to 19 (14 lb ft).

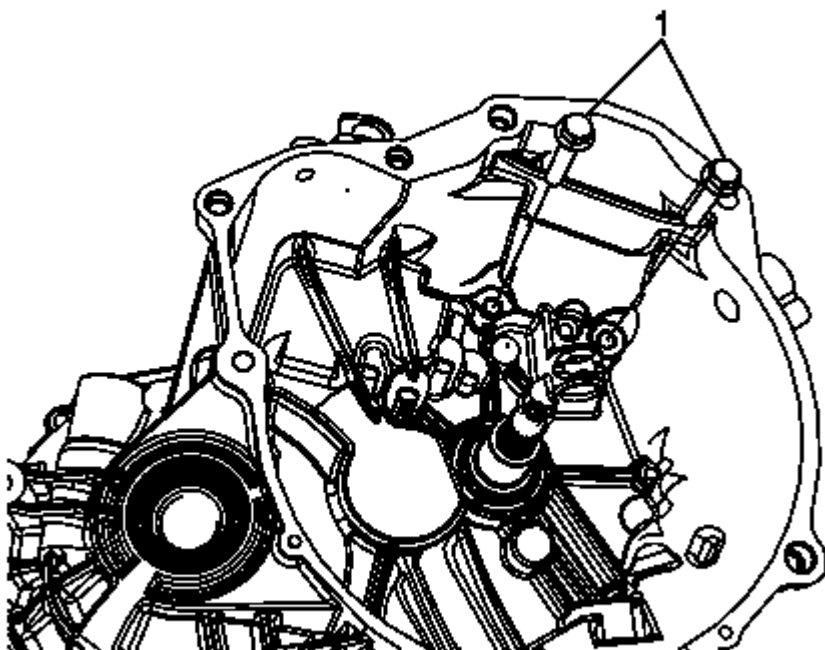


Fig. 96: Right Case Side Bolts

Courtesy of GENERAL MOTORS COMPANY

28. Install the bolts (1) onto the right case and tighten to 19 (14 lb ft).

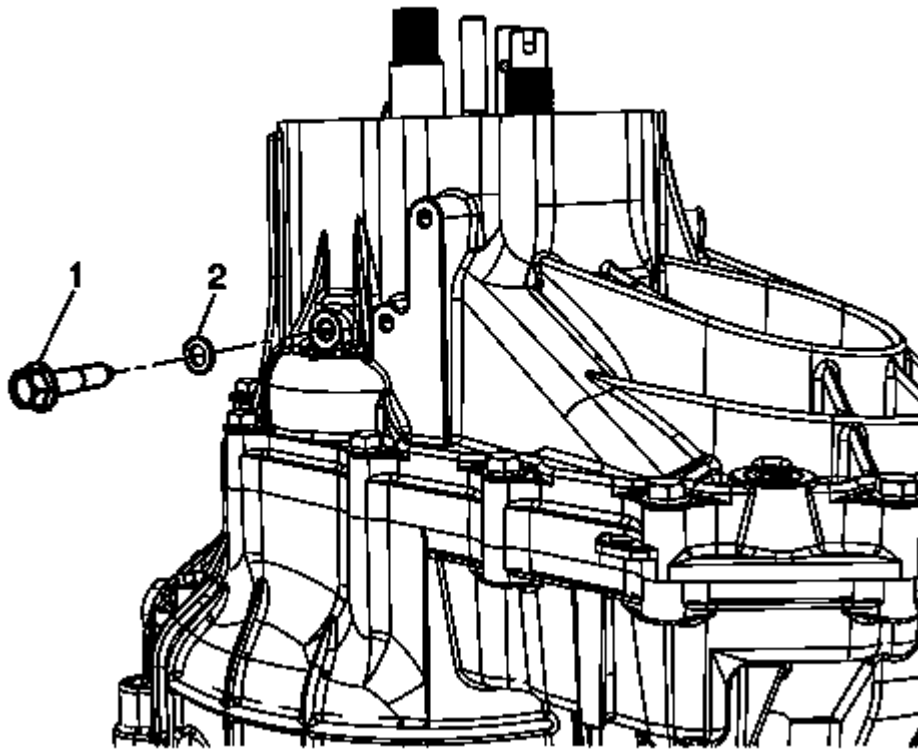


Fig. 97: Reverse Idle Gear Shaft Bolt And Gasket
Courtesy of GENERAL MOTORS COMPANY

29. Install the reverse idle gear shaft gasket (2) and bolt (1) and tighten to 33 (24 lb ft).

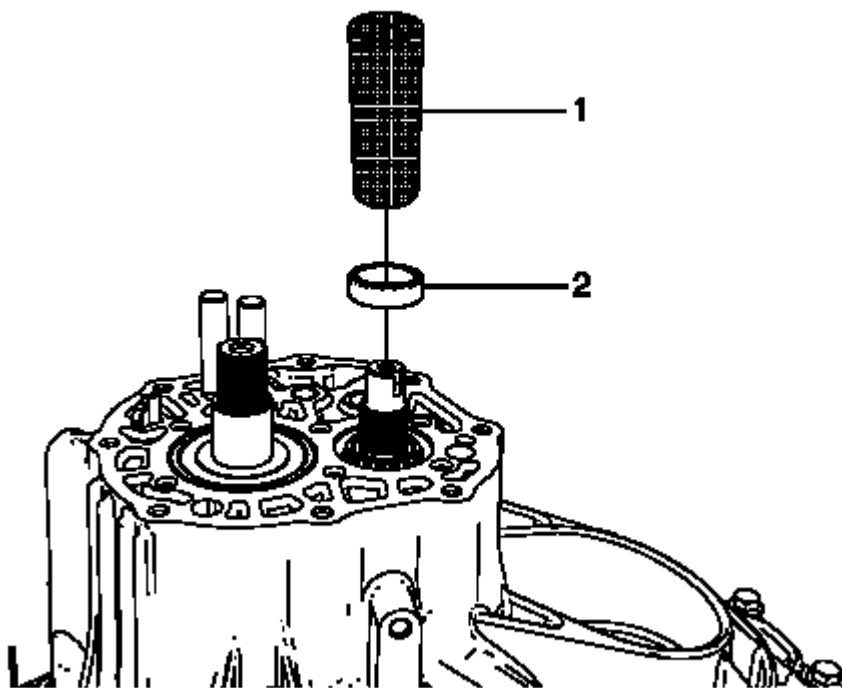


Fig. 98: Countershaft Bearing Outer Race
Courtesy of GENERAL MOTORS COMPANY

NOTE: Check if the bearing and the outer race are correctly installed by rotating counter shaft.

30. Install the countershaft bearing outer race (2) using the **DT-46496** gear, bearing installer (1).

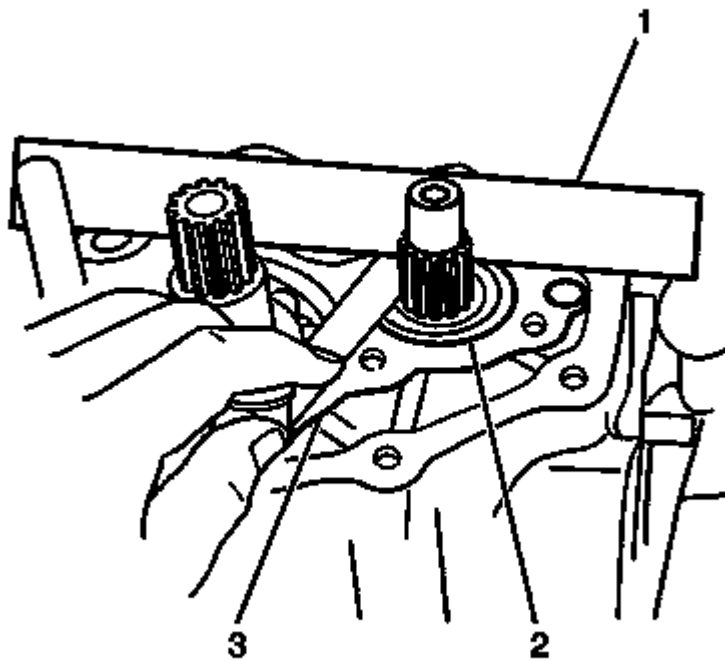


Fig. 99: Measuring Clearance Between Transmission Case Surface And Bearing Outer Race Using A Straight Ruler And A Gauge

Courtesy of GENERAL MOTORS COMPANY

31. Measure the clearance between the transmission case surface (3) and the bearing outer race (2) using a straight ruler (1) and a gauge. Refer to Transmission Case Surface and Bearing Outer Races Clearance Table in **Manual Transmission Specifications (HD)**.
32. Select a shim so that clearance is within standard.

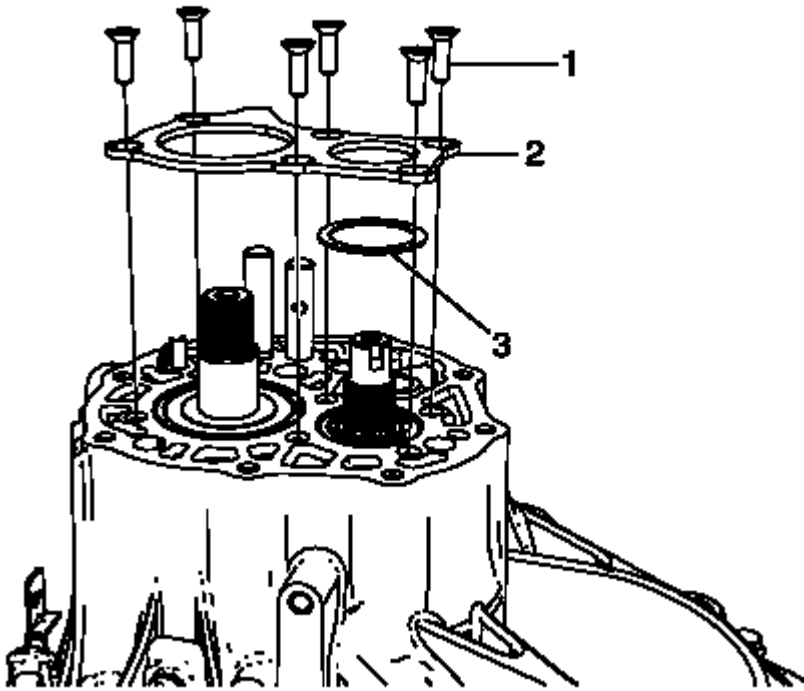


Fig. 100: Left Case Plate Screws And Plate
Courtesy of GENERAL MOTORS COMPANY

33. Install the counter shaft bearing shim (3).
34. Install the left case plate (2).
35. Install the 6 new left case plate screws (1) and tighten to 9 (80 lb in).

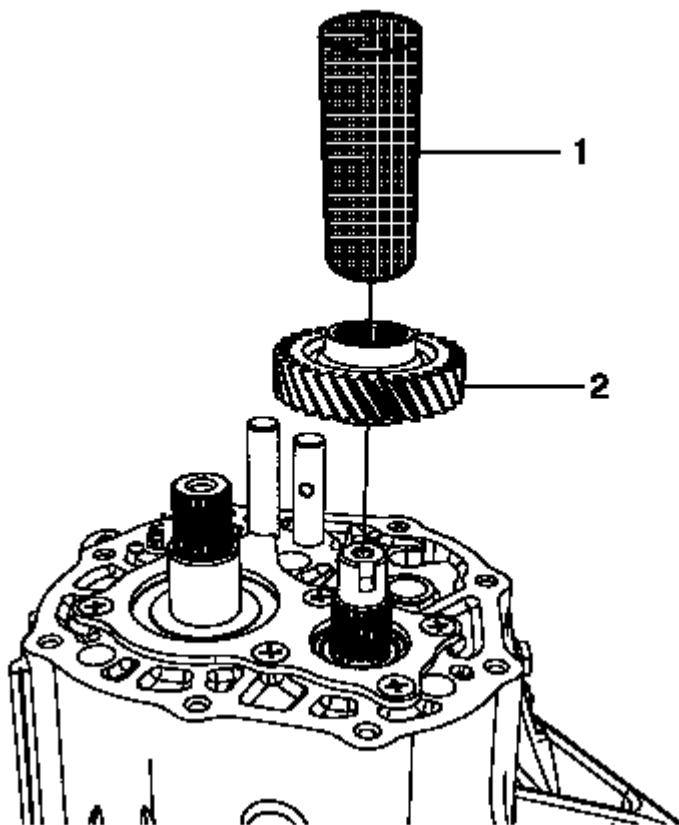


Fig. 101: Countershaft 5th Gear

Courtesy of GENERAL MOTORS COMPANY

NOTE: Position the machined boss side toward the side cover plate.

36. Install the countershaft 5th gear (2) using the **DT-49080** gear, bearing installer (1).

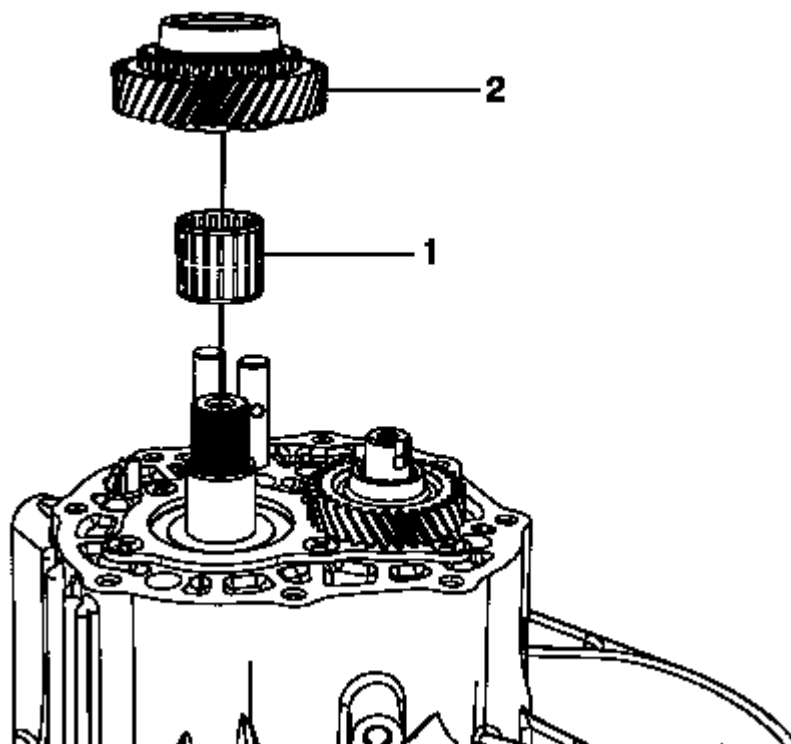


Fig. 102: Input Shaft 5th Gear Bearing
Courtesy of GENERAL MOTORS COMPANY

37. Insert the input shaft 5th gear bearing (1) into the input shaft.
38. Install the input shaft 5th gear (2).

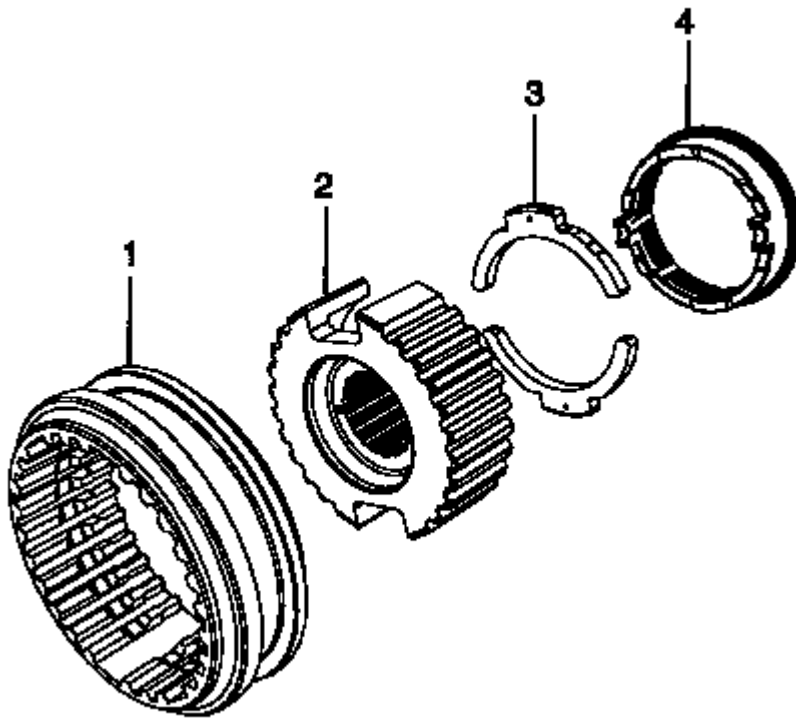


Fig. 103: Exploded View Of 5th Gear Synchronizer Hub Assembly
Courtesy of GENERAL MOTORS COMPANY

NOTE: Make sure that the lever mark must be showed after assembly.

39. Assemble the 5th gear synchronizer hub assembly.
- Position the longer boss side of hub (2) toward inner side.
 - Position the chamfered spline of sleeve (1) toward inner side and install the hub (2) to the sleeve (1).
 - Position the lever marks side toward outer side and install the levers (3) into the hub (2).
 - Install the synchronizer ring (4) inserting ring lugs into the spaces between levers (3).

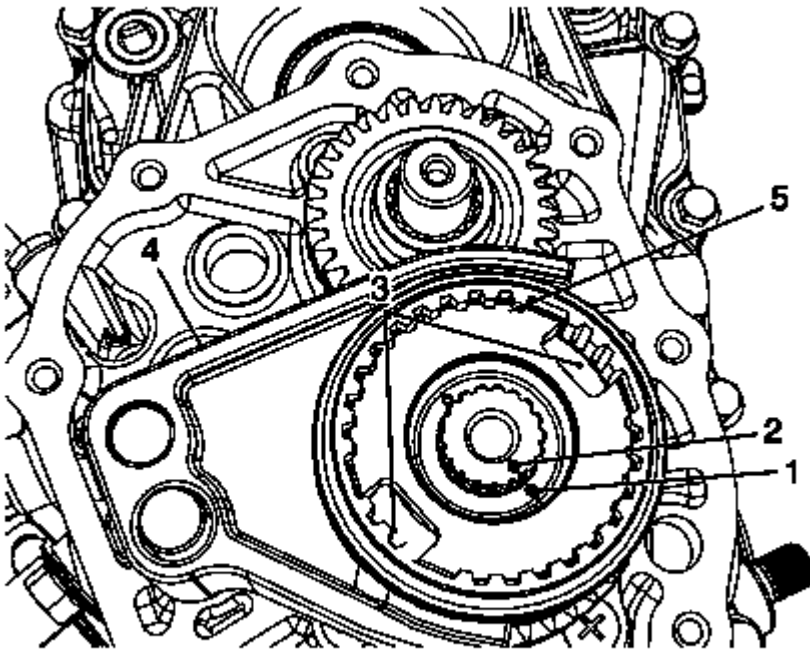


Fig. 104: 5th Gear Fork

Courtesy of GENERAL MOTORS COMPANY

NOTE: Position the longer boss side of hub toward inner side and match the hub mark (1) with the input shaft punched mark (2). Make sure that the lever marks (3) must be showed to the 5th synchronizer hub assembly.

40. Install 5th gear fork to the synchronizer hub assembly.
41. Install the 5th gear fork (4) and synchronizer hub assembly (5) to the input shaft.

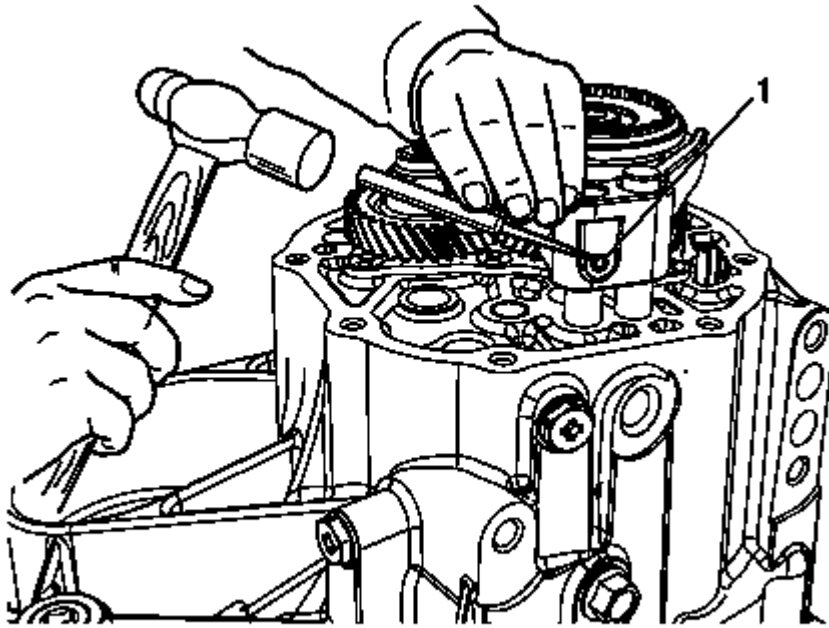


Fig. 105: Gear Shift Fork Pin

Courtesy of GENERAL MOTORS COMPANY

42. Install the new 5th gear shift fork pin (1) using a pin punch and hammer.

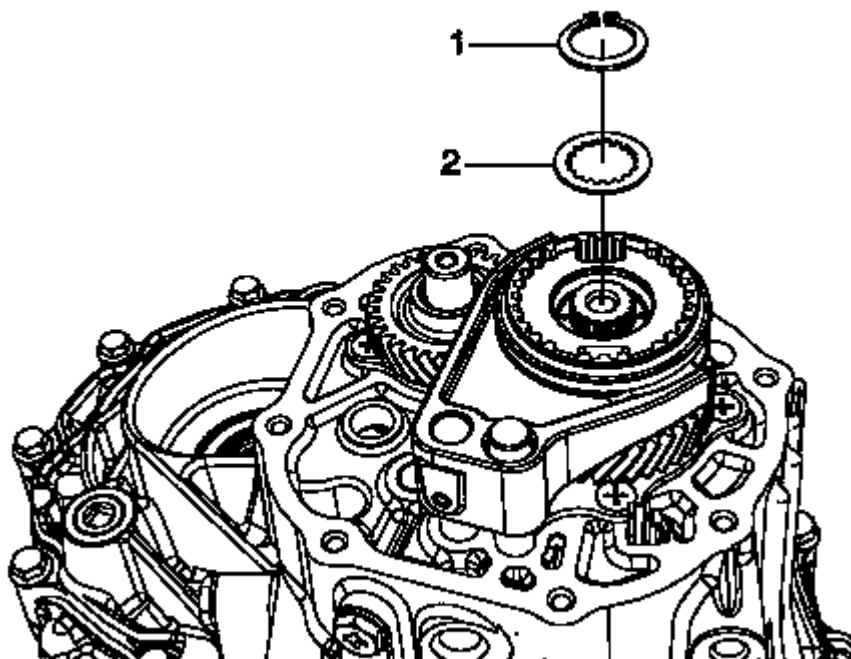


Fig. 106: Exploded View Of 5th Gear Synchronizer Hub Plate
Courtesy of GENERAL MOTORS COMPANY

43. Install the 5th gear synchronizer hub plate (2).
44. Install the new input shaft circlip (1).

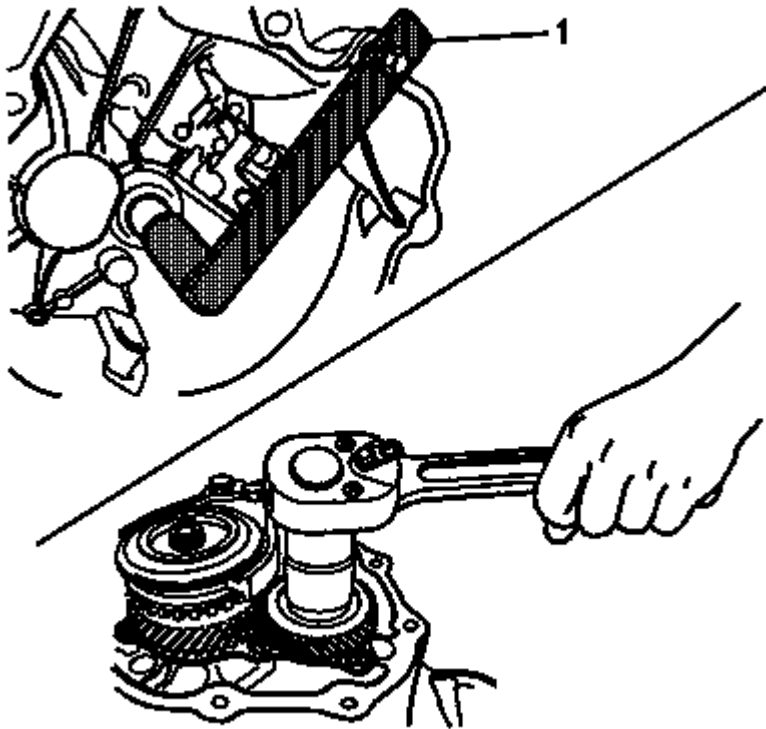


Fig. 107: Holding Input Shaft Using DT-49084
Courtesy of GENERAL MOTORS COMPANY

45. Move the shift shaft lever into the 5th gear position.
46. Hold the input shaft using the **DT-49084** input shaft holder (1).
47. Install the new countershaft nut and tighten to 70 (52 lb ft).
48. Caulk the nut using a chisel and hammer.

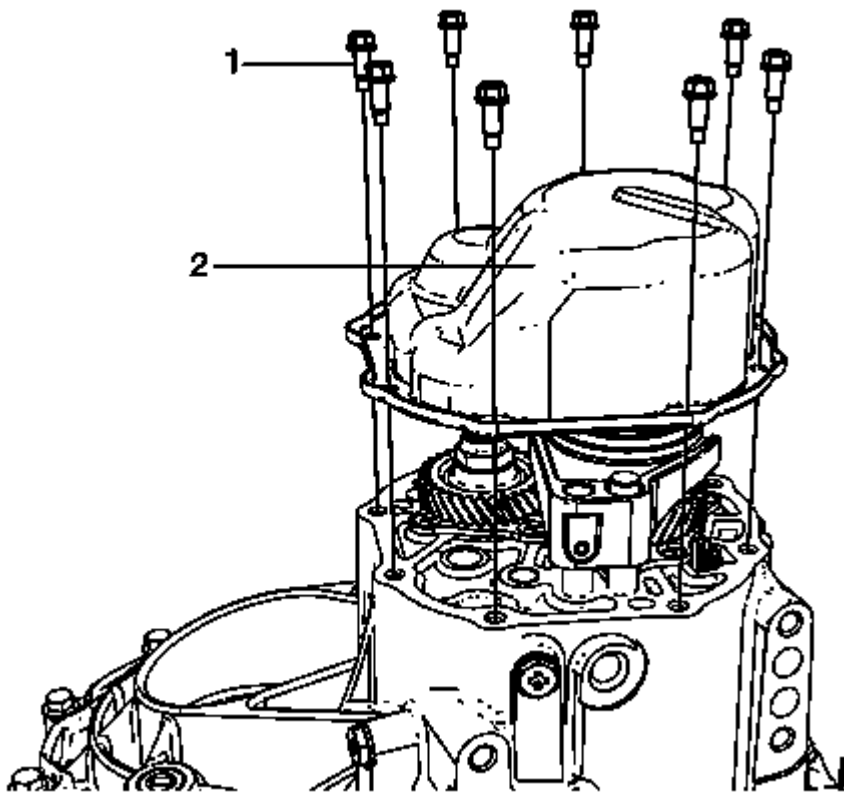


Fig. 108: Side Cover Bolts

Courtesy of GENERAL MOTORS COMPANY

49. Coat the side cover with recommended Side Cover Sealant-THREE BOND 1215 or LOCTITE 5702.
50. Install the side cover (2).
51. Install 8 side cover bolts (1) and tighten to 10 (89 lb in).

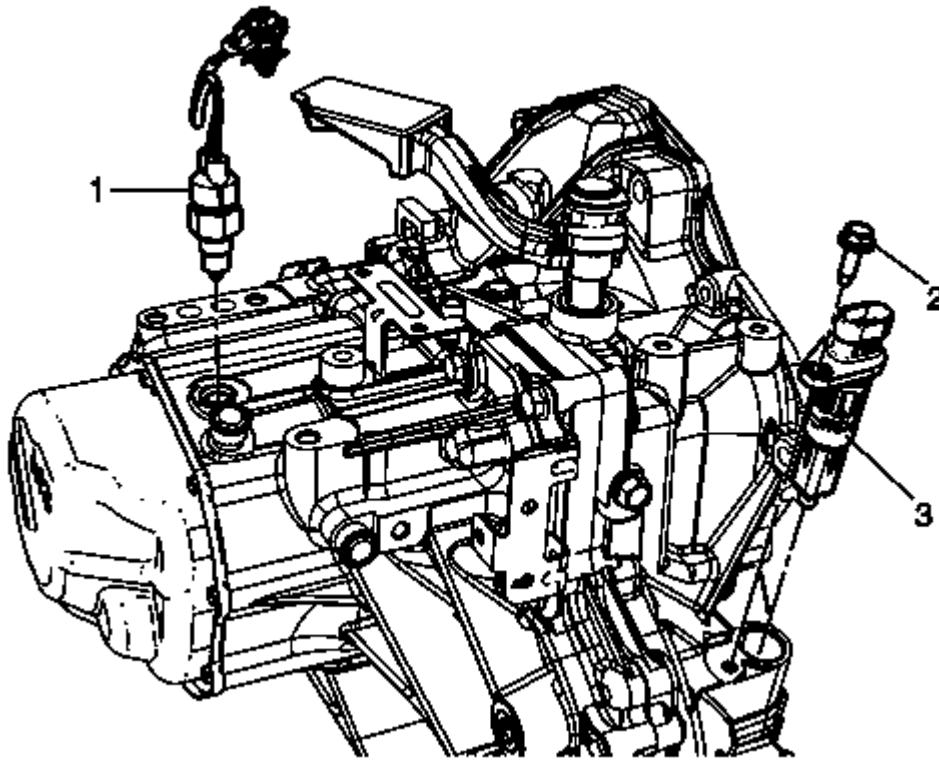


Fig. 109: Backup Light Switch

Courtesy of GENERAL MOTORS COMPANY

- 52. Install the vehicle speed sensor assembly (3).
- 53. Install the vehicle speed sensor assembly bolt (2) and tighten to 9 (80 lb in).
- 54. Install the backup light switch (1) and tighten to 17 (13 lb ft).

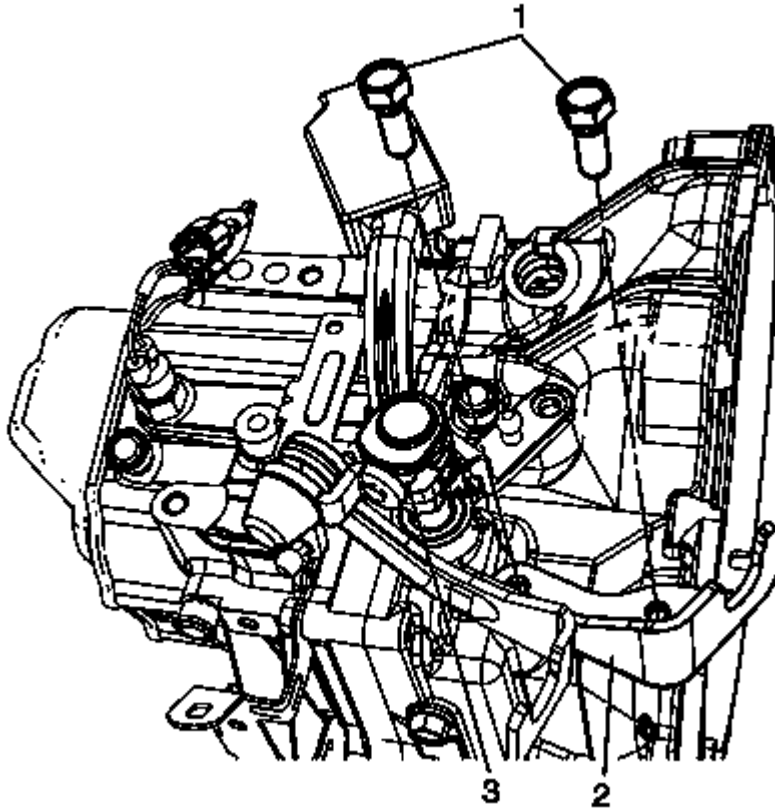


Fig. 110: Selector And Shift Lever Cable Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

55. Install the selector and shift lever cable bracket (2) and bushing (3).
56. Install the selector and shift lever cable bracket bolts (1) and tighten to 23 (17 lb ft).
57. Install the clutch release bearing, shaft and bushing. Refer to **Clutch Release Bearing Replacement**.
58. Install the clutch pedal arm. Refer to **Clutch Pedal Arm Replacement**.
59. Install the transmission assembly. Refer to **Transmission Replacement (MX2, MFM)**.

INPUT SHAFT DISASSEMBLE (HD)

Special Tools

DT-46494 Gear, Bearing Remover

For equivalent regional tools, refer to **Special Tools**.

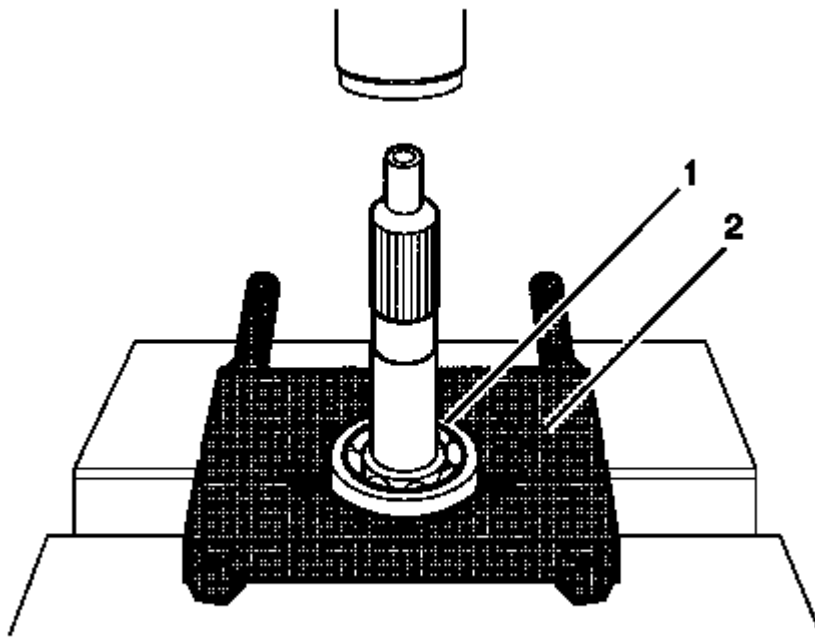


Fig. 111: Input Shaft Right Bearing
Courtesy of GENERAL MOTORS COMPANY

1. Remove the gear unit. Refer to **Transmission Disassemble (HD)**.
2. Position the bearing to the **DT-46494** gear, bearing remover (2) to the right bearing.
3. Remove the input shaft right bearing (1) using a press.

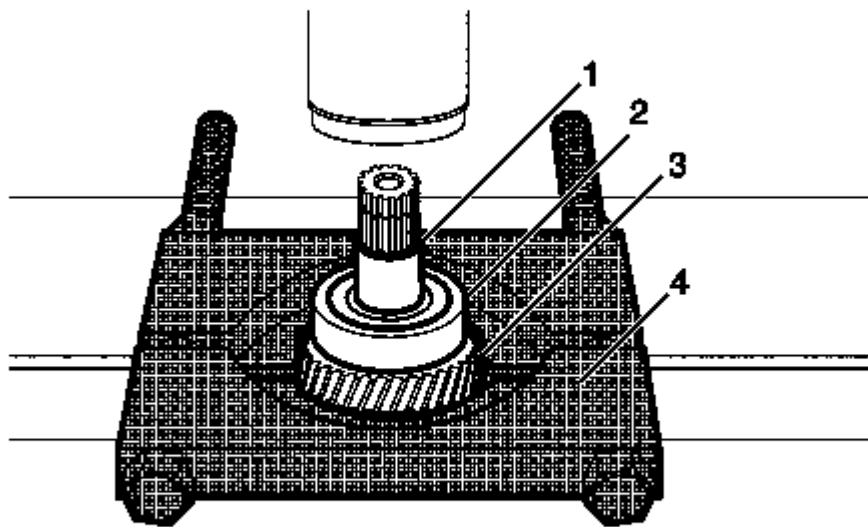


Fig. 112: 5th Gear Spacer, Left Bearing and 4th Gear
Courtesy of GENERAL MOTORS COMPANY

4. Position the 4th gear to the **DT-46494** gear, bearing remover (4).
5. Remove the 5th gear spacer (1), left bearing (2) and 4th gear (3) with the press.

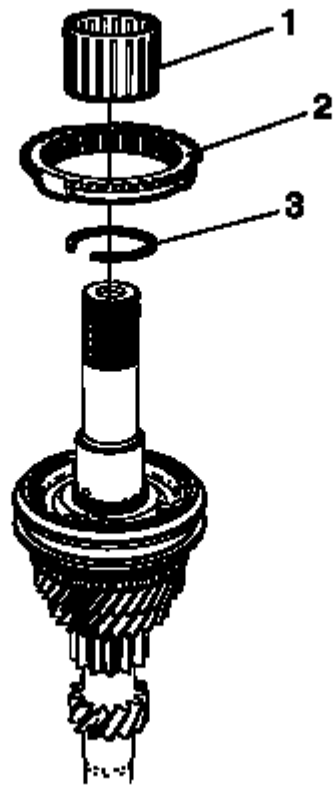


Fig. 113: 4th Gear Bearing

Courtesy of GENERAL MOTORS COMPANY

6. Remove the 4th gear bearing (1).
7. Remove the 4th gear synchronizer ring (2).
8. Remove the 3rd-4th synchronizer circlip (3).

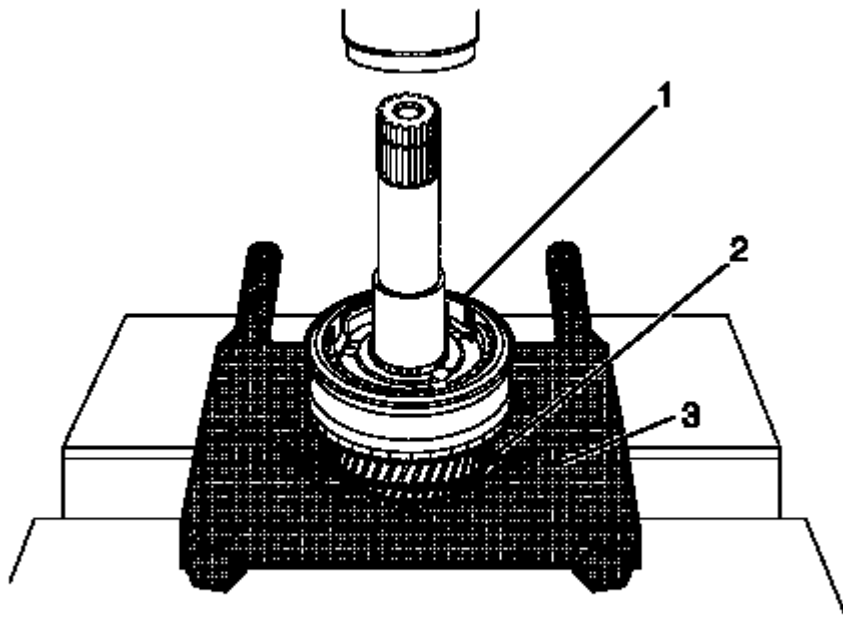


Fig. 114: 3rd-4th Synchronizer Hub Assembly
Courtesy of GENERAL MOTORS COMPANY

9. Position the 3rd gear to the **DT-46494** gear, bearing remover (3).
10. Remove the 3rd-4th synchronizer hub assembly (1) synchronizer ring and 3rd gear (2) with the press.

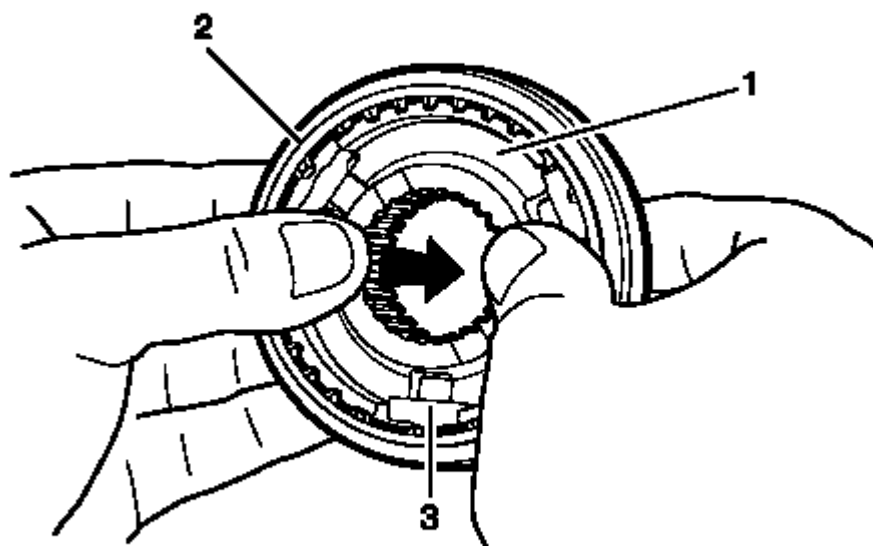


Fig. 115: 3rd-4th Synchronizer Hub Assembly
Courtesy of GENERAL MOTORS COMPANY

11. Push the hub (1) from the 3rd-4th synchronizer hub assembly
12. Remove the synchronizer sleeve (2) and key unit (3).

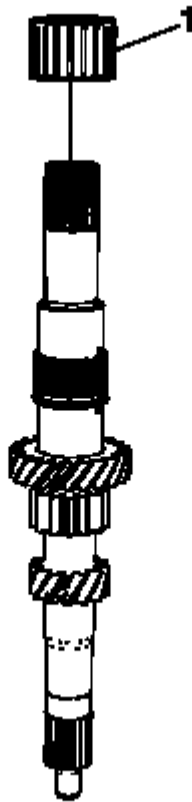


Fig. 116: Input Shaft 3rd Gear Bearing
Courtesy of GENERAL MOTORS COMPANY

13. Remove the input shaft 3rd gear bearing (1).

INPUT SHAFT ASSEMBLE (HD)

Special Tools

- **DT-46496** Gear, Bearing Installer
- **DT-49080** Gear, Bearing Installer

For equivalent regional tools, refer to **Special Tools**.

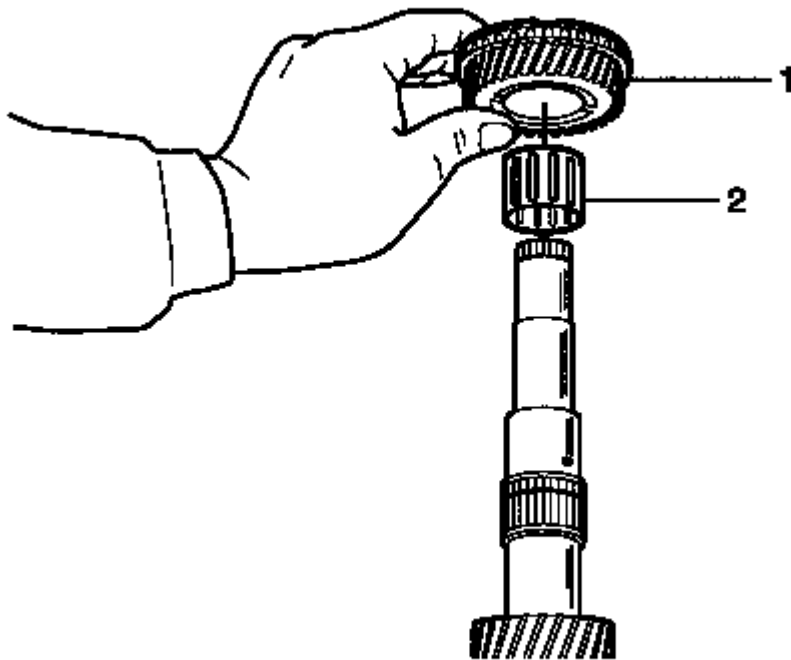


Fig. 117: 3rd Gear Bearing

Courtesy of GENERAL MOTORS COMPANY

NOTE: Coat all of the inner parts the gear, the bearing and the oil seal with gear fluid.

1. Install the 3rd gear bearing (2).
2. Install the 3rd gear and synchronizer ring (1).

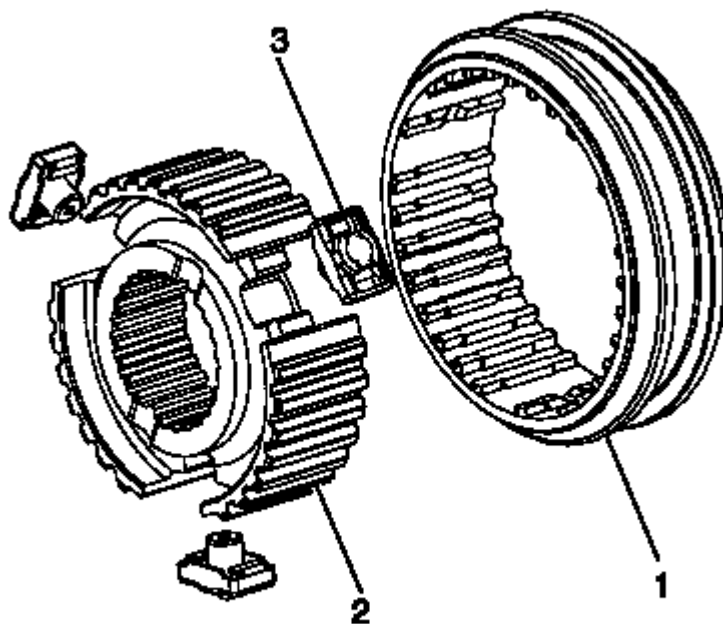


Fig. 118: 3rd-4th Synchronizer Hub
Courtesy of GENERAL MOTORS COMPANY

3. Install the 3rd-4th synchronizer hub (2) to the sleeve (1).

NOTE: **Make sure that the key units is properly seated into the key groove of sleeve and hub.**

4. Install the key units (3) into the key groove of the hub and sleeve.

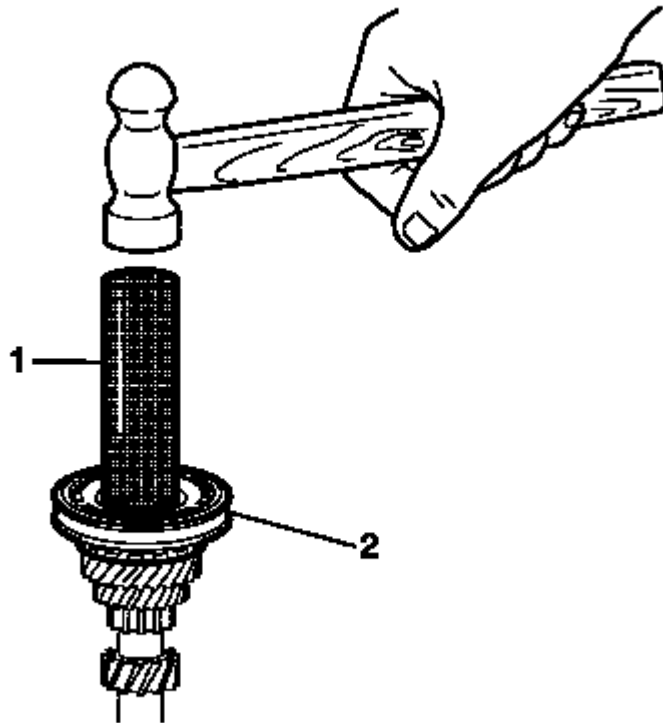


Fig. 119: View Of DT-46496 Gear, Bearing Installer And A Hammer
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- Position the longer flange of hub toward the third gear and match the key groove of hub to the synchronizer ring lug.
- When installing gear, bearing and hub assembly, install them slowly using the DT-46496 gear, bearing installer (1) and a hammer. If overpressed, the gear teeth may be damaged

5. Insert the 3rd-4th hub assembly (2) into the input shaft.
6. Install the 3rd-4th hub assembly using the **DT-46496** gear, bearing installer (1) and hammer.

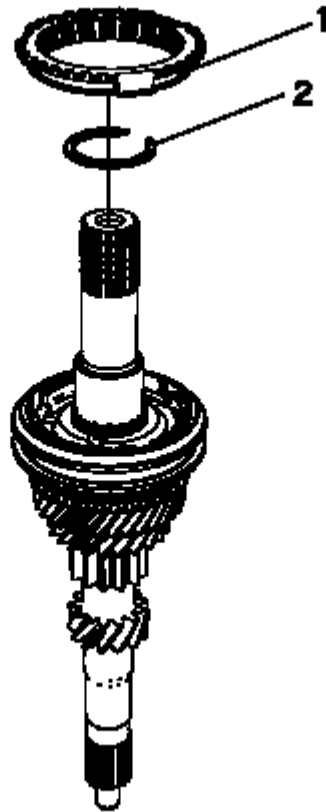


Fig. 120: 3rd-4th Synchronizer Circlip
Courtesy of GENERAL MOTORS COMPANY

7. Install the 3rd-4th synchronizer circlip (2).

NOTE: Match the synchronizer ring lug to the key groove of hub.

8. Install the 4th synchronizer ring (1).

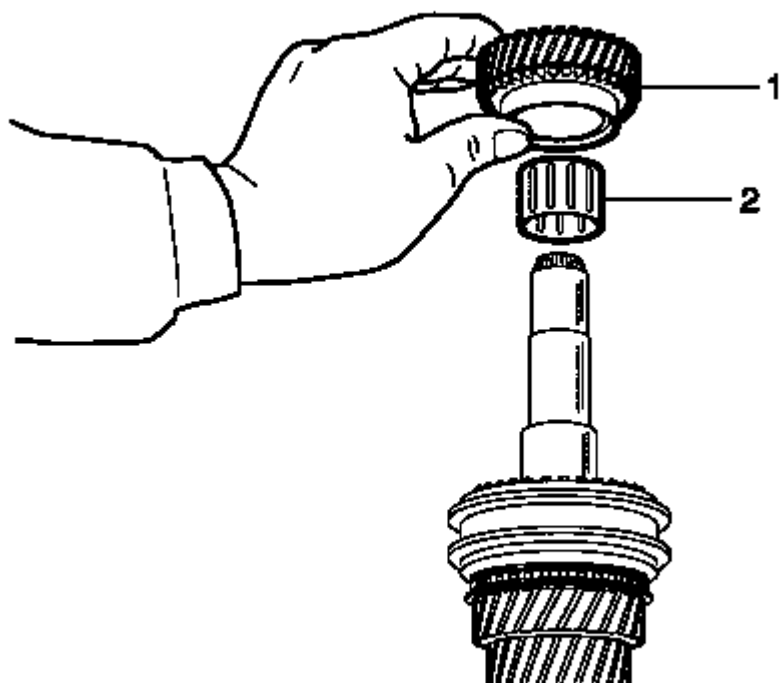


Fig. 121: Input Shaft 4th Gear Bearing And 4th Gear
Courtesy of GENERAL MOTORS COMPANY

9. Install the input shaft 4th gear bearing (2) and 4th gear (1).

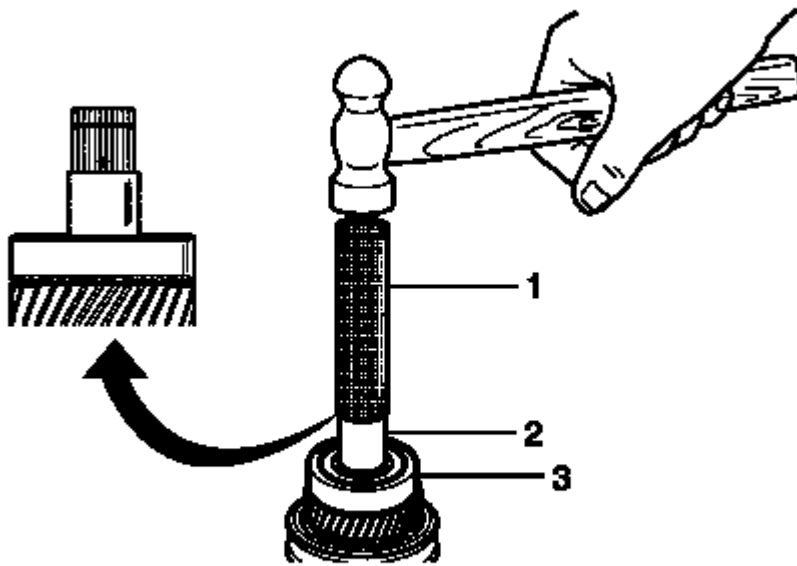


Fig. 122: Input Shaft Left Side Bearing
Courtesy of GENERAL MOTORS COMPANY

10. Install the input shaft left side bearing (3) using the **DT-49080** gear, bearing installer (1) and hammer.
11. Install the 5th gear spacer (2) using the **DT-49080** gear, bearing installer (1) and hammer.

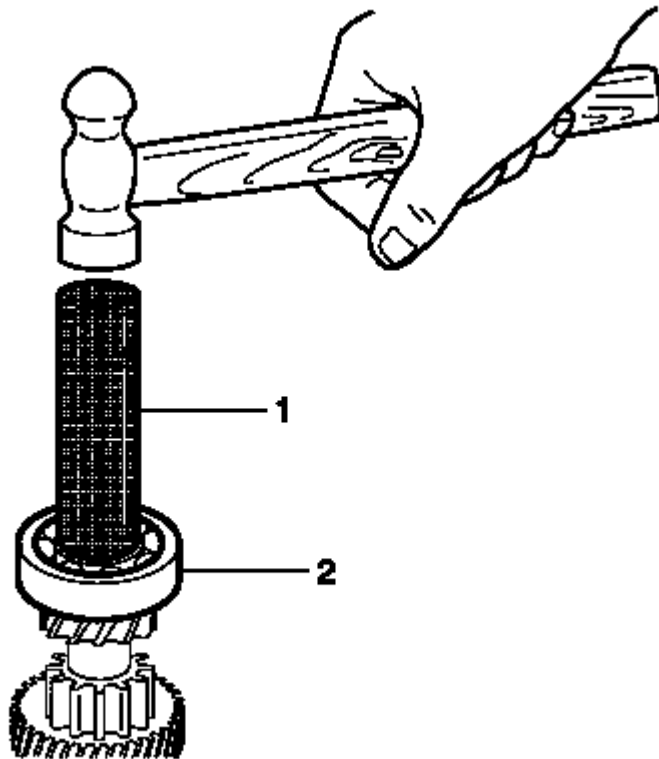


Fig. 123: Input Shaft Right Bearing
Courtesy of GENERAL MOTORS COMPANY

12. Install the input shaft right bearing (2) to the input shaft using the **DT-49080** gear, bearing installer (1) and hammer.
13. Install the gear unit. Refer to **Transmission Assemble (HD)**.

COUNTER GEAR SHAFT DISASSEMBLE (HD)

Special Tools

DT-46494 Gear, Bearing Remover

For equivalent regional tools, refer to **Special Tools**.

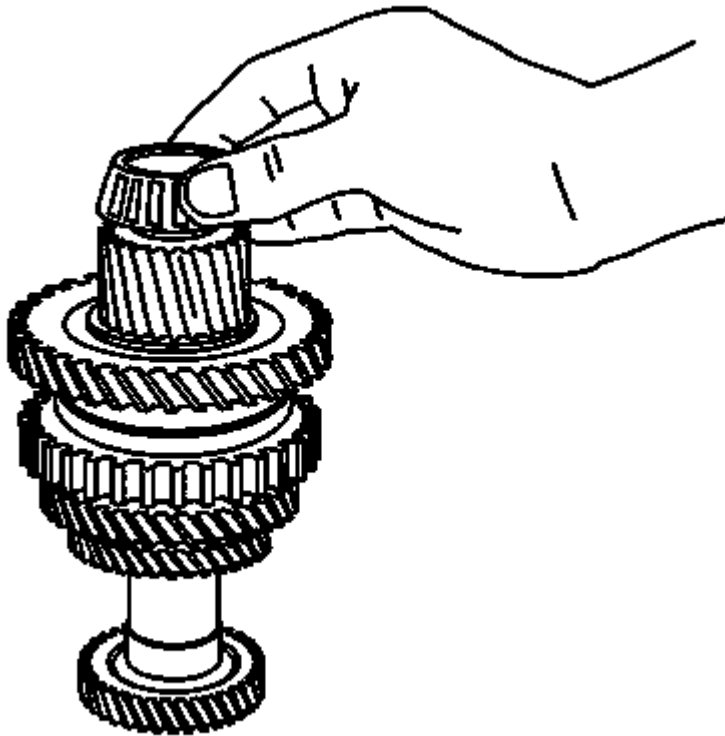


Fig. 124: Countershaft Right Side Bearing
Courtesy of GENERAL MOTORS COMPANY

1. Remove the gear unit. Refer to Transmission Disassemble (HD).
2. Remove the counter shaft right side bearing.

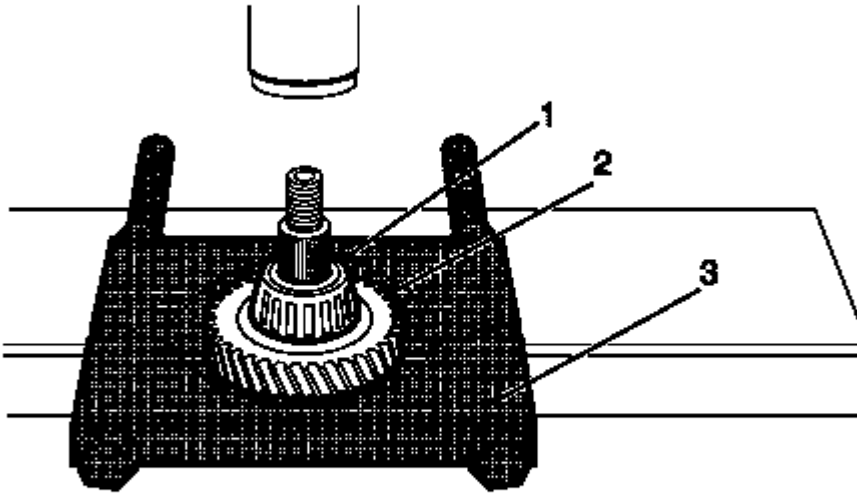


Fig. 125: Counter Shaft Left Bearing And 4th Gear
Courtesy of GENERAL MOTORS COMPANY

3. Position the 4th gear to the **DT-46494** gear, bearing remover (3).
4. Remove the counter shaft left bearing (1) and 4th gear (2) using a press.

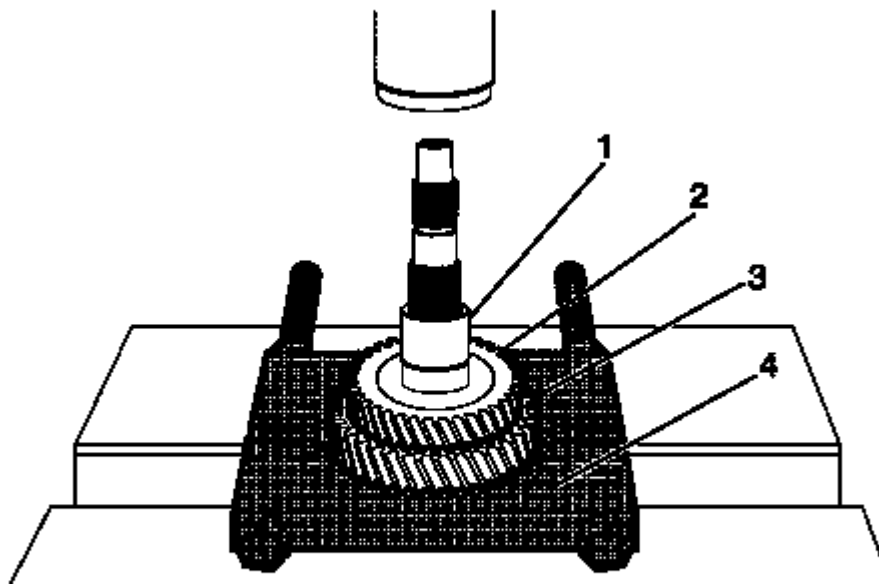


Fig. 126: Counter Shaft 3rd-4th Gear Spacer
Courtesy of GENERAL MOTORS COMPANY

5. Remove the counter shaft 3rd-4th gear spacer (1).
6. Position the 2nd gear to the **DT-46494** gear, bearing remover (4).
7. Remove the 3rd gear (2) and 2nd gear (3) with the press.

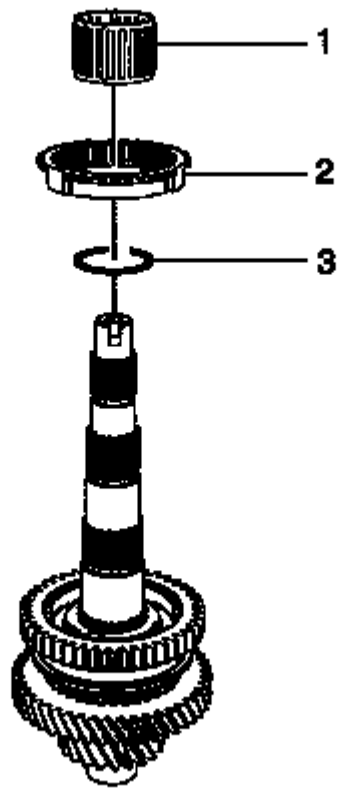


Fig. 127: Counter Shaft 2nd Gear Bearing
Courtesy of GENERAL MOTORS COMPANY

8. Remove the counter shaft 2nd gear bearing (1).
9. Remove the 2nd gear synchronizer ring (2).
10. Remove the 1st-2nd gear synchronizer circlip (3).

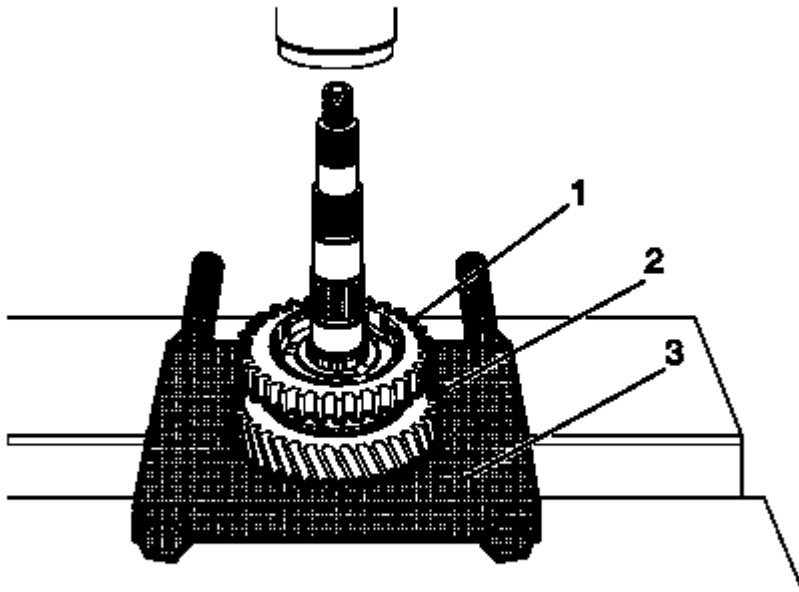


Fig. 128: 1st-2nd Gear Synchronizer Hub Assembly
Courtesy of GENERAL MOTORS COMPANY

11. Position the 1st gear to the **DT-46494** gear, bearing remover (3).
12. Remove the 1st-2nd gear synchronizer hub assembly (1), 1st gear synchronizer ring and 1st gear (2) with the press.
13. Remove the 1st gear synchronizer ring from the 1st gear.

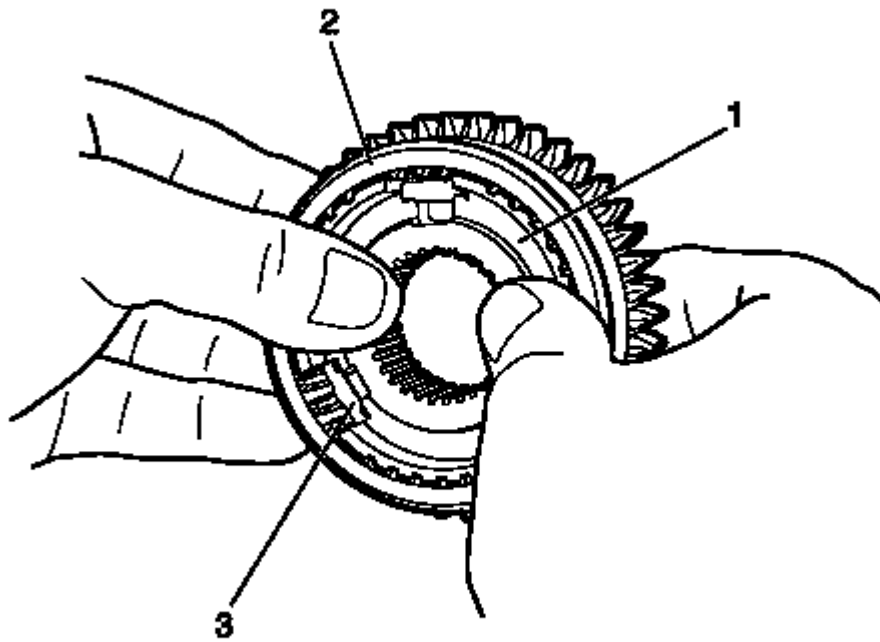


Fig. 129: Synchronizer Sleeve And Key Units
Courtesy of GENERAL MOTORS COMPANY

14. Push the hub (1) from the 1st-2nd gear synchronizer hub assembly.
15. Disassemble the synchronizer sleeve (2) and key units (3).

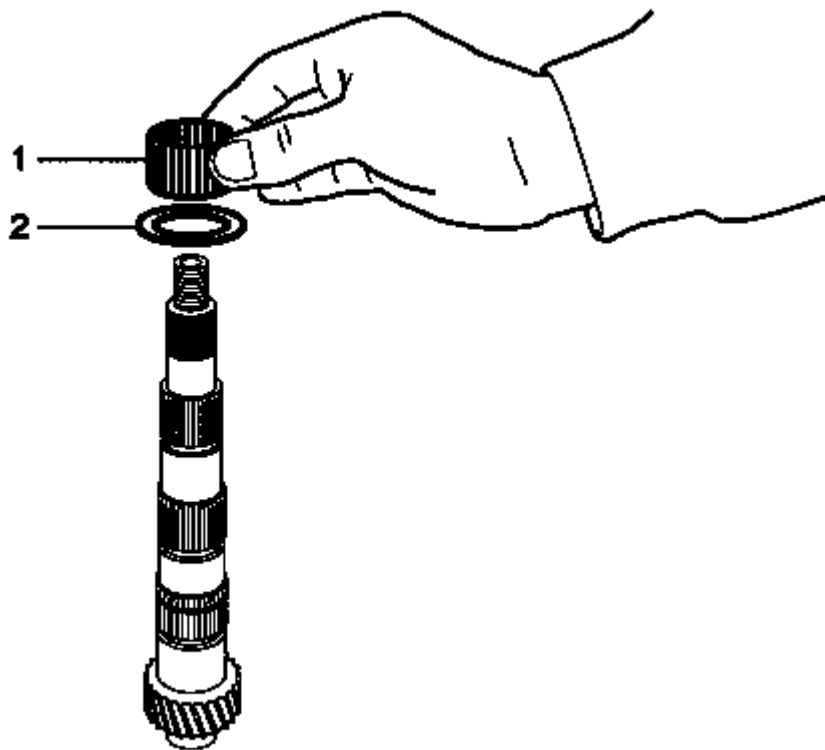


Fig. 130: Counter Shaft 1st Gear Bearing And 1st Gear Spacer
Courtesy of GENERAL MOTORS COMPANY

16. Remove the counter shaft 1st gear bearing (1) and the 1st gear spacer (2).

COUNTER GEAR SHAFT ASSEMBLE (HD)

Special Tools

- **DT-49079** Gear, Bearing Installer
- **DT-49080** Gear, Bearing Installer
- **DT-49081** Gear, Bearing Installer

For equivalent regional tools, refer to **Special Tools**.

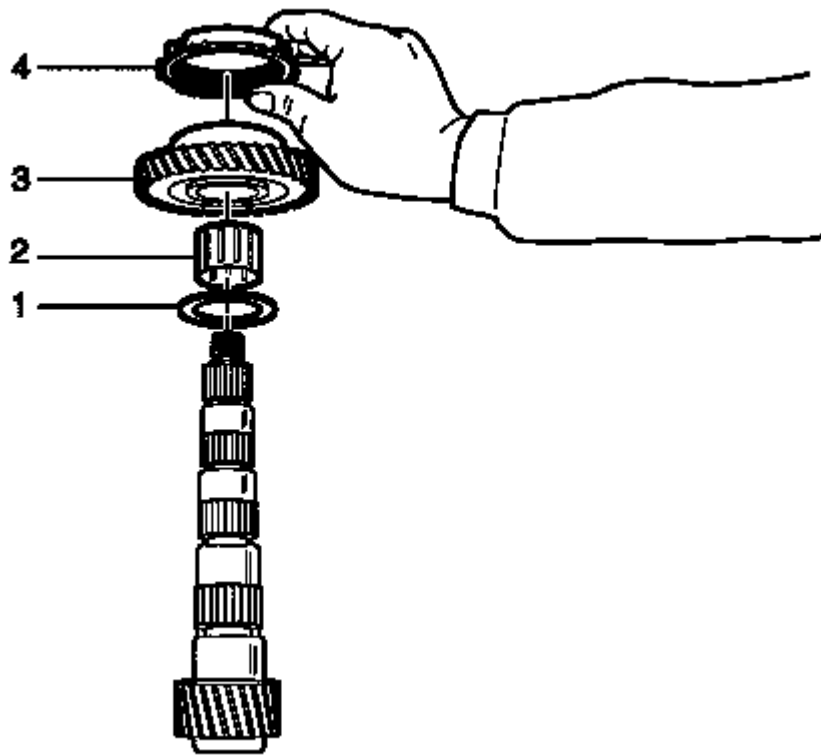


Fig. 131: 1st Gear Synchronizer Ring And 1st Gear Spacer
Courtesy of GENERAL MOTORS COMPANY

NOTE: Coat the inner parts of the gear, the bearing and the oil seal with gear fluid.

1. Install the 1st gear spacer (1).
2. Install the 1st gear bearing (2).
3. Install the 1st gear (3).
4. Install the 1st gear synchronizer ring (4).

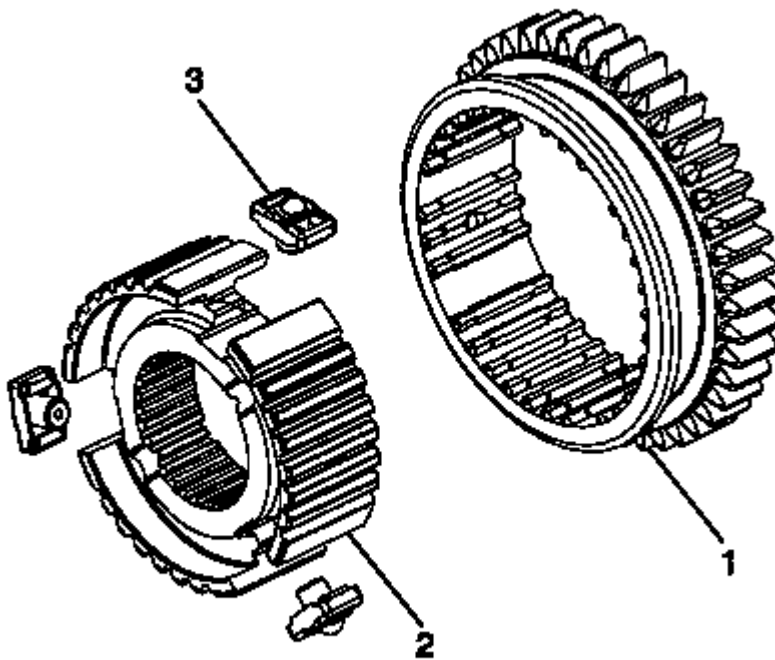


Fig. 132: 1st-2nd Gear Synchronizer Sleeve
Courtesy of GENERAL MOTORS COMPANY

NOTE: Make sure that the key units is properly seated into the key groove of sleeve and hub.

5. Install the hub (2) to the 1st-2nd gear synchronizer sleeve (1).
6. Install the key units (3) into the key groove of the hub and sleeve.

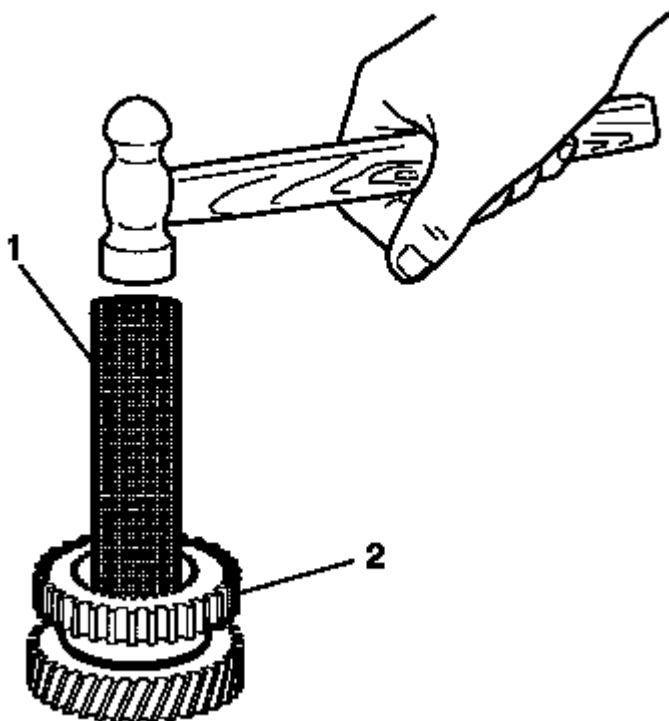


Fig. 133: 1st-2nd Gear Synchronizer Hub Assembly
Courtesy of GENERAL MOTORS COMPANY

NOTE: Match the key groove of hub to the 1st gear synchronizer ring lug.

7. Install the 1st-2nd gear synchronizer hub assembly (2) into the counter shaft using the **DT-49081** gear, bearing installer (1) and hammer.

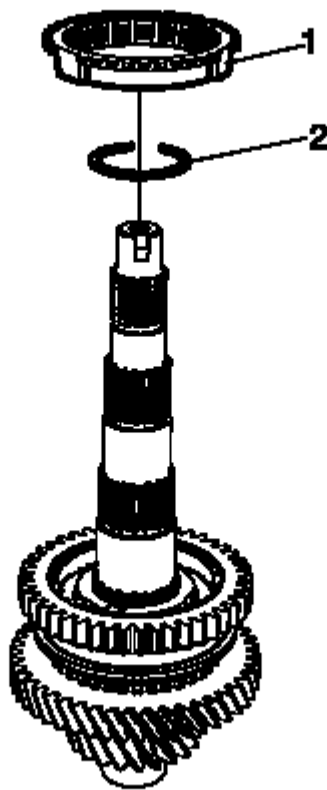


Fig. 134: 1st-2nd Gear Synchronizer Circlip
Courtesy of GENERAL MOTORS COMPANY

8. Install the 1st-2nd gear synchronizer circlip (2).

NOTE: Match the 2nd synchronizer ring lug to the key groove of hub.

9. Install the 2nd synchronizer ring (1).

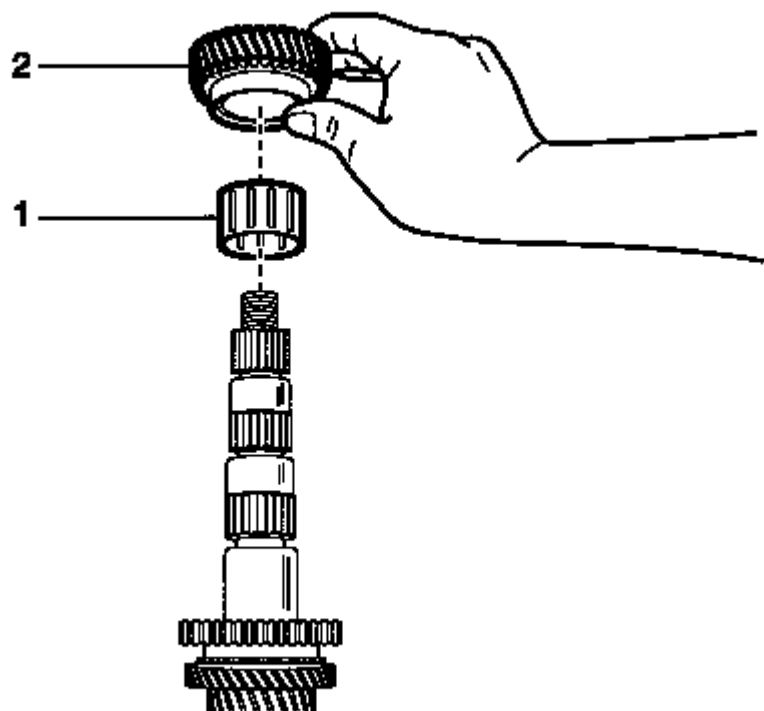


Fig. 135: 2nd Gear Bearing

Courtesy of GENERAL MOTORS COMPANY

10. Install the 2nd gear bearing (1).
11. Install the 2nd gear (2).

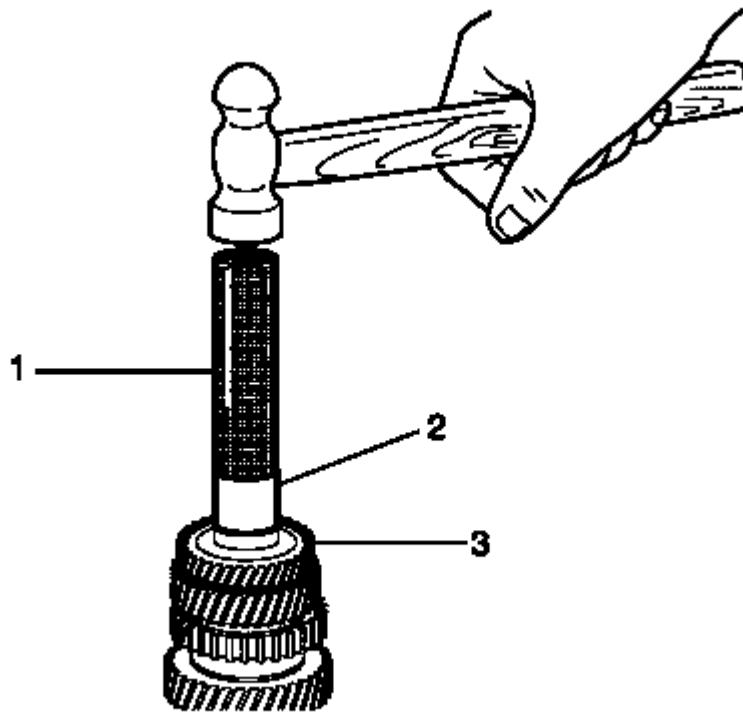


Fig. 136: 3rd-4th Gear Space

Courtesy of GENERAL MOTORS COMPANY

12. Insert the 3rd gear and the 3rd-4th gear spacer into the counter shaft.
13. Install the 3rd-4th gear spacer (2) and the 3rd gear (3) using the **DT-49079** gear, bearing installer (1) and a hammer.

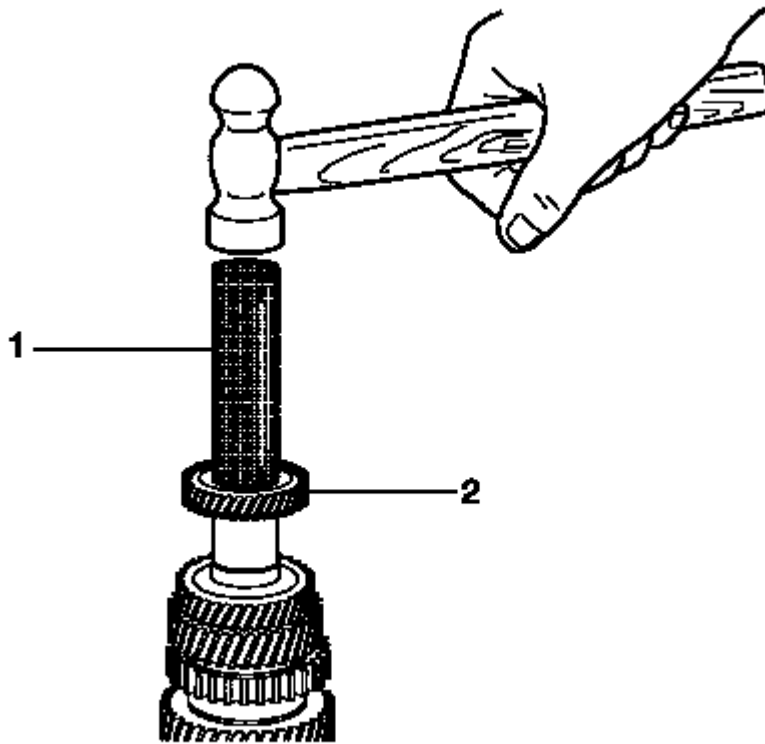


Fig. 137: Installing 4th Gear Using DT-49080 Tool
Courtesy of GENERAL MOTORS COMPANY

14. Install the 4th gear (2) to the counter shaft using the **DT-49080** gear, bearing installer (1) and a hammer.

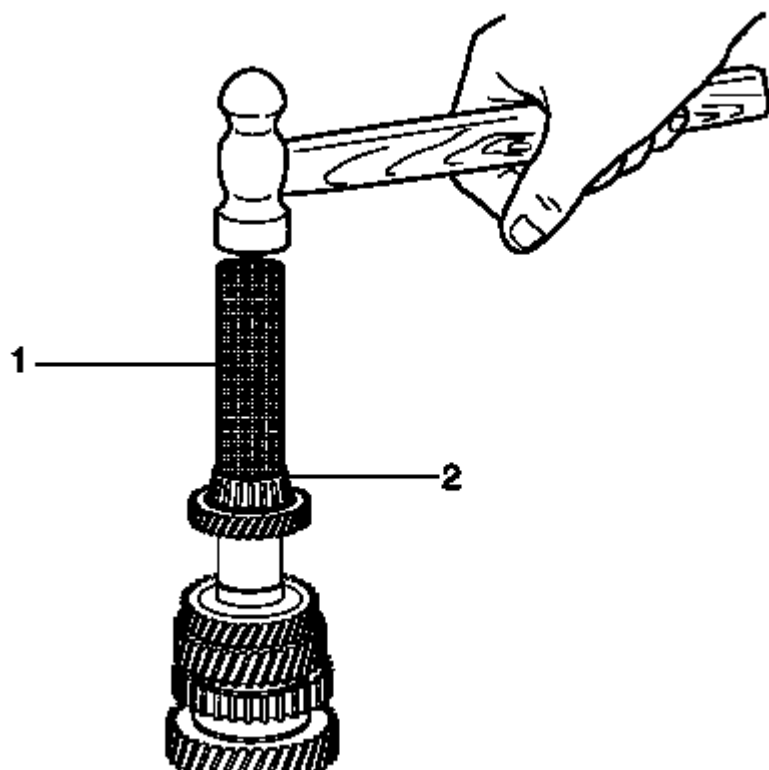


Fig. 138: Installing Left Side Bearing Using DT-49080 Tool
Courtesy of GENERAL MOTORS COMPANY

15. Install the left side bearing (2) onto the countershaft using the **DT-49080** gear, bearing installer (1) and hammer.

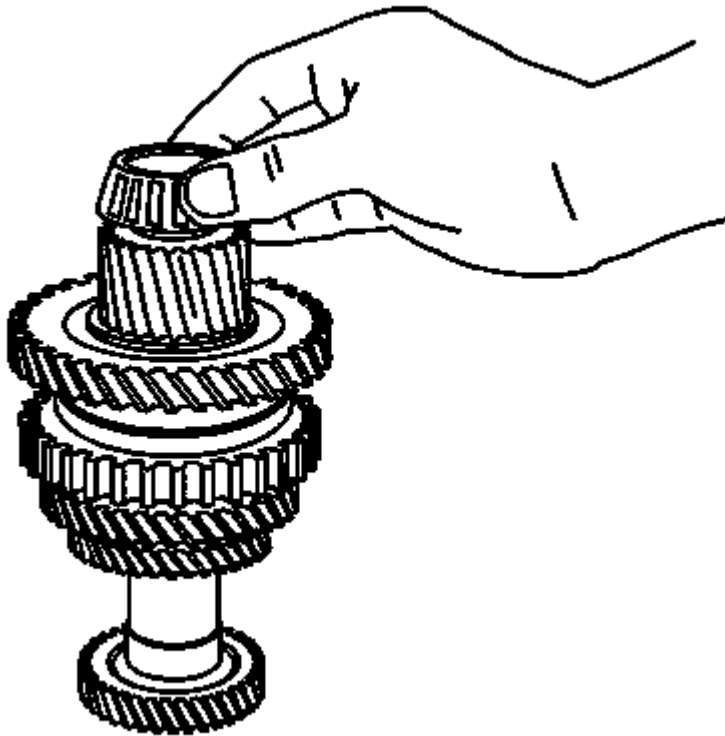


Fig. 139: Countershaft Right Side Bearing
Courtesy of GENERAL MOTORS COMPANY

16. Install the countershaft right side bearing.
17. Install the gear unit. Refer to **Transmission Assemble (HD)**.

SHIFT SHAFT AND FORK ASSEMBLIES DISASSEMBLE (HD)

1st-2nd Gear Shift Shaft Disassemble

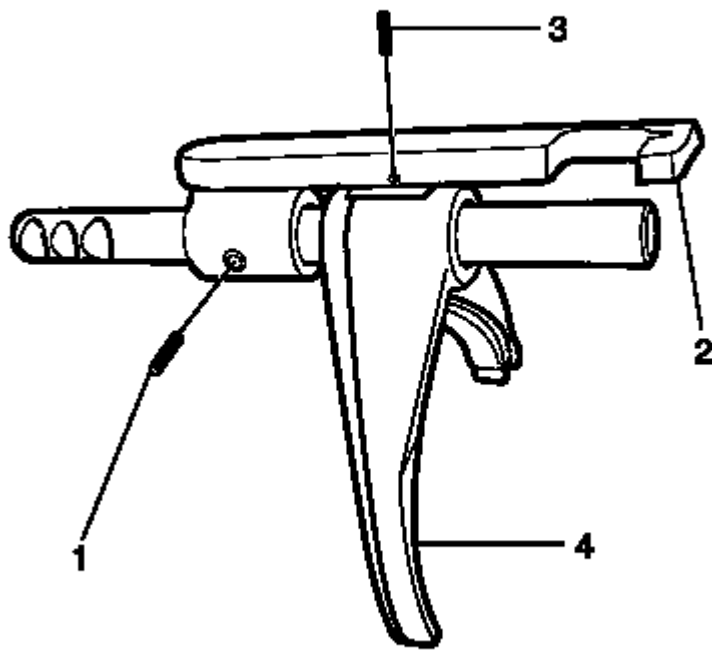


Fig. 140: 1st-2nd Gear Shift Yoke Pin And 1st-2nd Gear Shift Fork
Courtesy of GENERAL MOTORS COMPANY

1. Remove the gear unit. Refer to **Transmission Disassemble (HD)**.
2. Remove the 1st-2nd gear shift shaft assembly from the gear unit.
3. Fix the shift shaft assembly into a vise with a protector.

NOTE: **Mark the place and direction of the shift fork and yoke before removing them. This will aid the reassembly**

4. Remove the 1st-2nd gear shift yoke pin (1) using a pin punch and a hammer.
5. Remove the 1st-2nd gear shift yoke (2).
6. Remove the 1st-2nd gear shift fork pin (3) using a pin punch and a hammer.
7. Remove the 1st-2nd gear shift fork (4).

3rd-4th Gear Shift Shaft Disassemble

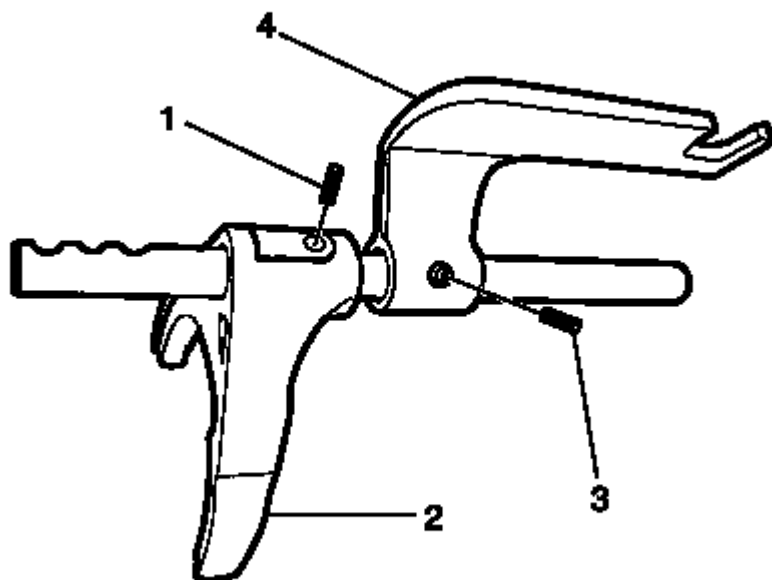


Fig. 141: 3rd-4th Gear Shift Fork Pin
Courtesy of GENERAL MOTORS COMPANY

1. Remove the gear unit. Refer to **Transmission Disassemble (HD)**.
2. Remove the 3rd-4th gear shift shaft assembly from the gear unit.
3. Fix the 3rd-4th gear shift shaft assembly into a vise with a protector.
4. Remove the 3rd-4th gear shift fork pin (1) using a pin punch and a hammer.
5. Remove the 3rd-4th gear shift fork (2).
6. Remove the 3rd-4th gear shift yoke pin (3) using a pin punch and a hammer.
7. Remove the 3rd-4th gear shift yoke (4).

5th Reverse Gear Shift Shaft Disassemble

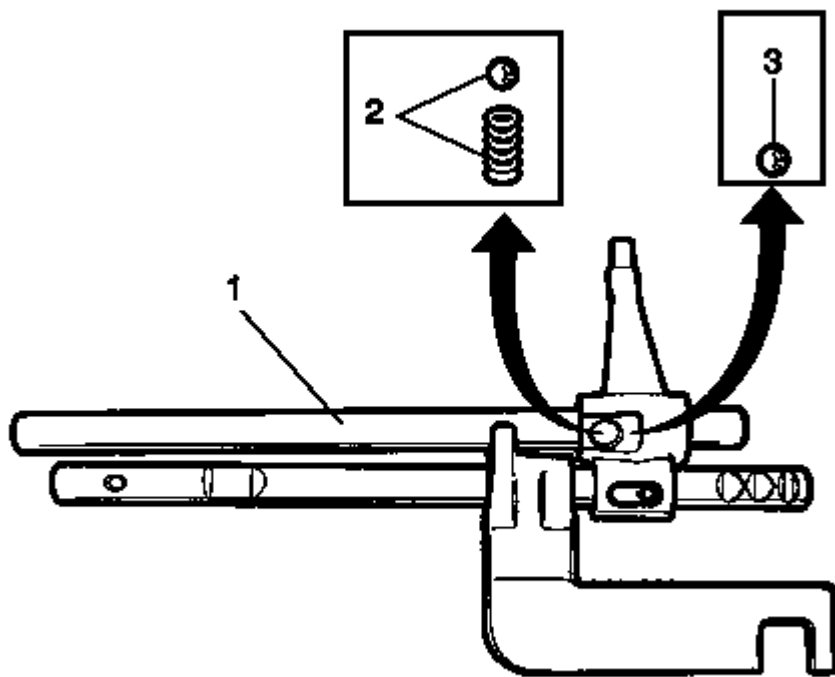


Fig. 142: 5th-Reverse Gear Ball And Reverse Shift Guide Ball
Courtesy of GENERAL MOTORS COMPANY

1. Remove the gear unit. Refer to **Transmission Disassemble (HD)**.
2. Remove the 5th-reverse gear shift shaft assembly from the gear unit.
3. Remove the shift shaft not installed with yoke by pushing (1).
4. Remove the 5th-reverse gear ball (3) and the reverse shift guide ball and spring (2) from the reverse shift arm.
5. Fix the shift shaft assembly into a vise with a protector.

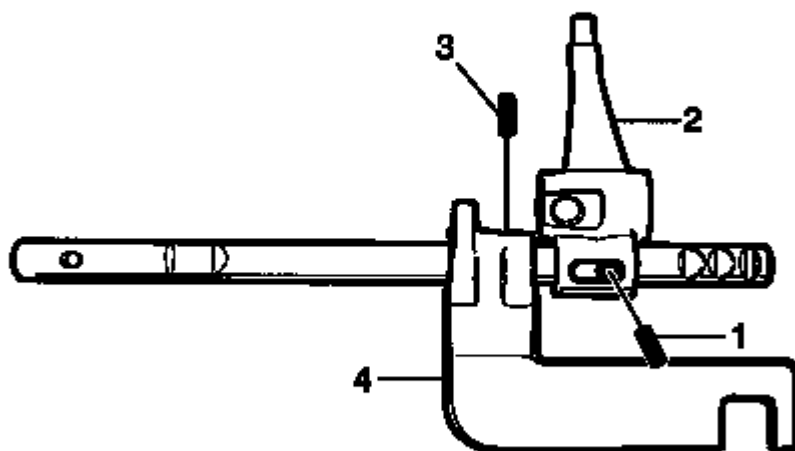


Fig. 143: 5th Gear Shift Yoke Pin And Reverse Gear Shift Arm
Courtesy of GENERAL MOTORS COMPANY

6. Remove the reverse gear shift arm pin (1) using a pin punch and hammer.
7. Remove the reverse gear shift arm (2).
8. Remove the 5th gear shift yoke pin (3) using a pin punch and a hammer.
9. Remove the 5th gear shift yoke (4).

SHIFT SHAFT AND FORK ASSEMBLIES CLEANING AND INSPECTION (HD)

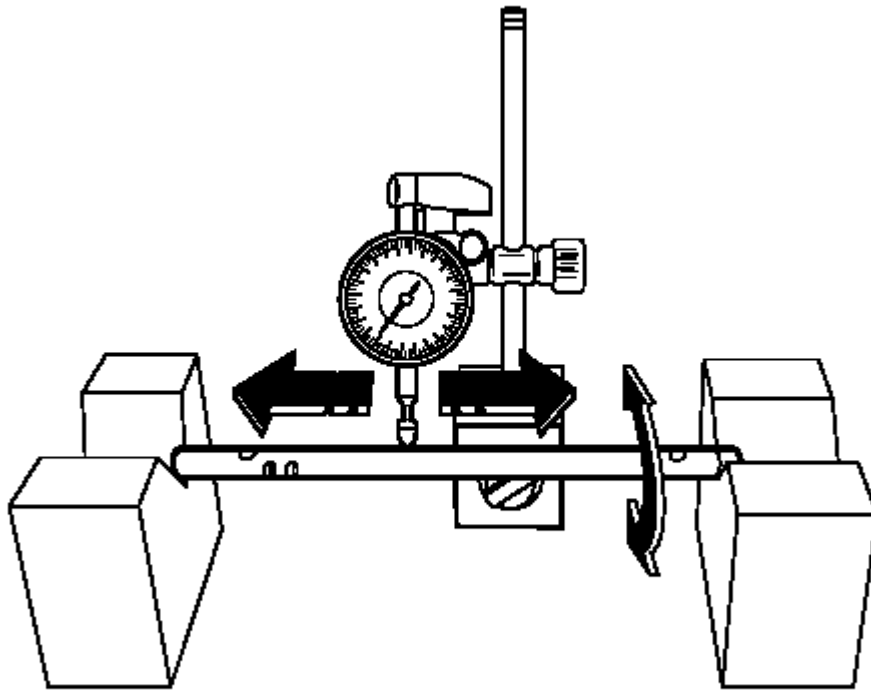


Fig. 144: Shift Shaft and Fork Assemblies Cleaning and Inspection (HD)
Courtesy of GENERAL MOTORS COMPANY

1. Inspect for bent, deformed or damaged shift shaft.
2. Replace the shift shaft if necessary

SHIFT FORK CLEANING AND INSPECTION (HD)

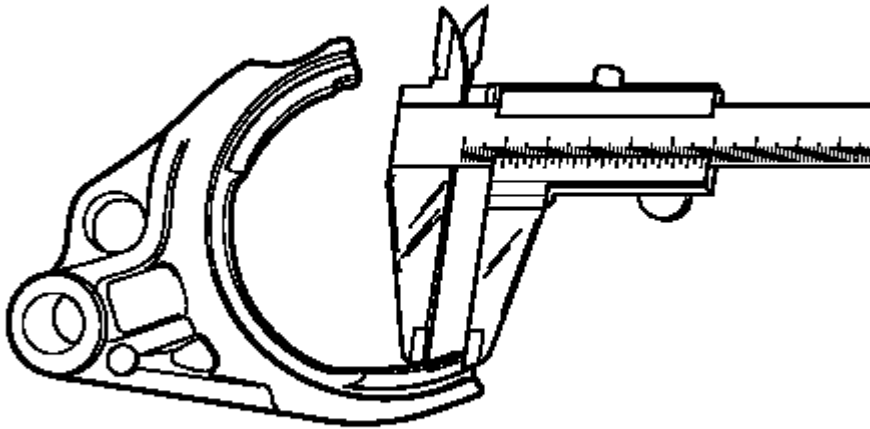


Fig. 145: Shift Fork Cleaning and Inspection (HD)
Courtesy of GENERAL MOTORS COMPANY

Measure the end thickness of shift fork and replace if necessary.

Specifications

- The standard shift fork end thickness for the low speed shift fork is 8.7 mm (0.343 in).
- The shift fork end thickness limit for the low speed shift fork is 8.56 mm (0.337 in).
- The standard shift fork end thickness for the high speed shift fork is 7.8 mm (0.307 in).
- The shift fork end thickness limit for the high speed shift fork is 7.66 mm (0.302 in).
- The standard shift fork end thickness for the fifth gear shift fork is 7.8 mm (0.307 in).
- The shift fork end thickness limit for the fifth gear shift fork is 7.66 mm (0.302 in).

SHIFT SHAFT AND FORK ASSEMBLIES ASSEMBLE (HD)

1st-2nd Gear Shift Shaft Assembly

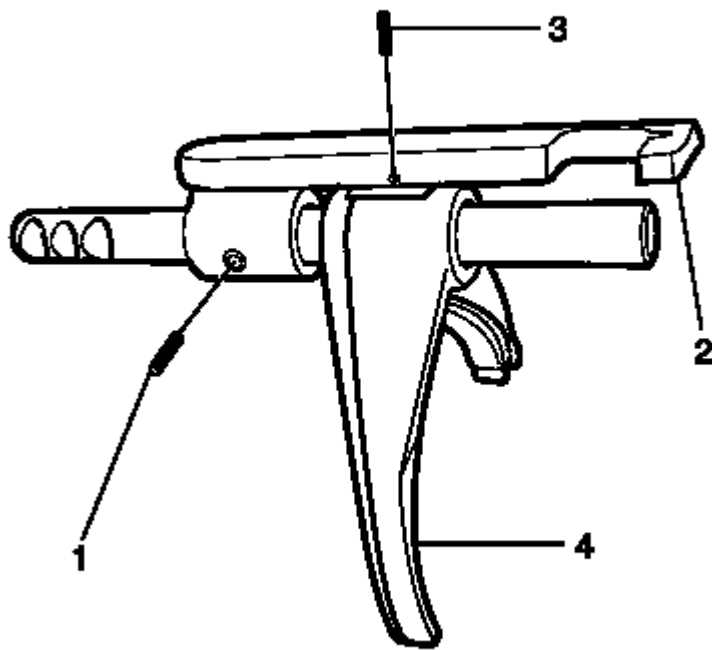


Fig. 146: 1st-2nd Gear Shift Yoke Pin And 1st-2nd Gear Shift Fork
Courtesy of GENERAL MOTORS COMPANY

1. Place the shift shaft into a vise with a protector.
2. Install the 1st-2nd gear shift fork (4).
3. Install the new 1st-2nd gear shift fork pin (3) using a pin punch and a hammer.
4. Install the 1st-2nd gear shift yoke (2).
5. Install the new 1st-2nd gear shift yoke pin (1) using a pin punch and a hammer.
6. Install the 1st-2nd gear shift shaft assembly into the gear unit.
7. Install the gear unit. Refer to **Transmission Assemble (HD)**.

3rd-4th Gear Shift Shaft Assembly

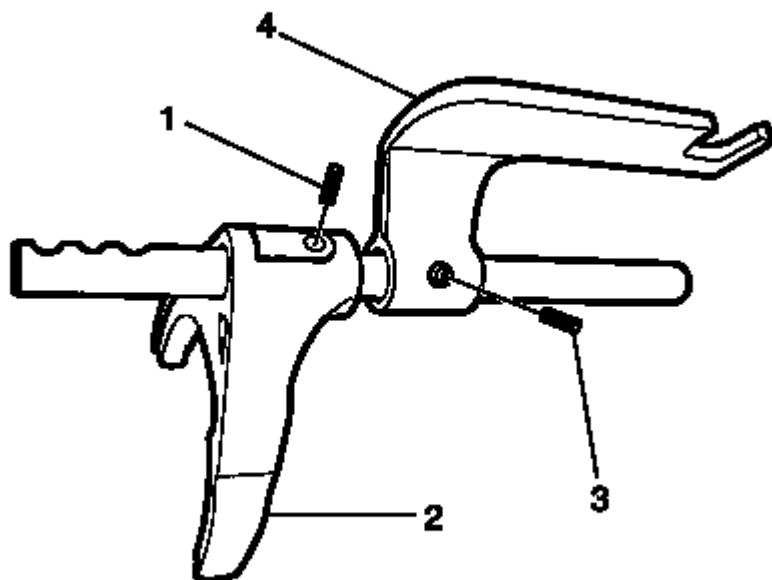


Fig. 147: 3rd-4th Gear Shift Fork Pin
Courtesy of GENERAL MOTORS COMPANY

1. Place the shift shaft into a vise with a protector.
2. Install the 3rd-4th gear shift yoke (4).
3. Install the new 3rd-4th gear shift yoke pin (3) using a pin punch and a hammer.
4. Install the 3rd-4th gear shift fork (2).
5. Install the new 3rd-4th gear shift fork pin (1) using a pin punch and a hammer.
6. Install the 3rd-4th gear shift shaft assembly into the gear unit.
7. Install the gear unit. Refer to **Transmission Assemble (HD)**.

5th Reverse Gear Shift Shaft Assembly

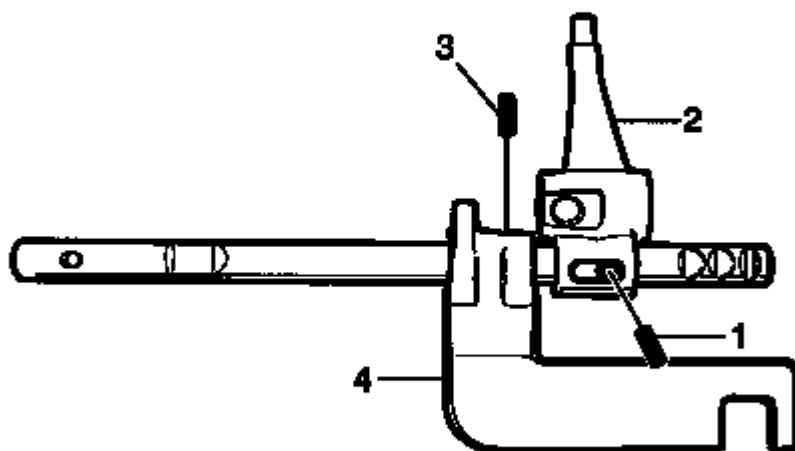


Fig. 148: 5th Gear Shift Yoke Pin And Reverse Gear Shift Arm
Courtesy of GENERAL MOTORS COMPANY

1. Place the shift shaft into a vise with a protector.
2. Install the 5th gear shift yoke (4).
3. Install the new 5th gear shift yoke pin (3) using a pin punch and a hammer.
4. Install the reverse gear shift arm (2).
5. Install the new reverse gear shift arm pin (1) using a pin punch and a hammer.

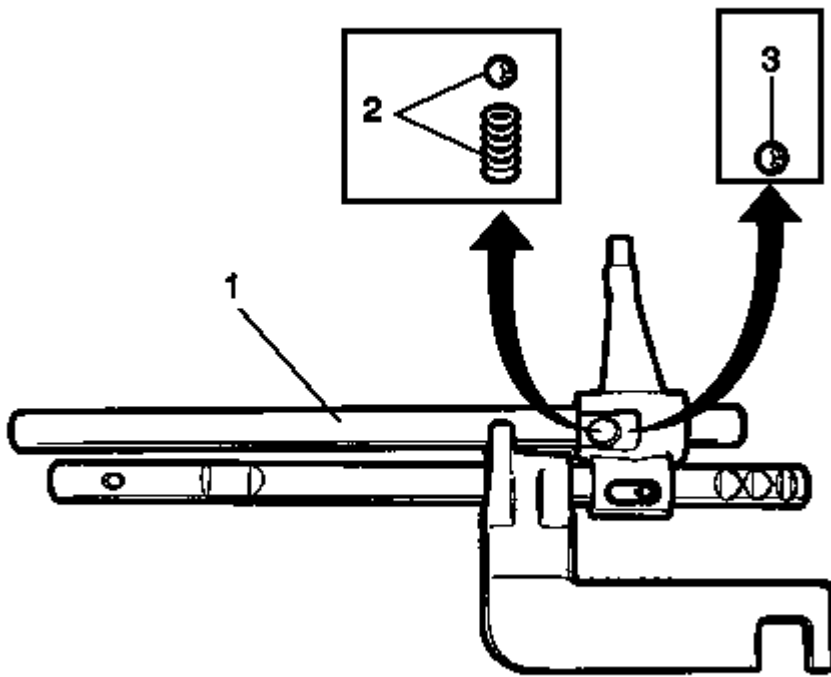


Fig. 149: 5th-Reverse Gear Ball And Reverse Shift Guide Ball
Courtesy of GENERAL MOTORS COMPANY

6. Install the reverse shift guide ball and spring (2).
7. Install the 5th-reverse gear ball (3).
8. Install the shift shaft by pushing (1).
9. Install 5th-reverse gear shift shaft assembly into the gear unit.
10. Install the gear unit. Refer to Transmission Disassemble (HD).

DESCRIPTION AND OPERATION

TRANSMISSION SYSTEM DESCRIPTION AND OPERATION

This 5-speed transmission assembly adopts the synchronized mesh type of 5 forward speed. The reverse speed gear is driven by sliding idle gear without synchronizer.

Reverse Gear Mis-Shift Preventing Mechanism

5th and reverse gear cam prevents the gear from directly being shifted from 5th to reverse when shifting to reverse from 5th. So, when shifting to reverse, be sure to shift to reverse from neutral position.

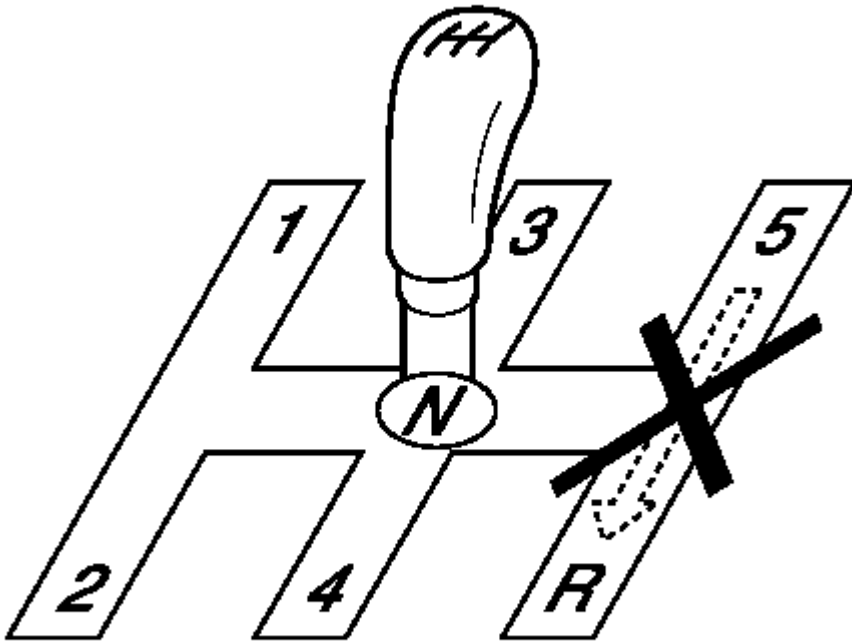


Fig. 150: Reverse Gear Mis-Shift Preventing Mechanism
Courtesy of GENERAL MOTORS COMPANY

In case of shifting to 5th gear, shift and select shaft rotates to right that shift and select lever arm fixes on the groove of 5th and reverse gear shift cam.

When shifting to reverse from 5th gear, shifting to reverse is impossible because 5th and reverse gear shift cam fixes on cam stopper case.

When shifting to reverse from neutral position between 5th and reverse, gear shift and select lever arm rotates to left and shifting is possible.

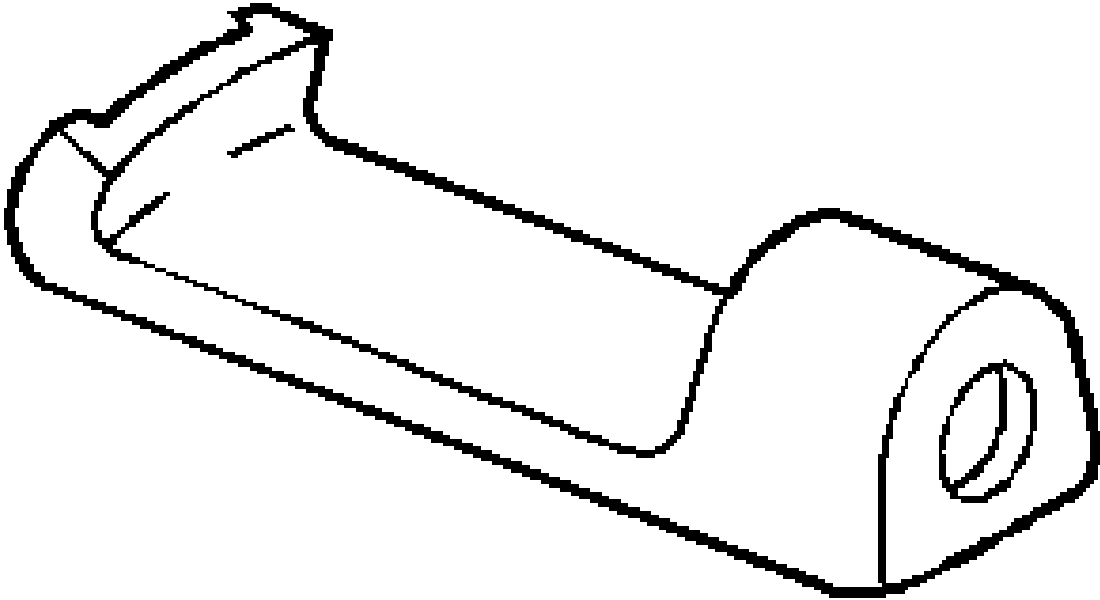
Differential

The differential is integrated with transmission case and installed on chassis together with the engine. It changes the direction of power and increase torque. The reduction gear is installed parallel to a counter shaft and is a helical gear type. The differential gear is a bevel gear type and is integrated with a reduction gear.

SPECIAL TOOLS AND EQUIPMENT

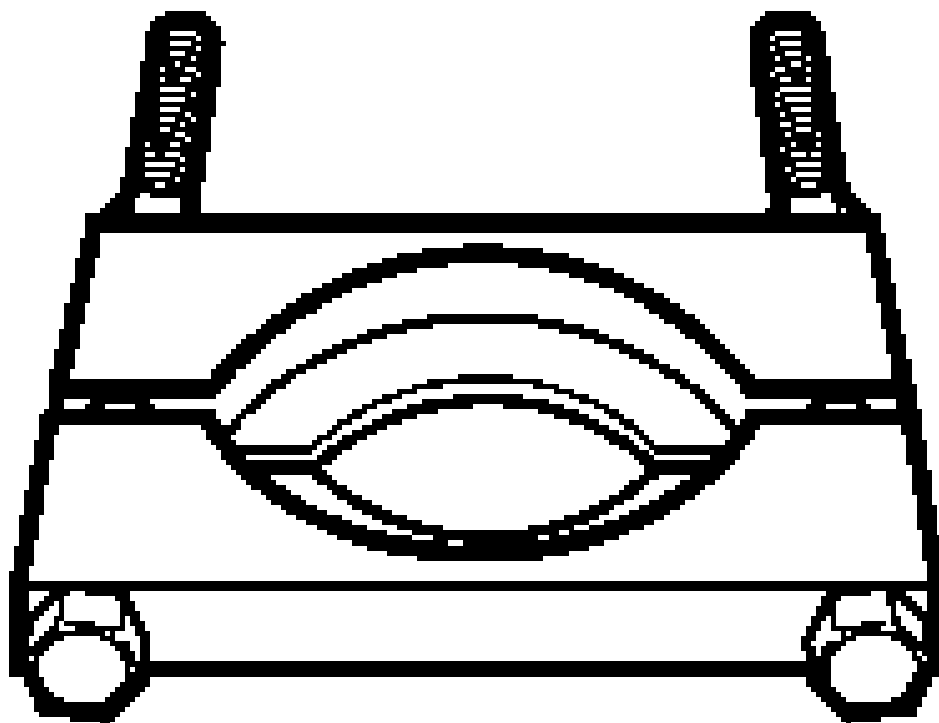
SPECIAL TOOLS

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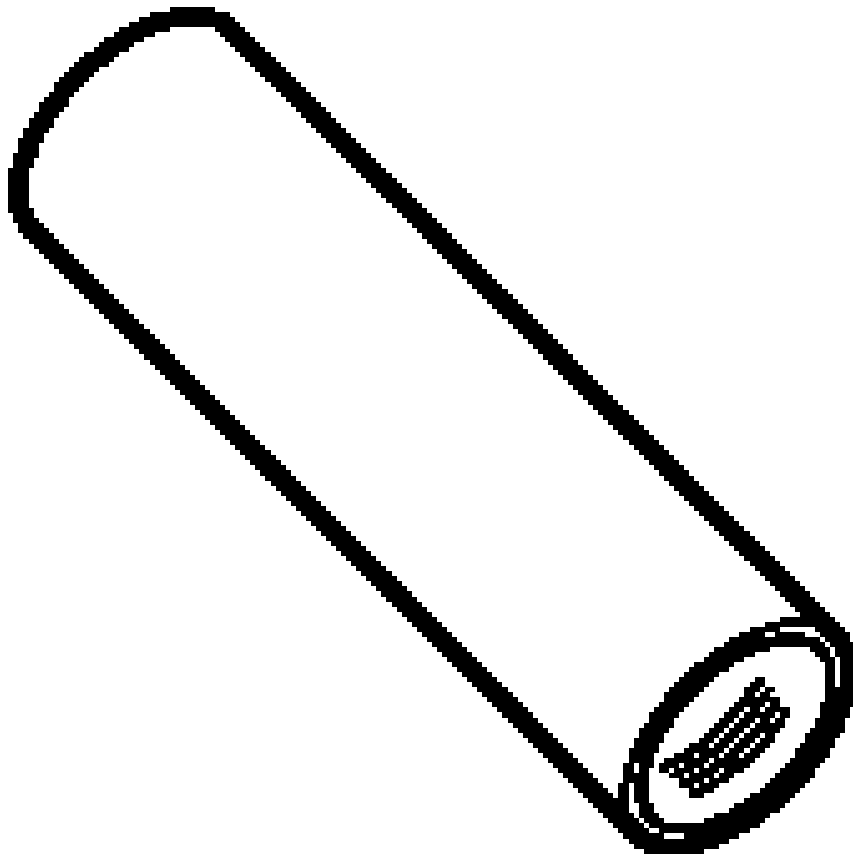
Illustration	Tool Number/Descrip
	DT-586 J-23129 Universal Sea Remover



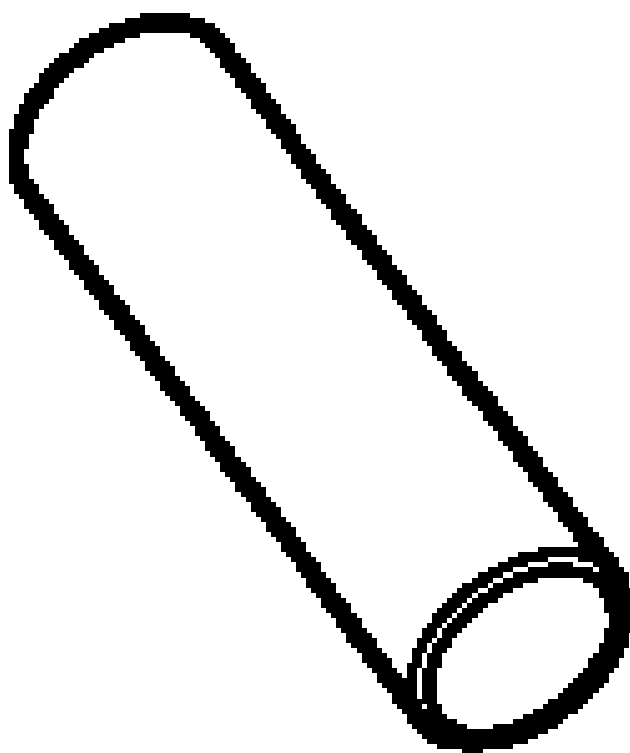
DT-7004
J-6125-1B
Slide Hammer



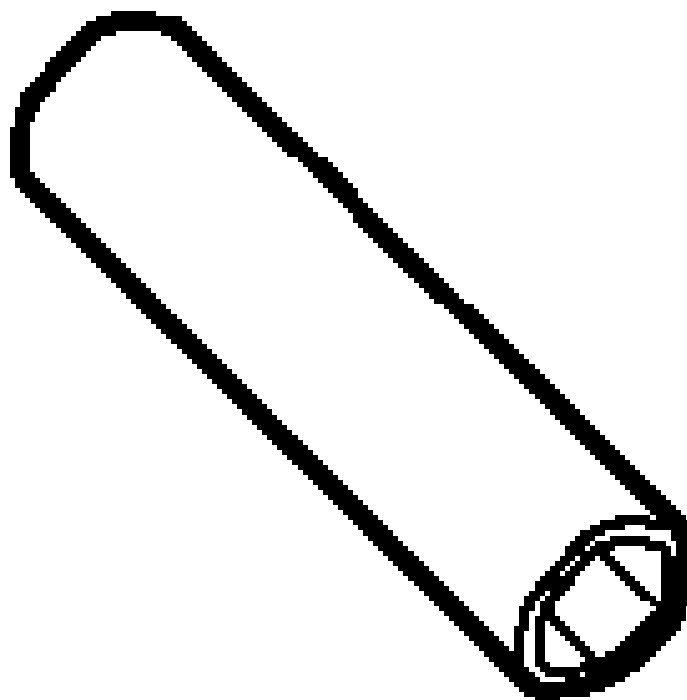
DT-46494
DW09921-5781
J-22912-A
Gear, Bearing
Remover



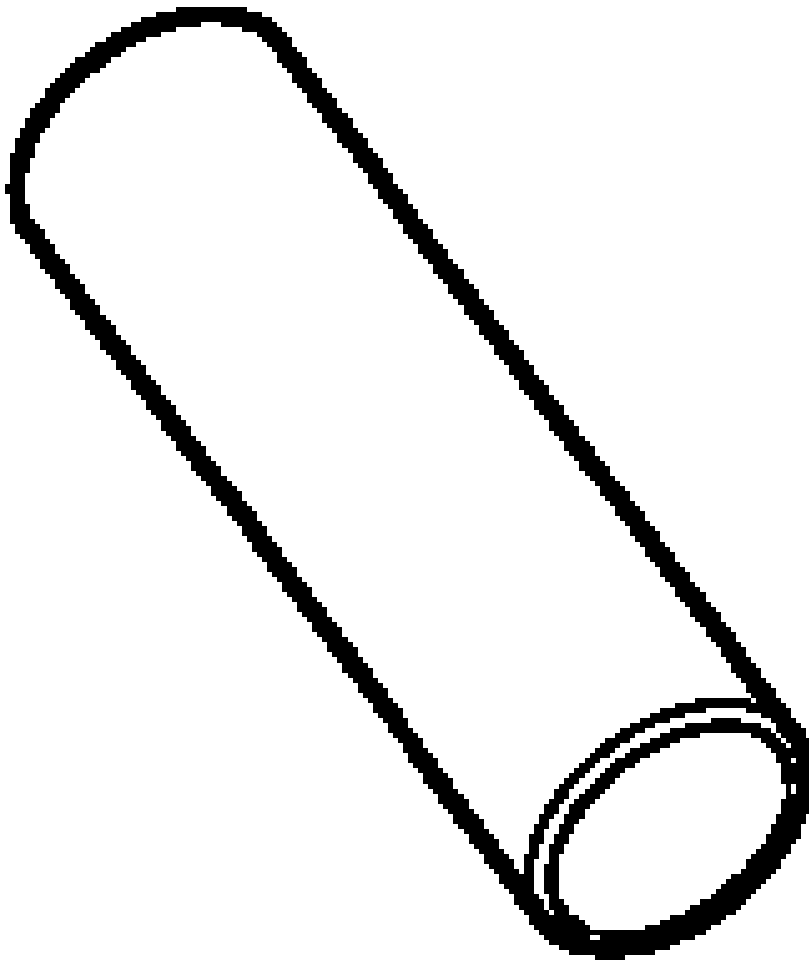
DT-46496
DW09940-5311
Gear, Bearing
Installer



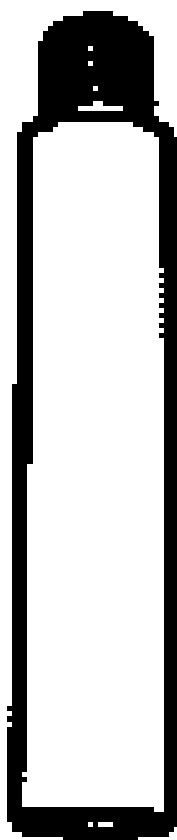
DT-49079
DT-46493
J-28406
Gear, Bearing
Installer



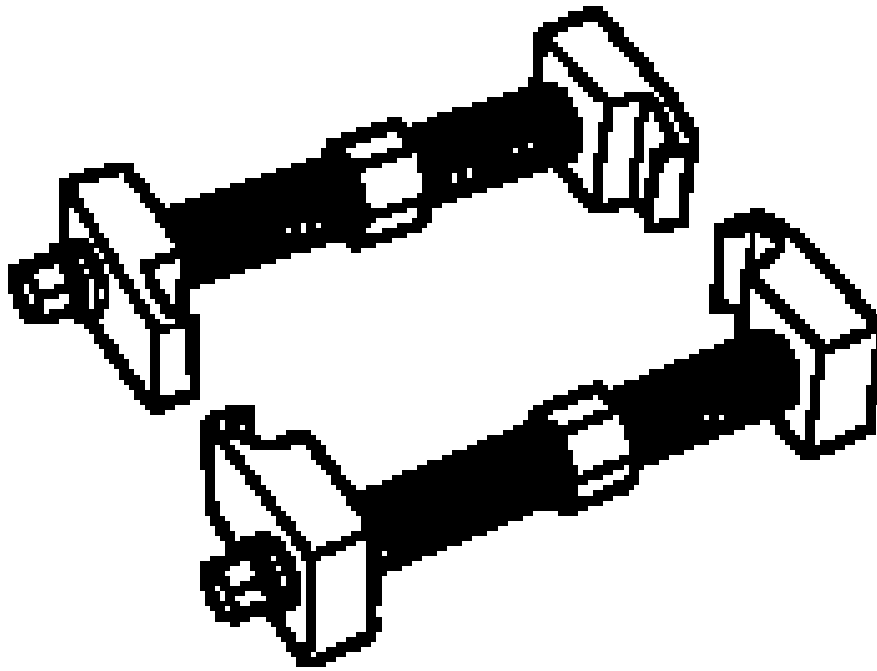
DT-49080
DT-46495
J-34844
Gear, Bearing
Installer



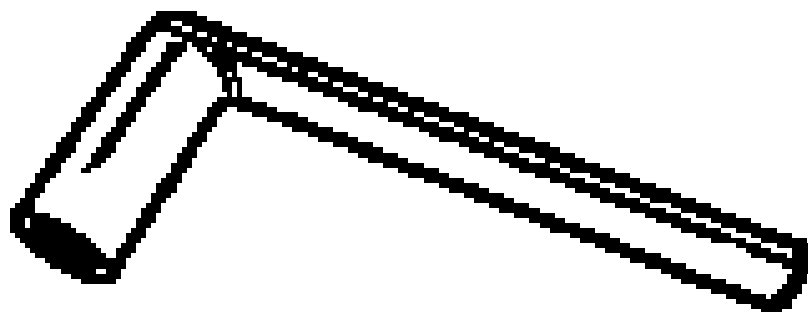
DT-49081
J-35664
Gear, Bearing
Installer



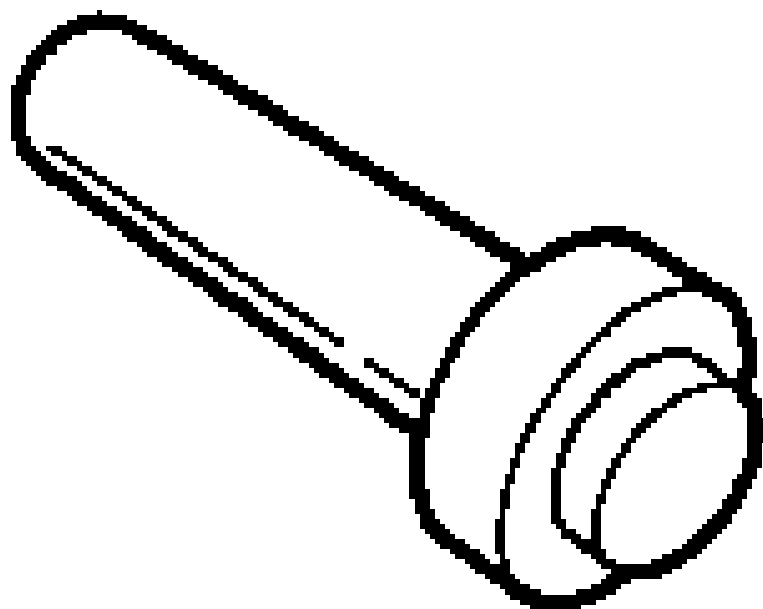
DT-49082
Needle Bearing
Remover/install



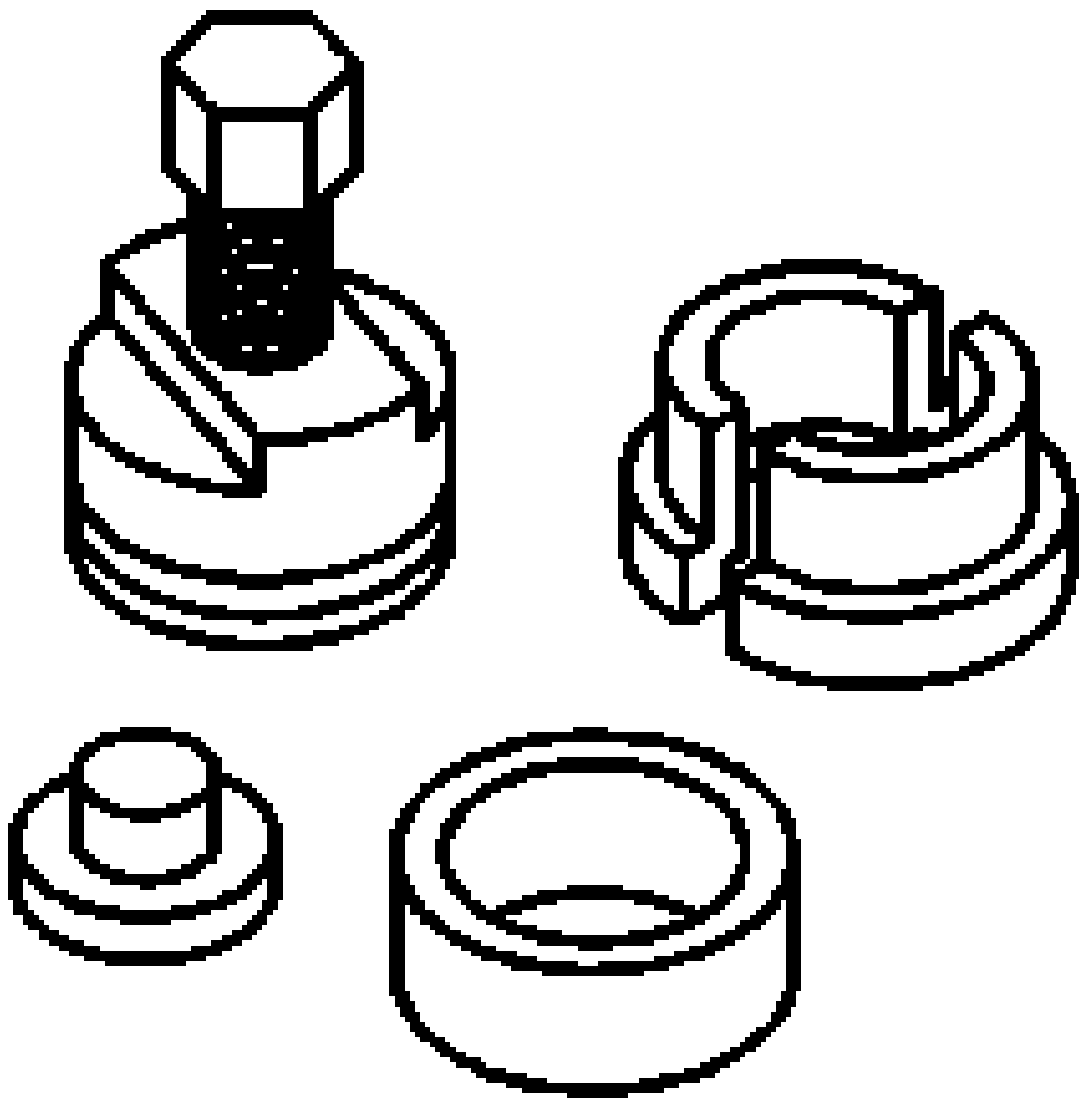
DT-49083
Needle Bearing
Installer



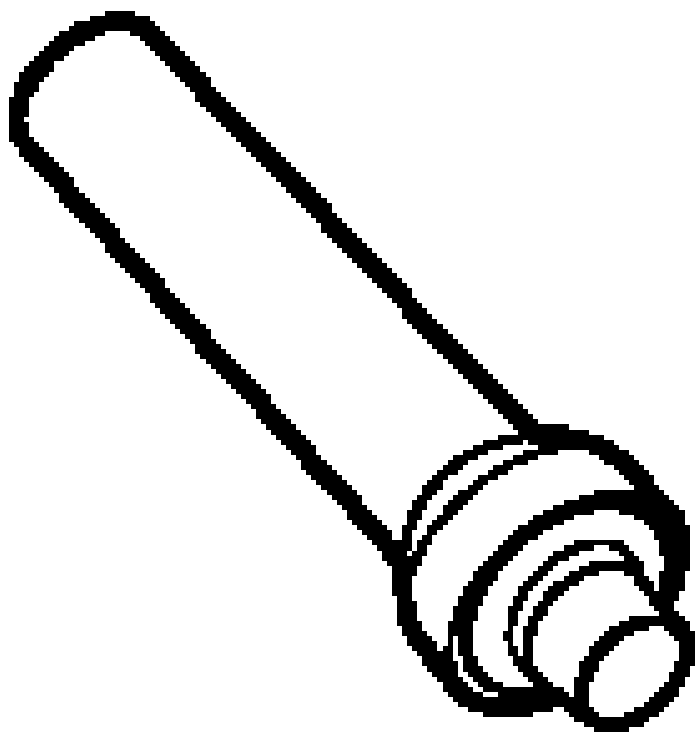
DT-49084
DT-47517
Input Shaft Hold



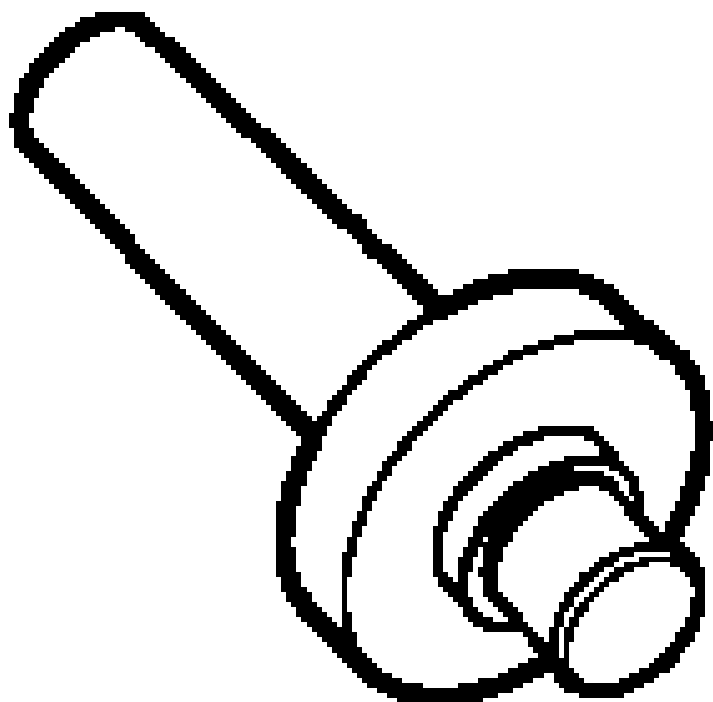
DT-49088
Oil Seal Install



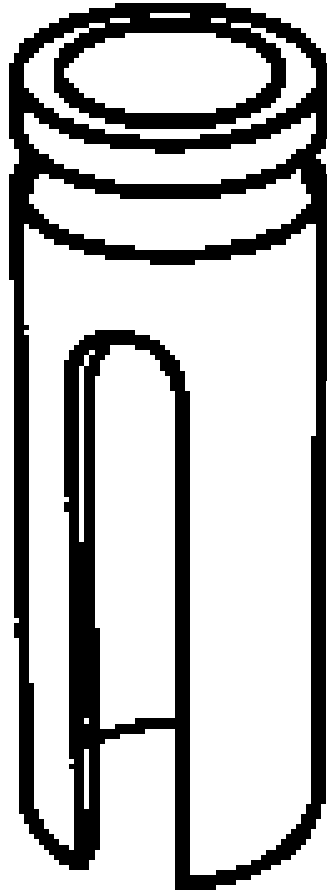
DT-46554
DW220-020A
Differential Bear
Puller and Plat
Adapter Kit



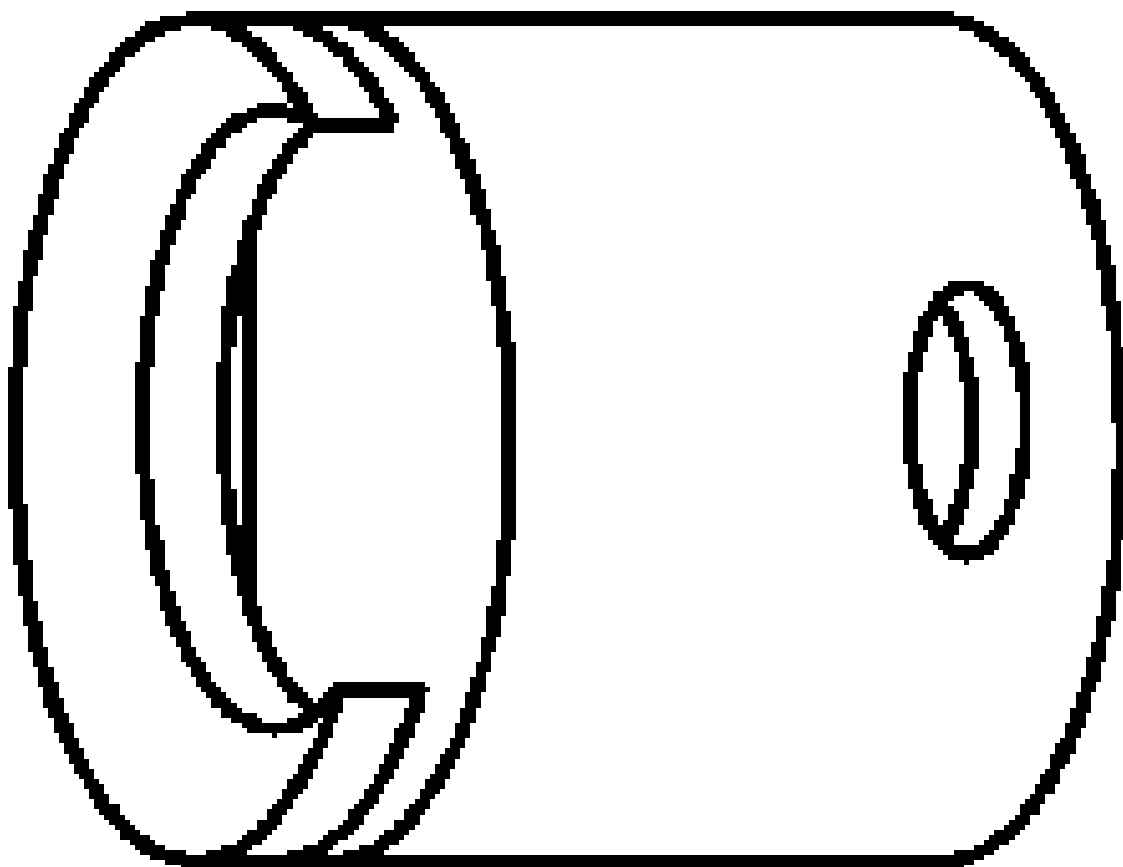
DT-50179
Input Shaft Se:
Installer



DT-50181
Oil Seal Install



DT-50182
Backup Lamp Sw
Remover/Install



DT-50511
Shift Detent Remo

ACCESSORIES & EQUIPMENT

Waterleaks - Spark

DIAGNOSTIC INFORMATION AND PROCEDURES

WATERLEAK TEST PREPARATION

- GM vehicles are designed to operate under normal environmental conditions.
- The design criteria for sealing materials and components takes into consideration the sealing forces required to withstand the natural elements. These specifications cannot take into consideration any artificial conditions, i.e., high pressure car washes.
- The water leak test procedure has been correlated to the natural elements and will determine the ability of a vehicle to perform under normal operating conditions.
- The first step in diagnosing a leak is determining the conditions under which a leak occurs. If the general leak area can be found, the exact entry point can be isolated using a water hose or an air hose. Some trim panels or components may need to be removed in order to repair the leak.
- If leaks are found around a door, door window, rear compartment lid or liftgate area this does not necessarily indicate a bad weatherstrip. An adjustment to these areas may resolve the condition.

Watertest Stand Assembly

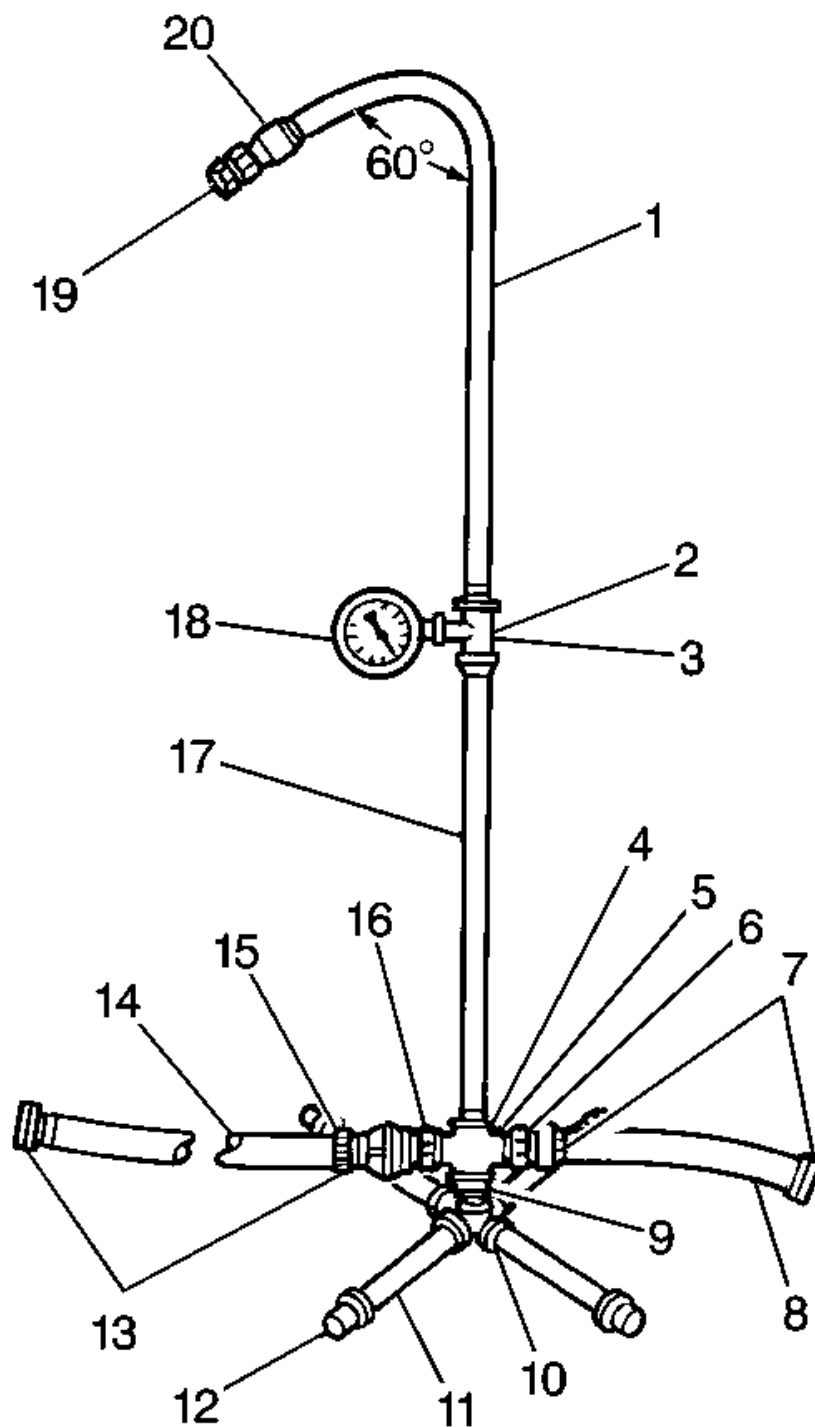


Fig. 1: View Of Watertest Stand Assembly
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Pipe (0.5 x 36 in)
2	Reducing Tee, Right Stand Only (0.5 x 0.5 x 0.25 in)
3	Coupling, Left Stand Only, (0.5 in)
4	Tee, Left Stand Only (0.5 in)
5	Cross, Right Stand Only (0.5 in)
6	Pipe to Hose Nipple, Right Stand Only (0.5 in)
7	Female Hose Coupling (5/8 in)
8	Input Hose, Right Stand Only (2.0 ft) (5/8 in diameter)
9	Close Nipple (0.5 in)
10	Cross (0.5 in) with Weld-On Cap (0.5 in)
11	Nipple (0.5 x 12 in)
12	Cap (0.5 in)
13	Female Hose Coupling (5/8 in)
14	Cross Hose (12 ft) (5/8 in diameter)
15	Hose Quick Connect
16	Pipe to Hose Nipple (0.5 in)
17	Pipe (0.5 x 60 in)
18	Water Pressure Gauge, Right Stand Only
19	Full Jet Spray Nozzle, No. 1/2GG-25 or Equivalent
20	Coupling (0.5 in)

1. Assemble the water test stand as shown.

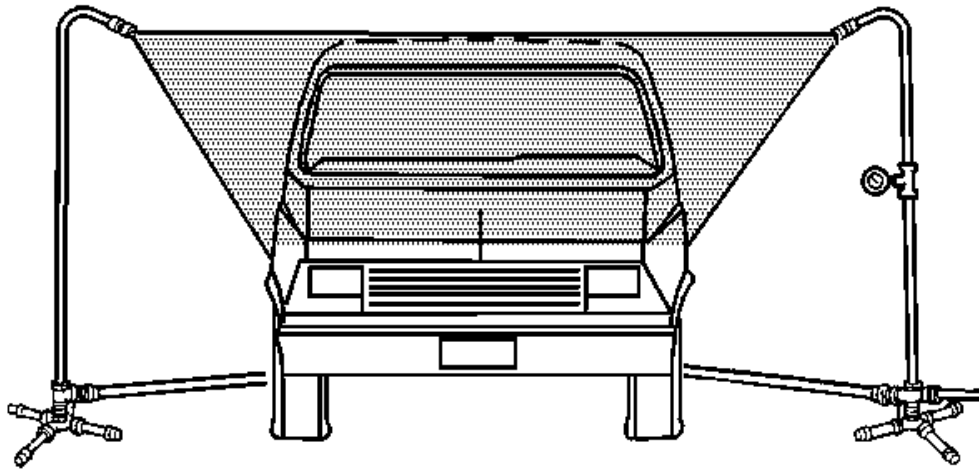


Fig. 2: Illustrating How Water Spray From Stands Should Overlap Vehicle
Courtesy of GENERAL MOTORS COMPANY

2. Position the stands as shown. The water spray from the stands should overlap the vehicle as shown.
3. Have an assistant inside of the vehicle during the test in order to locate any leaks.
4. The water pressure at the nozzle should maintain a 155 kPa (22 psi), for at least 4 minutes.

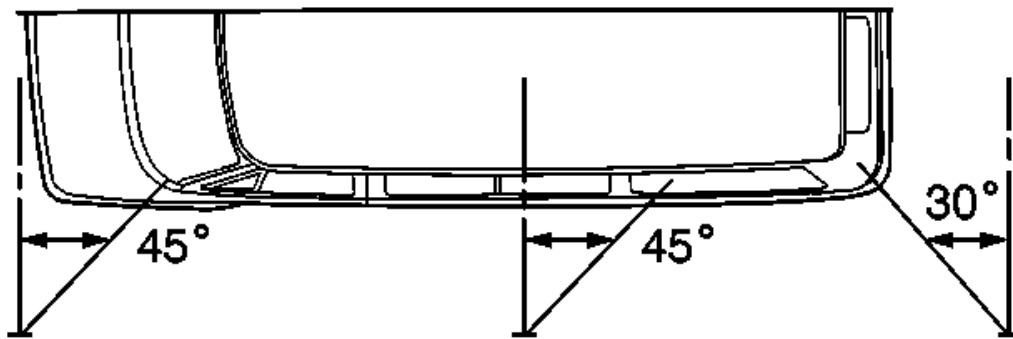


Fig. 3: Identifying Proper Water Spray Angles
Courtesy of GENERAL MOTORS COMPANY

5. In order to check the windshield, aim the water spray 30 degrees down and 45 degrees toward the rear.
Aim the water towards the corner of the windshield.
6. In order to check the side windows for leaks, position the water stand towards the center of the rear quarter, aiming the water spray 30 degrees down and 45 degrees toward the rear.
7. In order to check the back window, aim the water spray 30 degrees down and 30 degrees toward the front.

WATER HOSE TEST

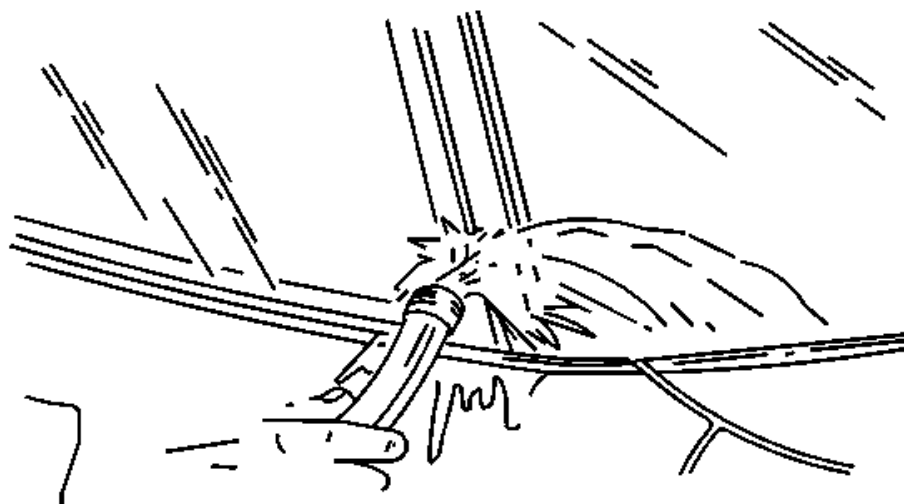


Fig. 4: Performing Water Hose Test
Courtesy of GENERAL MOTORS COMPANY

NOTE: Use a water hose without the nozzle attached.

1. Have an assistant inside of the vehicle in order to locate the leak.
2. Begin testing at the base of the window or the windshield.
3. Slowly move the hose upward and across the top of the vehicle.

AIR HOSE TEST

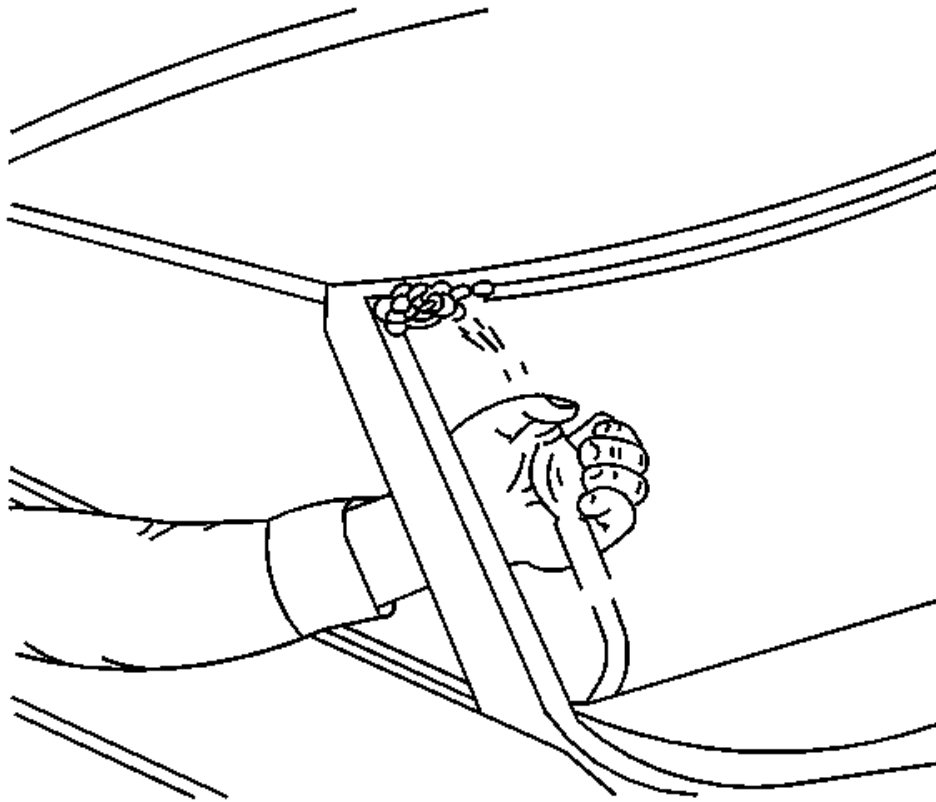


Fig. 5: Performing Air Hose Test

Courtesy of GENERAL MOTORS COMPANY

CAUTION: The air hose test should only be used on fully cured urethane adhesive. Otherwise, damage to the urethane adhesive bead could result in additional leaks.

1. Using a liquid detergent, diluted with water in a spray bottle, spray the window at the edges. Begin at the bottom and gradually move up and across the top.

NOTE: The compressed air should not exceed 205 kPa (30 psi).

2. Have an assistant inside of the vehicle with an air hose.
3. Have the assistant aim the compressed air at the suspected areas.

Bubbles will form in the soap solution at the location of the leak.

REPAIR INSTRUCTIONS

BODY WATERLEAK REPAIR

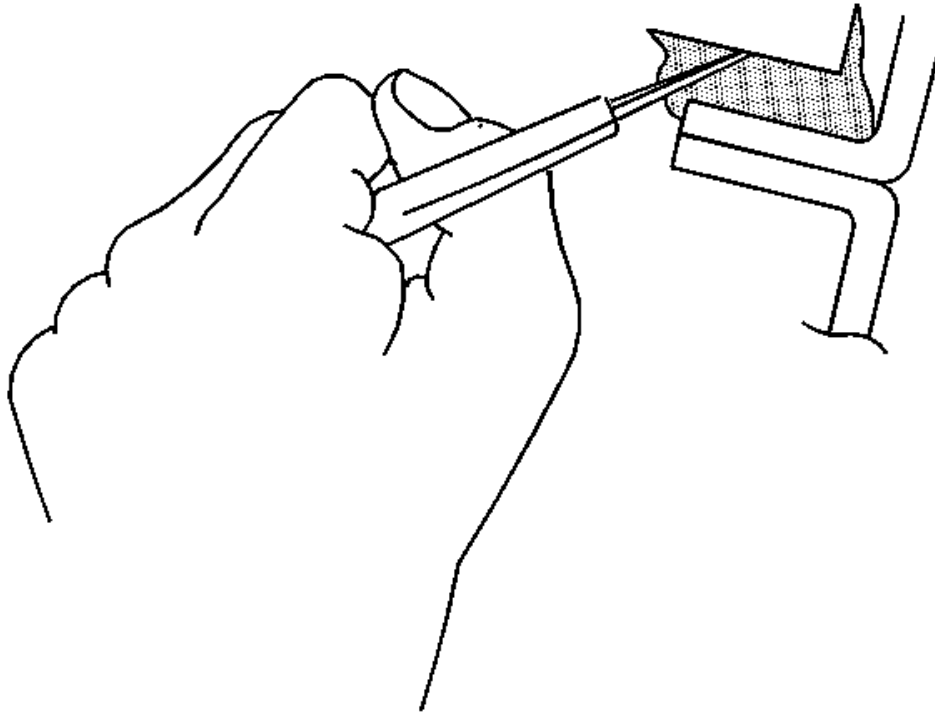


Fig. 6: Cutting Out Portion Of Adhesive Caulking (1 Of 2)
Courtesy of GENERAL MOTORS COMPANY

WARNING: If the vehicle interior is exposed to moisture and becomes soaked up to the level of the sensing and diagnostic module (SDM), the SDM and SDM harness connector must be replaced. The SDM could be activated when powered, which could cause airbag deployment and result in personal injury.

Depending on the location of the waterleak, you may have to remove certain interior components in order to repair the leak.

1. If the floor carpet is wet, refer to **Floor Carpet Drying** .

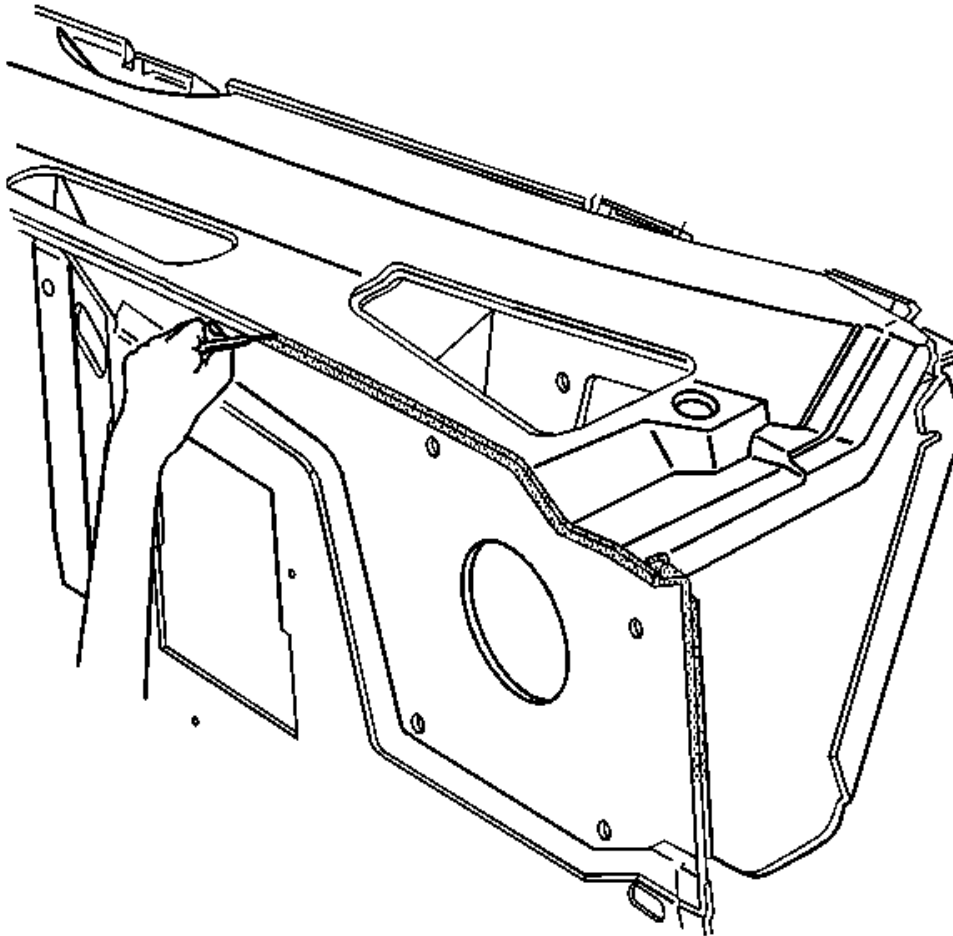


Fig. 7: Cutting Out Portion Of Adhesive Caulking (2 Of 2)
Courtesy of GENERAL MOTORS COMPANY

2. Cut out a portion of the adhesive caulk in the leak area from inside or outside of the vehicle.
3. Clean and remove all loose particles of the adhesive old caulk from the area.
4. Apply joint body and seam sealer where the old adhesive caulk was removed.
5. Allow the adhesive caulk to dry for several hours.
6. Test for leaks.
7. Install the trim, if removed.

STATIONARY WINDOW WATERLEAK REPAIR

WARNING: If any water enters the vehicle interior up to the level of the carpet or higher and soaks the carpet, the sensing and diagnostic module (SDM) and the SDM harness connector may need to be replaced. The SDM could be activated when powered, which could cause deployment of the air bag (s) and result in personal injury. Before attempting these procedures, the

SIR system must be disabled. Refer to Disabling the SIR System.

With the ignition OFF, inspect the SDM mounting area, including the carpet. If any significant soaking or evidence of significant soaking is detected, you must perform the following tasks:

- 1. Remove all water.**
- 2. Repair the water damage.**
- 3. Replace the SDM harness connector.**
- 4. Replace the SDM.**

Failure to follow these tasks could result in possible air bag deployment, personal injury or otherwise unneeded SIR system repairs.

1. If the floor carpet is wet refer to **Floor Carpet Drying** .
2. Remove the trim moldings or the headliner in order to repair the leak, if needed.
3. Determine the source of water entry.
4. If water is leaking at the edge of the windshield, reseal the windshield using Urethane Adhesive Caulking Kit GM P/N 12346392 or the equivalent.
5. If water leaks into the vehicle at the sides of the stationary windows, reseal the window using Urethane Adhesive Caulking Kit GM P/N 12346392 or the equivalent.

SUSPENSION

Wheel Alignment - Spark

SPECIFICATIONS

WHEEL ALIGNMENT SPECIFICATIONS

Wheel Alignment Specifications

RPO Restriction	Wheels	Caster		Cross Caster	Camber		Cross Camber	Total Toe	Steering Wheel Angle	Thrust Angle
		Left	Right	(Left - Right)	Left	Right	(Left - Right)	(Left + Right)		(Left - Right)/2
M300 Gasoline	Front	3.55° ± 0.75°	3.55° ± 0.75°	± 0.75°	-0.20° ± 0.75°	-0.20° ± 0.75°	± 0.75°	0.10° ± 0.20°	0.00° ± 2.50°	-
	Rear	-	-	-	-1.45° ± 0.50°	-1.45° ± 0.50°	± 0.75°	0.24° ± 0.35°	-	0.30°
M300 Diesel	Front	3.44° ± 0.75°	3.44° ± 0.75°	± 0.75°	0.05° ± 0.75°	0.05° ± 0.75°	± 0.75°	0.16° ± 0.20°	0.00° ± 2.50°	-
	Rear	-	-	-	-1.45° ± 0.50°	-1.45° ± 0.50°	± 0.75°	0.16° ± 0.35°	-	0.30°
M300 F	Front	3.65° ± 0.75°	3.65° ± 0.75°	± 0.75°	-0.42° ± 0.75°	-0.42° ± 0.75°	± 0.75°	0.04° ± 0.20°	0.00° ± 2.50°	-
	Rear	-	-	-	-1.45° ± 0.50°	-1.45° ± 0.50°	± 0.75°	0.30° ± 0.35°	-	0.30°

cf. M300 F means M300 federal version (NA market)

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Tie Rod Jam Nut	75 N.m	55 lb ft

REPAIR INSTRUCTIONS

WHEEL ALIGNMENT MEASUREMENT

Steering and vibration concerns are not always the result of incorrect alignment. One possible cause is wheel

and tire imbalance. Another possibility is tire lead due to worn or improperly manufactured tires. Lead/pull is defined as follows: At a constant highway speed on a typical straight road, lead/pull is the amount of effort required at the steering wheel to maintain the vehicle's straight path. Lead is the vehicle deviation from a straight path on a level road without pressure on the steering wheel. Refer to **Radial Tire Lead/Pull Correction** .

Before performing any adjustments affecting wheel alignment, perform the following inspections in order to ensure correct alignment readings:

- Inspect for visible damage to the suspension components and replace as necessary.
- Inspect the tires for the proper inflation and irregular tire wear. Refer to **Tire Diagnosis - Irregular or Premature Wear** .
- Inspect the runout of the wheels and the tires. Refer to **Tire and Wheel Runout Specifications** .
- Inspect the wheel bearings for backlash and excessive play. Refer to **Wheel Bearings Diagnosis** .
- Inspect the ball joints for looseness or wear.
- Inspect the tie rod ends for looseness or wear.
- Inspect the control arms and stabilizer shaft for looseness or wear.
- Inspect the steering gear for looseness at the frame. Refer to **Fastener Tightening Specifications** .
- Inspect the struts/shock absorbers for wear, leaks, and any noticeable noises. Refer to **Suspension Strut and Shock Absorber Testing - On Vehicle** .
- Inspect the vehicle trim height. Refer to **Trim Height Inspection** .
- Inspect the steering wheel for excessive drag or poor return due to stiff or rusted linkage or suspension components.
- Inspect the fuel level. The fuel tank should be full or the vehicle should have a compensating load added.

Give consideration to excess loads, such as tool boxes, sample cases, etc. If normally carried in the vehicle, these items should remain in the vehicle during alignment adjustments. Give consideration also to the condition of the equipment being used for the alignment. Follow the equipment manufacturer's instructions.

Satisfactory vehicle operation may occur over a wide range of alignment settings. However, if the setting exceeds the service allowable specifications, correct the alignment to the service preferred specifications. Refer to **Wheel Alignment Specifications**.

Perform the following steps in order to measure the front and rear alignment angles:

1. Install the alignment equipment according to the manufacturer's instructions.
2. Jounce the front and the rear bumpers 3 times prior to checking the wheel alignment.
3. Measure the alignment angles and record the readings.

NOTE: Record the "Before" and "After" alignment measurements.

4. Adjust alignment angles to vehicle specifications, if necessary. Refer to **Wheel Alignment Specifications**.

FRONT CASTER ADJUSTMENT

The front caster is not adjustable. If the front caster angle is not within specifications, inspect for suspension support misalignment or front suspension damage. Replace any damaged suspension components as necessary.

FRONT CAMBER ADJUSTMENT

The front camber is not adjustable. If the front camber angle is not within specifications, inspect for suspension support misalignment or front suspension damage. Replace any damaged suspension components as necessary.

WHEEL ALIGNMENT - STEERING WHEEL ANGLE AND/OR FRONT TOE ADJUSTMENT

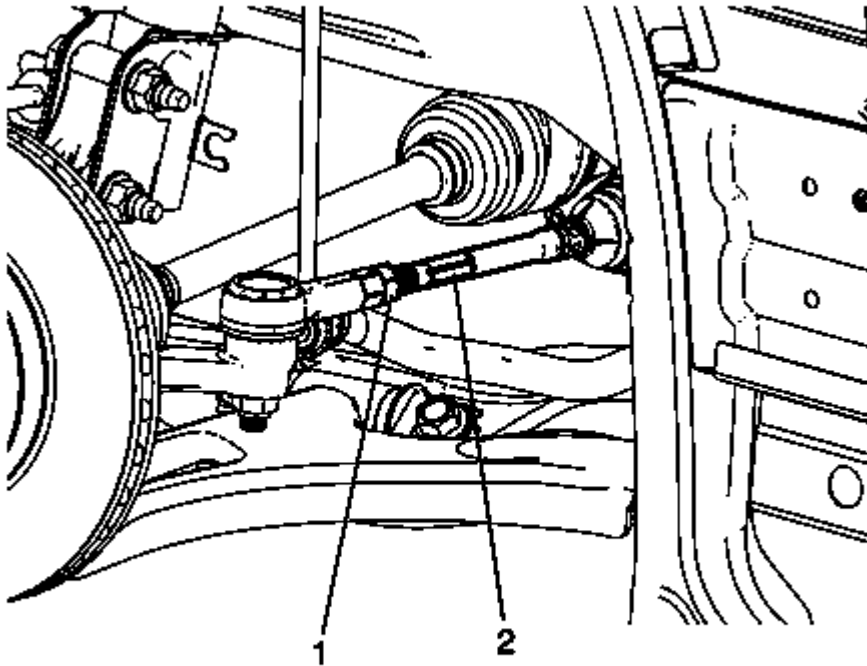


Fig. 1: Tie Rod Jam Nut

Courtesy of GENERAL MOTORS COMPANY

1. Ensure that the steering wheel is set in a straight ahead position and centered.
2. Loosen the tie rod jam nut (1).
3. Adjust the toe to specification by turning the adjuster (2). Refer to **Wheel Alignment Specifications**.

CAUTION: Refer to Fastener Caution .

4. Install the tie rod jam nut (1) and tighten to 75 N.m (55 lb ft).

DESCRIPTION AND OPERATION

CAMBER DESCRIPTION

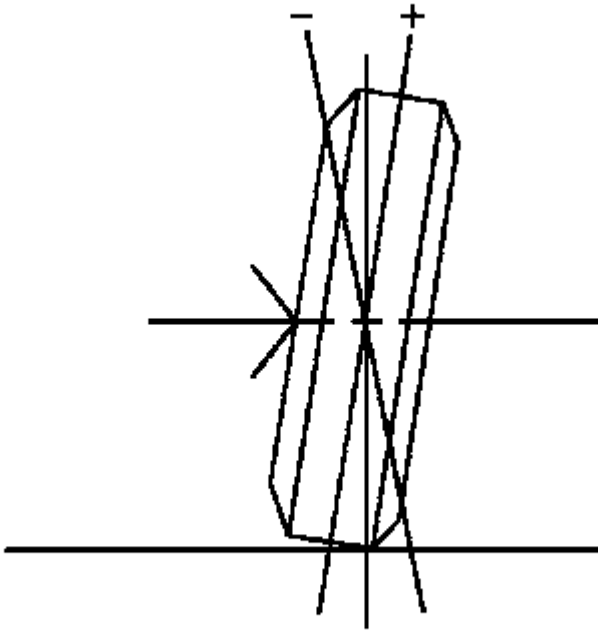


Fig. 2: Camber Description

Courtesy of GENERAL MOTORS COMPANY

Camber is the tilting of the wheels from the vertical when viewed from the front of the vehicle. When the wheels tilt outward at the top, the camber is positive (+). When the wheel tilts inward at the top, the camber is negative (-). The amount of tilt is measured in degrees from the vertical. Camber settings influence the directional control and the tire wear.

Too much positive camber will result in premature wear on the outside of the tire and cause excessive wear on the suspension parts.

Too much negative camber will result in premature wear on the inside of the tire and cause excessive wear on the suspension parts.

Unequal side-to-side camber of 1 degree or more will cause the vehicle to pull or lead to the side with the most positive camber.

CASTER DESCRIPTION

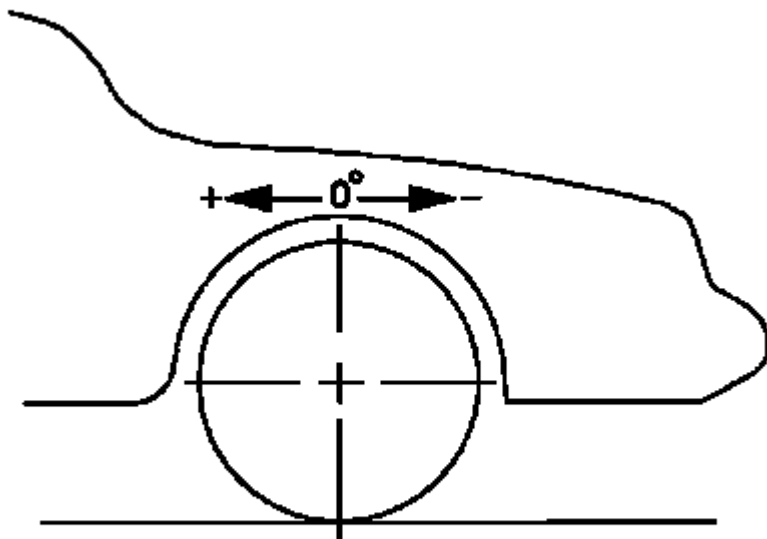


Fig. 3: Caster Description

Courtesy of GENERAL MOTORS COMPANY

Caster is the tilting of the uppermost point of the steering axis either forward or backward, when viewed from the side of the vehicle. A backward tilt is positive (+) and a forward tilt is negative (-). Caster influences directional control of the steering but does not affect the tire wear. Caster is affected by the vehicle height, therefore it is important to keep the body at its designed height.

Overloading the vehicle or a weak or sagging rear spring will affect caster. When the rear of the vehicle is lower than its designated trim height, the front suspension moves to a more positive caster. If the rear of the vehicle is higher than its designated trim height, the front suspension moves to a less positive caster.

With too little positive caster, steering may be touchy at high speed and wheel returnability may be diminished when coming out of a turn. If one wheel has more positive caster than the other, that wheel will pull toward the center of the vehicle. This condition will cause the vehicle to pull or lead to the side with the least amount of positive caster.

LEAD/PULL DESCRIPTION

NOTE: Vehicles will tend to lead/pull in the direction of the road slope as part of normal operation.

At a constant highway speed on a typical straight road, lead/pull is the amount of effort required at the steering wheel to maintain the vehicle's straight path.

Lead/pull is usually caused by the following factors:

- Road slope
- Variability in tire construction
- Wheel alignment (front cross caster and camber)
- Unbalanced steering gear

MEMORY STEER DESCRIPTION

Memory steer is when the vehicle wants to lead or pull in the direction the driver previously turned the vehicle. Additionally, after turning in the opposite direction, the vehicle will want to lead or pull in that direction.

SCRUB RADIUS DESCRIPTION

Ideally, the scrub radius is as small as possible. Normally, the SAI angle and the centerline of the tire and the wheel intersect below the road surface, causing a positive scrub radius. With struts, the SAI angle is much larger than the long arm/short arm type of suspension. This allows the SAI angle to intersect the camber angle above the road surface, forming a negative scrub radius. The smaller the scrub radius, the better the directional stability. Installing aftermarket wheels that have additional offset will dramatically increase the scrub radius. The newly installed wheels may cause the centerline of the tires to move further away from the spindle. This will increase the scrub radius.

A large amount of scrub radius can cause severe shimmy after hitting a bump. Four-wheel drive vehicles with large tires use a steering damper to compensate for an increased scrub radius. Scrub radius is not directly measurable by the conventional methods. Scrub radius is projected geometrically by engineers during the design phase of the suspension.

THRUST ANGLES DESCRIPTION

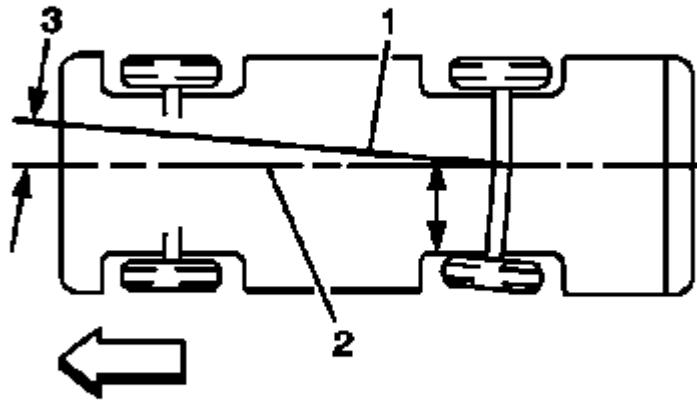


Fig. 4: Thrust Angles Description

Courtesy of GENERAL MOTORS COMPANY

The front wheels aim or steer the vehicle. The rear wheels control tracking. This tracking action relates to the thrust angle (3). The thrust angle is the path that the rear wheels take. Ideally, the thrust angle is geometrically aligned with the body centerline (2).

In the illustration, toe-in is shown on the left rear wheel, moving the thrust line (1) off center. The resulting deviation from the centerline is the thrust angle.

If the thrust angle is not set properly the vehicle may "dog track", the steering wheel may not be centered or it could be perceived as a bent axle. Thrust angle can be checked during a wheel alignment.

Positive thrust angle means the thrust line is pointing to the right hand side (RHS) of the vehicle.

Negative thrust angle means the thrust line is pointing to the left hand side (LHS) of the vehicle.

If the thrust angle is out of specification, moving the axle to body relationship will change the thrust angle reading.

If the vehicle is out in the Positive (+) direction-moving the RHS forward and/or LHS rearward will move the thrust angle towards zero degrees.

If the vehicle is out in the Negative (-) direction-moving the RHS rearward and/or LHS forward will move the thrust angle towards zero degrees.

TOE DESCRIPTION

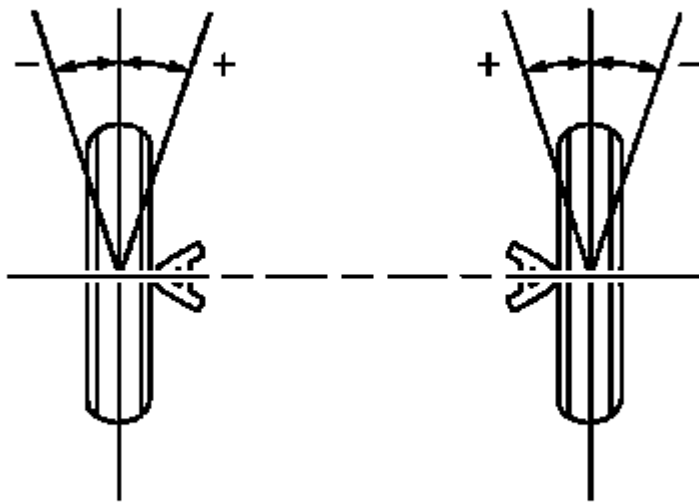


Fig. 5: Toe Description

Courtesy of GENERAL MOTORS COMPANY

Toe is a measurement of how much the front and/or rear wheels are turned in or out from a straight-ahead position. When the wheels are turned in, toe is positive (+). When the wheels are turned out, toe is negative (-). The actual amount of toe is normally only a fraction of a degree. The purpose of toe is to ensure that the wheels roll parallel.

Toe also offsets the small deflections of the wheel support system that occur when the vehicle is rolling forward. In other words, with the vehicle standing still and the wheels set with toe-in, the wheels tend to roll parallel on the road when the vehicle is moving. Improper toe adjustment will cause premature tire wear and cause steering instability.

TORQUE STEER DESCRIPTION

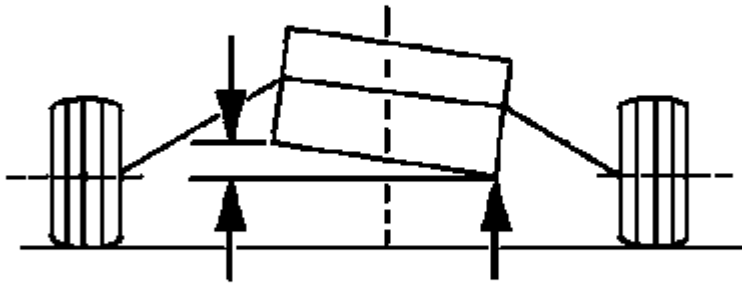


Fig. 6: Torque Steer Description
Courtesy of GENERAL MOTORS COMPANY

A vehicle pulls or leads in one direction during hard acceleration. A vehicle pulls or leads in the other direction during deceleration.

The following factors may cause torque steer to be more apparent on a particular vehicle:

- A slightly smaller diameter tire on the right front increases a right torque lead. Inspect the front tires for differences in the brand, the construction, or the size. If the tires appear to be similar, change the front tires from side-to-side and retest the vehicle. Tire and wheel assemblies have the most significant effect on torque steer correction.
- A large difference in the right and left front tire pressure
- Left-to-right differences in the front view axle angle may cause significant steering pull in a vehicle. The pull will be to the side with the most downward sloping axle from the differential to the wheels. Axles typically slope downward from the differential. The slope of the transaxle pan to level ground may be used as an indication of bias axle angles. The side with the higher transaxle pan (shown on the left side of the illustration) has the most downward sloping axle angle.

WANDER DESCRIPTION

Wander is the undesired drifting or deviation of a vehicle to either side from a straight path with hand pressure on the steering wheel. Wander is a symptom of the vehicle's sensitivity to external disturbances, such as road

crown and crosswind, and accentuated by poor on-center steering feel.

DRIVELINE/AXLE

Wheel Drive Shafts - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Wheel Drive Shaft Nut	240 N.m	177 lb ft

ADHESIVES, FLUIDS, LUBRICANTS AND SEALERS

Adhesives, Fluids, Lubricants and Sealers

Lubricant- Inner Joint and Boot	Lubricant- Outer Joint and Boot
CK-2 (YE)/90 grams	RBA (BK)/60 grams

DIAGNOSTIC INFORMATION AND PROCEDURES

SYMPTOMS - WHEEL DRIVE SHAFTS

NOTE: Complete the following steps prior to beginning the wheel drive shaft diagnosis.

1. Perform the **Vibration Analysis - Road Testing** in order to effectively diagnose the concern.
2. Review the system operation in order to become familiar with the system function. Refer to **Wheel Drive Shafts Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket equipment and modifications which could affect the operation of the wheel drive shafts or other rotating components.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Thoroughly inspect the entire wheel drive shaft for visible damage, leaking joint seals and missing seal clamps.
- Inspect the wheel drive shaft seals for cuts, tears or other damage which may allow the loss of lubricant and the entry of contaminants.

Symptom List

After performing the Visual/Physical Inspection and no visual signs of damage or other interference impairing the wheel drive shaft function is apparent, it may be necessary to remove the wheel drive shaft from the vehicle

and manipulate the joints manually. Any binding or otherwise impeded movement of the joints may indicate damage which could contribute to the concern. Refer to the following:

- **Click Noise In Turns**
- **Clunk When Accelerating from Coast**
- **Clunk Noise When Accelerating During Turns**

CLICK NOISE IN TURNS

A click noise occurring during turns may be caused by a worn or damaged wheel drive shaft outer joint. This may be more apparent while simultaneously turning and accelerating. This click is caused by wear and/or damage to the constant velocity joint bearings and/or races. Commonly, this damage or wear is caused by the loss of lubricating grease from the constant velocity joint and the entry of foreign material or contaminants.

Carefully inspect the wheel drive shaft seals for cuts, tears or other damage which may allow the lubricating grease to escape. The loss of this grease will cause damage to the wheel drive shaft constant velocity joint in a very short period of time.

If inspection reveals no visual evidence of wear or damage, it may be necessary to remove the wheel drive shaft from the vehicle and manipulate the outer joint manually. Any binding or impeded movement of the joint may indicate damage which could contribute to the concern.

CLUNK WHEN ACCELERATING FROM COAST

A clunk noise occurring when accelerating from coast or a standing start may be caused by a worn or damaged wheel drive shaft inner joint. The common cause of wheel drive shaft inner joint damage is the loss of lubricating grease and/or the presence of foreign material and contaminants in the joint. This usually occurs as a result of a torn or damaged inner joint seal.

Carefully inspect the wheel drive shaft seal for cuts, tears or other damage that may allow the loss of the lubricating grease and/or the entry of contaminants.

If inspection reveals no visual evidence of wear or damage, it may be necessary to remove the wheel drive shaft from the vehicle and manipulate the inner joint manually. Do not allow the joint to separate from the wheel drive shaft bar. Any binding or impeded movement of the joint may indicate damage which could contribute to the concern.

CLUNK NOISE WHEN ACCELERATING DURING TURNS

A clunk noise that occurs while accelerating during turns may be caused by wear and/or damage to the inboard and the outboard joints in combination. The loss of lubricant and/or the presence of contaminants can cause damage to the internal components of the joints.

Carefully inspect the joint seals for cuts, tears or other damage. Joint seals that are damaged may allow lubricant leakage and the entry of contaminants.

If inspection reveals no visual evidence of wear or damage, it may be necessary to remove the wheel drive shaft

from the vehicle and manipulate the joints manually. Do not allow the joints to separate from the wheel drive shaft bar. Any binding or impeded movement of the joints may indicate damage which could contribute to the concern.

REPAIR INSTRUCTIONS

FRONT WHEEL DRIVE SHAFT REPLACEMENT

Special Tools

- **DT-6332** Seal Protector
- **DT-50183** Wheel Drive Shaft Remover
- **DT-50186** Wheel Hub Holding Tool
- **DT-50188** Hub Spindle Remover

Removal Procedure

CAUTION: Refer to **Vehicle Lifting and Jacking Caution** .

1. Raise and support the vehicle. Refer to **Vehicle Lifting and Jacking Caution** .
2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
3. Drain the transmission fluid. Refer to **Transmission Fluid Drain and Fill** , for Y4A/Y4M Transmission, **Transmission Fluid Drain and Fill** , for AisinTM80-40 Transmission or **Transmission Fluid Drain and Fill (Maintenance)** , **Transmission Fluid Drain and Fill (Repair)** for Jatco CVT Transmission (Repair).

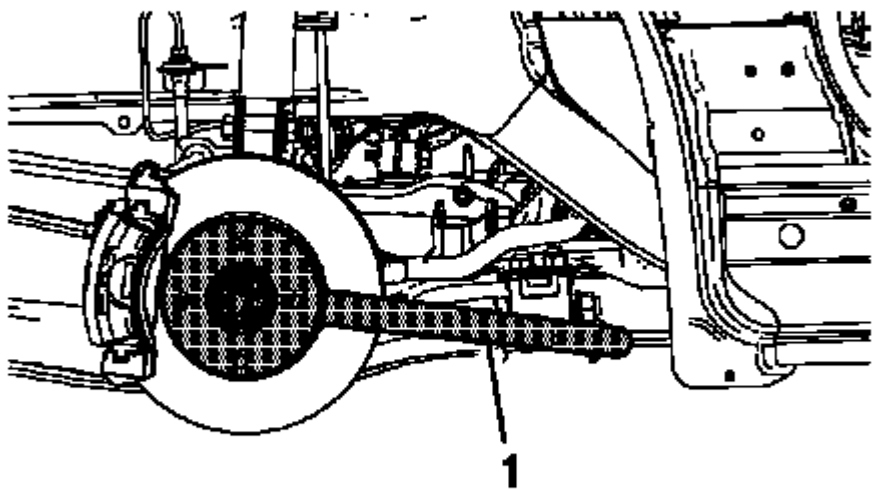


Fig. 1: Special Wheel Nut Tool

Courtesy of GENERAL MOTORS COMPANY

4. Install the **DT-50186** tool (1) to the wheel hub with the wheel nuts.

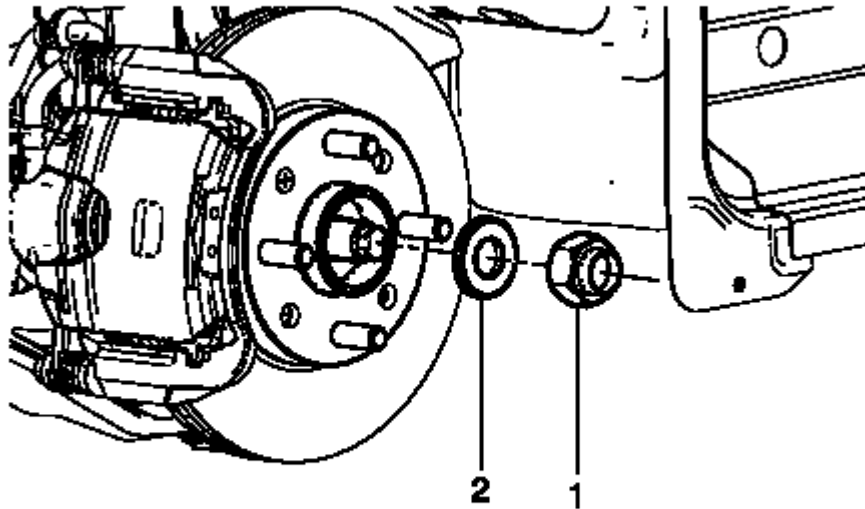


Fig. 2: Wheel Drive Shaft Retaining Nut And Washer
Courtesy of GENERAL MOTORS COMPANY

NOTE: Use a suitable tool to release the crimping on the wheel drive shaft retaining nut.

NOTE: The wheel drive shaft retaining nut (1) must be discarded after removal.

5. Remove the wheel drive shaft nut (1) and washer (2) from the wheel drive shaft and discard.
6. Remove the **DT-50186** tool from the wheel hub.
7. Disconnect the outer tie rod assembly from the steering knuckle. Refer to **Steering Linkage Outer Tie Rod Replacement** .
8. Separate the control arm ball joint from the steering knuckle. Refer to **Lower Control Arm Replacement** .

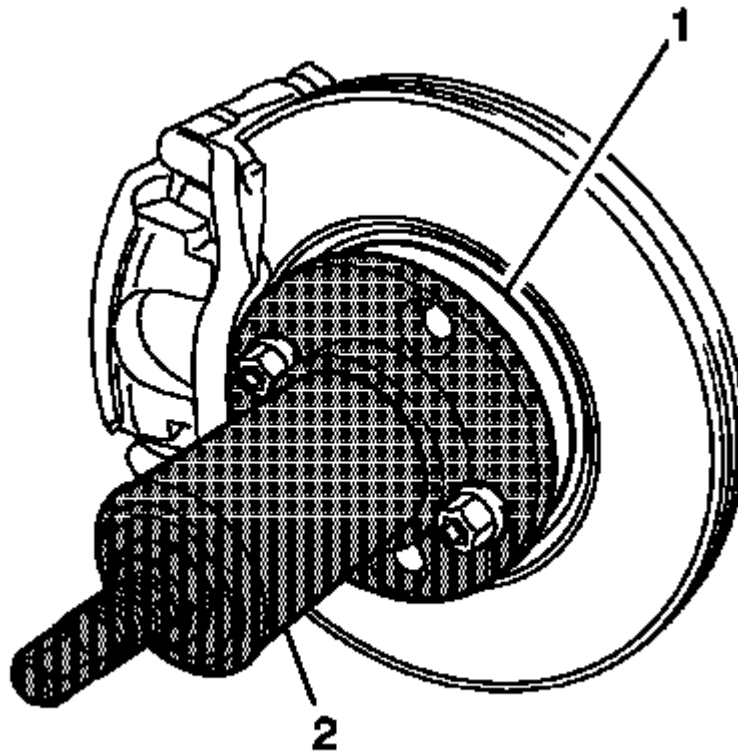


Fig. 3: Special Tool DT-50188

Courtesy of GENERAL MOTORS COMPANY

9. Using the **DT-50188** remover (2), separate the wheel drive shaft from the steering knuckle (1).

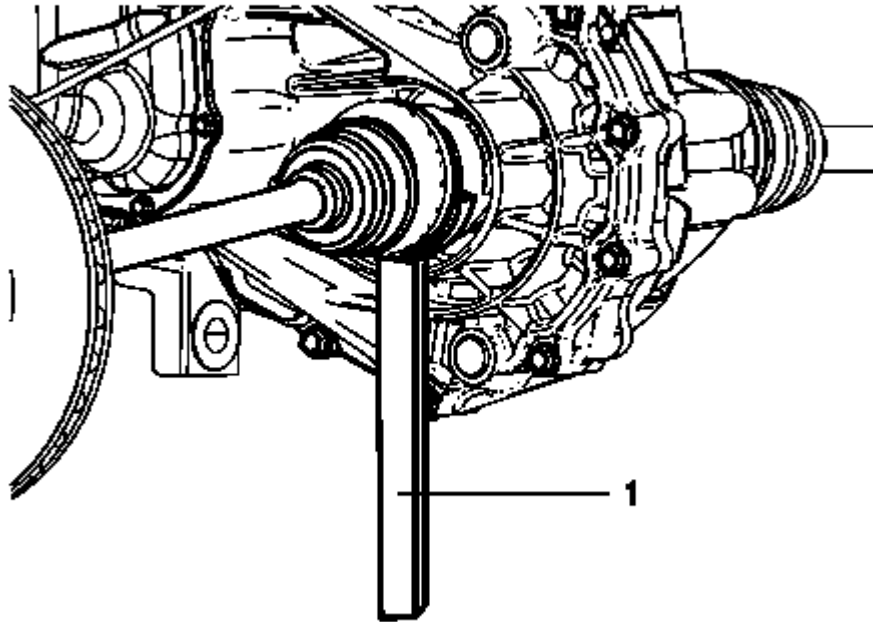


Fig. 4: Special Tool DT-50188

Courtesy of GENERAL MOTORS COMPANY

10. For the manual transmission, install the **DT-50183** remover (1) on the groove of inner joint and remove the wheel drive shaft from the transaxle.

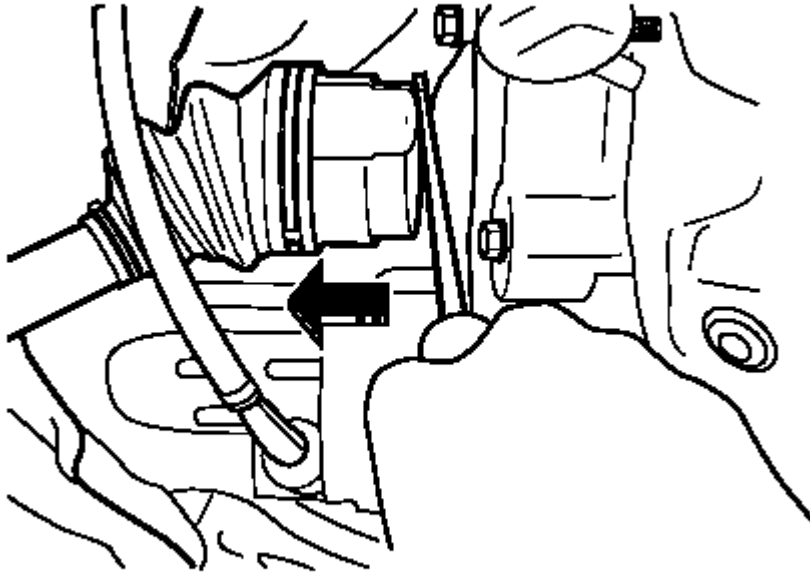


Fig. 5: Removing Wheel Drive Shaft From Transaxle
Courtesy of GENERAL MOTORS COMPANY

11. For the automatic transmission, insert a big flat-head screwdriver between the inner joint and the transaxle and remove the wheel drive shaft from the transaxle.

Installation Procedure

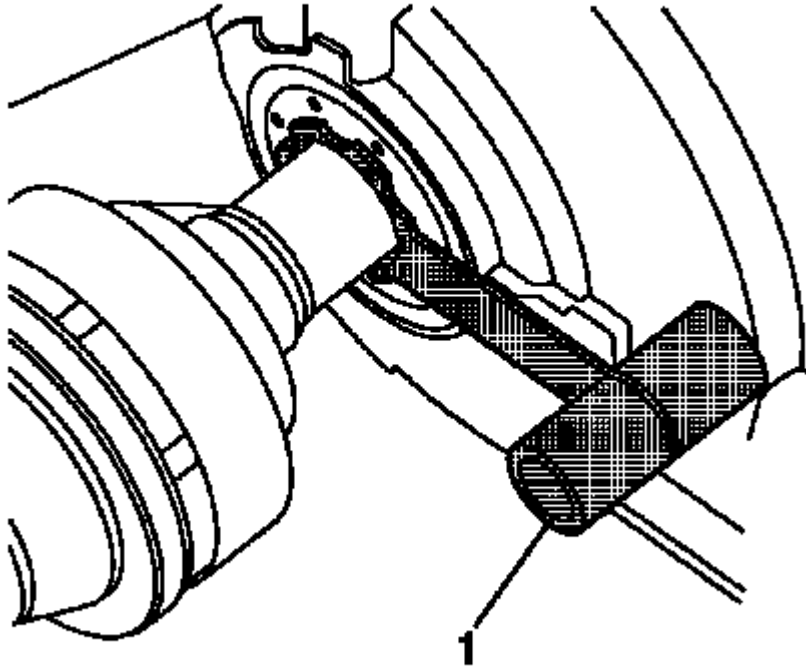


Fig. 6: Protector Tool

Courtesy of GENERAL MOTORS COMPANY

1. Position the **DT-6332** protector in the transaxle.
2. Install the wheel drive shaft until the wheel drive shaft splines are past the axle seal.
3. Remove the **DT-6332** protector from the wheel drive shaft.
4. Install the wheel drive shaft until it is fully seated in the transaxle.

NOTE: In the following step, **DO NOT** pull on the wheel drive shaft. Pull only on the inner joint.

5. With the wheel drive shaft installed, grasp the inner tripod housing and pull the tripod outward to ensure that the wheel drive shaft is properly engaged. The wheel drive shaft will remain in place if properly installed.
6. Install the wheel drive shaft to the front wheel hub/bearing.
7. Install the control arm ball joint to the steering knuckle. Refer to **Lower Control Arm Replacement** .
8. Install the outer tie rod assembly to the steering knuckle. Refer to **Steering Linkage Outer Tie Rod Replacement** .

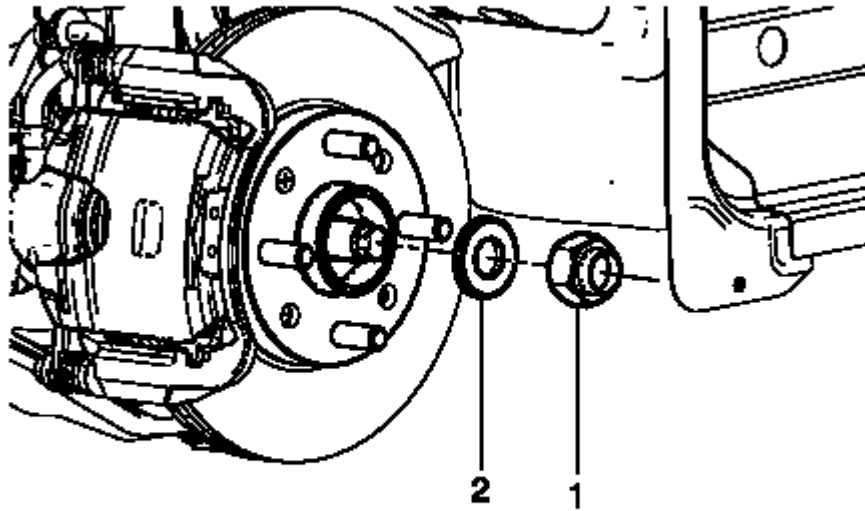


Fig. 7: Wheel Drive Shaft Retaining Nut And Washer
Courtesy of GENERAL MOTORS COMPANY

9. Hand tighten the NEW wheel drive shaft nut (2) on the wheel drive shaft (1).

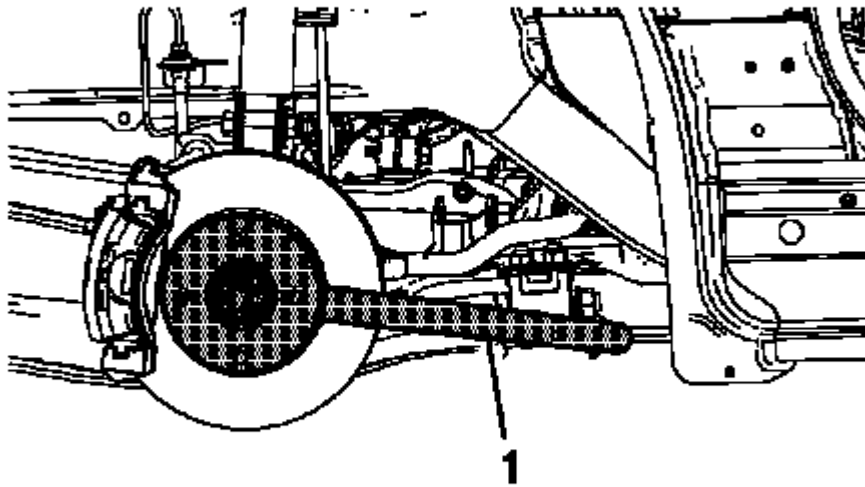


Fig. 8: Special Wheel Nut Tool

Courtesy of GENERAL MOTORS COMPANY

10. Install the **DT-50186** tool (1) to the wheel hub with two wheel nuts.
11. Support the **DT-50186** tool (1) outer end on a safety stand.

CAUTION: Refer to Fastener Caution .

12. Using a torque wrench and the appropriate size socket, install the wheel drive shaft nut and tighten to 240 (177 lb ft).
13. Remove the **DT-50186** tool (1) from the wheel hub.

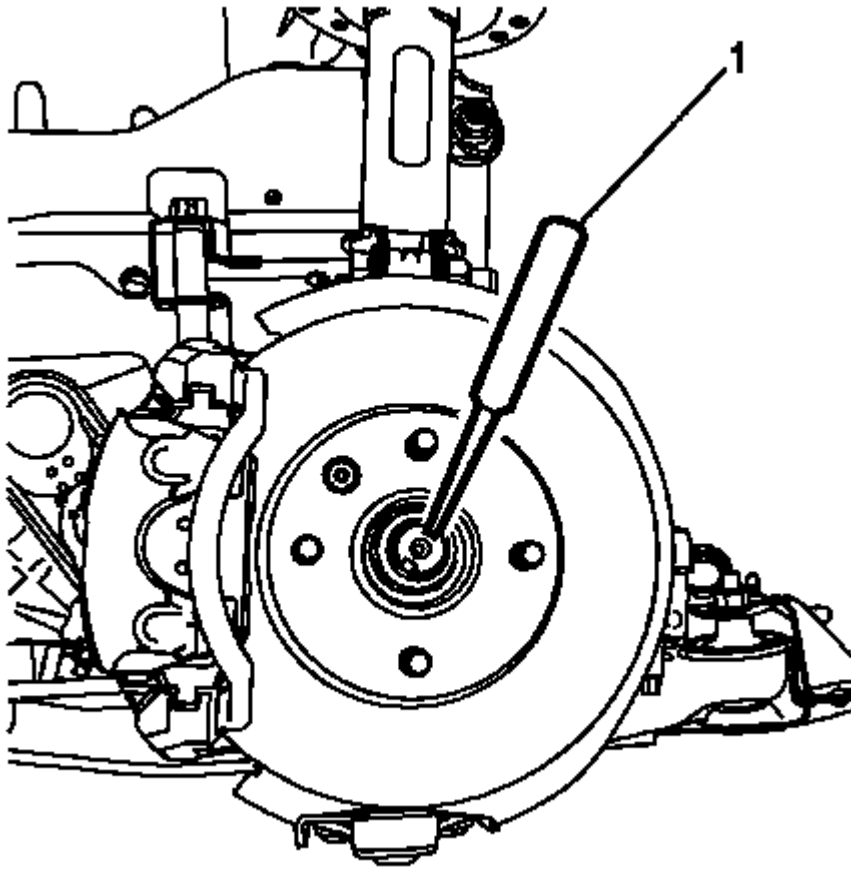


Fig. 9: Staking Wheel Drive Shaft Nut With Punch
Courtesy of GENERAL MOTORS COMPANY

14. Using a punch (1), stake the wheel drive shaft nut.
15. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
16. Lower the vehicle.
17. Fill the transaxle fluid and inspect the fluid level of the transaxle. Refer to **Transmission Fluid Drain and Fill** , for Y4A/Y4M Transmission, **Transmission Fluid Drain and Fill** , for Aisin 80-40 Transmission or **Transmission Fluid Drain and Fill (Maintenance)** , **Transmission Fluid Drain and Fill (Repair)** for Jatco CVT Transmission (Repair).

FRONT WHEEL DRIVE SHAFT INNER JOINT REPLACEMENT

Disassemble Procedure

1. Remove the wheel drive shaft from the vehicle. Refer to **Front Wheel Drive Shaft Replacement**.

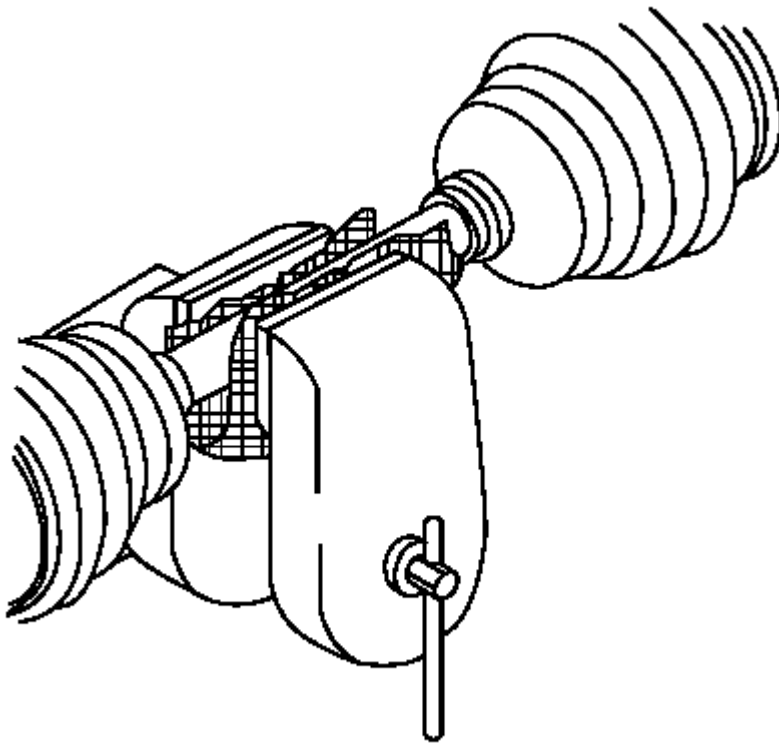


Fig. 10: Wheel Drive Shaft Bar

Courtesy of GENERAL MOTORS COMPANY

2. Position wheel drive shaft bar in a soft-jawed vise and clamp securely.

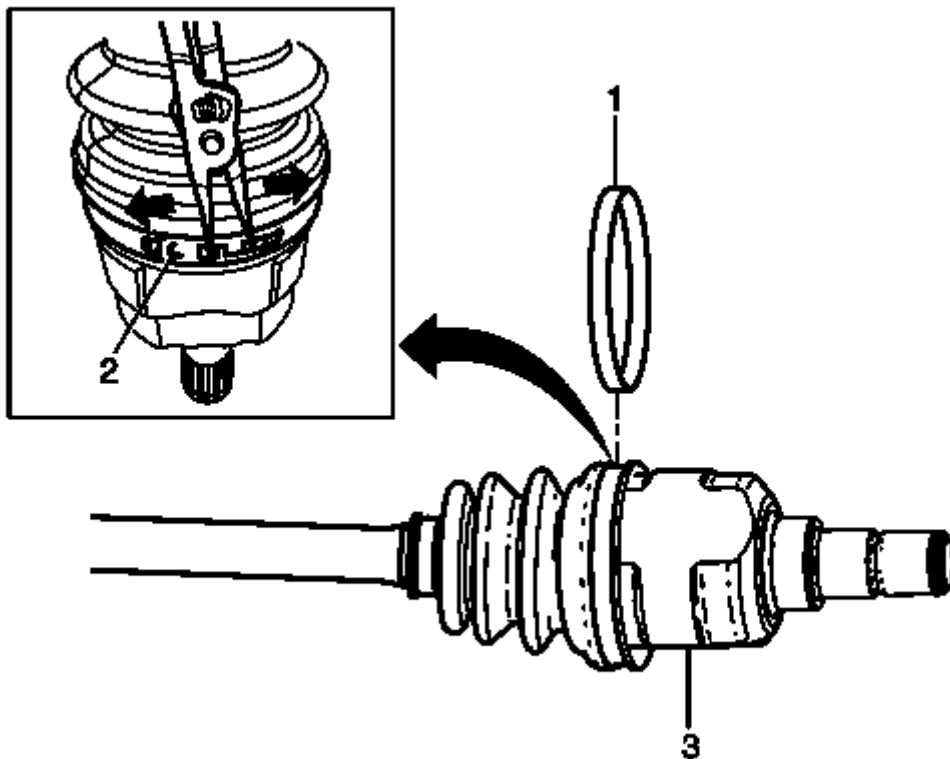


Fig. 11: Removing Boot Retaining Clamp Using A Needle-Nose Plier
Courtesy of GENERAL MOTORS COMPANY

3. Using a needle-nose plier, remove the boot retaining clamp (1) with the ear (2) released for the tripod housing (3).

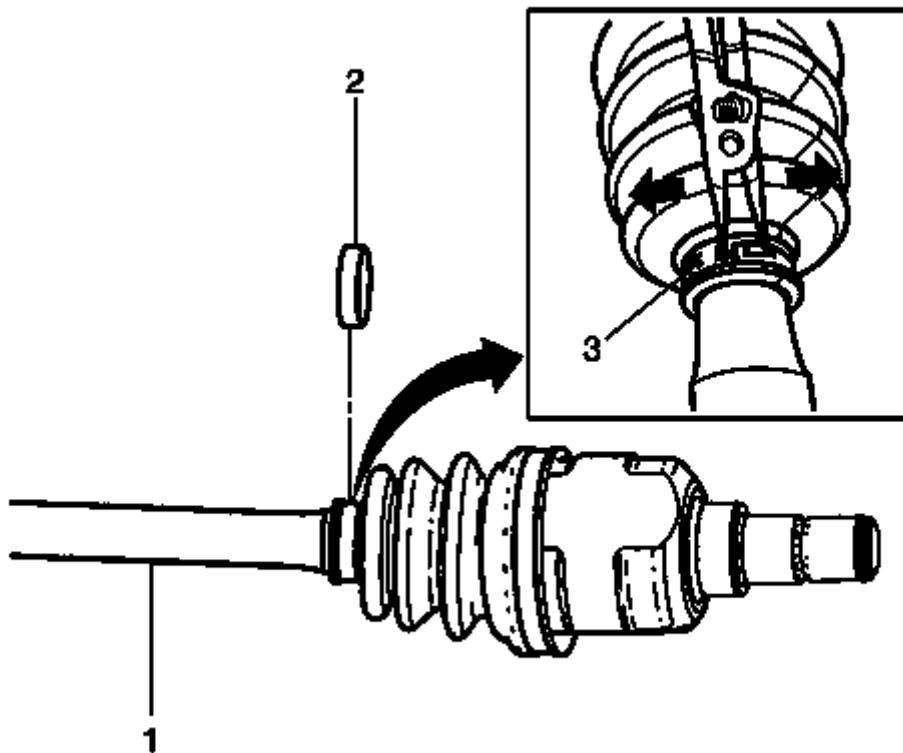


Fig. 12: Removing Boot Retaining Clamp Using A Needle-Nose Plier
Courtesy of GENERAL MOTORS COMPANY

4. Using a needle-nose plier, remove the boot retaining clamp (2) with the ear (3) released for the wheel drive shaft (1).

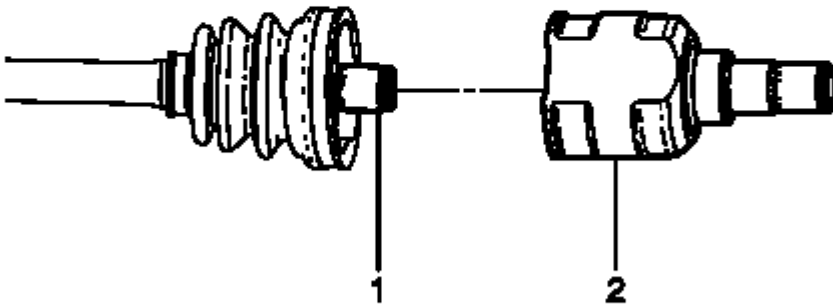


Fig. 13: Tripod Housing And Wheel Drive Shaft
Courtesy of GENERAL MOTORS COMPANY

5. Remove the tripod housing (2) from the wheel drive shaft (1).

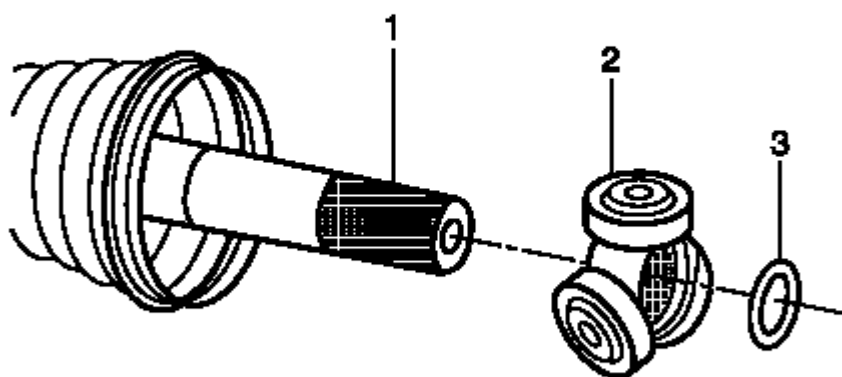


Fig. 14: Retaining Ring And Tripod Spider
Courtesy of GENERAL MOTORS COMPANY

6. Remove the retaining ring (3) and the tripod spider (2) from the wheel drive shaft (1).

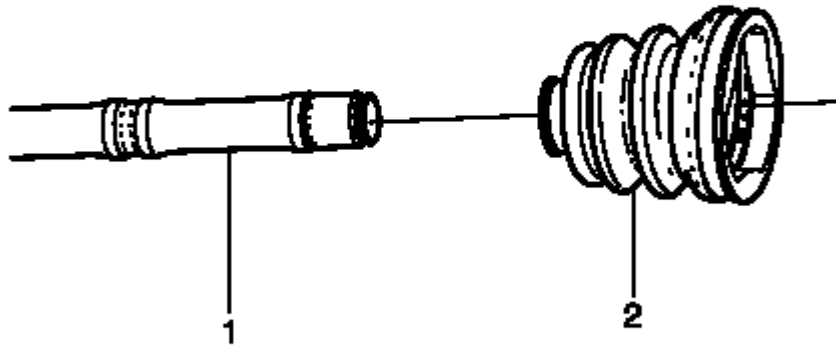


Fig. 15: Boot And Wheel Drive Shaft
Courtesy of GENERAL MOTORS COMPANY

7. Remove the boot (2) from the wheel drive shaft (1).
8. Inspect the wheel drive shaft inner joint for damage and excessive wear. Refer to **Wheel Drive Shaft Inner Joint Inspection**.

Assemble Procedure

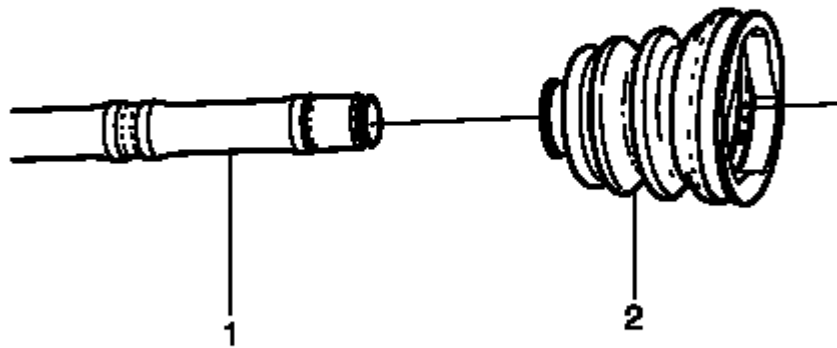


Fig. 16: Boot And Wheel Drive Shaft
Courtesy of GENERAL MOTORS COMPANY

NOTE: Ensure the seal clamp is positioned correctly in the seal groove.

1. Position the boot (2) on the wheel drive shaft (1).

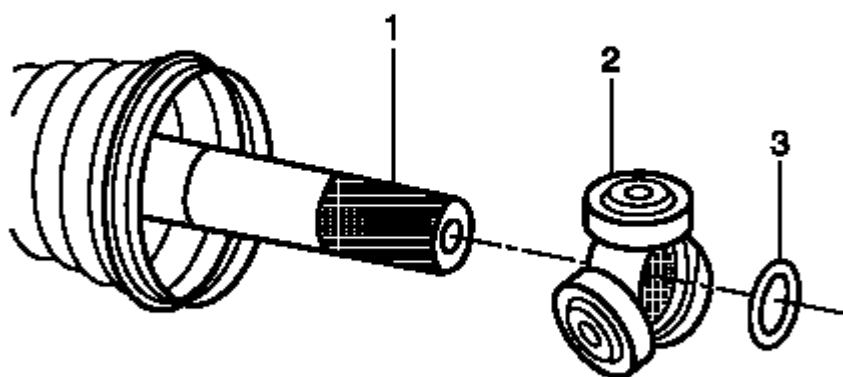


Fig. 17: Retaining Ring And Tripod Spider
Courtesy of GENERAL MOTORS COMPANY

2. Install the tripod spider assembly (2) to the wheel drive shaft (1), until seated against shoulder.
3. Install the retaining ring (3) in the wheel drive shaft (1).

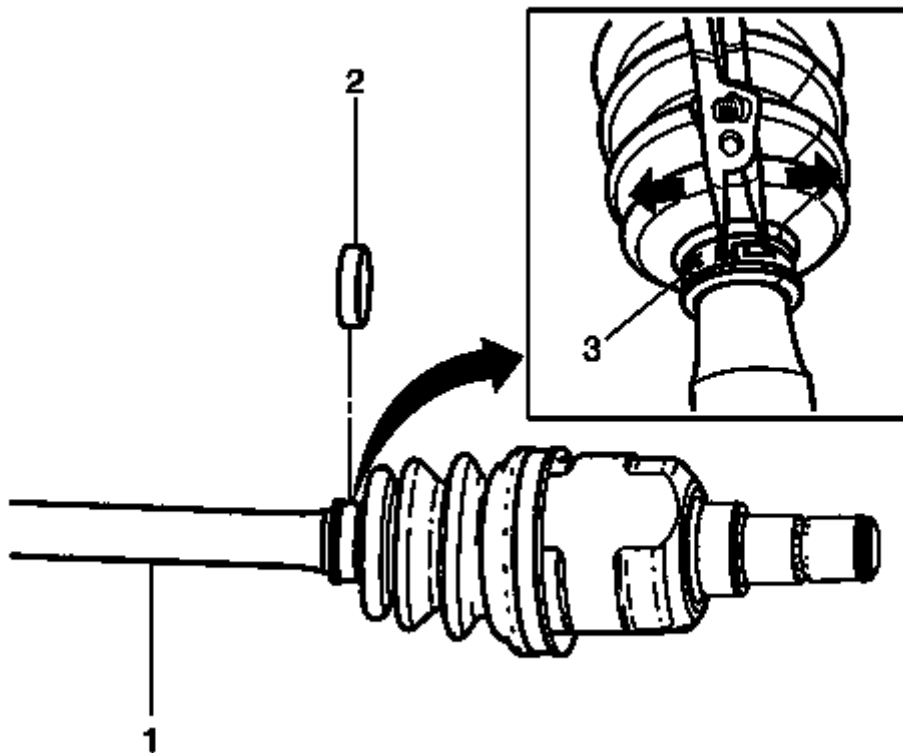


Fig. 18: Removing Boot Retaining Clamp Using A Needle-Nose Plier
Courtesy of GENERAL MOTORS COMPANY

4. Using the needle-nose plier, install the boot retaining clamp (2) with the ear (3) hooked for the wheel drive shaft (1).
5. Place approximately half of the lubricant in the boot and the other half in the in the tripod housing.

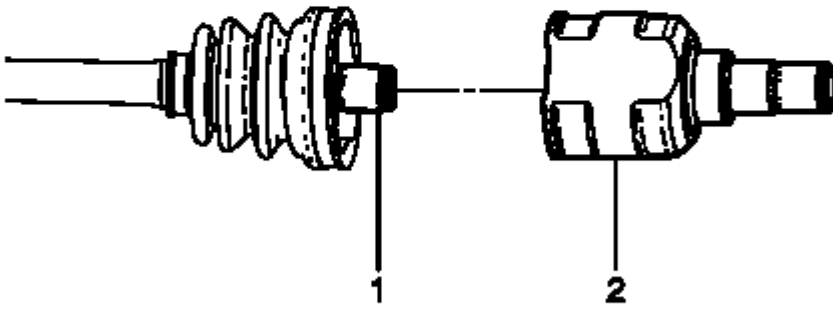


Fig. 19: Tripod Housing And Wheel Drive Shaft
Courtesy of GENERAL MOTORS COMPANY

6. Install the tripod housing (2) on the wheel drive shaft (1).

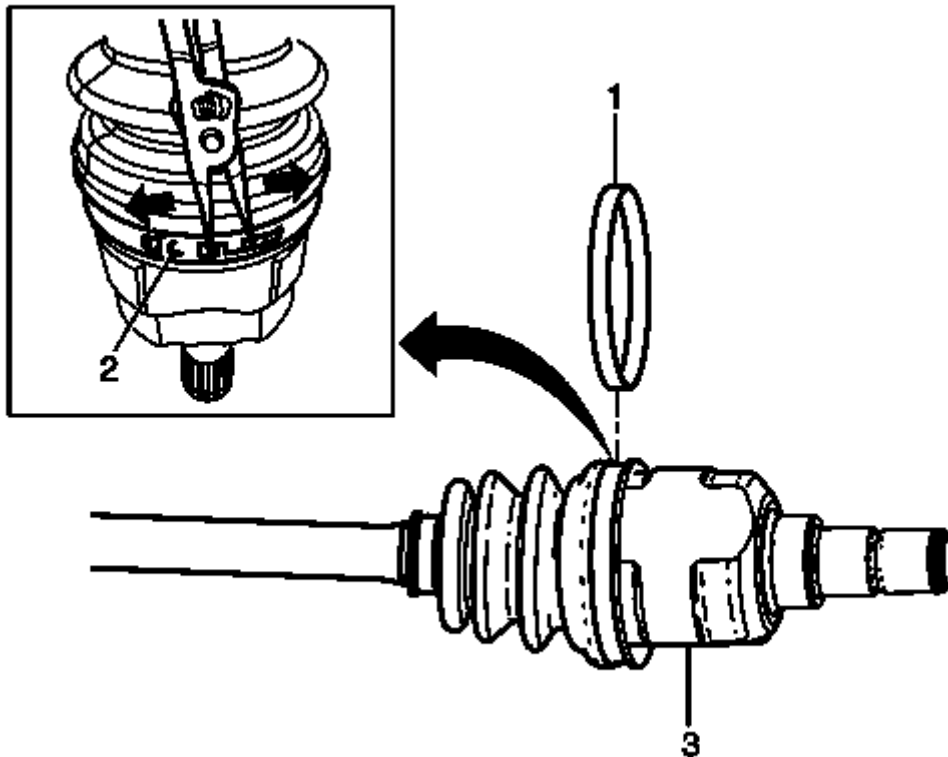


Fig. 20: Removing Boot Retaining Clamp Using A Needle-Nose Plier
Courtesy of GENERAL MOTORS COMPANY

7. Using a needle-nose plier, install the boot retaining clamp (1) with the ear (2) hooked for the tripod housing (3).
8. Move the tripod assembly in a circular motion 4 or 5 times to distribute the grease in the tripod assembly.
9. Install the wheel drive shaft from the vehicle. Refer to **Front Wheel Drive Shaft Replacement**.

FRONT WHEEL DRIVE SHAFT OUTER JOINT REPLACEMENT

Special Tools

DT-50185 Wheel Drive Shaft Outer Joint Boot Clamp Installer

NOTE: Outer constant velocity joint and axle shaft cannot be separated and are replaced as a complete assembly.

Disassemble Procedure

1. Remove the wheel drive shaft from the vehicle. Refer to **Front Wheel Drive Shaft Replacement**.

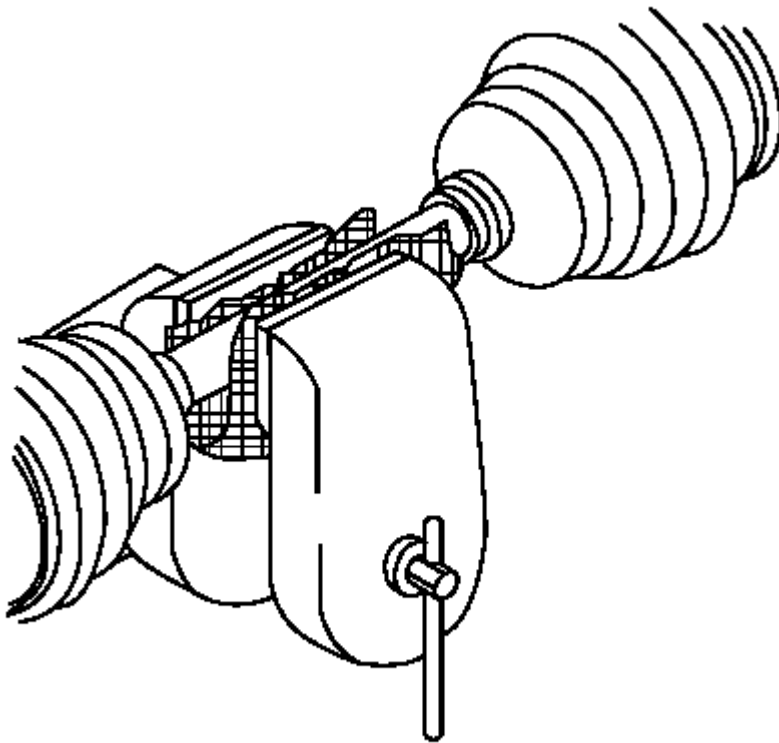


Fig. 21: Wheel Drive Shaft Bar

Courtesy of GENERAL MOTORS COMPANY

2. Clamp the drive axle shaft in a soft-jawed vice.
3. Remove the inner joint boot from the wheel drive shaft. Refer to **Front Wheel Drive Shaft Inner Joint Replacement**.

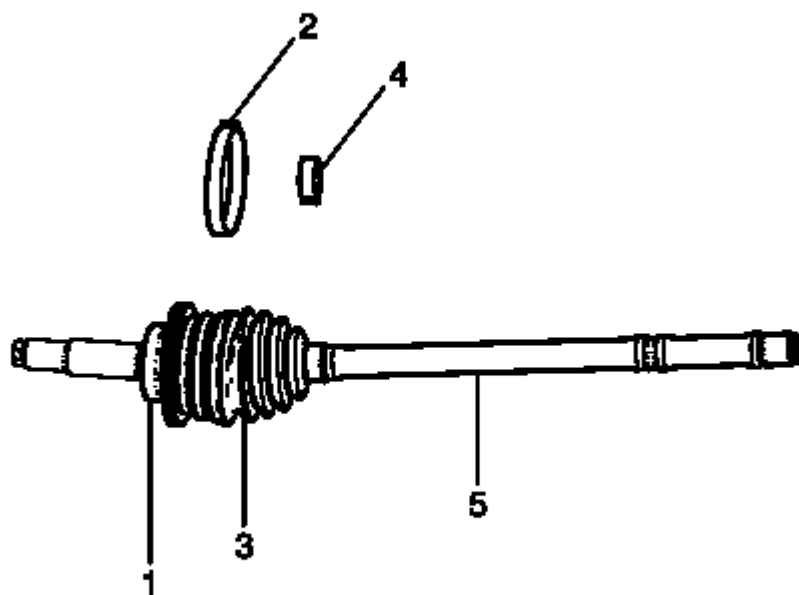


Fig. 22: Boot Retaining Clamp, Outer Joint And Boot
Courtesy of GENERAL MOTORS COMPANY

4. Using a flat-bladed tool, remove the boot retaining clamp (2) from the outer joint (1) and the boot (3). Discard the clamp.
5. Using a pair of side cutters, remove and discard the boot retaining clamp (4) from the boot (3) and the wheel drive shaft (5). Discard the clamp.

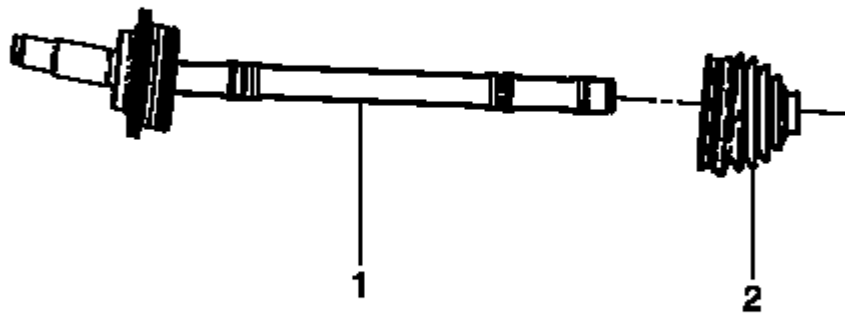


Fig. 23: Boot And Wheel Drive Shaft
Courtesy of GENERAL MOTORS COMPANY

6. Slide the boot toward the inner joint and remove the boot (2) from the wheel drive shaft (1).

Assemble Procedure

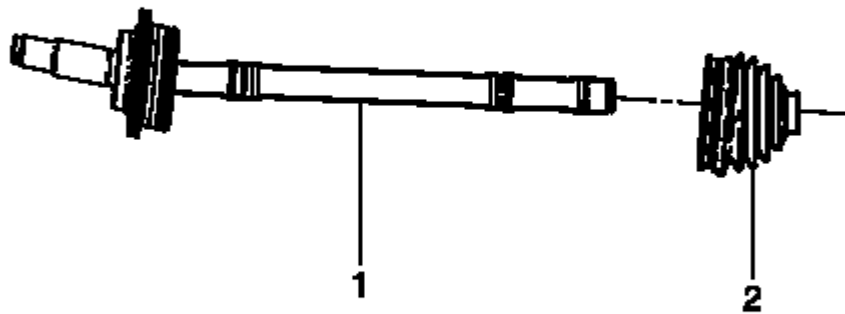


Fig. 24: Boot And Wheel Drive Shaft
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Ensure the seal clamp is positioned correctly in the seal groove.**

1. Position the boot (2) on the wheel drive shaft (1).

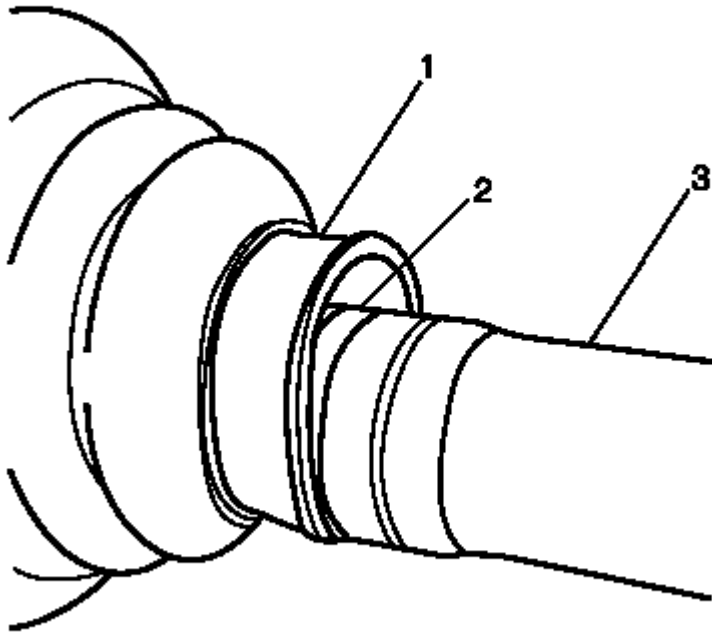


Fig. 25: Boot And Wheel Drive Shaft
Courtesy of GENERAL MOTORS COMPANY

2. Ensure that the boot (1) is properly seated in the groove (2) in the wheel drive shaft (3).

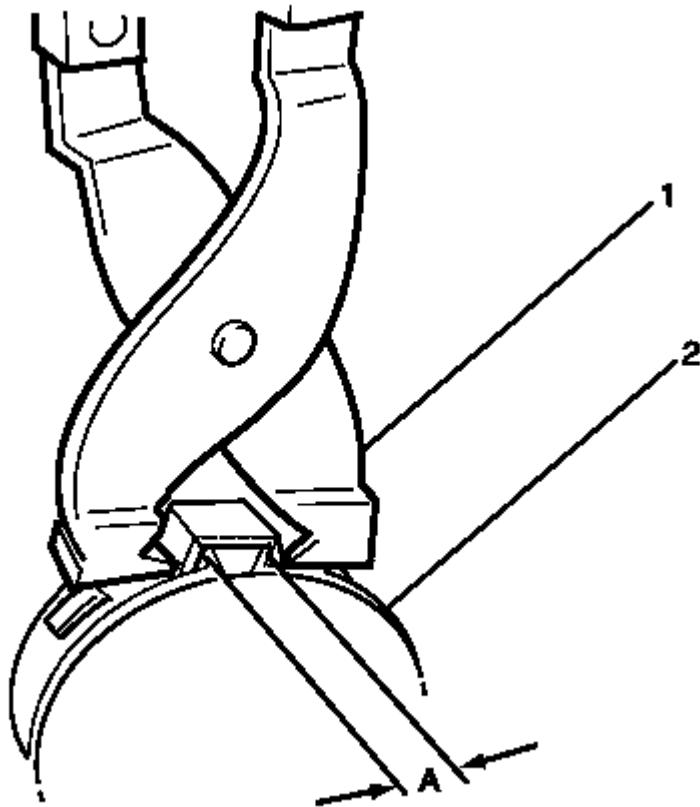


Fig. 26: Wheel Drive Shaft Outer Joint Boot Clamp Installer
Courtesy of GENERAL MOTORS COMPANY

3. Using the **DT-50185** wheel drive shaft outer joint boot clamp installer (1), close the clamp (2) for the wheel drive shaft until the gap (A) measures 2.10 mm (0.83 in).

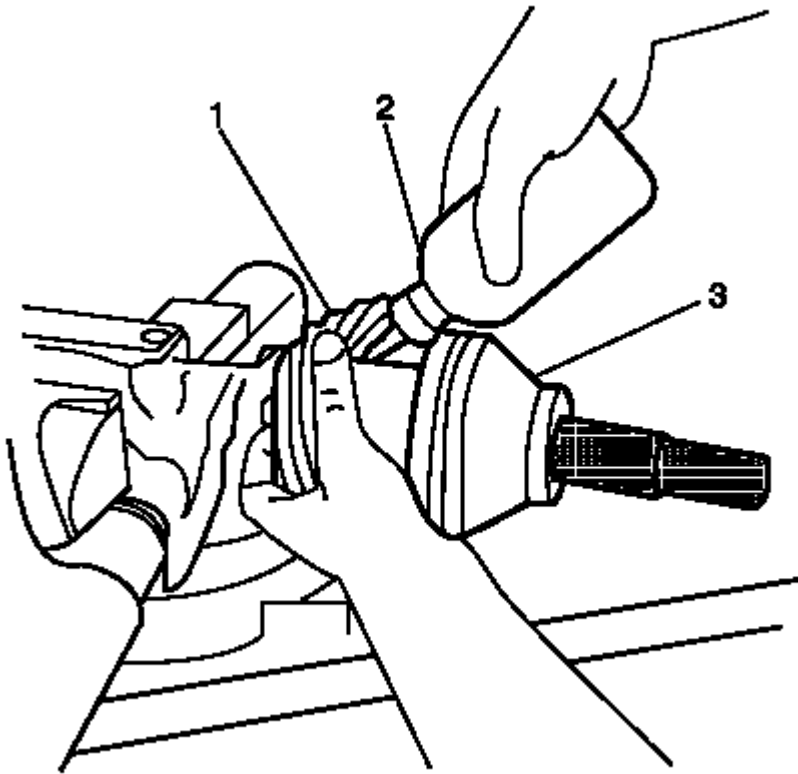


Fig. 27: Placing Lubricant Inside Outer Joint Boot
Courtesy of GENERAL MOTORS COMPANY

4. Place approximately half the lubricant (2) inside the outer joint boot (1) and the other half in the outer joint (3)

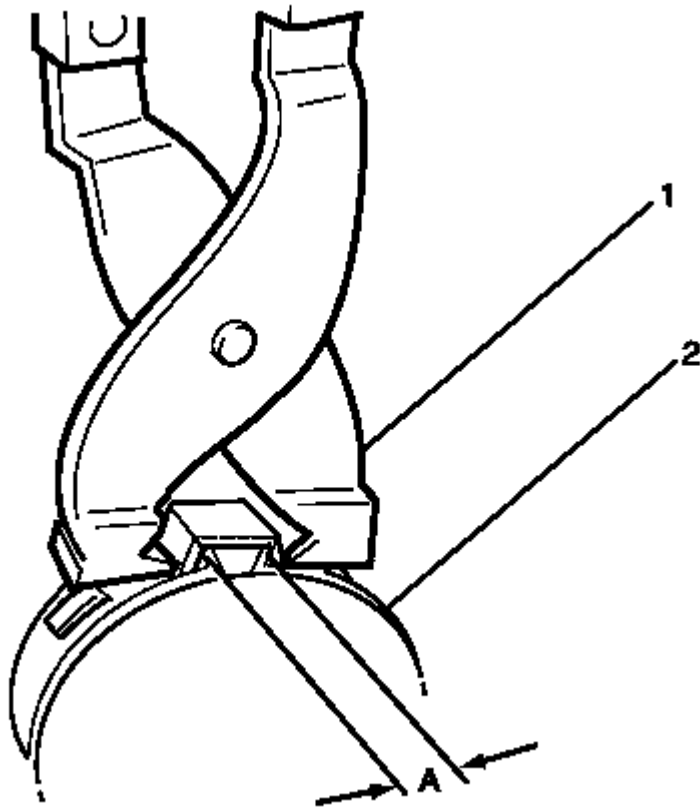


Fig. 28: Wheel Drive Shaft Outer Joint Boot Clamp Installer
Courtesy of GENERAL MOTORS COMPANY

5. Using the **DT-50185** wheel drive shaft outer joint boot clamp installer (1), close the clamp (2) for the outer joint until the gap (A) measures 2.10 mm (0.83 in).
6. Remove the wheel drive shaft from the bench vise.
7. Move the outer joint in a circular motion 4 to 5 times to distribute the lubricant.
8. Install the wheel drive shaft in the vehicle. Refer to **Front Wheel Drive Shaft Replacement**.

WHEEL DRIVE SHAFT INNER JOINT INSPECTION

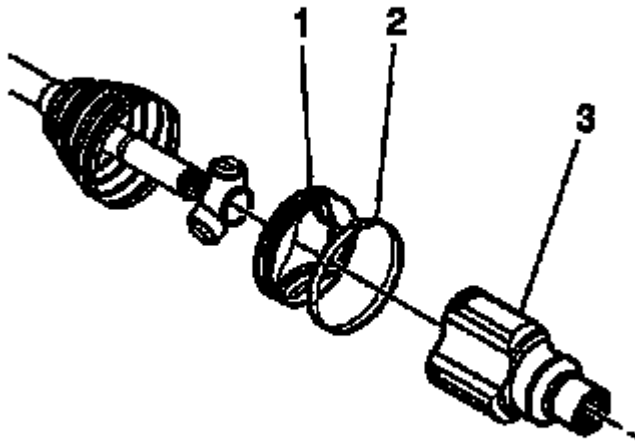


Fig. 29: Drive Shaft Tripod Bushing Clamp And Tripod Housing
Courtesy of GENERAL MOTORS COMPANY

1. Remove the wheel drive shaft tripod bushing clamp (2) from the tripod housing (3).
2. Remove the wheel drive shaft tripod housing (3) from the wheel drive shaft.
3. Remove the wheel drive shaft tripod joint boot bushing (1).
4. Using a suitable cleaner, remove the excess grease from the tripod assembly.
5. Inspect the following items for damage or excessive wear:
 - The wheel drive shaft tripod boot
 - The wheel drive shaft tripod assembly
 - The wheel drive shaft tripod joint housing
 - The wheel drive shaft
6. If any of the items in step 5 are found to be defective, replace those items that are serviceable.

DESCRIPTION AND OPERATION

WHEEL DRIVE SHAFTS DESCRIPTION AND OPERATION

Wheel drive shafts are flexible assemblies consisting of an inner tripod joint and an outer constant velocity joint connected by an axle shaft. The inner joint is completely flexible and can plunge in and out. The outer joint is

also flexible, but cannot plunge in and out. These drive axles are used to transmit rotational force from the transaxle to the front tire and wheel assemblies.

Seal and Clamp

The wheel drive shafts use inboard and outboard joint seals made of thermoplastic material and clamps made of stainless steel. The functions of the seals are as follows:

- The seals protect the internal parts of the inboard and outboard joints.
 - They protect the joint lubricating grease from surrounding detrimental atmospheric conditions, such as extreme temperatures, ozone gas, etc.
 - They protect the joint lubricating grease from foreign materials, such as stones, dirt, water, salt, etc.
- The seals facilitate angular and axial movement of the inboard joint.
- The seals facilitate angular movement of the outboard joint.

The function of the clamps is as follows:

- Provide a leak proof connection at both the housing and the axle shaft for the inboard and outboard joints.
- The thermoplastic material performs well against normal handling, operational wear and conditions. This material however, is not strong enough to withstand abusive handling or damage due to objects such as sharp tools or the sharp edge of any other surrounding component on the vehicle.

Inner Joint

The inner joints are of the tripod design without an over-extension limitation retainer. The inner joints incorporate a male spline which interlocks with the transaxle or the intermediate drive shaft if equipped, using snap rings.

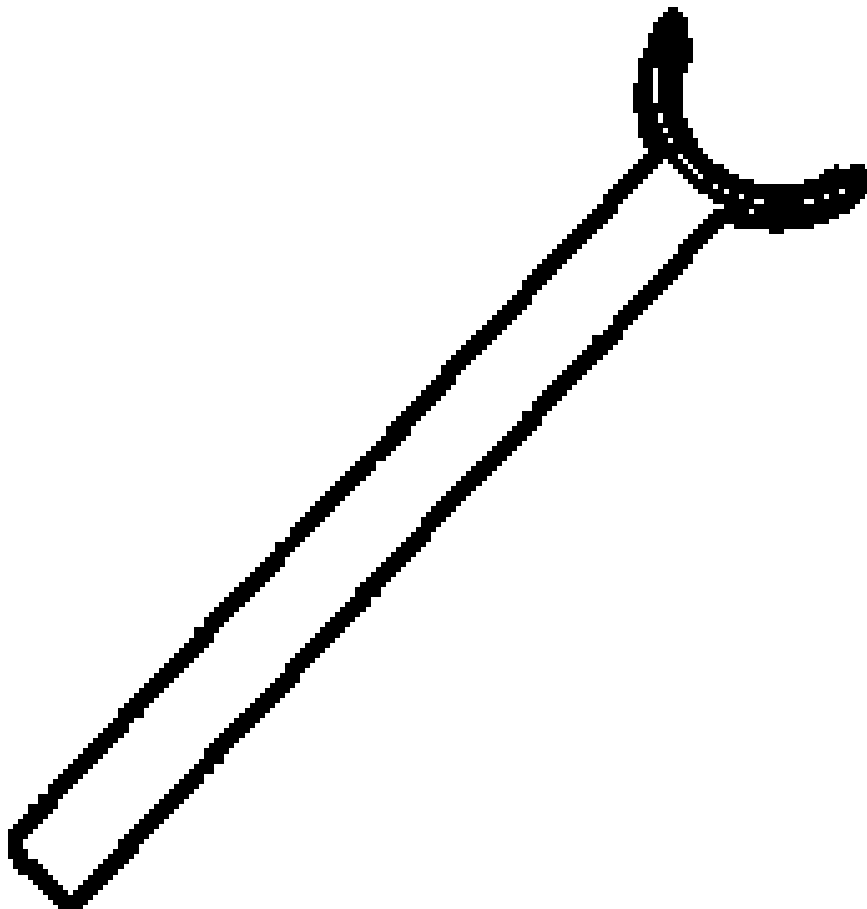
Outer Joint

The outer joints are of the Rzeppa, constant velocity joint design. The shaft end which mates with the wheel bearing and hub assembly, incorporates a spline.

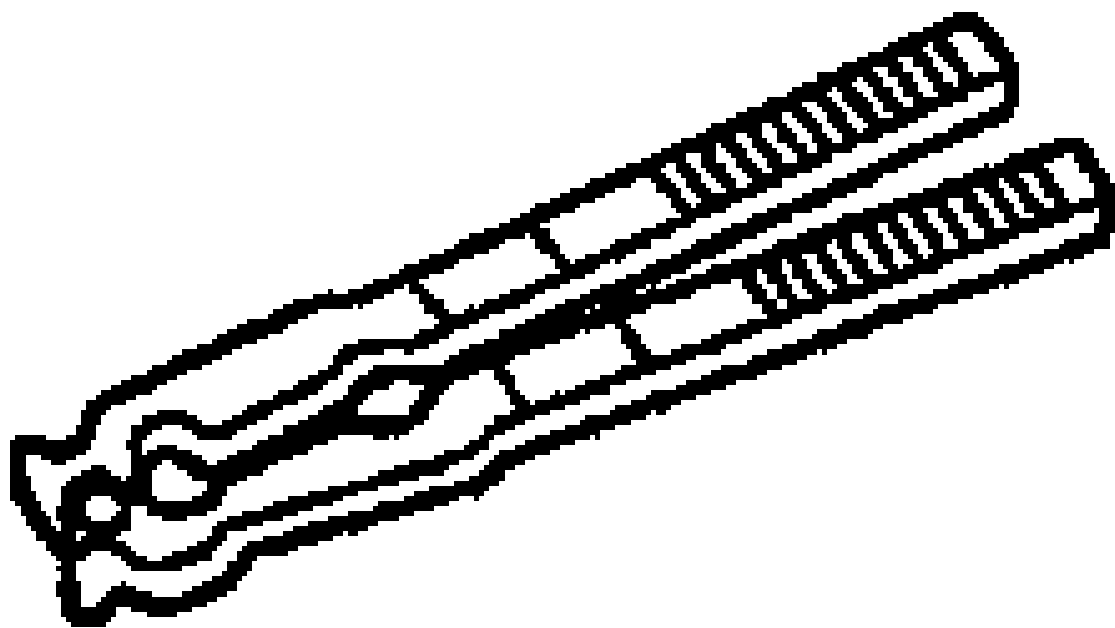
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

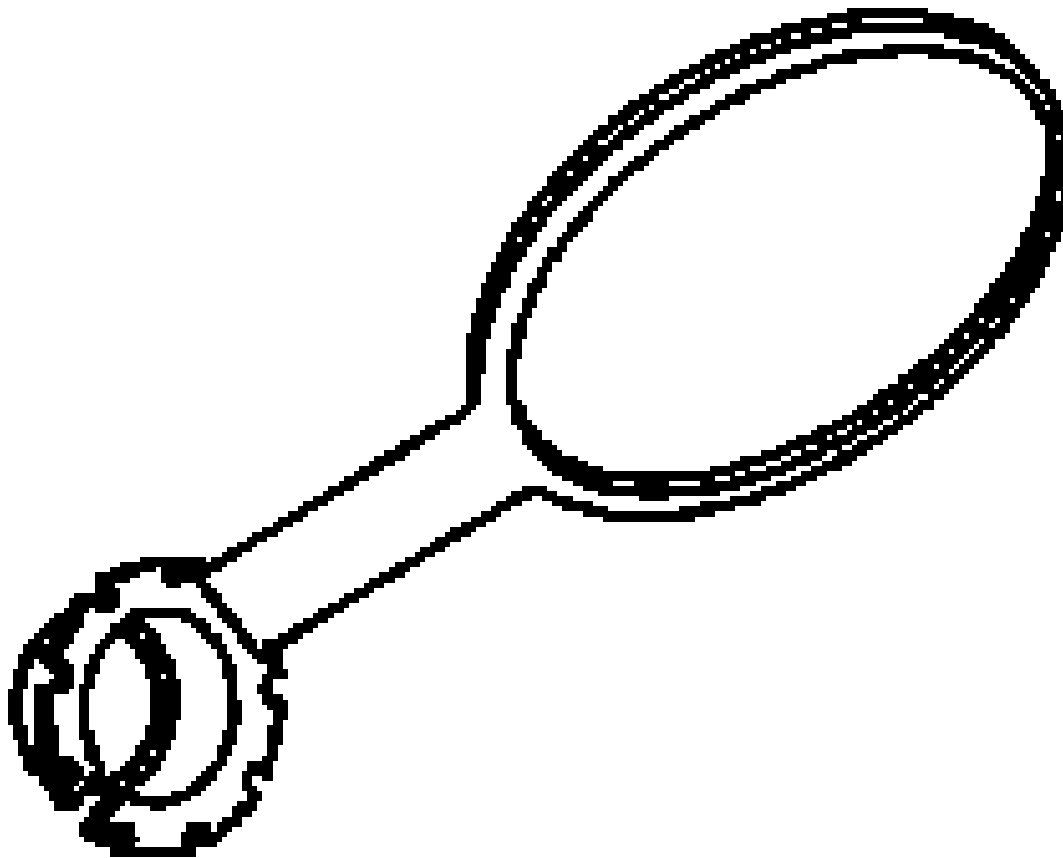
Illustration	Tool Number/ Description



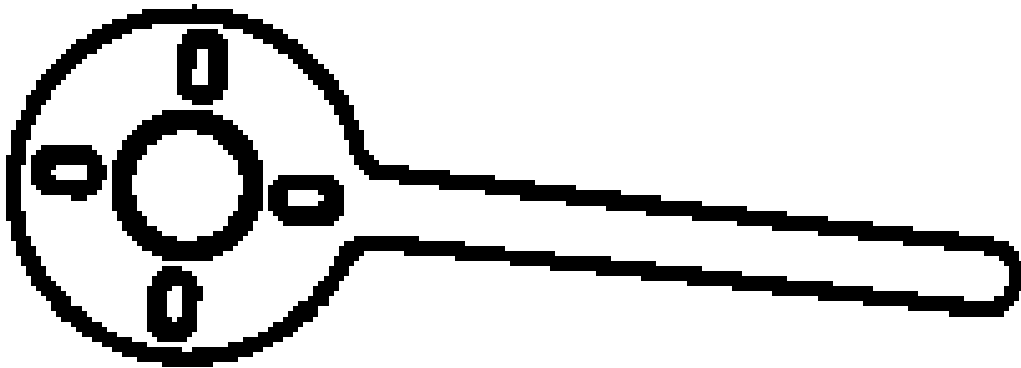
DT-50183
Wheel
Drive Shaft
Remover



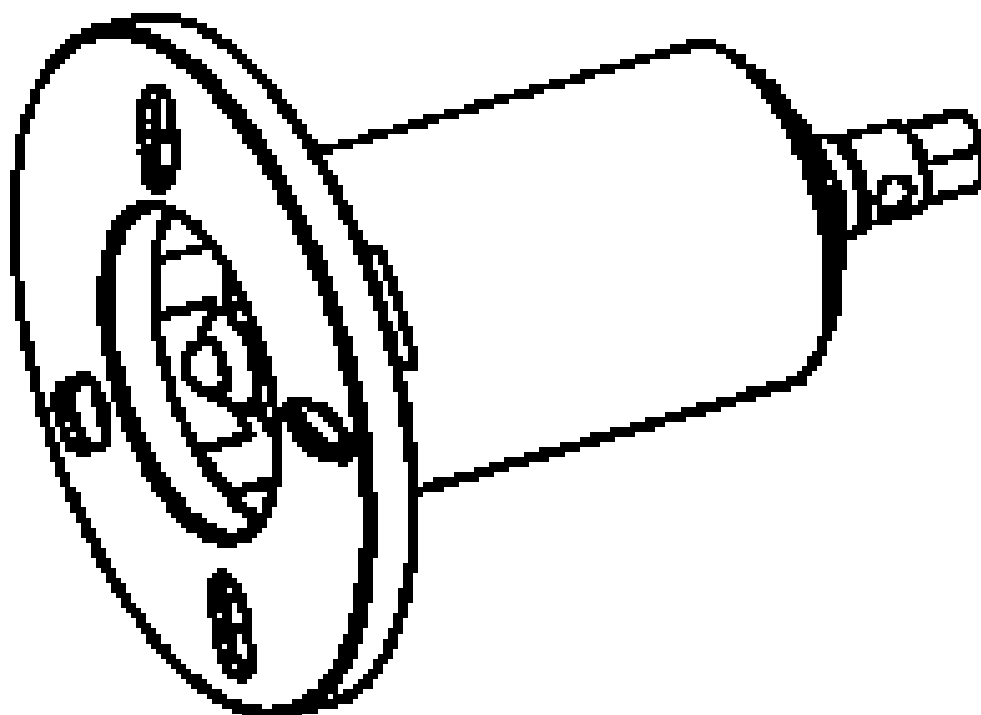
DT-50185
CH-804
Wheel
Drive Shaft
Outer Joint
Boot Clamp
Installer



DT-6332
J-44394
Seal
Protector



DT-50186
Wheel Hub
Holding
Tool



DT-50188
CH-45859
Hub
Spindle
Remover

ACCESSORIES & EQUIPMENT

Wipers and Washers - Spark

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Rear Window Wiper Arm Nut	9 N.m	80 lb in
Rear Window Wiper Motor Bolt	8 N.m	71 lb in
Windshield Washer Solvent Container Nut	9 N.m	80 lb in
Windshield Wiper Arm Nut	24 N.m	18 lb in
Windshield Wiper Motor Bolt	13 N.m	10 lb ft
Windshield Wiper Motor Nut	23 N.m	17 lb ft
Windshield Wiper Transmission Frame Bolt	10 N.m	89 lb in

SCHEMATIC WIRING DIAGRAMS

WIPER/WASHER WIRING SCHEMATICS

Controls and Front Wipers Wiring Schematics

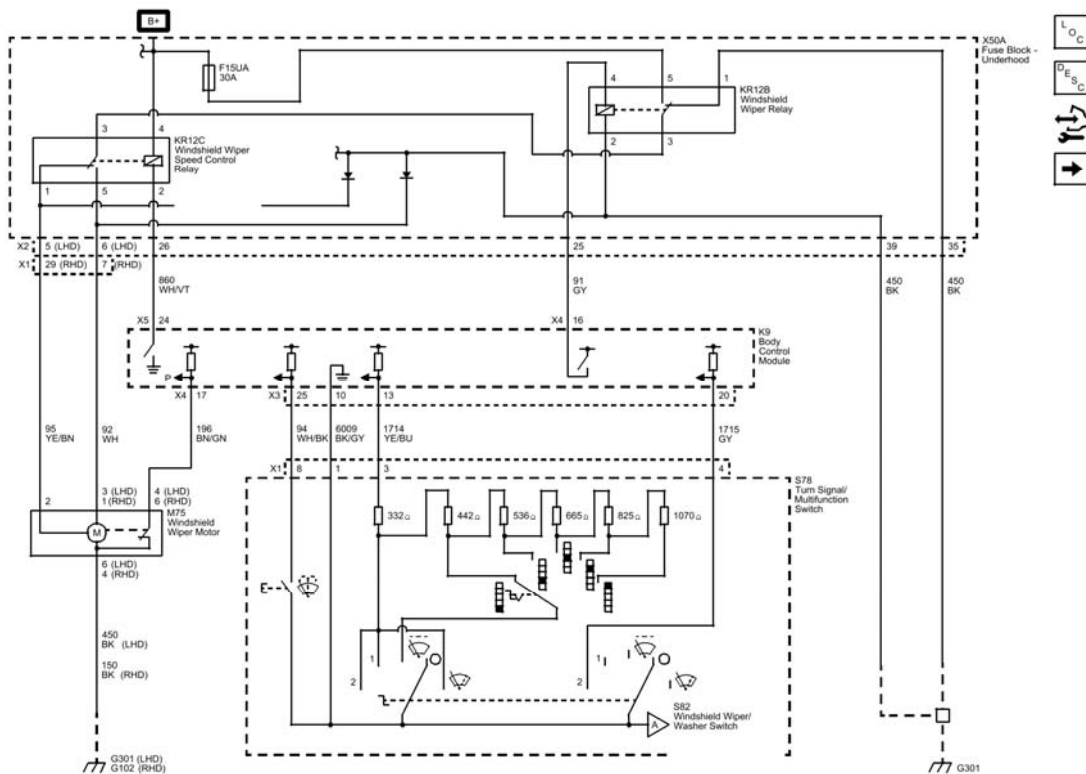


Fig. 1: Controls and Front Wipers Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Controls and Rear Wiper Wiring Schematics

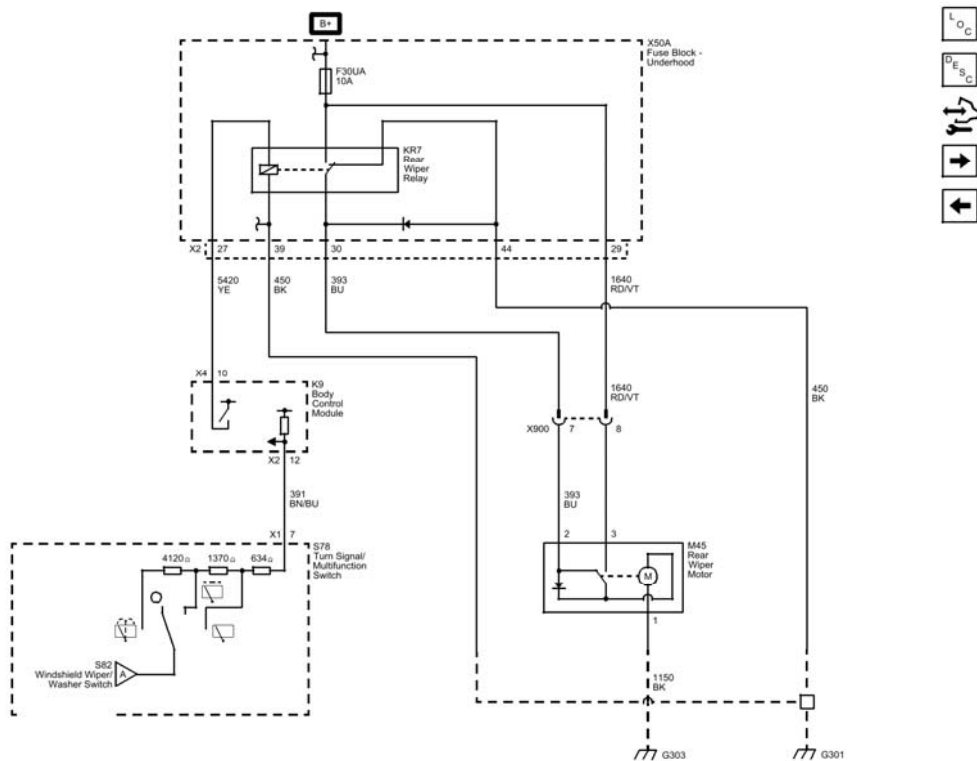


Fig. 2: Controls and Rear Wiper Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Front and Rear Washers Wiring Schematics

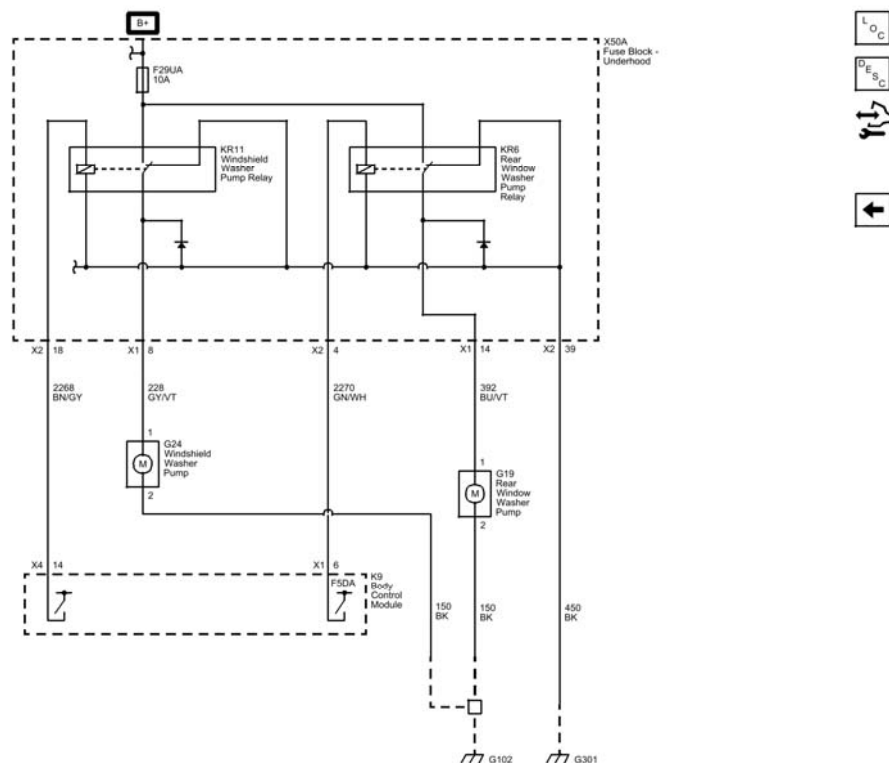


Fig. 3: Front and Rear Washers Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC B370B</u>	DTC B370B 02 Rear Wiper Function Control Circuit Short to Ground DTC B370B 01 Rear Wiper Function Control Circuit Short to Voltage DTC B370B 04 Rear Wiper Function Control Circuit Open
<u>DTC B3715 or B3875</u>	DTC B3715 01 Windshield Wiper Relay Circuit Short to Battery DTC B3715 02 Windshield Wiper Relay Circuit Short to Ground DTC B3715 04 Windshield Wiper Relay Circuit Open DTC B3875 01 Windshield Wiper High Speed Relay Circuit Short to Battery

	DTC B3875 02 Windshield Wiper High Speed Relay Circuit Short to Ground DTC B3875 04 Windshield Wiper High Speed Relay Circuit Open
<u>DTC B3811</u>	DTC B3811 Rear Washer Relay Circuit
<u>DTC B3873</u>	DTC B3873 01 Front Washer Relay Circuit Short to Battery DTC B3873 02 Front Washer Relay Circuit Short to Ground DTC B3873 04 Front Washer Relay Circuit Open Circuit

DTC B370B: REAR WIPER FUNCTION CONTROL

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B370B 02

Rear Wiper Function Control Circuit Short to Ground

DTC B370B 01

Rear Wiper Function Control Circuit Short to Voltage

DTC B370B 04

Rear Wiper Function Control Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Rear Wiper Switch Signal	2	1	1	-
Rear Wiper Motor Control	1	1	2	-
Rear Window Wiper Relay Control	B370B 02	B370B 04	B370B 01	-
Rear Wiper Relay Control	1	1	2	-
Rear Wiper Motor Ground	-	1	1	-
Rear Wiper Relay Ground	-	1	-	-

- | |
|---|
| <ol style="list-style-type: none">1. Rear Wiper Inoperative.2. Rear Wiper Always ON. |
|---|

Circuit/System Description

The body control module (BCM) controls the single speed rear wiper motor by its active high output to the external rear wiper motor relay. When the BCM activates its output and applies battery to the coil of the relay, the relay energizes, allowing battery voltage from the fuse to be applied through the switched contacts of the rear wiper motor relay to the control input of the rear wiper motor. The motor then operates continuously at low speed.

Conditions for Running the DTC

- Vehicle in Service Mode
- The system voltage is between 9-16 V.

Conditions for Setting the DTC

A short to ground or an open/high resistance is detected in the rear window wiper control circuit.

Action Taken When the DTC Sets

Rear wiper operation is suspended.

Conditions for Clearing the DTC

A current DTC clears when the diagnostic runs and passes.

Reference Information

Schematic Reference

Wiper/Washer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Wiper/Washer System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**

- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Rear Wiper Switch parameter changes between Off and On when turning the rear wipers ON and OFF..
 - **If the parameter does not change**

Refer to Circuit/System Testing - Rear Wiper/Washer Switch Malfunction.
 - **If the parameter changes**
3. Verify the Rear Wiper Motor turns On when commanding the Rear Wiper Active with a scan tool.
 - **If the Rear Wiper Motor does not turn ON**

Refer to Circuit/System Testing - Rear Wiper Motor Malfunction
 - **If the Rear Wiper Motor turns ON**
4. All OK.

Circuit/System Testing

Rear Wiper/Washer Switch Malfunction

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch. It may take up to 11 min for all vehicle systems to power down.
2. Test for less than 10 ohms between the low reference circuit terminal 1 and ground.
 - **If 10 ohms or greater**
 1. Vehicle OFF.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If less than 10 ohms**
3. Vehicle in Service Mode.
4. Test for greater than 8 V between the signal circuit terminal 7 and ground.
 - **If less than 8 V**
 1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit and ground
 - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance
- 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
- **If 8 V or greater**
- 5. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
- 6. Test for less than 1 V between the S82 Windshield Wiper/Washer Switch signal circuit terminal 7 and ground.
 - **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**
- 7. Test or replace the S82 Windshield Wiper/Washer Switch.

Rear Wiper Motor Malfunction

1. Vehicle OFF, and all vehicle systems OFF. Disconnect the harness connector at the M45 Rear Wiper Motor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 1 and ground.
 - **If 10 ohms or greater**
 1. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal 3 and the ground circuit terminal 1.
 - **If the test lamp does not illuminate**
 1. Vehicle OFF, remove the test lamp. Disconnect the X2 harness connector at the X50A Fuse Block - Underhood.
 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the X50A Fuse Block - Underhood.
 - **If the test lamp illuminates**
5. Connect a test lamp between the control circuit terminal 2 and the ground circuit terminal 1.
6. Verify the test lamp does NOT turn ON and OFF when commanding the Rear Wiper On and Off with a scan tool.
 - **If the test lamp turns ON and OFF**

Test or replace the M45 Rear Wiper Motor.

- **If the test lamp does not turn ON and OFF**
- 7. Vehicle OFF, connect the harness connector at the M45 Rear Wiper Motor. Disconnect the X2 harness connector at the X50A Fuse Block - Underhood, It may take up to 2 min for all vehicle systems to power down.
- 8. Test for less than 10 ohms between each ground circuit listed below and ground:
 - Terminal 39
 - Terminal 44
 - **If 10 ohms or greater**
 - 1. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
- 9. Vehicle in Service Mode.
- 10. Verify the M45 Rear Wiper Motor is not activated.
 - **If the M45 Rear Wiper Motor is activated**
 - 1. Vehicle OFF, disconnect the harness connector at the M45 Rear Wiper Motor, vehicle in Service Mode.
 - 2. Test for less than 1 V between the control circuit terminal 2 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the M45 Rear Wiper Motor.
 - **If the M45 Rear Wiper Motor is not activated**
- 11. Connect a 20 A fused jumper wire between both of the circuits listed below and B+:
 - B+ Circuit Terminal 29
 - Control Circuit Terminal 30
- 12. Verify the M45 Rear Wiper Motor activates.
 - **If the M45 Rear Wiper Motor does not activate**
 - 1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the M45 Rear Wiper Motor, vehicle in Service Mode.
 - 2. Test for infinite resistance between the control circuit and ground.
 - If less than Infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 - 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the M45 Rear Wiper Motor.
 - **If the M45 Rear Wiper Motor activates**
- 13. Vehicle OFF, connect the X2 harness connector at the X50A Fuse Block - Underhood. Disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
- 14. Verify the M45 Rear Wiper Motor is not activated.
 - **If the M45 Rear Wiper Motor is activated**

1. Vehicle OFF, disconnect the X2 harness connector at the X50A Fuse Block - Underhood, vehicle in Service Mode.
2. Test for less than 1 V between the control circuit terminal 27 and B+.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the X50A Fuse Block - Underhood.
 - **If the M45 Rear Wiper Motor is not activated**
15. Connect a 10 A fused jumper wire between the control circuit terminal 10 and B+.
16. Verify the M45 Rear Wiper Motor activates.
 - **If the M45 Rear Wiper Motor does not activate**
 1. Vehicle OFF, remove the jumper wire, disconnect the X2 harness connector at the X50A Fuse Block - Underhood.
 2. Test for infinite resistance between the control circuit terminal 27 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If less than infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the X50A Fuse Block - Underhood.
 - **If the M45 Rear Wiper Motor activates**
17. Test or replace the K9 Body Control Module.

Component Testing

Windshield Wiper/Washer Switch

1. Vehicle OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch.
2. Test for infinite resistance between the signal terminal 7 and the low reference terminal 1 with the rear window washer switch in the open position.
 - **If less than infinite resistance**

Replace the S82 Windshield Wiper/Washer Switch.
 - **If infinite resistance**
3. Verify the resistance reading is within the range specified below between the signal circuit terminal 7 and the low reference circuit terminal 1 by cycling the switch between Rear Wiper position and Rear Washers position.
 - Rear Wiper : 624-644ohms
 - Rear Wiper Sweep : 1.99-2.01kohms
 - Rear Washer : 6.11-6.13kohms
 - **If not within range specified**

Replace the S82 Windshield Wiper/Washer Switch.

- If within range specified

4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Rear Window Wiper Motor Replacement**
- **Windshield Wiper and Washer Switch Replacement**
- **Control Module References** or BCM replacement, programming and setup

DTC B3715 OR B3875: WINDSHIELD WIPER RELAY

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B3715 01

Windshield Wiper Relay Circuit Short to Battery

DTC B3715 02

Windshield Wiper Relay Circuit Short to Ground

DTC B3715 04

Windshield Wiper Relay Circuit Open

DTC B3875 01

Windshield Wiper High Speed Relay Circuit Short to Battery

DTC B3875 02

Windshield Wiper High Speed Relay Circuit Short to Ground

DTC B3875 04

Windshield Wiper High Speed Relay Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Windshield Wiper Switch Signal terminal 3	1	1	1	-
Windshield Wiper Switch Signal terminal 4	4	2	-	-
Windshield Wiper Motor Park Signal	3	3	-	-
Windshield Wiper Relay Control	B3715 02	B3715 04	B3715 01	-
Windshield Wiper Speed Control Relay Control	B3875 02	B3875 04	B3875 01	-
Windshield Wiper High Speed Motor Control	2	2	4	-
Front Wiper Low Speed Motor Control	1	1	4	-
Windshield Wiper Switch Low Reference	-	1, 2	-	-
Windshield Wiper Motor Ground	-	1, 2, 3	-	-
Windshield Wiper Relay Ground	-	1	-	-
1. Delay or Low Speed Wipers Inoperative 2. High Speed Wipers Inoperative 3. Wipers Do Not Park 4. Wipers Always ON				

Circuit/System Description

The body control module (BCM) controls the wiper motor based on input from the windshield wiper/washer switch. The BCM monitors the wiper/washer switch through two separate signal circuits and a low reference circuit. The windshield wiper switch high signal circuit is used to determine high speed wiper operation, the windshield wiper switch low signal is used to determine low speed, intermittent, and mist operation through the use of a resistor ladder, and the windshield washer switch signal circuit is used to determine washer operation.

The BCM controls the windshield wiper motor through two output controls, controlling two relays which determine the desired wiper speed, high or low.

Conditions for Running the DTC

- The DTC runs only when a wiper output is actively being requested by the BCM.
- The system voltage is between 9-16 V.

Conditions for Setting the DTC

- A short to ground is detected in the Front Wiper Relay control circuit or in the High Speed Relay control circuit.
- A short to voltage or an open/high resistance is detected in the Front Wiper Relay control circuit or in the

High Speed Relay control circuit.

Action Taken When the DTC Sets

The BCM will not activate the wiper output.

Conditions for Clearing the DTC

- A current DTC will clear when the condition for setting the fault is no longer present.
- A history DTC will clear after 50 consecutive ignition cycles without a fault present.

Reference Information

Schematic Reference

Wiper/Washer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Wiper/Washer System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Windshield Wiper High Speed Switch parameter changes between Active and Inactive when activating the high speed windshield wipers.
 - **If the parameter does not change**

Refer to Circuit/System Testing - Windshield Wiper/Washer Switch Malfunction.
 - **If the parameter changes**

3. Verify the scan tool Windshield Wiper Switch parameter changes between Off and Low when activating the low speed windshield wipers.

- **If the parameter does not change**

Refer to Circuit/System Testing - Windshield Wiper/Washer Switch Malfunction.

- **If the parameter changes**

4. Verify the scan tool Windshield Wiper Switch parameter changes between Delay 1 and Delay 5 when cycling the intermittent speed windshield wipers.

- **If the parameter does not change**

Test or replace the S82 Windshield Wiper/Washer Switch.

- **If the parameter changes**

5. Verify the M75 Windshield Wiper Motor changes between Off, Low, and High when cycling the S82 Windshield Wiper/Washer Switch between Off, Low, and High.

- **If the Windshield Wiper Motor does not cycle between Off, Low, and High**

Refer to Circuit/System Testing - Windshield Wiper Motor Malfunction

- **If the Windshield Wiper Motor cycles between Off, Low, and High**

6. Ignition OFF.

7. Verify the scan tool Windshield Wiper Park Switch parameter is Active.

- **If the parameter does not change**

Refer to Circuit/System Testing - Windshield Wiper Motor Malfunction.

- **If the parameter changes**

8. All OK.

Circuit/System Testing

Windshield Wiper/Washer Switch Malfunction

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch. It may take up to 11 min for all vehicle systems to power down.

2. Test for less than 10 ohms between the low reference circuit terminal 1 and ground.

- **If 10 ohms or greater**

1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.

2. Test for less than 2 ohms in the low reference circuit end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, replace the K9 Body Control Module.

- **If less than 10 ohms**

3. Ignition ON.
4. Verify the scan tool Windshield Wiper High Speed Switch parameter is Inactive.
 - **If not Inactive**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal 4 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 4 and the low reference circuit terminal 1.
6. Verify the scan tool Windshield Wiper High Speed Switch parameter is Active.
 - **If not Active**
 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If Active**
7. Test for greater than 8 V between the signal circuit terminal 3 and ground.
 - **If less than 8 V**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit and ground
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If 8 V or greater**
8. Ignition OFF, disconnect the X3 harness connector at the K9 Body Control Module, ignition ON.
9. Test for less than 1 V between the S82 Windshield Wiper/Washer Switch signal circuit terminal 3 and ground.
 - **If 1 V or greater**

Repair the short to voltage on the circuit.
 - **If less than 1 V**

10. Test or replace the S82 Windshield Wiper/Washer Switch.

Windshield Wiper Motor Malfunction

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the M75 Windshield Wiper Motor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 ohms between the appropriate ground circuit terminal listed below and ground.
 - Terminal 6, (LHD)
 - Terminal 4, (RHD)
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Ignition ON.
4. Verify the scan tool Windshield Wiper Park Switch parameter is Inactive.
 - **If not Inactive**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the appropriate signal circuit terminal listed below and ground.
 - Terminal 4, (LHD)
 - Terminal 6, (RHD)
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If Inactive**
5. Install a 3 A fused jumper wire between the appropriate signal circuit terminal listed below and ground.
 - Terminal 4, (LHD)
 - Terminal 6, (RHD)
6. Verify the scan tool Windshield Wiper Park Switch parameter is Active.
 - **If not Active**
 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If Active**

7. Connect a test lamp between the control circuit terminal 2 and ground, ignition ON.
8. Verify the test lamp does NOT turn ON and OFF when commanding the Windshield Washer Relay Low and Off with a scan tool.

- **If the test lamp turns ON and OFF**

Test or replace the M75 Windshield Wiper Motor.

- **If the test lamp does not turn ON and OFF**

9. Connect a test lamp between the appropriate circuit terminal listed below and ground, ignition ON.
 - Terminal 3, (LHD)
 - Terminal 1, (RHD)
10. Verify the test lamp does NOT turn ON and OFF when commanding the Windshield Washer Relay High and Off with a scan tool.

- **If the test lamp turns ON and OFF**

Test or replace the M75 Windshield Wiper Motor.

- **If the test lamp does not turn ON and OFF**

11. Ignition OFF and all vehicle systems OFF, connect the harness connector at the M75 Windshield Wiper Motor. Disconnect the X2 (LHD) or X1 and X2 (RHD) harness connector(s) at the X50A Fuse Block - Underhood. It may take up to 2 min for all vehicle systems to power down.
12. Test for less than 10 ohms between the ground circuit terminals listed below and ground.

- Terminal 39
- Terminal 35

- **If 10 ohms or greater**

1. Ignition OFF.
2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.

- **If less than 10 ohms**

13. Ignition ON.

14. Verify the M75 Windshield Wiper Motor is not activated.

- **If the M75 Windshield Wiper Motor is activated**

1. Ignition OFF, disconnect the harness connector at the M75 Windshield Wiper Motor, ignition ON.
2. Test for less than 1 V between the control circuit terminals listed below and ground.
 - Terminal 2
 - Terminal 3, (LHD)
 - Terminal 1, (RHD)
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the M75 Windshield Wiper Motor.

- **If the M75 Windshield Wiper Motor is not activated**
- 15. Connect a 20 A fused jumper wire between the control circuit terminals listed below, one at a time, and B+.
 - Terminal 5, (LHD)
 - Terminal 29, (RHD)
 - Terminal 6, (LHD)
 - Terminal 7, (RHD)
- 16. Verify the M75 Windshield Wiper Motor activates.
 - **If the M75 Windshield Wiper Motor does not activate**
 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the M75 Windshield Wiper Motor.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than Infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the M75 Windshield Wiper Motor.
 - **If the M75 Windshield Wiper Motor activates**
- 17. Ignition OFF, connect the X2 (LHD) or X1 and X2 (RHD) harness connector(s) at the X50A Fuse Block - Underhood. Disconnect the X4 harness connector at the K9 Body Control Module, ignition ON.
- 18. Verify the M75 Windshield Wiper Motor low speed is not activated.
 - **If the M75 Windshield Wiper Motor low speed is activated**
 1. Ignition OFF, disconnect the X2 harness connector at the X50A Fuse Block - Underhood, ignition ON.
 2. Test for less than 1 V between the X2 harness connector at the X50A Fuse Block - Underhood control circuit terminal 16 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the X50A Fuse Block - Underhood.
 - **If the M75 Windshield Wiper Motor low speed is not activated**
- 19. Ignition OFF, disconnect the X5 harness connector at the K9 Body Control Module, ignition ON.
- 20. Verify the M75 Windshield Wiper Motor High Speed is not activated.
 - **If the M75 Windshield Wiper Motor high speed is activated**
 1. Ignition OFF, disconnect the X2 harness connector at the X50A Fuse Block - Underhood, ignition ON.
 2. Test for infinite resistance between the X2 harness connector at the X50A Fuse Block - Underhood control circuit terminal 24 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the X50A Fuse Block - Underhood.
 - **If the M75 Windshield Wiper Motor high speed is not activated**

21. Connect a 10 A fused jumper wire between the control circuit terminal 16 X4 and B+.
22. Verify the M75 Windshield Wiper Motor activates.
 - **If the M75 Windshield Wiper Motor does not activate**
 1. Ignition OFF, remove the jumper wire, disconnect the X2 harness connector at the X50A Fuse Block - Underhood.
 2. Test for infinite resistance between the X2 harness connector at the X50A Fuse Block - Underhood control circuit terminal 25 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If less than infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the X50A Fuse Block - Underhood.
 - **If the M75 Windshield Wiper Motor activates**
23. Connect a 10 A fused jumper wire between the control circuit terminal 24 X5 and ground.
24. Verify the M75 Windshield Wiper Motor activates.
 - **If the M75 Windshield Wiper Motor does not activate**
 1. Ignition OFF, remove the jumper wire, disconnect the X2 harness connector at the X50A Fuse Block - Underhood.
 2. Test for less than 1 V between the X2 harness connector at the X50A Fuse Block - Underhood control circuit terminal 26 and ground.
 - If 1 V or greater, repair the short to ground on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the X50A Fuse Block - Underhood.
 - **If the M75 Windshield Wiper Motor activates**
25. Replace the K9 Body Control Module.

Component Testing

Windshield Wiper/Washer Switch

1. Ignition OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch.
2. Test for infinite resistance between the signal terminal 4 and the low reference terminal 1 with the switch in the open position.
 - **If less than infinite resistance**

Replace the S82 Windshield Wiper/Washer Switch.
 - **If infinite resistance**
3. Test for less than 2 ohms between the signal circuit terminal 4 and the low reference circuit terminal 1

with the switch in the closed position.

- **If 2 ohms or greater**

Replace the S82 Windshield Wiper/Washer Switch.

- **If less than 2 ohms**

4. Test for infinite resistance between the signal terminal 3 and the low reference terminal 1 with the switch in the open position.

- **If less than infinite resistance**

Replace the S82 Windshield Wiper/Washer Switch.

- **If infinite resistance**

5. Verify the resistance readings are within the specified range listed below between the signal circuit terminal 3 and the low reference circuit terminal 1 by pushing the switch in the listed positions below.

- Delay 1 : 3.75-3.85kohms
- Delay 2 : 2.75-2.85kohms
- Delay 3 : 1.95-2.05kohms
- Delay 4 : 1.25-1.35kohms
- Delay 5 : 765-775ohms

- **If not within the specified range**

Replace the S82 Windshield Wiper/Washer Switch.

- **If within the specified range**

6. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Windshield Wiper Motor Replacement**
- **Windshield Wiper and Washer Switch Replacement**
- **Control Module References** for BCM replacement, programming and setup

DTC B3811: REAR WASHER RELAY

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B3811

Rear Washer Relay Circuit

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Rear Washer Switch Control	2	3	3	-
Rear Washer Relay Control	B3811 02	B3811 04	B3811 01	-
Rear Washer Fluid Pump Control	1	1	2	-
Rear Washer Fluid Pump Ground	-	1	1, 2	-
1. Rear Washer Inoperative. 2. Rear Washer Always ON. 3. Rear Wipers and Washers Inoperative.				

Circuit/System Description

When the body control module (BCM) detects that the Rear Wiper/Wash switch has activated the momentary Wash switch, it activates a high side drive output which supplies battery to the coil of the rear washer pump relay. This energizes the relay, which switches battery power to the washer pump motor. The BCM will also activate continuous low speed windshield wipers as described above. This Washer and Wiper operation shall be continued so long as the switch remains active. Upon termination, the rear wash motor will be deactivated and the wiper shall move to its Park position and deactivate.

Conditions for Running the DTC

- Ignition ON.
- The system voltage is between 9-16 V.

Conditions for Setting the DTC

B3811 01

A short to voltage has been detected on the rear window washer pump relay control circuit

B3811 02

A short to ground is detected in the rear washer relay control circuit.

B3811 04

A open/high resistance has been detected on the rear window washer pump relay control circuit

Action Taken When the DTC Sets

Rear washer operation is disabled.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- A history DTC will clear after 50 consecutive ignition cycles without a fault present.

Reference Information

Schematic Reference

Wiper/Washer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Wiper/Washer System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Rear Wiper Switch parameter changes between Off and On when pressing the windshield washer switch.

- **If the parameter does not change**

Refer to **Rear Wiper System Malfunction**

- **If the parameter changes**

3. Verify the rear window washers turn On when commanding the Rear Washer Relay Active with a scan tool.

- **If the Rear Window Washers do not turn ON**

Refer to Circuit/System Testing

- **If the Rear Window Washers turn ON**

4. All OK.

Circuit/System Testing

1. Ignition OFF, and all vehicle systems OFF. Disconnect the harness connector at the G19 Rear Window Washer Pump. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 2 and ground.
 - **If 10 ohms or greater**
 1. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Connect a test lamp between the control circuit terminal 1 and the ground circuit terminal 2, ignition ON.
4. Verify the test lamp does NOT turn ON and OFF when commanding the Rear Washer Relay Active and Inactive with a scan tool.
 - **If the test lamp turns ON and OFF**

Test or replace the G19 Rear Window Washer Pump.

- **If the test lamp does not turn ON and OFF**

5. Ignition OFF, connect the harness connector at the G19 Rear Window Washer Pump. Disconnect the X2 harness connector at the X50A Fuse Block - Underhood, It may take up to 2 min for all vehicle systems to power down.
6. Test for less than 10 ohms between the ground circuit terminal 39 and ground.
 - **If 10 ohms or greater**
 1. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
7. Ignition OFF, connect the X2 harness connector at the X50A Fuse Block - Underhood. Disconnect the X1 harness connector at the X50A Fuse Block - Underhood, ignition ON.
8. Verify the G19 Rear Window Washer Pump is not activated.
 - **If the G19 Rear Window Washer Pump is activated**
 1. Ignition OFF, disconnect the harness connector at the G19 Rear Window Washer Pump, ignition ON.
 2. Test for less than 1 V between the control circuit terminal 1 and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the G19 Rear Window Washer Pump.
 - **If the G19 Rear Window Washer Pump is not activated**
9. Connect a 20 A fused jumper wire between the control circuit terminal 14 and B+.
 10. Verify the G19 Rear Window Washer Pump activates.
 - **If the G19 Rear Window Washer Pump does not activate**
 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the G19 Rear Window Washer Pump, ignition ON.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than Infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the G19 Rear Window Washer Pump.
 - **If the G19 Rear Window Washer Pump activates**
 11. Ignition OFF, connect the X1 harness connector at the X50A Fuse Block - Underhood. Disconnect the X1 harness connector at the K9 Body Control Module, ignition ON.
 12. Verify the G19 Rear Window Washer Pump is not activated.
 - **If the G19 Rear Window Washer Pump is activated**
 1. Ignition OFF, disconnect the X2 harness connector at the X50A Fuse Block - Underhood, ignition ON.
 2. Test for less than 1 V between the control circuit terminal 4 and B+.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the X50A Fuse Block - Underhood.
 - **If the G19 Rear Window Washer Pump is not activated**
 13. Connect a 10 A fused jumper wire between the control circuit terminal 6 and B+.
 14. Verify the G19 Rear Window Washer Pump activates.
 - **If the G19 Rear Window Washer Pump does not activate**
 1. Ignition OFF, remove the jumper wire, disconnect the X2 harness connector at the X50A Fuse Block - Underhood.
 2. Test for infinite resistance between the control circuit terminal 4 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If less than infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the X50A Fuse Block - Underhood.
 - **If the G19 Rear Window Washer Pump activates**
 15. Replace the K9 Body Control Module.

Component Testing

Windshield Wiper/Washer Switch

1. Ignition OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch.
2. Test for infinite resistance between the signal terminal 7 and the low reference terminal 1 with the rear window washer switch in the open position.

- **If less than infinite resistance**

Replace the S82 Windshield Wiper/Washer Switch.

- **If infinite resistance**

3. Verify the resistance reading is within the range specified below between the signal circuit terminal 7 and the low reference circuit terminal 2 by cycling the switch between Rear Wiper position and Rear Washers position.

- Rear Wiper : 624-644ohms
- Rear Wiper Sweep : 1.99-2.01kohms
- Rear Washer : 6.11-6.13kohms

- **If not within range specified**

Replace the S82 Windshield Wiper/Washer Switch.

- **If within range specified**

4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Relay Replacement (Within an Electrical Center)** , **Relay Replacement (Attached to Wire Harness)**
- **Windshield Washer Pump Replacement**
- **Windshield Wiper and Washer Switch Replacement**
- **Control Module References** for BCM replacement, programming and setup

DTC B3873: FRONT WASHER RELA

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B3873 01

Front Washer Relay Circuit Short to Battery

DTC B3873 02

Front Washer Relay Circuit Short to Ground

DTC B3873 04

Front Washer Relay Circuit Open Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Windshield Washer Switch Signal	2	1	-	-
Windshield Washer Pump Control	1	1	2	-
Windshield Washer Relay Control	B3873 02	B3873 04	B3873 01	-
Windshield Washer Pump Ground	-	1	-	-
Windshield Wiper/Washer Switch Low Reference	-	1	-	-
1. Washer Inoperative 2. Washer Always ON				

Circuit/System Description

The body control module (BCM) controls the windshield washer pump based on an input from the windshield wiper/washer switch. The BCM monitors the washer switch through the windshield washer switch signal circuit. When the washer switch is closed, ground is supplied to the windshield washer switch signal circuit. When this is the case, the BCM will command the windshield washer pump and the low speed wipers on.

Conditions for Running the DTC

- Ignition ON.
- The system voltage is between 9-16 V.

Conditions for Setting the DTC

- A short to ground or an open/high resistance is detected in the windshield washer relay control circuit.
- A short to voltage is detected in the windshield washer relay control circuit.

Action Taken When the DTC Sets

Washer operation is suspended.

Conditions for Clearing the DTC

A current DTC clears when the diagnostic runs and passes.

Reference Information

Schematic Reference

Wiper/Washer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Wiper/Washer System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Windshield Washer Switch parameter changes between Active and Inactive when pressing the windshield washer switch.
 - **If the parameter does not change**

Refer to Circuit/System Testing - Windshield Wiper/Washer Switch Malfunction.
 - **If the parameter changes**
3. Verify the windshield washers turn On when commanding the Windshield Washer Relay Active with a scan tool.
 - **If the Windshield Washers do not turn ON**

Refer to Circuit/System Testing - Windshield Washer Pump Malfunction
 - **If the Windshield Washers turn ON**

4. All OK.

Circuit/System Testing

Windshield Wiper/Washer Switch Malfunction

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch. It may take up to 11 min for all vehicle systems to power down.
2. Test for less than 10 ohms between the low reference circuit terminal 1 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If less than 10 ohms**
3. Ignition ON.
4. Verify the scan tool Windshield Washer Switch parameter is Inactive.
 - **If not Inactive**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal 8 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 8 and the low reference circuit terminal 1.
6. Verify the scan tool Windshield Washer Switch parameter is Active.
 - **If not Active**
 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If Active**
7. Test or replace the S82 Windshield Wiper/Washer Switch.

Windshield Washer Pump Malfunction

1. Ignition OFF, and all vehicle systems OFF. Disconnect the harness connector at the G24 Windshield Washer Pump. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 2 and ground.
 - **If 10 ohms or greater**
 1. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Connect a test lamp between the control circuit terminal 1 and the ground circuit terminal 2, ignition ON.
4. Verify the test lamp does NOT turn ON and OFF when commanding the Windshield Washer Relay Active and Inactive with a scan tool.
 - **If the test lamp turns ON and OFF**

Test or replace the G24 Windshield Washer Pump.

- **If the test lamp does not turn ON and OFF**
5. Ignition OFF, connect the harness connector at the G24 Windshield Washer Pump. Disconnect the X2 harness connector at the X50A Fuse Block - Underhood, It may take up to 2 min for all vehicle systems to power down.
 6. Test for less than 10 ohms between the ground circuit terminal 39 and ground.
 - **If 10 ohms or greater**
 1. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
 7. Ignition OFF, connect the X2 harness connector at the X50A Fuse Block - Underhood and disconnect the X1 harness connector at the X50A Fuse Block - Underhood, ignition ON..
 8. Verify the G24 Windshield Washer Pump is not activated.
 - **If the G24 Windshield Washer Pump is activated**
 1. Ignition OFF, disconnect the harness connector at the G24 Windshield Washer Pump, ignition ON.
 2. Test for less than 1 V between the control circuit terminal 1 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the G24 Windshield Washer Pump.
 - **If the G24 Windshield Washer Pump is not activated**
 9. Connect a 20 A fused jumper wire between the control circuit terminal 8 and B+.
 10. Verify the G24 Windshield Washer Pump activates.
 - **If the G24 Windshield Washer Pump does not activate**
 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the G24 Windshield Washer Pump, ignition ON.
 2. Test for infinite resistance between the control circuit and ground.

- If less than Infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
- 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the G24 Windshield Washer Pump.
 - **If the G24 Windshield Washer Pump activates**
- 11. Ignition OFF, connect the X1 harness connector at the X50A Fuse Block - Underhood. Disconnect the X4 harness connector at the K9 Body Control Module, ignition ON.
- 12. Verify the G24 Windshield Washer Pump is not activated.
 - **If the G24 Windshield Washer Pump is activated**
 1. Ignition OFF, disconnect the X2 harness connector at the X50A Fuse Block - Underhood, ignition ON.
 2. Test for less than 1 V between the control circuit terminal 18 and B+.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the X50A Fuse Block - Underhood.
 - **If the G24 Windshield Washer Pump is not activated**
- 13. Connect a 10 A fused jumper wire between the control circuit terminal 14 and B+.
- 14. Verify the G24 Windshield Washer Pump activates.
 - **If the G24 Windshield Washer Pump does not activate**
 1. Ignition OFF, remove the jumper wire, disconnect the X2 harness connector at the X50A Fuse Block - Underhood.
 2. Test for infinite resistance between the control circuit terminal 18 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If less than infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the X50A Fuse Block - Underhood.
 - **If the G24 Windshield Washer Pump activates**
- 15. Replace the K9 Body Control Module.

Component Testing

Windshield Wiper/Washer Switch

1. Ignition OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch.
2. Test for infinite resistance between the signal terminal 8 and the low reference terminal 1 with the switch in the open position.
 - **If less than infinite resistance**

Replace the S82 Windshield Wiper/Washer Switch.

- **If infinite resistance**
- 3. Test for less than 2 ohms between the signal circuit terminal 8 and the low reference circuit terminal 1 with the switch in the closed position.

- **If 2 ohms or greater**

Replace the S82 Windshield Wiper/Washer Switch.

- **If less than 2 ohms**

- 4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Windshield Washer Pump Replacement**
- **Relay Replacement (Within an Electrical Center)** , **Relay Replacement (Attached to Wire Harness)**
- **Windshield Wiper and Washer Switch Replacement**
- **Control Module References** for BCM replacement, programming, and setup.

SYMPTOMS - WIPER/WASHER SYSTEMS

NOTE: **The following steps must be completed before using the symptom tables:**

1. Perform **Diagnostic System Check - Vehicle** , in order to verify that all of the following conditions are true:
 - No DTCs are set.
 - The control modules can communicate via the serial data link.
2. Refer to **Wiper/Washer System Description and Operation** in order to familiarize yourself with the system functions.

Visual/Physical Inspection

- Inspect for aftermarket devices which may affect the operation of the windshield wiper/washer system. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which may cause the symptom.
- Inspect the washer fluid reservoir for the proper fluid level.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Windshield Wiper System Malfunction**
- **Washer Malfunction**
- **Rear Washer System Malfunction**
- **Rear Wiper System Malfunction**

WINDSHIELD WIPER SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B3715 01

Windshield Wiper Relay Circuit Short to Battery

DTC B3715 02

Windshield Wiper Relay Circuit Short to Ground

DTC B3715 04

Windshield Wiper Relay Circuit Open

DTC B3875 01

Windshield Wiper High Speed Relay Circuit Short to Battery

DTC B3875 02

Windshield Wiper High Speed Relay Circuit Short to Ground

DTC B3875 04

Windshield Wiper High Speed Relay Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Windshield Wiper Switch Signal				

terminal 3	1	1	1	-
Windshield Wiper Switch Signal terminal 4	4	2	-	-
Windshield Wiper Motor Park Signal	3	3	-	-
Windshield Wiper Relay Control	B3715 02	B3715 04	B3715 01	-
Windshield Wiper Speed Control Relay Control	B3875 02	B3875 04	B3875 01	-
Windshield Wiper High Speed Motor Control	2	2	4	-
Front Wiper Low Speed Motor Control	1	1	4	-
Windshield Wiper Switch Low Reference	-	1, 2	-	-
Windshield Wiper Motor Ground	-	1, 2, 3	-	-
Windshield Wiper Relay Ground	-	1	-	-
1. Delay or Low Speed Wipers Inoperative 2. High Speed Wipers Inoperative 3. Wipers Do Not Park 4. Wipers Always ON				

Circuit/System Description

The body control module (BCM) controls the wiper motor based on input from the windshield wiper/washer switch. The BCM monitors the wiper/washer switch through two separate signal circuits and a low reference circuit. The windshield wiper switch high signal circuit is used to determine high speed wiper operation, the windshield wiper switch low signal is used to determine low speed, intermittent, and mist operation through the use of a resistor ladder, and the windshield washer switch signal circuit is used to determine washer operation.

The BCM controls the windshield wiper motor through two output controls, controlling two relays which determine the desired wiper speed, high or low.

Conditions for Running the DTC

- The DTC runs only when a wiper output is actively being requested by the BCM.
- The system voltage is between 9-16 V.

Conditions for Setting the DTC

- A short to ground is detected in the Front Wiper Relay control circuit or in the High Speed Relay control circuit.
- A short to voltage or an open/high resistance is detected in the Front Wiper Relay control circuit or in the High Speed Relay control circuit.

Action Taken When the DTC Sets

The BCM will not activate the wiper output.

Conditions for Clearing the DTC

- A current DTC will clear when the condition for setting the fault is no longer present.
- A history DTC will clear after 50 consecutive ignition cycles without a fault present.

Reference Information

Schematic Reference

Wiper/Washer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Wiper/Washer System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Windshield Wiper High Speed Switch parameter changes between Active and Inactive when activating the high speed windshield wipers.
 - **If the parameter does not change**

Refer to Circuit/System Testing - Windshield Wiper/Washer Switch Malfunction.

- **If the parameter changes**
3. Verify the scan tool Windshield Wiper Switch parameter changes between Off and Low when activating the low speed windshield wipers.
 - **If the parameter does not change**

Refer to Circuit/System Testing - Windshield Wiper/Washer Switch Malfunction.

- **If the parameter changes**

4. Verify the scan tool Windshield Wiper Switch parameter changes between Delay 1 and Delay 5 when cycling the intermittent speed windshield wipers.

- **If the parameter does not change**

Test or replace the S82 Windshield Wiper/Washer Switch.

- **If the parameter changes**

5. Verify the M75 Windshield Wiper Motor changes between Off, Low, and High when cycling the S82 Windshield Wiper/Washer Switch between Off, Low, and High.

- **If the Windshield Wiper Motor does not cycle between Off, Low, and High**

Refer to Circuit/System Testing - Windshield Wiper Motor Malfunction

- **If the Windshield Wiper Motor cycles between Off, Low, and High**

6. Ignition OFF.
7. Verify the scan tool Windshield Wiper Park Switch parameter is Active.

- **If the parameter does not change**

Refer to Circuit/System Testing - Windshield Wiper Motor Malfunction.

- **If the parameter changes**

8. All OK.

Circuit/System Testing

Windshield Wiper/Washer Switch Malfunction

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch. It may take up to 11 min for all vehicle systems to power down.
2. Test for less than 10 ohms between the low reference circuit terminal 1 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If less than 10 ohms**
3. Ignition ON.
4. Verify the scan tool Windshield Wiper High Speed Switch parameter is Inactive.
 - **If not Inactive**

1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
2. Test for infinite resistance between the signal circuit terminal 4 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
- **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 4 and the low reference circuit terminal 1.
6. Verify the scan tool Windshield Wiper High Speed Switch parameter is Active.
 - **If not Active**
 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If Active**
7. Test for greater than 8 V between the signal circuit terminal 3 and ground.
 - **If less than 8 V**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit and ground
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If 8 V or greater**
8. Ignition OFF, disconnect the X3 harness connector at the K9 Body Control Module, ignition ON.
9. Test for less than 1 V between the S82 Windshield Wiper/Washer Switch signal circuit terminal 3 and ground.
 - **If 1 V or greater**

Repair the short to voltage on the circuit.
 - **If less than 1 V**
10. Test or replace the S82 Windshield Wiper/Washer Switch.

Windshield Wiper Motor Malfunction

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the M75 Windshield Wiper Motor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 ohms between the appropriate ground circuit terminal listed below and ground.
 - Terminal 6, (LHD)
 - Terminal 4, (RHD)
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Ignition ON.
4. Verify the scan tool Windshield Wiper Park Switch parameter is Inactive.
 - **If not Inactive**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the appropriate signal circuit terminal listed below and ground.
 - Terminal 4, (LHD)
 - Terminal 6, (RHD)
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If Inactive**
5. Install a 3 A fused jumper wire between the appropriate signal circuit terminal listed below and ground.
 - Terminal 4, (LHD)
 - Terminal 6, (RHD)
6. Verify the scan tool Windshield Wiper Park Switch parameter is Active.
 - **If not Active**
 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If Active**
7. Connect a test lamp between the control circuit terminal 2 and ground, ignition ON.
8. Verify the test lamp does NOT turn ON and OFF when commanding the Windshield Washer Relay Low and Off with a scan tool.

- **If the test lamp turns ON and OFF**

Test or replace the M75 Windshield Wiper Motor.

- **If the test lamp does not turn ON and OFF**

9. Connect a test lamp between the appropriate circuit terminal listed below and ground, ignition ON.
 - Terminal 3, (LHD)
 - Terminal 1, (RHD)
10. Verify the test lamp does NOT turn ON and OFF when commanding the Windshield Washer Relay High and Off with a scan tool.

- **If the test lamp turns ON and OFF**

Test or replace the M75 Windshield Wiper Motor.

- **If the test lamp does not turn ON and OFF**

11. Ignition OFF and all vehicle systems OFF, connect the harness connector at the M75 Windshield Wiper Motor. Disconnect the X2 (LHD) or X1 and X2 (RHD) harness connector(s) at the X50A Fuse Block - Underhood. It may take up to 2 min for all vehicle systems to power down.
12. Test for less than 10 ohms between the ground circuit terminals listed below and ground.
 - Terminal 39
 - Terminal 35
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
13. Ignition ON.
14. Verify the M75 Windshield Wiper Motor is not activated.

- **If the M75 Windshield Wiper Motor is activated**

1. Ignition OFF, disconnect the harness connector at the M75 Windshield Wiper Motor, ignition ON.
2. Test for less than 1 V between the control circuit terminals listed below and ground.
 - Terminal 2
 - Terminal 3, (LHD)
 - Terminal 1, (RHD)
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the M75 Windshield Wiper Motor.

- **If the M75 Windshield Wiper Motor is not activated**

15. Connect a 20 A fused jumper wire between the control circuit terminals listed below, one at a time, and B+.

- Terminal 5, (LHD)
 - Terminal 29, (RHD)
 - Terminal 6, (LHD)
 - Terminal 7, (RHD)
16. Verify the M75 Windshield Wiper Motor activates.
 - **If the M75 Windshield Wiper Motor does not activate**
 - 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the M75 Windshield Wiper Motor.
 - 2. Test for infinite resistance between the control circuit and ground.
 - If less than Infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 - 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the M75 Windshield Wiper Motor.
 - **If the M75 Windshield Wiper Motor activates**
 17. Ignition OFF, connect the X2 (LHD) or X1 and X2 (RHD) harness connector(s) at the X50A Fuse Block - Underhood. Disconnect the X4 harness connector at the K9 Body Control Module, ignition ON.
 18. Verify the M75 Windshield Wiper Motor low speed is not activated.
 - **If the M75 Windshield Wiper Motor low speed is activated**
 - 1. Ignition OFF, disconnect the X2 harness connector at the X50A Fuse Block - Underhood, ignition ON.
 - 2. Test for less than 1 V between the X2 harness connector at the X50A Fuse Block - Underhood control circuit terminal 16 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the X50A Fuse Block - Underhood.
 - **If the M75 Windshield Wiper Motor low speed is not activated**
 19. Ignition OFF, disconnect the X5 harness connector at the K9 Body Control Module, ignition ON.
 20. Verify the M75 Windshield Wiper Motor High Speed is not activated.
 - **If the M75 Windshield Wiper Motor high speed is activated**
 - 1. Ignition OFF, disconnect the X2 harness connector at the X50A Fuse Block - Underhood, ignition ON.
 - 2. Test for infinite resistance between the X2 harness connector at the X50A Fuse Block - Underhood control circuit terminal 24 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the X50A Fuse Block - Underhood.
 - **If the M75 Windshield Wiper Motor high speed is not activated**
 21. Connect a 10 A fused jumper wire between the control circuit terminal 16 X4 and B+.
 22. Verify the M75 Windshield Wiper Motor activates.
 - **If the M75 Windshield Wiper Motor does not activate**

1. Ignition OFF, remove the jumper wire, disconnect the X2 harness connector at the X50A Fuse Block - Underhood.
2. Test for infinite resistance between the X2 harness connector at the X50A Fuse Block - Underhood control circuit terminal 25 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If less than infinite resistance
3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the X50A Fuse Block - Underhood.
 - **If the M75 Windshield Wiper Motor activates**
23. Connect a 10 A fused jumper wire between the control circuit terminal 24 X5 and ground.
24. Verify the M75 Windshield Wiper Motor activates.
 - **If the M75 Windshield Wiper Motor does not activate**
 - 1. Ignition OFF, remove the jumper wire, disconnect the X2 harness connector at the X50A Fuse Block - Underhood.
 - 2. Test for less than 1 V between the X2 harness connector at the X50A Fuse Block - Underhood control circuit terminal 26 and ground.
 - If 1 V or greater, repair the short to ground on the circuit.
 - If less than 1 V
 - 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the X50A Fuse Block - Underhood.
 - **If the M75 Windshield Wiper Motor activates**
25. Replace the K9 Body Control Module.

Component Testing

Windshield Wiper/Washer Switch

1. Ignition OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch.
2. Test for infinite resistance between the signal terminal 4 and the low reference terminal 1 with the switch in the open position.
 - **If less than infinite resistance**

Replace the S82 Windshield Wiper/Washer Switch.

 - **If infinite resistance**
3. Test for less than 2 ohms between the signal circuit terminal 4 and the low reference circuit terminal 1 with the switch in the closed position.
 - **If 2 ohms or greater**

Replace the S82 Windshield Wiper/Washer Switch.

- **If less than 2 ohms**

4. Test for infinite resistance between the signal terminal 3 and the low reference terminal 1 with the switch in the open position.

- **If less than infinite resistance**

Replace the S82 Windshield Wiper/Washer Switch.

- **If infinite resistance**

5. Verify the resistance readings are within the specified range listed below between the signal circuit terminal 3 and the low reference circuit terminal 1 by pushing the switch in the listed positions below.
 - Delay 1 : 3.75-3.85kohms
 - Delay 2 : 2.75-2.85kohms
 - Delay 3 : 1.95-2.05kohms
 - Delay 4 : 1.25-1.35kohms
 - Delay 5 : 765-775ohms
- **If not within the specified range**

Replace the S82 Windshield Wiper/Washer Switch.

- **If within the specified range**

6. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Windshield Wiper Motor Replacement**
- **Windshield Wiper and Washer Switch Replacement**
- **Control Module References** for BCM replacement, programming and setup

WASHER MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B3873 01

Front Washer Relay Circuit Short to Battery

DTC B3873 02

Front Washer Relay Circuit Short to Ground

DTC B3873 04

Front Washer Relay Circuit Open Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Windshield Washer Switch Signal	2	1	-	-
Windshield Washer Pump Control	1	1	2	-
Windshield Washer Relay Control	B3873 02	B3873 04	B3873 01	-
Windshield Washer Pump Ground	-	1	-	-
Windshield Wiper/Washer Switch Low Reference	-	1	-	-
1. Washer Inoperative 2. Washer Always ON				

Circuit/System Description

The body control module (BCM) controls the windshield washer pump based on an input from the windshield wiper/washer switch. The BCM monitors the washer switch through the windshield washer switch signal circuit. When the washer switch is closed, ground is supplied to the windshield washer switch signal circuit. When this is the case, the BCM will command the windshield washer pump and the low speed wipers on.

Conditions for Running the DTC

- Ignition ON.
- The system voltage is between 9-16 V.

Conditions for Setting the DTC

- A short to ground or an open/high resistance is detected in the windshield washer relay control circuit.
- A short to voltage is detected in the windshield washer relay control circuit.

Action Taken When the DTC Sets

Washer operation is suspended.

Conditions for Clearing the DTC

A current DTC clears when the diagnostic runs and passes.

Reference Information

Schematic Reference

Wiper/Washer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Wiper/Washer System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Windshield Washer Switch parameter changes between Active and Inactive when pressing the windshield washer switch.
 - **If the parameter does not change**

Refer to Circuit/System Testing - Windshield Wiper/Washer Switch Malfunction.
 - **If the parameter changes**
3. Verify the windshield washers turn On when commanding the Windshield Washer Relay Active with a scan tool.
 - **If the Windshield Washers do not turn ON**

Refer to Circuit/System Testing - Windshield Washer Pump Malfunction
 - **If the Windshield Washers turn ON**
4. All OK.

Circuit/System Testing

Windshield Wiper/Washer Switch Malfunction

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch. It may take up to 11 min for all vehicle systems to power down.
2. Test for less than 10 ohms between the low reference circuit terminal 1 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If less than 10 ohms**
3. Ignition ON.
4. Verify the scan tool Windshield Washer Switch parameter is Inactive.
 - **If not Inactive**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal 8 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 8 and the low reference circuit terminal 1.
6. Verify the scan tool Windshield Washer Switch parameter is Active.
 - **If not Active**
 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If Active**
7. Test or replace the S82 Windshield Wiper/Washer Switch.

Windshield Washer Pump Malfunction

1. Ignition OFF, and all vehicle systems OFF. Disconnect the harness connector at the G24 Windshield Washer Pump. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 ohms between the ground circuit terminal 2 and ground.
 - **If 10 ohms or greater**
 1. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Connect a test lamp between the control circuit terminal 1 and the ground circuit terminal 2, ignition ON.
4. Verify the test lamp does NOT turn ON and OFF when commanding the Windshield Washer Relay Active and Inactive with a scan tool.
 - **If the test lamp turns ON and OFF**

Test or replace the G24 Windshield Washer Pump.

- **If the test lamp does not turn ON and OFF**
5. Ignition OFF, connect the harness connector at the G24 Windshield Washer Pump. Disconnect the X2 harness connector at the X50A Fuse Block - Underhood, It may take up to 2 min for all vehicle systems to power down.
 6. Test for less than 10 ohms between the ground circuit terminal 39 and ground.
 - **If 10 ohms or greater**
 1. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
 7. Ignition OFF, connect the X2 harness connector at the X50A Fuse Block - Underhood and disconnect the X1 harness connector at the X50A Fuse Block - Underhood, ignition ON..
 8. Verify the G24 Windshield Washer Pump is not activated.
 - **If the G24 Windshield Washer Pump is activated**
 1. Ignition OFF, disconnect the harness connector at the G24 Windshield Washer Pump, ignition ON.
 2. Test for less than 1 V between the control circuit terminal 1 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the G24 Windshield Washer Pump.
 - **If the G24 Windshield Washer Pump is not activated**
 9. Connect a 20 A fused jumper wire between the control circuit terminal 8 and B+.
 10. Verify the G24 Windshield Washer Pump activates.
 - **If the G24 Windshield Washer Pump does not activate**
 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the G24 Windshield Washer Pump, ignition ON.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than Infinite resistance, repair the short to ground on the circuit.

- If infinite resistance
- 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the G24 Windshield Washer Pump.
 - **If the G24 Windshield Washer Pump activates**
- 11. Ignition OFF, connect the X1 harness connector at the X50A Fuse Block - Underhood. Disconnect the X4 harness connector at the K9 Body Control Module, ignition ON.
- 12. Verify the G24 Windshield Washer Pump is not activated.
 - **If the G24 Windshield Washer Pump is activated**
 1. Ignition OFF, disconnect the X2 harness connector at the X50A Fuse Block - Underhood, ignition ON.
 2. Test for less than 1 V between the control circuit terminal 18 and B+.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the X50A Fuse Block - Underhood.
 - **If the G24 Windshield Washer Pump is not activated**
- 13. Connect a 10 A fused jumper wire between the control circuit terminal 14 and B+.
- 14. Verify the G24 Windshield Washer Pump activates.
 - **If the G24 Windshield Washer Pump does not activate**
 1. Ignition OFF, remove the jumper wire, disconnect the X2 harness connector at the X50A Fuse Block - Underhood.
 2. Test for infinite resistance between the control circuit terminal 18 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If less than infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the X50A Fuse Block - Underhood.
 - **If the G24 Windshield Washer Pump activates**
- 15. Replace the K9 Body Control Module.

Component Testing

Windshield Wiper/Washer Switch

1. Ignition OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch.
2. Test for infinite resistance between the signal terminal 8 and the low reference terminal 1 with the switch in the open position.
 - **If less than infinite resistance**

Replace the S82 Windshield Wiper/Washer Switch.
 - **If infinite resistance**

3. Test for less than 2 ohms between the signal circuit terminal 8 and the low reference circuit terminal 1 with the switch in the closed position.

- **If 2 ohms or greater**

Replace the S82 Windshield Wiper/Washer Switch.

- **If less than 2 ohms**

4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Windshield Washer Pump Replacement**
- **Relay Replacement (Within an Electrical Center)** , **Relay Replacement (Attached to Wire Harness)**
- **Windshield Wiper and Washer Switch Replacement**
- **Control Module References** for BCM replacement, programming, and setup.

REAR WIPER SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Rear Wiper Switch Signal	2	1	1	-
Rear Wiper MotorControl	1	1	2	-
Rear Window Wiper Relay Control	1	1	2	-
Rear Wiper Relay Control	1	1	2	-
Rear Wiper Motor Ground	-	1	1	-
Rear Wiper Relay Ground	-	1	-	-
1. Rear Wiper Inoperative. 2. Rear Wiper Always ON.				

Circuit/System Description

The body control module (BCM) controls the single speed rear wiper motor by its active high output to the external rear wiper motor relay. When the BCM activates its output and applies battery to the coil of the relay,

the relay energizes, allowing battery voltage from the fuse to be applied through the switched contacts of the rear wiper motor relay to the control input of the rear wiper motor. The motor then operates continuously at low speed.

Reference Information

Schematic Reference

Wiper/Washer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Wiper/Washer System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Rear Wiper Switch parameter changes between Off and On when turning the rear wipers ON and OFF..
 - **If the parameter does not change**

Refer to Circuit/System Testing - Rear Wiper/Washer Switch Malfunction.
 - **If the parameter changes**
3. Verify the Rear Wiper Motor turns On when commanding the Rear Wiper Active with a scan tool.
 - **If the Rear Wiper Motor does not turn ON**

Refer to Circuit/System Testing - Rear Wiper Motor Malfunction
 - **If the Rear Wiper Motor turns ON**

4. All OK.

Circuit/System Testing

Rear Wiper/Washer Switch Malfunction

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch. It may take up to 11 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the low reference circuit terminal 1 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If less than 10 ohms**
3. Ignition ON.
4. Test for greater than 8 V between the signal circuit terminal 7 and ground.
 - **If less than 8 V**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit and ground
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K9 Body Control Module.
 - **If 8 V or greater**
5. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module, ignition ON.
6. Test for less than 1 V between the S82 Windshield Wiper/Washer Switch signal circuit terminal 7 and ground.
 - **If 1 V or greater**

Repair the short to voltage on the circuit.
 - **If less than 1 V**
7. Test or replace the S82 Windshield Wiper/Washer Switch.

Rear Wiper Motor Malfunction

1. Ignition OFF, and all vehicle systems OFF. Disconnect the harness connector at the M45 Rear Wiper Motor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 1 and ground.

- **If 10 ohms or greater**

1. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.

- **If less than 10 ohms**

3. Ignition ON.
4. Verify a test lamp illuminates between the B+ circuit terminal 3 and the ground circuit terminal 1.
 - **If the test lamp does not illuminate**
 1. Ignition OFF, remove the test lamp. Disconnect the X2 harness connector at the X50A Fuse Block - Underhood.
 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the X50A Fuse Block - Underhood.
 - **If the test lamp illuminates**
5. Connect a test lamp between the control circuit terminal 2 and the ground circuit terminal 1.
6. Verify the test lamp does NOT turn ON and OFF when commanding the Rear Wiper On and Off with a scan tool.
 - **If the test lamp turns ON and OFF**

Test or replace the M45 Rear Wiper Motor.

- **If the test lamp does not turn ON and OFF**

7. Ignition OFF, connect the harness connector at the M45 Rear Wiper Motor. Disconnect the X2 harness connector at the X50A Fuse Block - Underhood, It may take up to 2 minutes for all vehicle systems to power down.
8. Test for less than 10 ohms between the ground circuits listed below and ground.
 - Terminal 39
 - Terminal 44
 - **If 10 ohms or greater**
 1. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
9. Ignition ON.
10. Verify the M45 Rear Wiper Motor is not activated.
 - **If the M45 Rear Wiper Motor is activated**
 1. Ignition OFF, disconnect the harness connector at the M45 Rear Wiper Motor, ignition ON.
 2. Test for less than 1 V between the control circuit terminal 1 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.

- If less than 1 V, replace the M45 Rear Wiper Motor.
 - **If the M45 Rear Wiper Motor is not activated**
11. Connect a 20 A fused jumper wire between the circuits listed below and B+.
 - B+ Circuit Terminal 29
 - Control Circuit Terminal 30
 12. Verify the M45 Rear Wiper Motor activates.
 - **If the M45 Rear Wiper Motor does not activate**
 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the M45 Rear Wiper Motor, ignition ON.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than Infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the M45 Rear Wiper Motor.
 - **If the M45 Rear Wiper Motor activates**
 13. Ignition OFF, connect the X2 harness connector at the X50A Fuse Block - Underhood. Disconnect the X4 harness connector at the K9 Body Control Module, ignition ON.
 14. Verify the M45 Rear Wiper Motor is not activated.
 - **If the M45 Rear Wiper Motor is activated**
 1. Ignition OFF, disconnect the X2 harness connector at the X50A Fuse Block - Underhood, ignition ON.
 2. Test for less than 1 V between the control circuit terminal 10 and B+.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the X50A Fuse Block - Underhood.
 - **If the M45 Rear Wiper Motor is not activated**
 15. Connect a 10 A fused jumper wire between the control circuit terminal 10 and B+.
 16. Verify the M45 Rear Wiper Motor activates.
 - **If the M45 Rear Wiper Motor does not activate**
 1. Ignition OFF, remove the jumper wire, disconnect the X2 harness connector at the X50A Fuse Block - Underhood.
 2. Test for infinite resistance between the control circuit terminal 27 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If less than infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the X50A Fuse Block - Underhood.
 - **If the M45 Rear Wiper Motor activates**

17. Test or replace the K9 Body Control Module.

Component Testing

Windshield Wiper/Washer Switch

1. Ignition OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch.
2. Test for infinite resistance between the signal terminal 7 and the low reference terminal 1 with the rear window washer switch in the open position.
 - **If less than infinite resistance**

Replace the S82 Windshield Wiper/Washer Switch.
 - **If infinite resistance**
3. Verify the resistance reading is within the range specified below between the signal circuit terminal 7 and the low reference circuit terminal 1 by cycling the switch between Rear Wiper position and Rear Washers position.
 - Rear Wiper : 624-644ohms
 - Rear Wiper Sweep : 1.99-2.01kohms
 - Rear Washer : 6.11-6.13kohms
 - **If not within range specified**

Replace the S82 Windshield Wiper/Washer Switch.
 - **If within range specified**
4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Rear Window Wiper Motor Replacement**
- **Windshield Wiper and Washer Switch Replacement**
- **Control Module References** or BCM replacement, programming and setup

REAR WASHER SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B3811

Rear Washer Relay Circuit

For symptom byte information, refer to Symptom Byte List .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Rear Washer Switch Control	2	3	3	-
Rear Washer Relay Control	B3811 02	B3811 04	B3811 01	-
Rear Washer Fluid Pump Control	1	1	2	-
Rear Washer Fluid Pump Ground	-	1	1, 2	-
1. Rear Washer Inoperative. 2. Rear Washer Always ON. 3. Rear Wipers and Washers Inoperative.				

Circuit/System Description

When the body control module (BCM) detects that the Rear Wiper/Wash switch has activated the momentary Wash switch, it activates a high side drive output which supplies battery to the coil of the rear washer pump relay. This energizes the relay, which switches battery power to the washer pump motor. The BCM will also activate continuous low speed windshield wipers as described above. This Washer and Wiper operation shall be continued so long as the switch remains active. Upon termination, the rear wash motor will be deactivated and the wiper shall move to its Park position and deactivate.

Conditions for Running the DTC

- Ignition ON.
- The system voltage is between 9-16 V.

Conditions for Setting the DTC

B3811 01

A short to voltage has been detected on the rear window washer pump relay control circuit

B3811 02

A short to ground is detected in the rear washer relay control circuit.

B3811 04

A open/high resistance has been detected on the rear window washer pump relay control circuit

Action Taken When the DTC Sets

Rear washer operation is disabled.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- A history DTC will clear after 50 consecutive ignition cycles without a fault present.

Reference Information

Schematic Reference

Wiper/Washer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Wiper/Washer System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Rear Wiper Switch parameter changes between Off and On when pressing the windshield washer switch.

- **If the parameter does not change**

Refer to **Rear Wiper System Malfunction**

- **If the parameter changes**

3. Verify the rear window washers turn On when commanding the Rear Washer Relay Active with a scan tool.

- **If the Rear Window Washers do not turn ON**

Refer to Circuit/System Testing

- **If the Rear Window Washers turn ON**

4. All OK.

Circuit/System Testing

1. Ignition OFF, and all vehicle systems OFF. Disconnect the harness connector at the G19 Rear Window Washer Pump. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 2 and ground.
 - **If 10 ohms or greater**
 1. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Connect a test lamp between the control circuit terminal 1 and the ground circuit terminal 2, ignition ON.
4. Verify the test lamp does NOT turn ON and OFF when commanding the Rear Washer Relay Active and Inactive with a scan tool.
 - **If the test lamp turns ON and OFF**

Test or replace the G19 Rear Window Washer Pump.

- **If the test lamp does not turn ON and OFF**

5. Ignition OFF, connect the harness connector at the G19 Rear Window Washer Pump. Disconnect the X2 harness connector at the X50A Fuse Block - Underhood, It may take up to 2 min for all vehicle systems to power down.
6. Test for less than 10 ohms between the ground circuit terminal 39 and ground.
 - **If 10 ohms or greater**
 1. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
7. Ignition OFF, connect the X2 harness connector at the X50A Fuse Block - Underhood. Disconnect the X1 harness connector at the X50A Fuse Block - Underhood, ignition ON.
8. Verify the G19 Rear Window Washer Pump is not activated.
 - **If the G19 Rear Window Washer Pump is activated**
 1. Ignition OFF, disconnect the harness connector at the G19 Rear Window Washer Pump, ignition ON.
 2. Test for less than 1 V between the control circuit terminal 1 and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the G19 Rear Window Washer Pump.
 - **If the G19 Rear Window Washer Pump is not activated**
9. Connect a 20 A fused jumper wire between the control circuit terminal 14 and B+.
 10. Verify the G19 Rear Window Washer Pump activates.
 - **If the G19 Rear Window Washer Pump does not activate**
 - 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the G19 Rear Window Washer Pump, ignition ON.
 - 2. Test for infinite resistance between the control circuit and ground.
 - If less than Infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 - 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the G19 Rear Window Washer Pump.
 - **If the G19 Rear Window Washer Pump activates**
 11. Ignition OFF, connect the X1 harness connector at the X50A Fuse Block - Underhood. Disconnect the X1 harness connector at the K9 Body Control Module, ignition ON.
 12. Verify the G19 Rear Window Washer Pump is not activated.
 - **If the G19 Rear Window Washer Pump is activated**
 - 1. Ignition OFF, disconnect the X2 harness connector at the X50A Fuse Block - Underhood, ignition ON.
 - 2. Test for less than 1 V between the control circuit terminal 4 and B+.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the X50A Fuse Block - Underhood.
 - **If the G19 Rear Window Washer Pump is not activated**
 13. Connect a 10 A fused jumper wire between the control circuit terminal 6 and B+.
 14. Verify the G19 Rear Window Washer Pump activates.
 - **If the G19 Rear Window Washer Pump does not activate**
 - 1. Ignition OFF, remove the jumper wire, disconnect the X2 harness connector at the X50A Fuse Block - Underhood.
 - 2. Test for infinite resistance between the control circuit terminal 4 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If less than infinite resistance
 - 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the X50A Fuse Block - Underhood.
 - **If the G19 Rear Window Washer Pump activates**
 15. Replace the K9 Body Control Module.

Component Testing

Windshield Wiper/Washer Switch

1. Ignition OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch.
2. Test for infinite resistance between the signal terminal 7 and the low reference terminal 1 with the rear window washer switch in the open position.
 - **If less than infinite resistance**

Replace the S82 Windshield Wiper/Washer Switch.

- **If infinite resistance**
3. Verify the resistance reading is within the range specified below between the signal circuit terminal 7 and the low reference circuit terminal 2 by cycling the switch between Rear Wiper position and Rear Washers position.
 - Rear Wiper : 624-644ohms
 - Rear Wiper Sweep : 1.99-2.01kohms
 - Rear Washer : 6.11-6.13kohms
 - **If not within range specified**

Replace the S82 Windshield Wiper/Washer Switch.

- **If within range specified**
4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Relay Replacement (Within an Electrical Center)** , **Relay Replacement (Attached to Wire Harness)**
- **Windshield Washer Pump Replacement**
- **Windshield Wiper and Washer Switch Replacement**
- **Control Module References** for BCM replacement, programming and setup

REPAIR INSTRUCTIONS

WINDSHIELD WIPER AND WASHER SWITCH REPLACEMENT

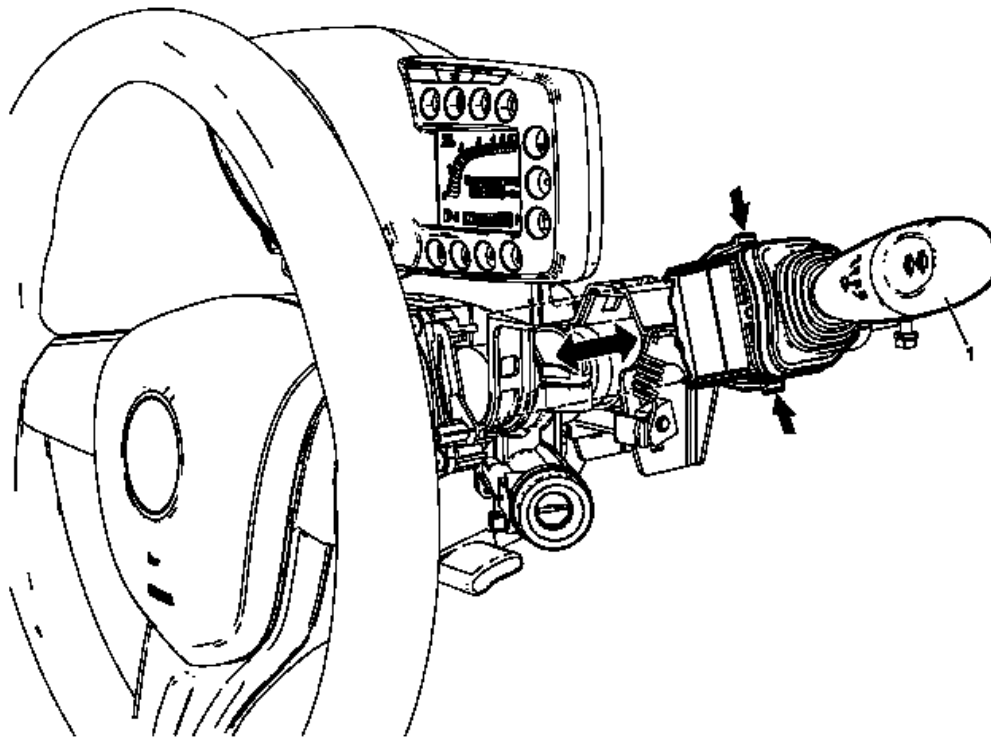


Fig. 4: Windshield Wiper And Washer Switch
 Courtesy of GENERAL MOTORS COMPANY

Windshield Wiper and Washer Switch Replacement

Callout	Component Name
Preliminary Procedure Remove the steering column upper trim covers. Refer to <u>Steering Column Upper Trim Cover Replacement</u> .	
1	Windshield Wiper Washer Switch TIP: Release the retaining tab and then remove the switch.

WINDSHIELD WASHER NOZZLE HOSE REPLACEMENT

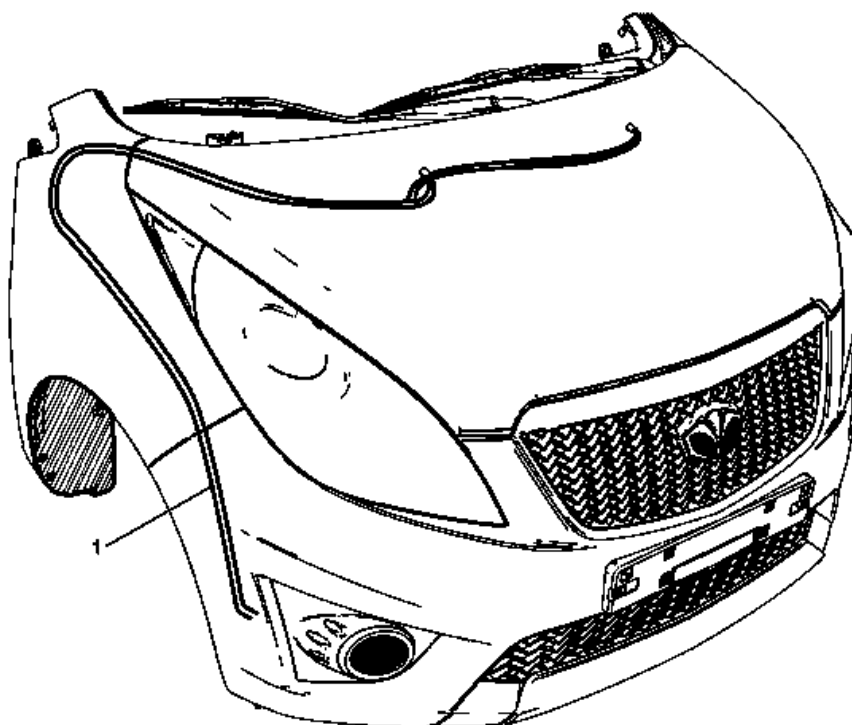


Fig. 5: Windshield Washer Nozzle Hose
 Courtesy of GENERAL MOTORS COMPANY

Windshield Washer Nozzle Hose Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the hood insulator. 2. Place a clean container under the front passenger side (RHD: driver side) near where the windshield washer nozzle and windshield washer pump hose will be disconnected. 3. Remove the front wheelhouse liner to access the washer nozzle hose. Refer to <u>Front Wheelhouse Liner Replacement</u> . 4. Recover all lost windshield washer solvent.	
1	Windshield Washer Nozzle Hose TIP: Disconnect the washer hose from both hood mounted washer nozzles.

WINDSHIELD WASHER NOZZLE REPLACEMENT

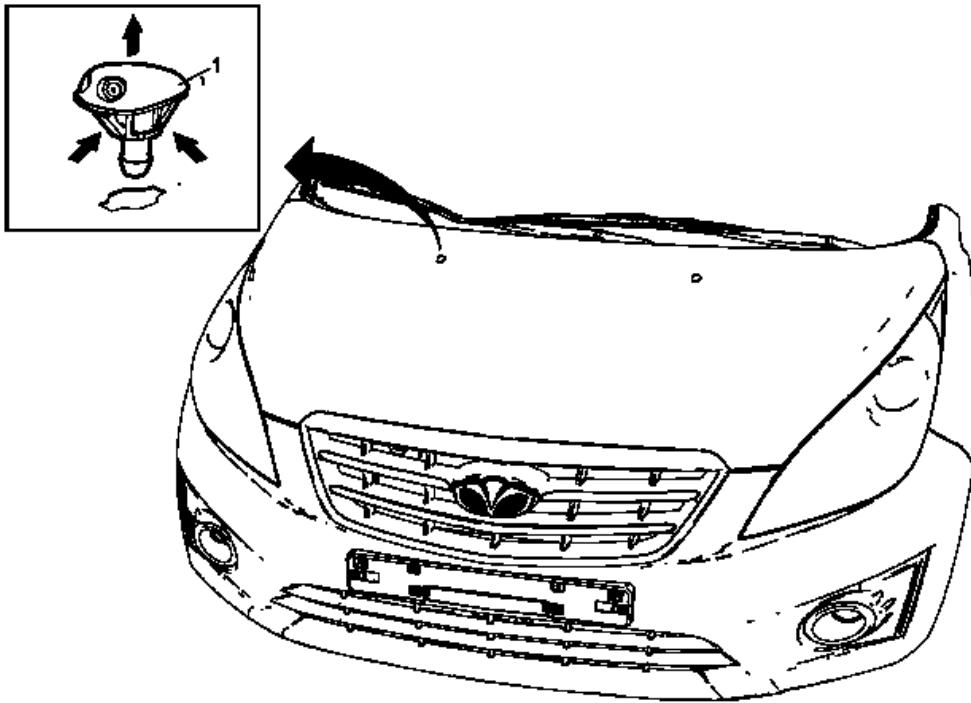


Fig. 6: Windshield Washer Nozzle
 Courtesy of GENERAL MOTORS COMPANY

Windshield Washer Nozzle Replacement

Callout	Component Name
Preliminary Procedures	
1. Disconnect the washer hose from the washer nozzles. 2. Remove the hood insulator.	
1	Windshield Washer Nozzle Assembly TIP: Push the washer nozzle retaining tab from the bottom side in order to release the nozzle and push the nozzle outboard from the hood to remove.

REAR WINDOW WASHER NOZZLE REPLACEMENT

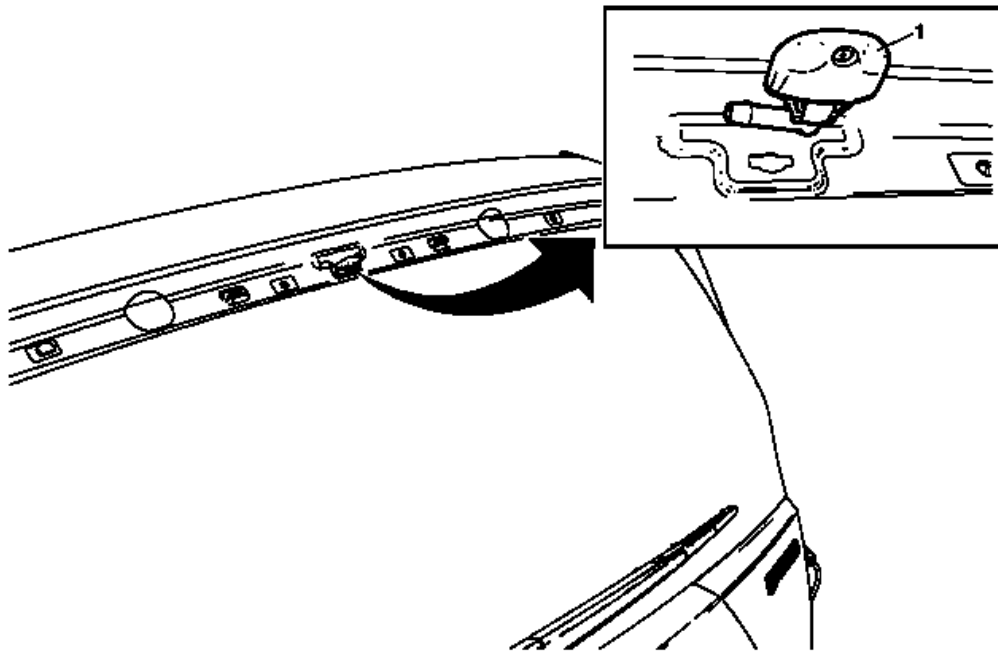


Fig. 7: Rear Window Washer Nozzle
 Courtesy of GENERAL MOTORS COMPANY

Rear Window Washer Nozzle Replacement

Callout	Component Name
Preliminary Procedures	
1. Remove the rear end spoiler. Refer to <u>Rear End Spoiler Replacement</u> . 2. Remove the rear window washer nozzle hose.	
1	Rear Window Washer Nozzle TIP: Push the washer nozzle retaining tab from the bottom side.

WINDSHIELD WASHER SOLVENT CONTAINER FILLER TUBE REPLACEMENT

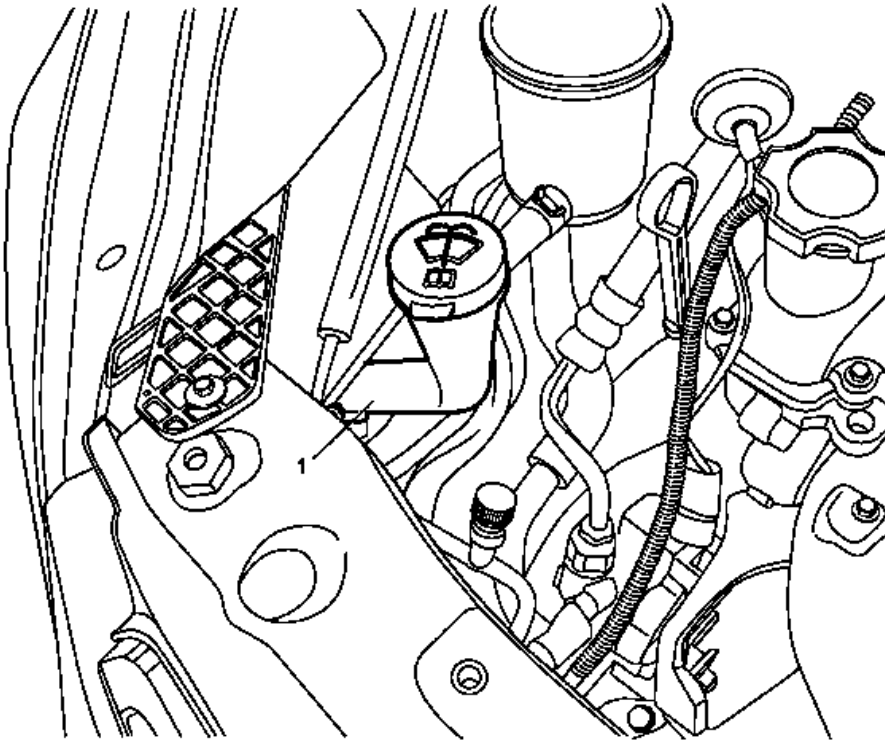


Fig. 8: Windshield Washer Solvent Container Filler Tube
Courtesy of GENERAL MOTORS COMPANY

Windshield Washer Solvent Container Filler Tube Replacement

Callout	Component Name
1	Windshield Washer Solvent Container Filler Tube Assembly Procedure Pull the upper tube assembly from the lower washer container and inspect the grommet, replace if damaged.

WINDSHIELD WASHER SOLVENT CONTAINER REPLACEMENT

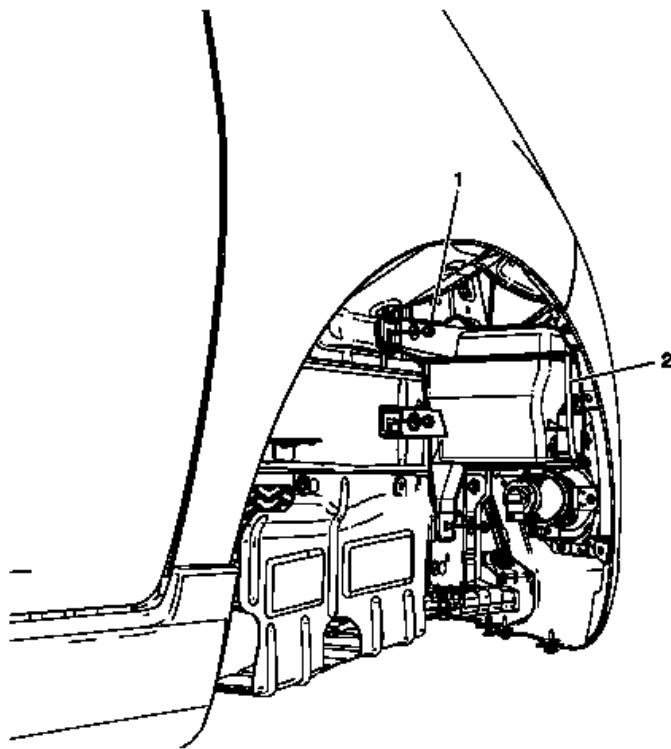


Fig. 9: Windshield Washer Solvent Container
 Courtesy of GENERAL MOTORS COMPANY

Windshield Washer Solvent Container Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the tire and wheel. Refer to <u>Tire and Wheel Removal and Installation</u> . 2. Remove the front wheelhouse liner. Refer to <u>Front Wheelhouse Liner Replacement</u> . 3. Disconnect the washer hose from the washer pump. 4. Disconnect the electrical connector.	
1	Windshield Washer solvent Container Nut (Qty: 3) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 9 N.m (80 lb in)
2	Windshield Washer Solvent Container Assembly

WINDSHIELD WASHER PUMP REPLACEMENT

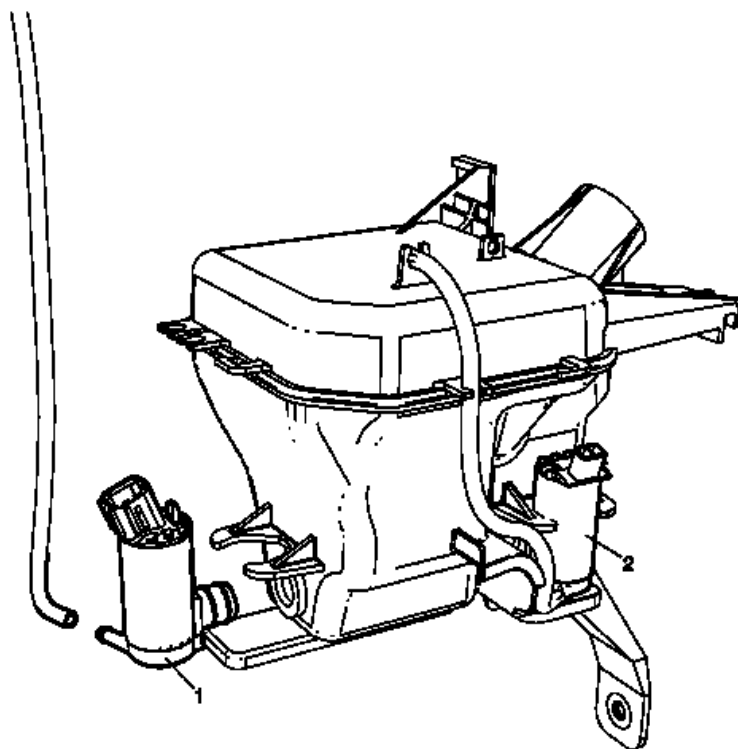


Fig. 10: Windshield Washer Pump
 Courtesy of GENERAL MOTORS COMPANY

Windshield Washer Pump Replacement

Callout	Component Name
Preliminary Procedures	
1. Remove the tire and wheel. Refer to <u>Tire and Wheel Removal and Installation</u> . 2. Remove the front wheelhouse liner. Refer to <u>Front Wheelhouse Liner Replacement</u> . 3. Disconnect the washer hose from the washer pump. 4. Disconnect the electrical connector.	
1	Windshield Washer Solvent Pump
2	Rear Window Washer Solvent Pump

AIR INLET GRILLE PANEL REPLACEMENT

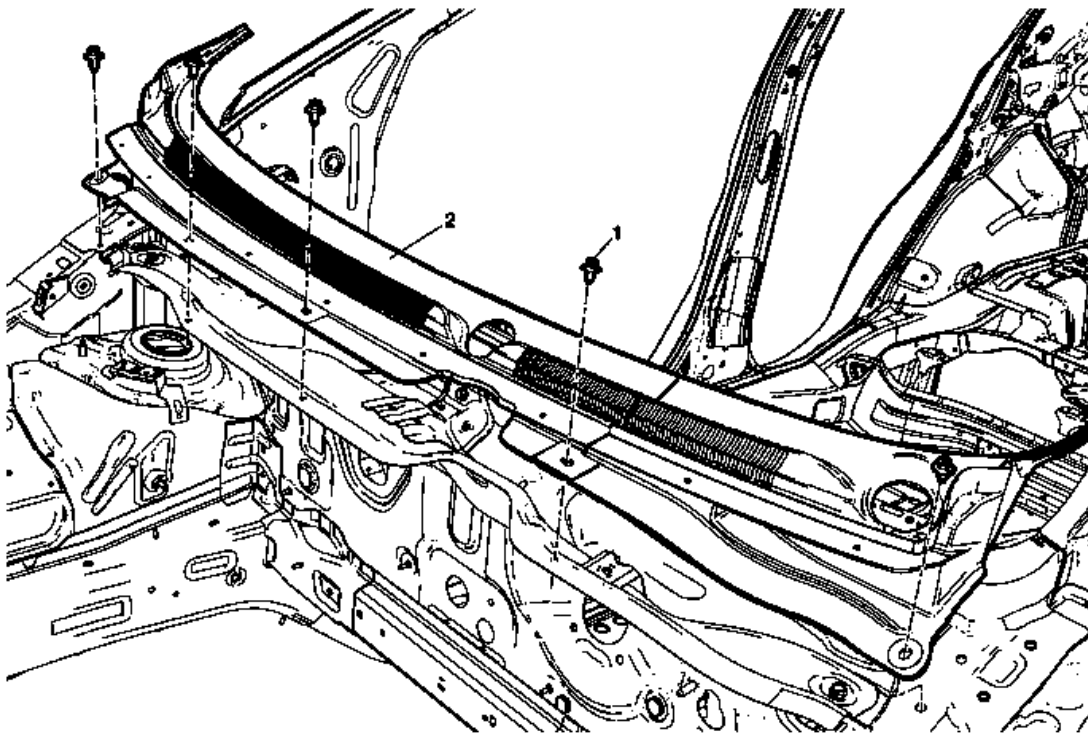


Fig. 11: Air Inlet Grille Panel
 Courtesy of GENERAL MOTORS COMPANY

Air Inlet Grille Panel Replacement

Callout	Component Name
Preliminary Procedure	
Remove the wiper arms. Refer to <u>Windshield Wiper Arm Replacement</u> .	
1	Air Inlet Grille Panel Clip (Qty: 5)
2	Air Inlet Grille Panel Assembly
Procedure	
Remove hood rear weatherstrip.	

WINDSHIELD WIPER ARM REPLACEMENT

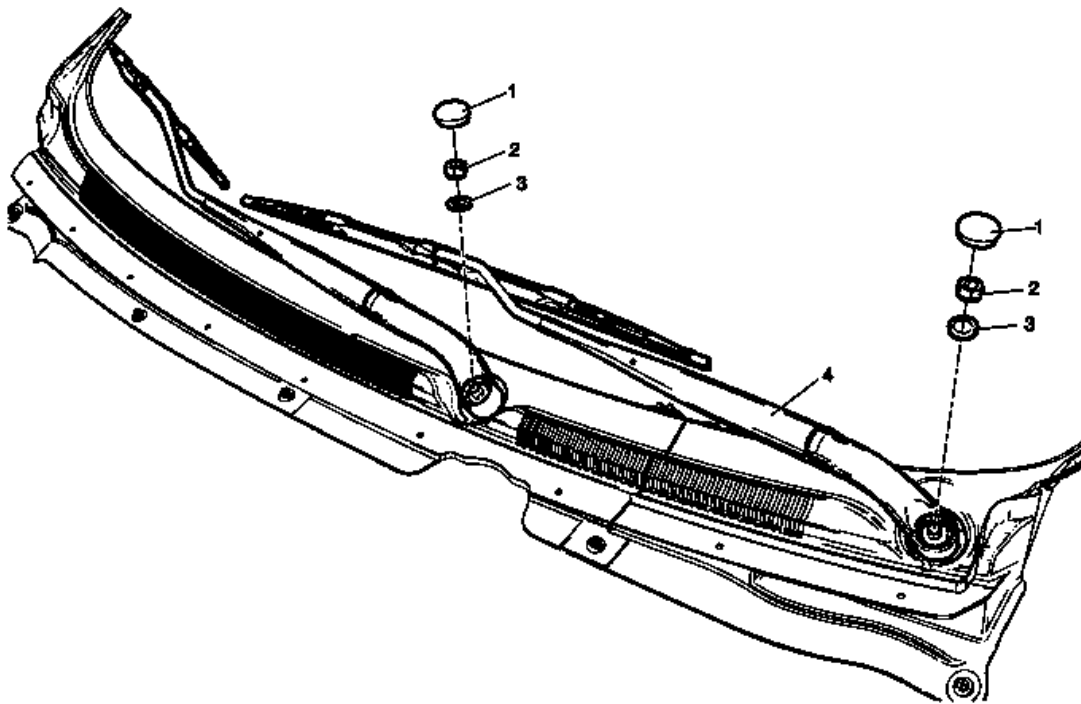


Fig. 12: Windshield Wiper Arm
 Courtesy of GENERAL MOTORS COMPANY

Windshield Wiper Arm Replacement

Callout	Component Name
1	Windshield Wiper Arm Finish Cap TIP: Use a small flat-bladed tool to remove finish cap.
2	Windshield Wiper Arm Nut (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 24 N.m (18 lb in)
3	Windshield Wiper Arm Washer
4	Windshield Wiper Arm Assembly TIP: Use the wiper arm puller if the arm fails to release from the wiper motor pivot shaft.

REAR WINDOW WIPER ARM REPLACEMENT

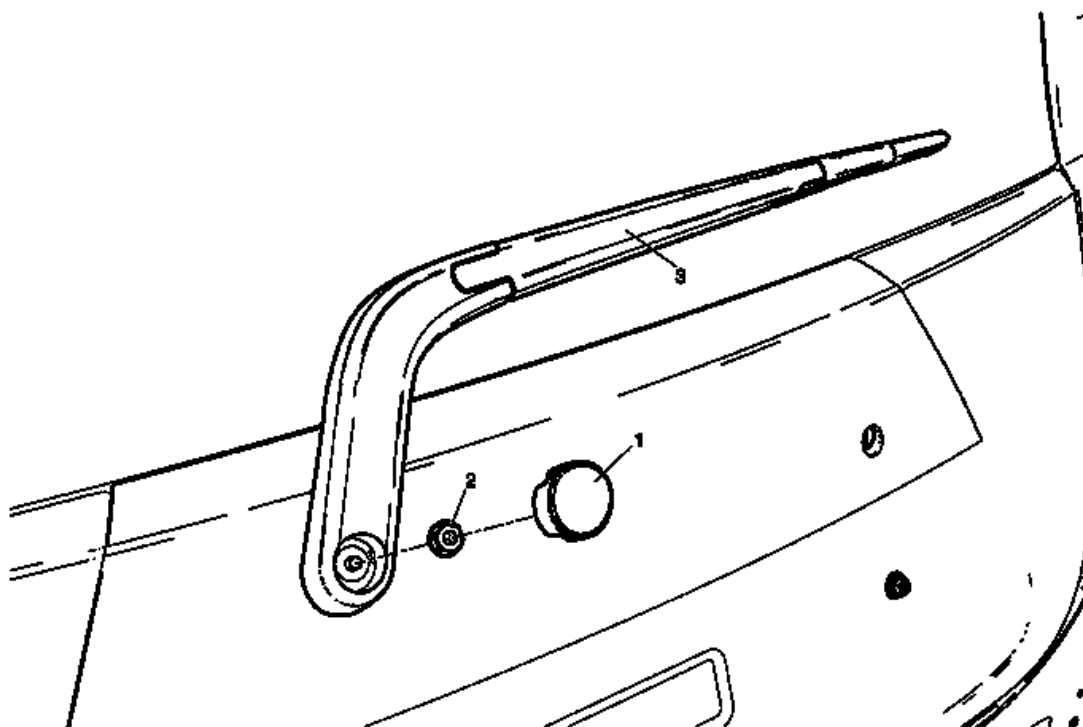


Fig. 13: Rear Window Wiper Arm
 Courtesy of GENERAL MOTORS COMPANY

Rear Window Wiper Arm Replacement

Callout	Component Name
1	Rear Window Wiper Arm Finish Cap TIP: Use a small flat-bladed tool to remove finish cap.
2	Rear Window Wiper Arm Nut CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
3	Rear Window Wiper Arm Assembly TIP: Use the wiper arm puller if the arm fails to release from the wiper motor pivot shaft.

WINDSHIELD WIPER BLADE REPLACEMENT

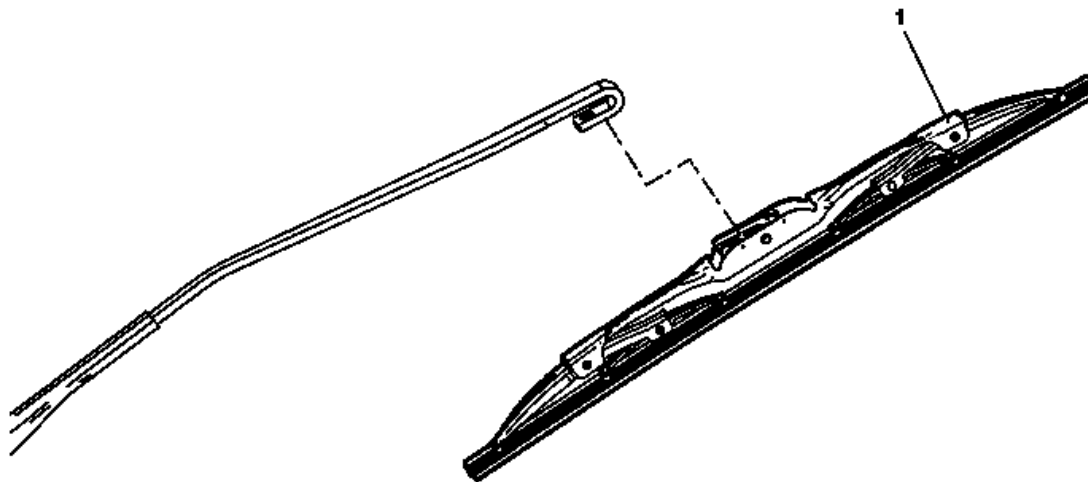


Fig. 14: Windshield Wiper Blade
 Courtesy of GENERAL MOTORS COMPANY

Windshield Wiper Blade Replacement

Callout	Component Name
Preliminary Procedure	
Raise the wiper arm up off the windshield.	
1	Windshield Wiper Arm Blade Assembly
	Procedure
	1. Push inward the square tab at the center top side of the wiper blade. 2. Rotate the wiper blade downward slightly. 3. Carefully release the wiper arm back to the windshield.
	TIP: Discard if rubber appears worn or does not wipe the windshield clean.

REAR WINDOW WIPER BLADE REPLACEMENT

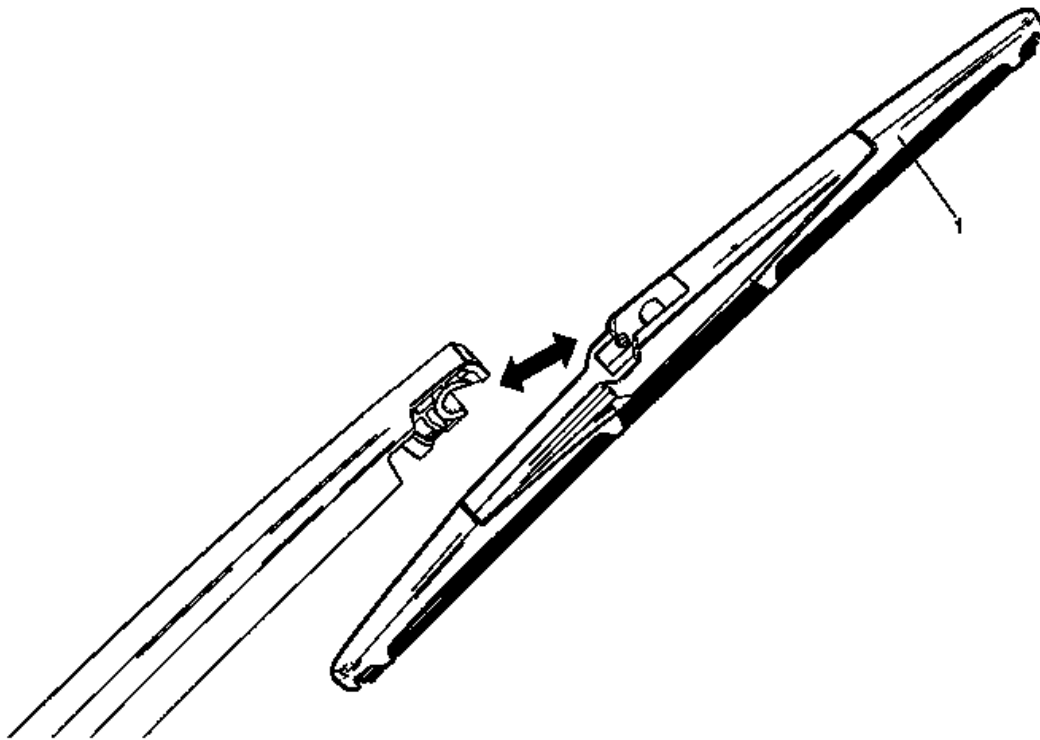


Fig. 15: Rear Window Wiper Blade
Courtesy of GENERAL MOTORS COMPANY

Rear Window Wiper Blade Replacement

Callout	Component Name
1	Rear Window Wiper Arm Blade Assembly Procedure Push the rear window wiper blade from the rear window wiper arm.

WINDSHIELD WIPER MOTOR REPLACEMENT

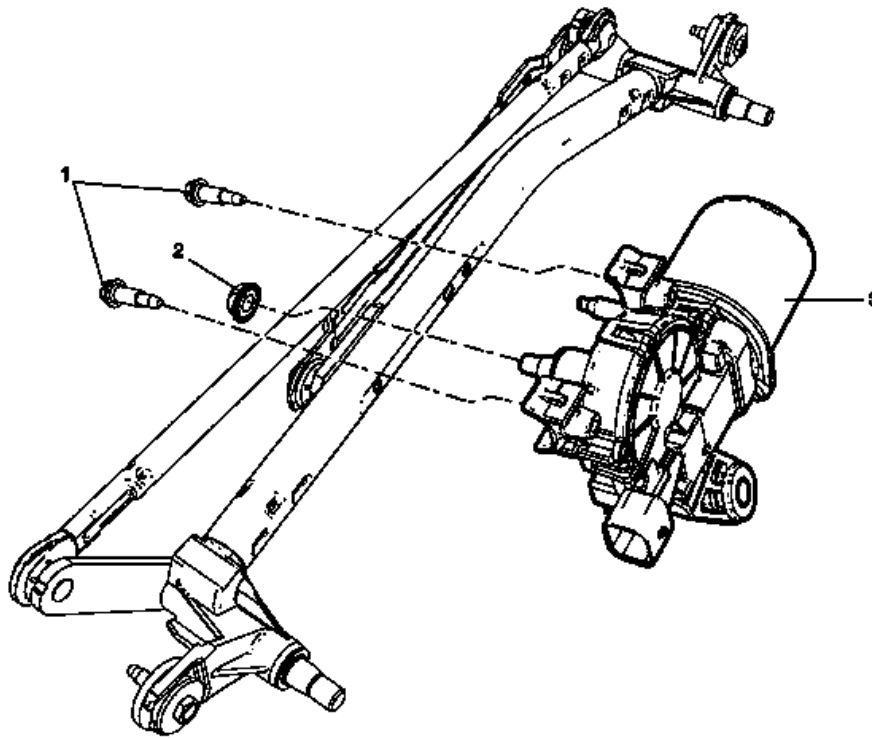


Fig. 16: Windshield Wiper Motor
 Courtesy of GENERAL MOTORS COMPANY

Windshield Wiper Motor Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the windshield wiper arms. Refer to <u>Windshield Wiper Arm Replacement</u>. 2. Remove the air inlet grille panel. Refer to <u>Air Inlet Grille Panel Replacement</u>. 3. Remove the windshield wiper transmission. Refer to <u>Windshield Wiper Transmission Replacement</u>.	
1	Windshield Wiper Motor Bolt (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 13 N.m (10 lb ft)
2	Windshield Wiper Motor Nut (Qty: 1) Tighten 23 N.m (17 lb ft)
3	Windshield Wiper Motor Assembly

REAR WINDOW WIPER MOTOR REPLACEMENT

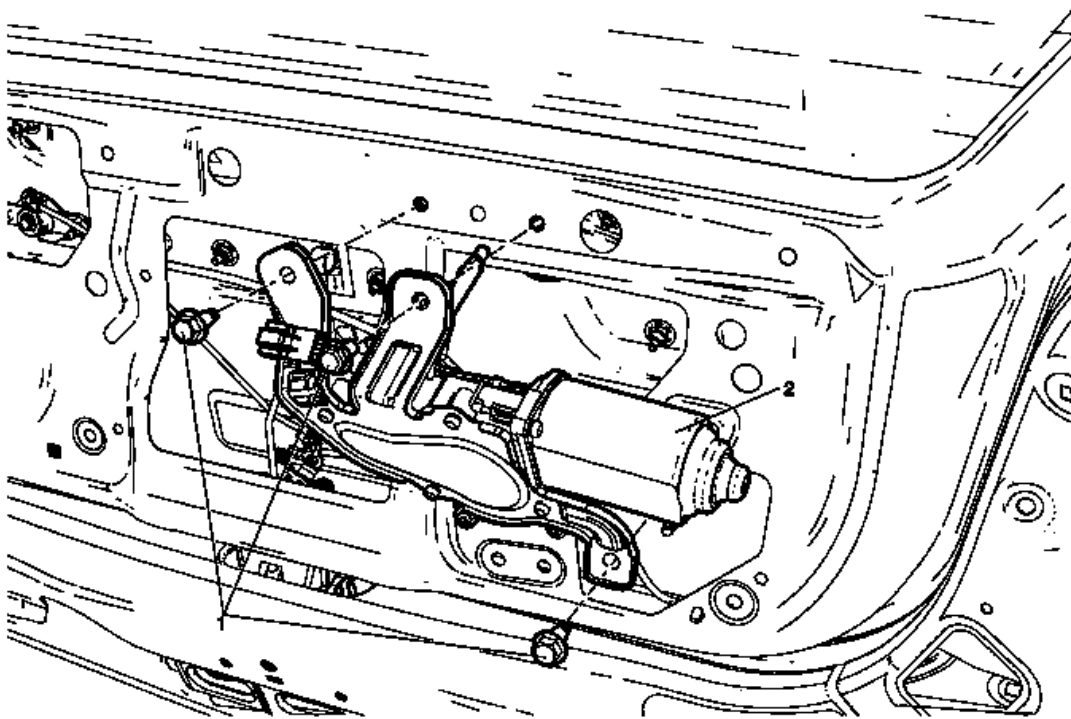


Fig. 17: Rear Window Wiper Motor
Courtesy of GENERAL MOTORS COMPANY

Rear Window Wiper Motor Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the rear window wiper arms. Refer to <u>Rear Window Wiper Arm Replacement</u>. 2. Remove the liftgate trim panel. Refer to <u>Liftgate Trim Panel Replacement</u>. 3. Disconnect the wiper motor connector.	
1	Rear Window Wiper Motor Bolt (Qty: 3) CAUTION: Refer to <u>Fastener Caution</u>. Tighten 8 N.m (71 lb in)
2	Rear Window Wiper Motor Assembly

WINDSHIELD WIPER TRANSMISSION REPLACEMENT

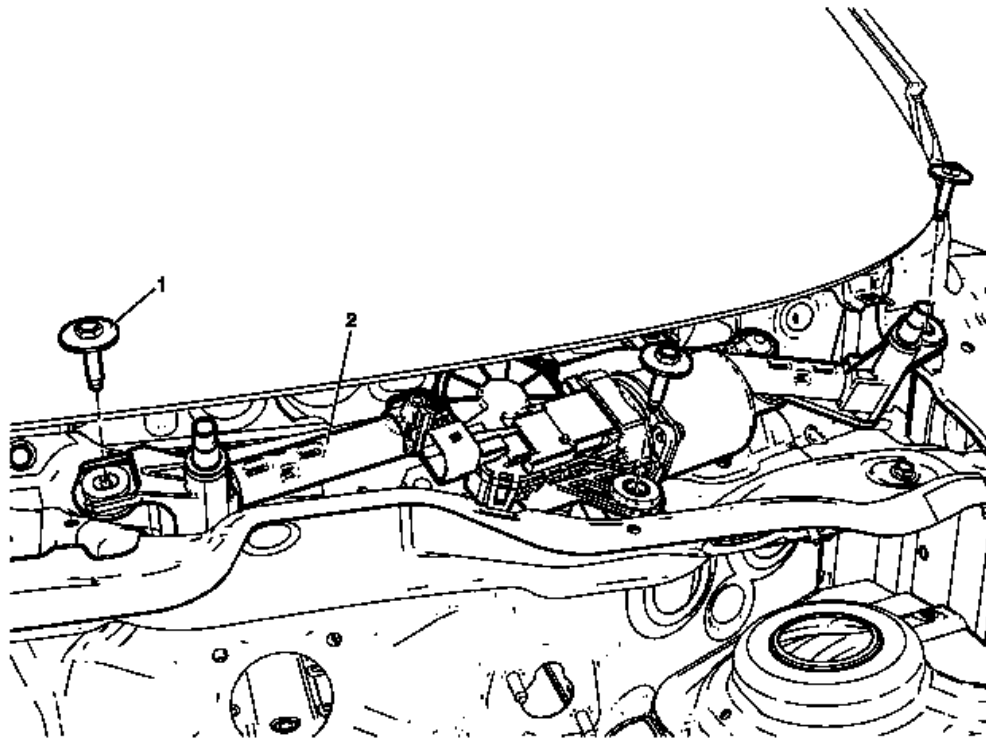


Fig. 18: Windshield Wiper Transmission
 Courtesy of GENERAL MOTORS COMPANY

Windshield Wiper Transmission Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the windshield wiper arms. Refer to <u>Windshield Wiper Arm Replacement</u>. 2. Remove the air inlet grille panel. Refer to <u>Air Inlet Grille Panel Replacement</u>.	
1	Windshield Wiper Transmission Frame Bolt (Qty: 3) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 10 N.m (89 lb in)
2	Windshield Wiper Transmission Frame Assembly

WINDSHIELD WIPER ARM ADJUSTMENT

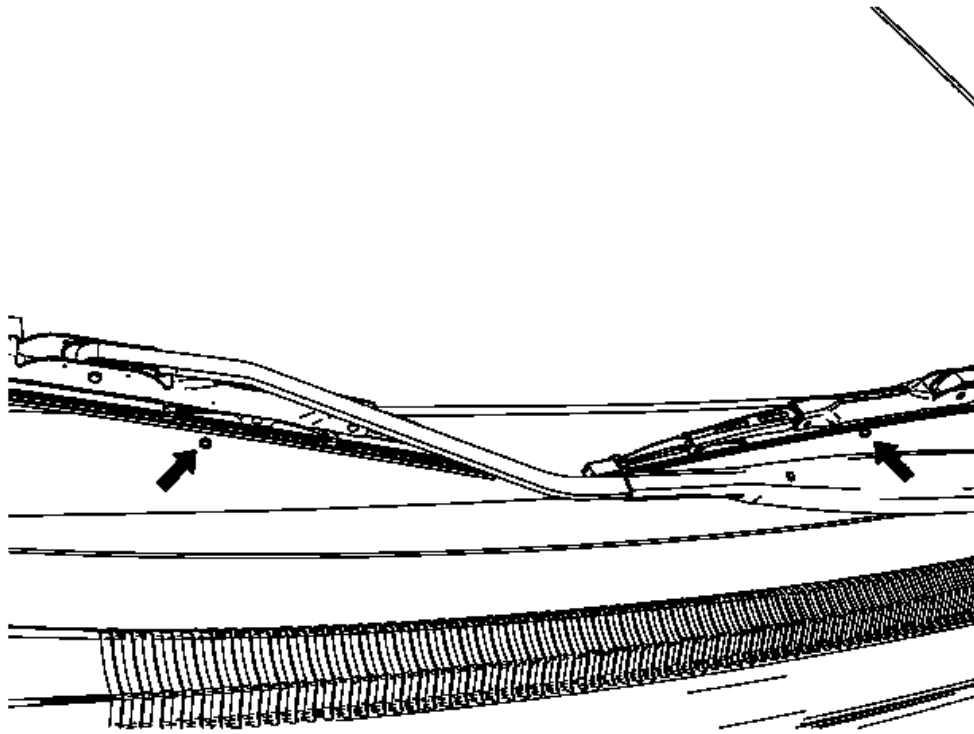


Fig. 19: Windshield Wiper Arm
 Courtesy of GENERAL MOTORS COMPANY

Windshield Wiper Arm Adjustment

Callout	Component Name
TIP: When installing the windshield wiper arm, perform this procedure for wiper arm to be in original position.	
1. Check the mark to install the wiper arm at the lower blackout of the windshield. 2. Position the wiper arm blade to this mark.	

DESCRIPTION AND OPERATION

WIPER/WASHER SYSTEM DESCRIPTION AND OPERATION

Wiper/Washer System Components

The wiper/washer system consists of the following electrical components:

- Windshield Wiper Relay
- Windshield Wiper Speed Control Relay
- Windshield Washer Pump Relay
- Windshield Washer Pump
- Windshield Wiper Motor

- Windshield Wiper/Washer Switch
- Windshield Wiper Motor Fuse
- Windshield Washer Pump Fuse
- Body Control Module (BCM)
- Rear Wiper Motor
- Rear Wiper Motor Fuse
- Rear Wiper Relay
- Rear Washer Pump Relay
- Rear Washer Pump Fuse

Windshield Wiper System

The body control module (BCM) determines the front wipe/wash system mode of operation by monitoring several signals from the Windshield Wiper/Washer Switch as indicated in the wiper switch.

The Windshield Wiper/Washer Switch receives a reference ground signal from the BCM. Each input of the BCM provides a switched battery pull-up for each front wiper/washer switch output signal it receives. All the BCM inputs are recognized as active when the wiper switch provides a path to the referenced ground signal. The first signal received by the BCM is the result of 6 resistors in the front wiper switch configured as a resistor ladder network. This signal is connected to a BCM analog to digital input. Depending on the function selected (High, Low, Intermittent 1 thru 5, Mist, Off), the Windshield Wiper/Washer Switch connects a different set of resistors into the circuit resulting in different voltages appearing on the BCM A/D input. By monitoring this voltage, the BCM determines how to control the wiper motor On/Off Relay. It should be noted that High, Low, and Mist all have the same value on this signal circuit. The second signal received from the front wiper switch is active only when the front wiper switch is in the high speed wiper position. When the wiper switch is not in the high speed position, the switch is open and the signal circuit is pulled to battery by the BCM. When the wiper switch is in the high speed position, the switch pulls the circuit low. The BCM determines how to control the Wiper high/low speed relay from this input. The third signal received from the front wiper switch is from the momentary windshield wash control switch. When the washer switch is not active the switch is open and the signal circuit is pulled to battery by the BCM. When the washer switch is active, the switch pulls the circuit low. The BCM controls the windshield wash and windshield wash activated wiper operation based on this input.

The BCM controls Windshield Wiper Motor operation through two output signals and the monitoring of one input signal. The two outputs (one high side drive, one low side drive) are used to control two external wiper motor relays: Windshield Wiper Motor on/off relay: which provides the wiper motor with battery power when it is activated by the high side drive signal (switched battery) from the BCM. When left deactivated, the normally closed contacts provide a ground to the wiper motor. Wiper high/low speed relay: when activated by a low side drive signal (ground) from the BCM, it switches the power supplied by the wiper motors on/off relay to the motors high speed input. When left deactivated, the normally closed contacts connect the power supplied by the wiper motors on/off relay to the motors low speed input. The input used by the BCM is from the park switch located in the wiper motor assembly. When the wiper blades are not in the park position, the wiper park switch is open and the circuit is pulled up to battery by the BCM. When the wiper blades are in the park position at the bottom of the glass, the wiper park switch closes to ground pulling the park signal circuit low.

To initiate low speed operation, the BCM only energizes the front Windshield Wiper Motor on/off relay. This allows battery voltage from the wiper fuse to be applied through the switched contacts of the wiper motor on/off

relay, through the normally closed contacts of the wiper high/low speed relay, to the low speed control circuit of the windshield wiper motor.

Redundant high speed switch pass through. The BCM provides redundant circuitry which places battery power on its wiper motor on/off relay output with activation of its low assertion high speed wiper switch input. The BCM shall be capable of doing this, even if the module has lost all microprocessor control. This redundant circuit shall supply power while in the RUN and CRANK power modes. however; while in the CRANK power mode, the pass through shall only be active if the BCM is NOT in a computer operating properly state.

To initiate high speed operation, the BCM energizes both the Windshield Wiper Motor on/off relay and the wiper high/low speed relay. This allows battery voltage from the wiper fuse to be applied through the switched contacts of the wiper motor on/off relay, through the switched contacts of the wiper high/low speed relay, to the high speed control circuit of the windshield wiper motor.

Parking the wiper motor. In order to perform an accurate read of the park switch and to ensure the wipers will come to rest while still in the park position, parking of the wipers only occurs while in a low speed wiper mode. This requires that if the wipers are performing a high speed wiper operation at the time they are required to park, the BCM shall transition the Wipers to low speed by deactivating the wiper high/low relay before attempting to park. In order to park the wipers, the BCM monitors the park circuit until the park switch pulls the park circuit to ground. At this time, the BCM will immediately deactivate the wiper motor on/off relay. The relay contacts will switch back to their normally closed position and will apply ground to the wiper motor power inputs through the normally closed contacts of the wiper high/low relay. This deactivates and dynamically brakes the wiper motor in the park position. When the wiper switch is turned to the OFF position while the wiper motor is somewhere in mid-cycle, the BCM will continue to operate the motor until the wipers reach the park position. If the BCM is running the wiper motor and does not see a state transition of the park switch after 8 s, the wipers will stop immediately when the wiper switch is turned to OFF. If the ignition is turned OFF while the wipers are in mid-cycle, the wipers will stop immediately, regardless of position. The BCM will park the wipers next time the ignition is turned ON.

The windshield wiper system MIST operation is identical to LOW speed operation, except that the MIST switch is a press and release type switch. When the wiper switch is moved to the MIST position and released, low speed wiper motor operation is started and will continue until 1 cycle is complete. If the wiper switch is moved to the MIST position and held, the wiper motor will operate in the LOW speed mode until the switch is released.

Windshield wiper intermittent operation is a low speed wiper motor function with a variable delay interval between the wiper motor cycles. The duration of the delay is controlled by the front wiper control switches intermittent 1 through intermittent 5 settings. The wiper operation is as follows

1. The BCM will initiate a single wipe by activating its windshield wiper ON/OFF relay output.
2. At the completion of a single wipe, the BCM will park the wipers as described above.
3. The BCM will then pause the wipers in their park position for the time duration associated with intermittent delay switch setting.
4. When the delay time expires repeat Steps 1 and 3 until the system is turned off or taken out of intermittent mode. If the wiper switch is moved from a longer delay interval to a shorter delay interval, the BCM will command an immediate wipe cycle and reset the delay timer to the shorter delay interval.

Intermittent wiper operation may be vehicle speed sensitive. When enabled, the speed compensated intermittent feature causes the intermittent wiper delay intervals to become shorter as a function of increased speed. As vehicle speed is reduced the intervals will become closer to the predetermined

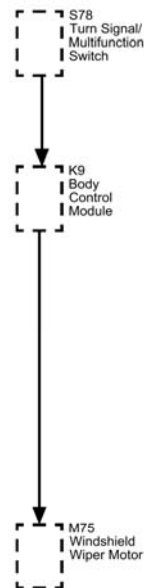


Fig. 20: Windshield Wiper System
Courtesy of GENERAL MOTORS COMPANY

Windshield Washer System

The BCM controls the windshield wash operation and windshield wash activated wiper operation. When the BCM detects the activation of the momentary windshield wash control switch, it activates its washer pump relay drive output which supplies battery power to the coil of the washer pump relay. This energizes the relay, which switches battery power to the pump motor. The BCM will also activate continuous low speed windshield wipes as described above. Upon deactivation of the windshield wash control switch, the body control module (BCM) shall deactivate the wash motor and will also park the wiper motor as described above unless the drip wipe feature is enabled. On some vehicles the drip wipe feature will be enabled and cause the system to provide additional wiping of the windshield after the switch has been released and fluid is no longer being applied. The windshield washer switch feature may attempt to detect a stuck switch. When enabled, activation of the wash feature shall be limited to 10 seconds.

On vehicles with the Rear Wash feature a single reversing wash motor may be utilized for both the front and rear wash operation. In this system the wash motor is operated in one direction to spray fluid on the front windshield and then operated in the reverse direction to spray fluid on the rear window. The BCM Controls the reversing wash motor through two High Side Drive outputs. One controls the Windshield Wiper Motor Relay and one controls the Rear Wiper Relay.

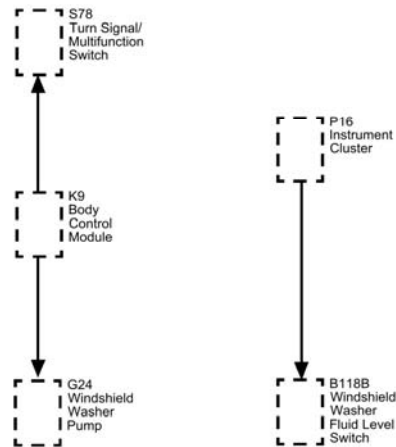


Fig. 21: Wiper/Washer System Description
 Courtesy of GENERAL MOTORS COMPANY

Rear Wiper System

On vehicles equipped with a Rear Wiper, the BCM determines of the Rear Wipe/Wash System Mode of Operation by monitoring the multiplexed output of the Windshield Wiper/Washer Switch. The Rear Wiper Relay uses a reference ground signal from the BCM. The BCM provides a switched Battery pull-up for the Rear Wiper Relay switch output signal it receives. All the BCM inputs are recognized as active when the Rear Wiper Relay switch provides a path to the referenced ground signal. The Rear Wiper/Washer signal received by the BCM is the result of 3 resistors in the Windshield Wiper/Washer Switch configured as a resistor ladder network. This signal is connected to a BCM Analog to Digital Input which also provides a switched Battery pull-up for the circuit. Depending on the function selected (Low, Intermittent, Off, Wash), the Rear Wiper Control Switch connects a different set of resistors into the circuit resulting in different voltages appearing on the BCM A/D input. By monitoring this voltage, the BCM determines how to control the Rear Wiper Relay and the Rear Washer Relay.

The BCM Controls the single speed Rear Wiper Motor by its Active High output to the external Rear Wiper Relay. When the BCM activates its output and applies Battery to the coil of the relay, the relay energizes, allowing Battery voltage from the fuse to be applied through the switched contacts of the Rear Wiper Relay to the Rear Wiper Motors control input. The motor then operates continuously at low speed. The BCM does not control the parking of the Rear Wiper Motor, it is self parking. When the BCM deactivates its output, the contacts of the Rear Wiper Relay switch back to ground which will be used by the wiper for Dynamic Braking. The Rear Wipers internal park switch and circuitry will sustain motor operation until the wiper arm has returned to its Park position.

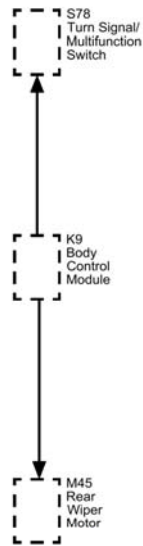


Fig. 22: Rear Wiper System Description
Courtesy of GENERAL MOTORS COMPANY

Rear Wash

When the Body Control Module detects that the Rear wiper/washer switch has activated the momentary Wash switch, it activates a High Side Drive output which supplies Battery to the coil of the Rear Washer Pump Relay. This energizes the Relay, which switches Battery Power to the Washer Pump Motor. The BCM will also activate continuous Low Speed Windshield Wipers as described above. The BCM software will attempt to detect a stuck Rear Wash Switch. A stuck Rear Wash Switch condition is detected if the Rear Wash Motor Relay Output has been continuously active for 10 seconds or more. Upon detecting this the BCM will fail soft the state of the Rear Wash Control to Inactive. This shall cause the System to perform as if the momentary Wash control had been released.

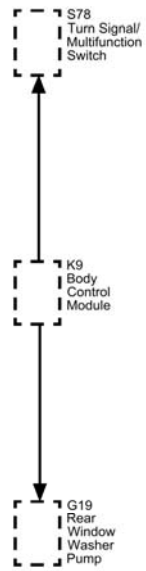


Fig. 23: Rear Wash System Description
Courtesy of GENERAL MOTORS COMPANY

ACCESSORIES & EQUIPMENT

Wiring Systems and Power Management - Repair Instructions - Spark

REPAIR INSTRUCTIONS

GMLAN AND MEDIA ORIENTED SYSTEMS TRANSPORT (MOST) WIRING REPAIRS

Special Tools

- **EL-38125-10** Splice Sleeve Crimping Tool
- DuraSeal splice sleeves
- A wire stripping tool

For equivalent regional tools, refer to **Special Tools** .

The DuraSeal splice sleeves have the following 2 critical features:

- A special heat shrink sleeve environmentally seals the splice. The heat shrink sleeve contains a sealing adhesive inside.
- A cross hatched (knurled) core crimp provides necessary contact integrity for the sensitive, low energy circuits.

The GM Local Area Network (GMLAN) System requires special wiring repair procedures due to the sensitive nature of the circuitry. Follow the specific procedures and instructions when working on GMLAN connectors and terminals.

GMLAN Repairs

NOTE: **When making a repair to any GMLAN network, the original wire length after the repair must be the same length as before the repair. If the network is a twisted pair, the twist must be maintained after the repair is completed.**

GMLAN has 2 types of networks, low speed and high speed. Low speed GMLAN has a single wire and works at slow speeds. High speed GMLAN has 2 wires in a twisted pair and works at higher speeds. For more information on GMLAN, refer to **Data Link Communications Description and Operation** .

GMLAN Connector Terminal Repair

NOTE: **A terminated lead can be used to replace damaged connector terminals for both high speed and low speed GMLAN systems. When making a connector terminal repair on a GMLAN high speed system with twisted pair wires, do not untwist the wires more than necessary to make the repair.**

If the individual terminals are damaged on any GMLAN connection, use the appropriate connector repair procedure in order to repair the terminal. Refer to **Connector Repairs** for the appropriate connector repair

procedure.

GMLAN Wire Repair

NOTE: Refer to Wiring Repairs in the service information connector end views or the vehicle schematics in order to determine the correct wire size for the circuit you are repairing. You must obtain this information in order to ensure circuit integrity.

If any wire except the pigtail is damaged, repair the wire by splicing in a new section of wire of the same gauge size (0.5 mm² , 0.8 mm² , 1.0 mm² etc.). Use the DuraSeal splice sleeves and **EL-38125-10** tool. For wiring repair, refer to **Splicing Copper Wire Using Splice Sleeves** .

Media Oriented Systems Transport (MOST) Wiring Repair

NOTE: If harness repair/analysis is performed, MOST bus Twist Pair unshielded wire should be 0.22 mm gauge wire with at least one twist per each 1 45/64 inch (45 mm) and must not be untwisted for more than 3 15/16 of an inch (10 cm).

The following conditions need to be met to ensure a valid continuity:

- Untwisted length for all MOST 50 circuits at each wire harness connector should be no longer 50 mm max (25 mm preferred).
- When wire repairs are made, a minimum 25 twists/meter for all MOST 50 circuits.
- MOST 50 has specific receive and transmit I/O.

The transmit of one module is connected to receive of the next module in ring topology.

RELAY REPLACEMENT (ATTACHED TO WIRE HARNESS)

Removal Procedure

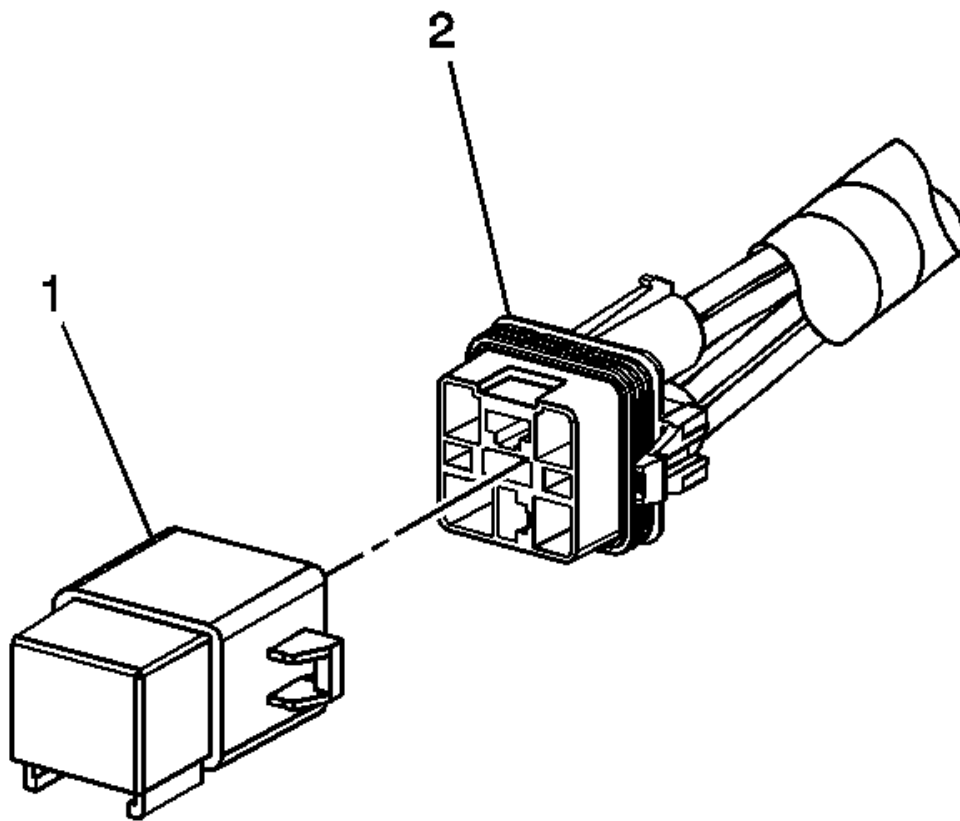


Fig. 1: Identifying Relay & Wire Harness Connector
Courtesy of GENERAL MOTORS COMPANY

1. Locate the relay. Refer to the **Master Electrical Component List** to locate the relay in the vehicle.
2. Remove any fasteners which hold the relay in place.
3. Remove any connector position assurance (CPA) devices or secondary locks.

NOTE: **Use care when removing a relay in a wiring harness when the relay is secured by fasteners or tape.**

4. Separate the relay (1) from the wire harness connector (2).

Installation Procedure

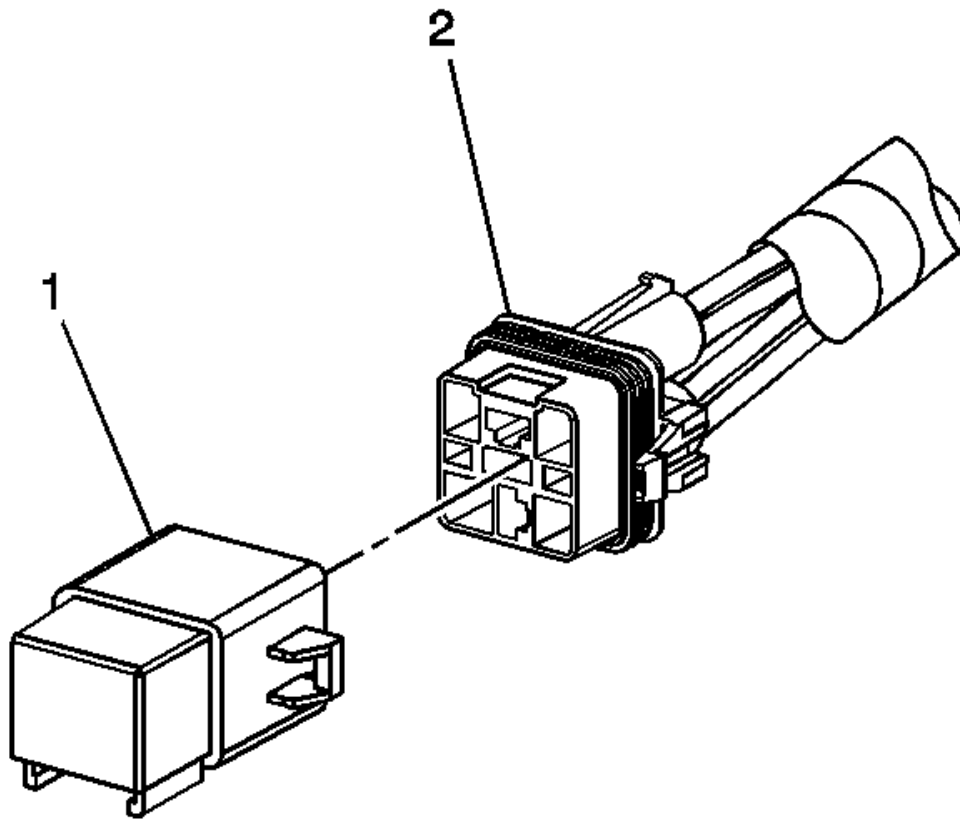


Fig. 2: Identifying Relay & Wire Harness Connector
Courtesy of GENERAL MOTORS COMPANY

1. Connect the relay (1) to the wire harness connector (2).
2. Install any connector position assurance (CPA) devices or secondary locks.
3. Install the relay using any fasteners or tape that originally held the relay in place.

RELAY REPLACEMENT (WITHIN AN ELECTRICAL CENTER)

Special Tools

EL-43244 Relay Puller Pliers

Removal Procedure

1. Remove the electrical center cover.

NOTE:

- Always note the orientation of the relay.

- If equipped with a notch style relay; observe the location of the notch on the old relay to verify the new relay is installed with the notch in the same location.
- Ensure that the electrical center is secure, as not to put added stress on the wires or terminals.

2. Locate the relay. Refer to **Electrical Center Identification Views** to locate the electrical center where the relay exists.

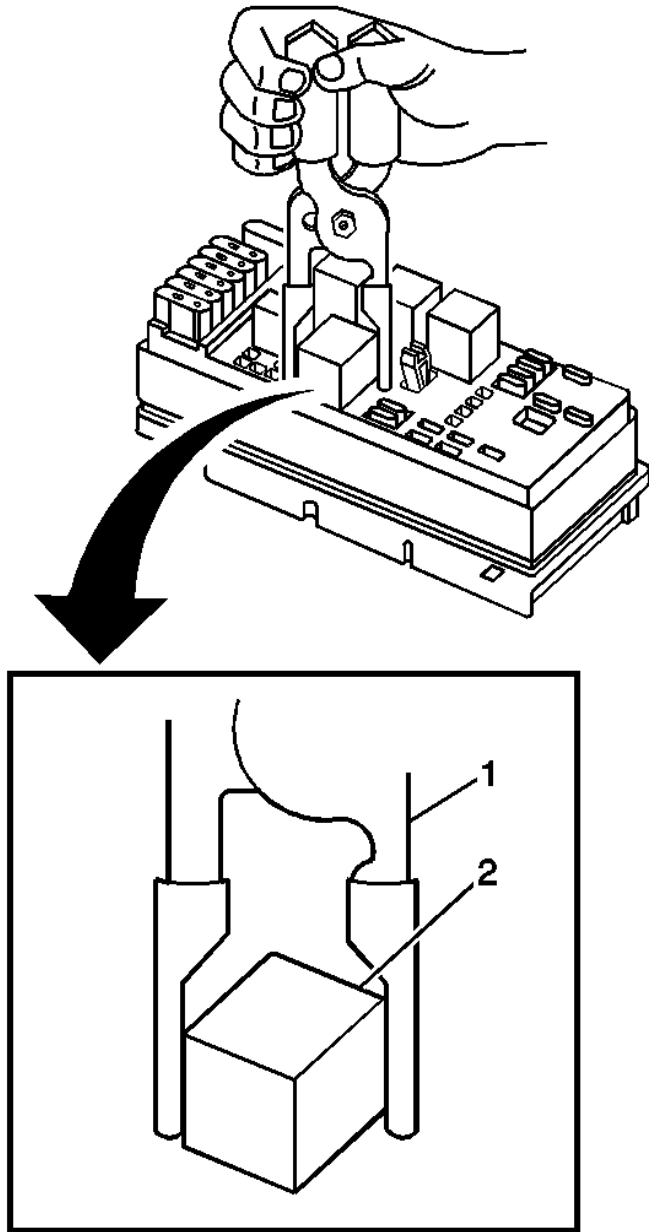


Fig. 3: Removing/Installing Relay
Courtesy of GENERAL MOTORS COMPANY

3. Using the EL-43244 (1) position the tool on opposing corners of the relay (2).

CAUTION: Use EL-43244 to pull the relay straight out from the electrical center terminals. The use of pliers or a flat bladed tool could damage the electrical center.

4. Remove the relay (2) from the electrical center.

Installation Procedure

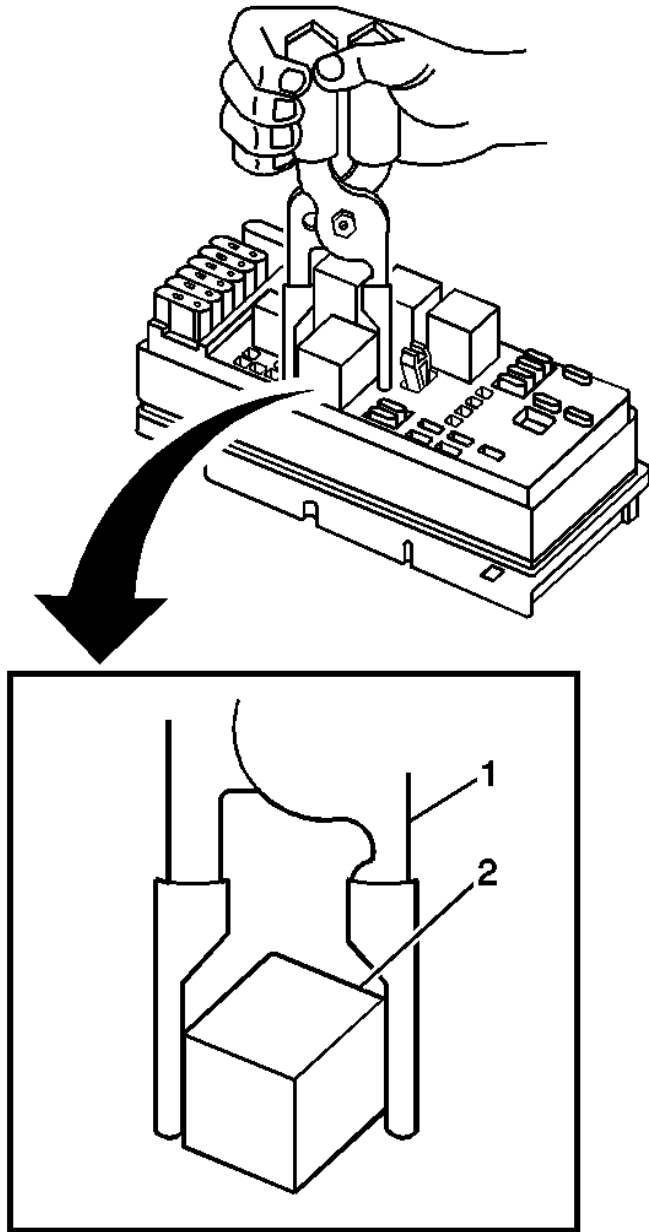


Fig. 4: Removing/Installing Relay
Courtesy of GENERAL MOTORS COMPANY

1. Install the relay (2) in the same position as removed.
2. Install the electrical center cover.

FUSE BLOCK REPLACEMENT

Removal Procedure

1. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection .

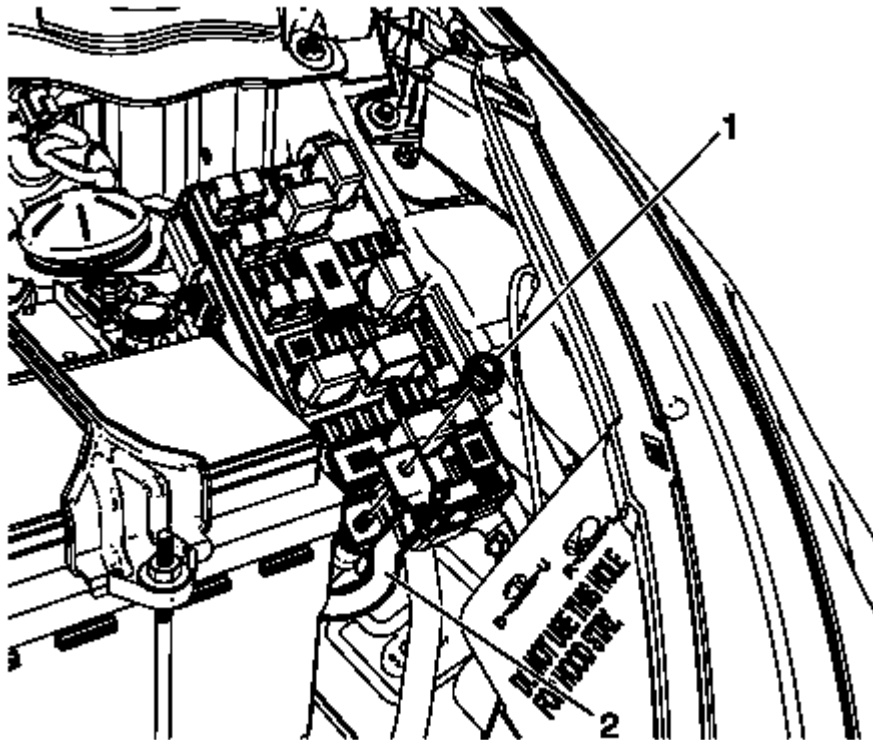


Fig. 5: Positive Battery Cable Nut

Courtesy of GENERAL MOTORS COMPANY

2. Unlock the retaining tabs on the fuse block and open the cover.
3. Remove the positive battery cable nut (1) and the positive battery cable (2) from the battery.

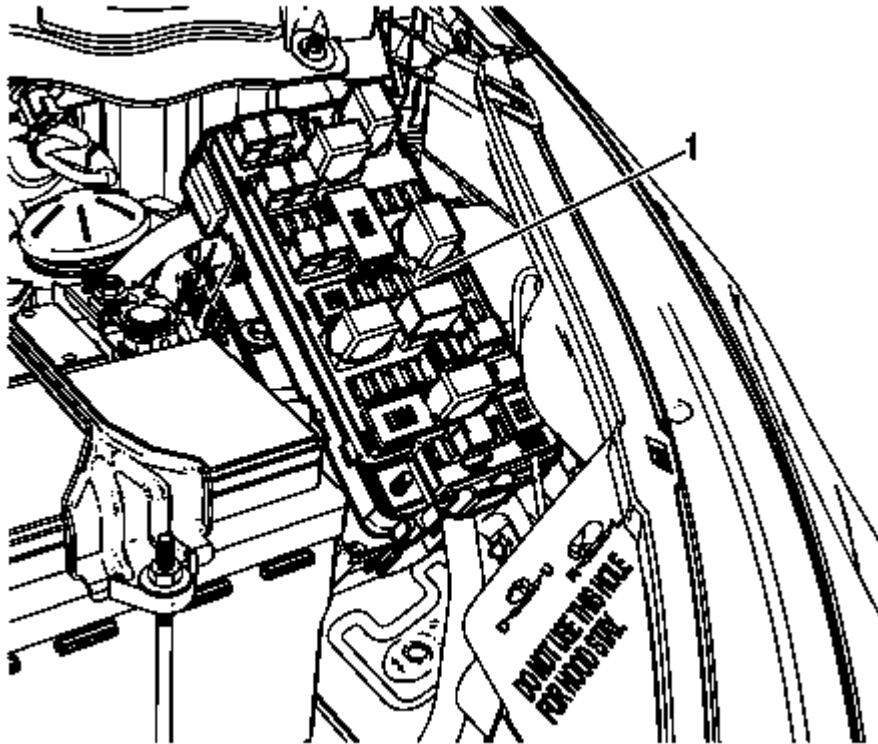


Fig. 6: Fuse Plate

Courtesy of GENERAL MOTORS COMPANY

4. Remove fuse plate (1) from fuse block.

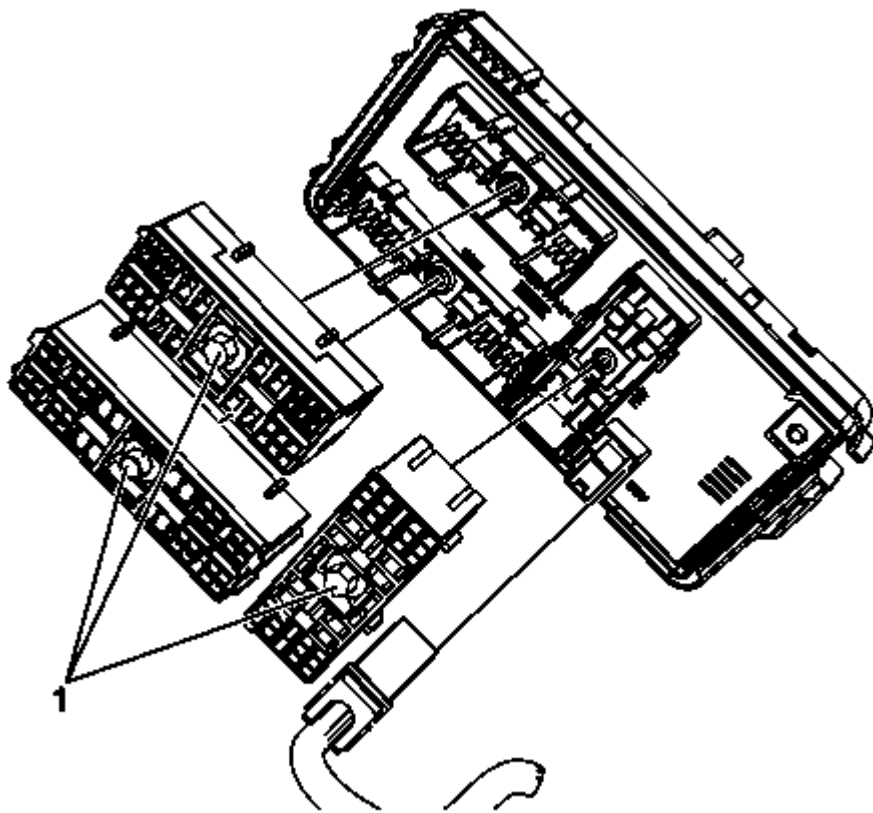


Fig. 7: Fuse Plate And Bolts

Courtesy of GENERAL MOTORS COMPANY

5. Remove the bolts (1) retaining the wiring harness to the fuse plate and remove wiring harness.

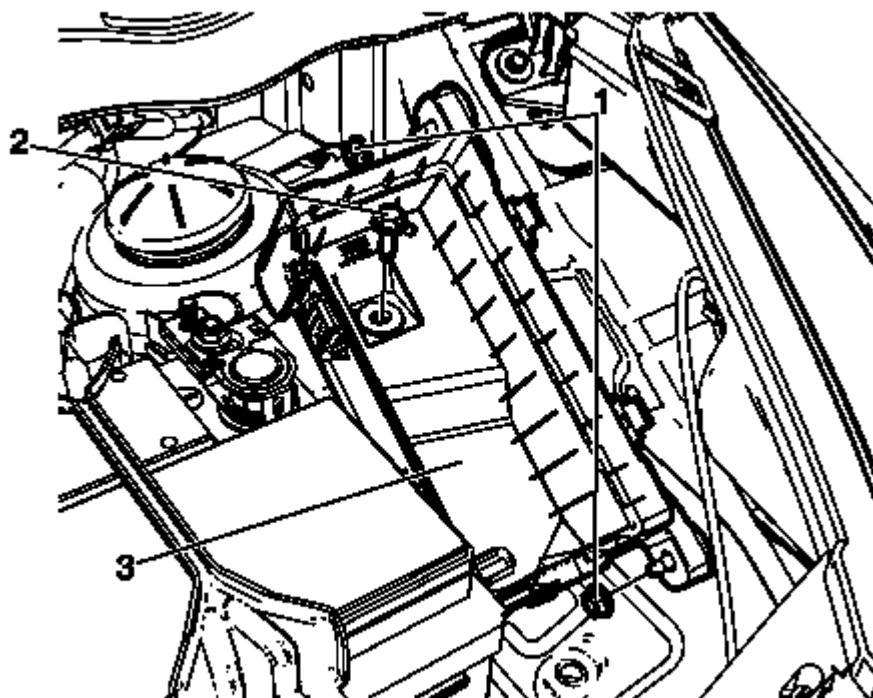


Fig. 8: Fuse Block Housing Fasteners
Courtesy of GENERAL MOTORS COMPANY

6. Remove fuse block housing fasteners (1, 2) and fuse block housing (3).

Installation Procedure

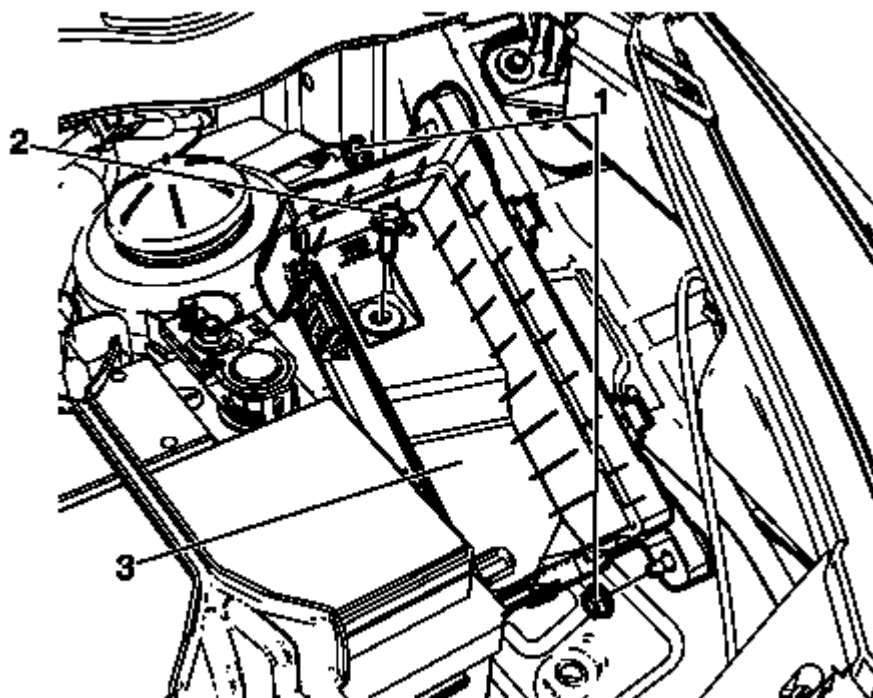


Fig. 9: Fuse Block Housing Fasteners
Courtesy of GENERAL MOTORS COMPANY

1. Install fuse block housing.

CAUTION: Refer to Fastener Caution .

2. Install the fuse block housing fasteners (1, 2) and tighten to 7 (62 lb in).

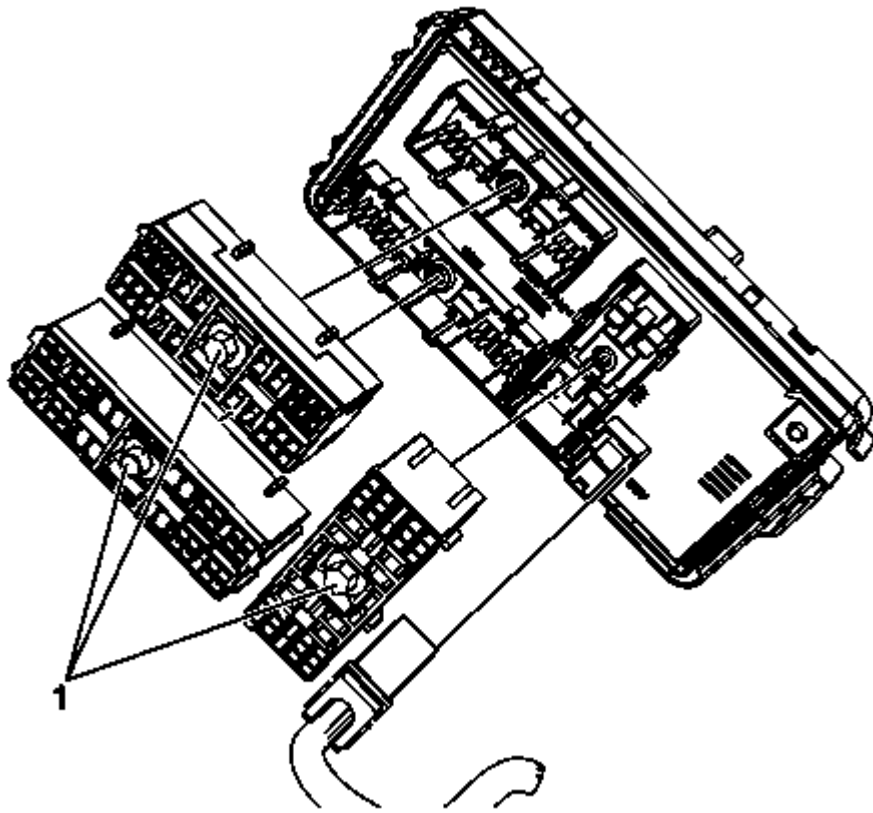


Fig. 10: Fuse Plate And Bolts

Courtesy of GENERAL MOTORS COMPANY

3. Install wiring harness and tighten the bolts (1) to 6 (53 lb in).

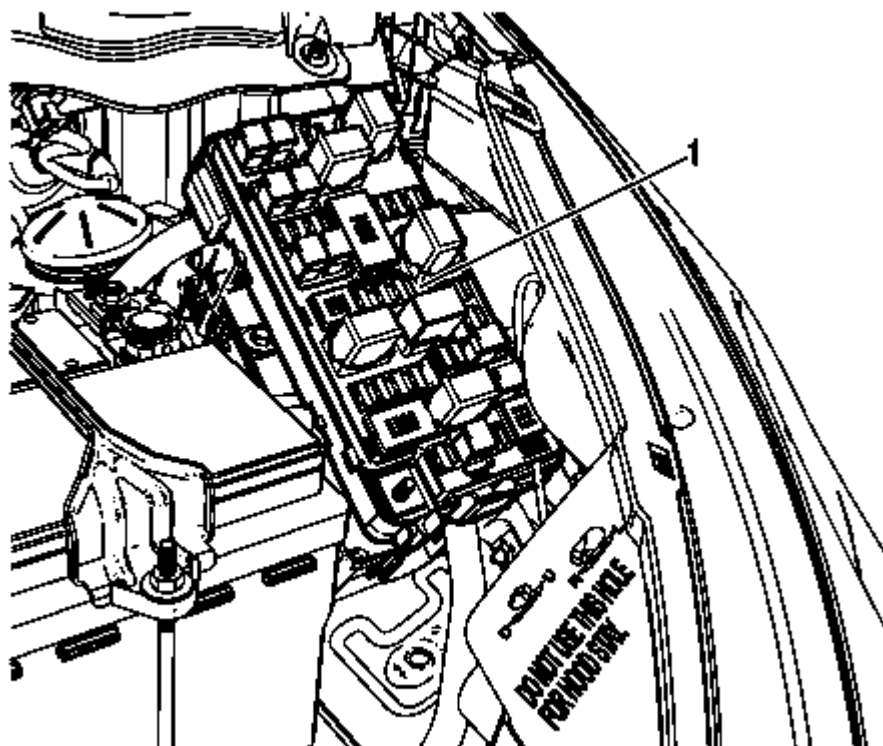


Fig. 11: Fuse Plate

Courtesy of GENERAL MOTORS COMPANY

4. Install fuse plate (1) to the fuse block housing.

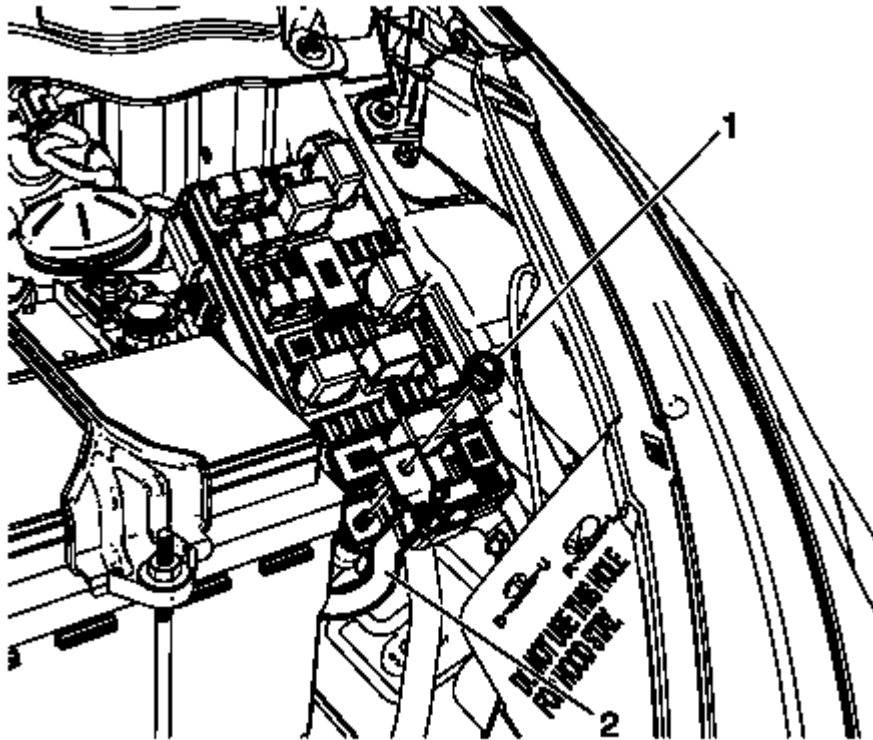


Fig. 12: Positive Battery Cable Nut

Courtesy of GENERAL MOTORS COMPANY

5. Install the positive battery cable nut (1) and the positive battery cable (2) and tighten to 10 (89 lb in).
6. Close fuse block.
7. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .

IGNITION LOCK CYLINDER REPLACEMENT (TYPE B)

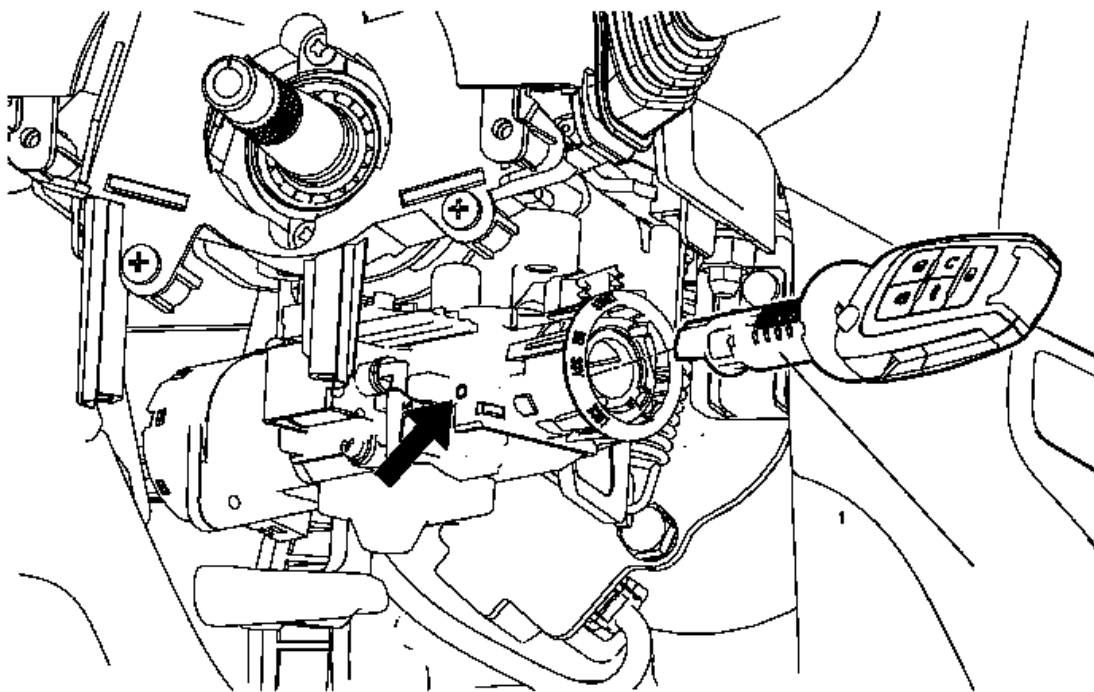


Fig. 13: Ignition Lock Cylinder (Type B)
 Courtesy of GENERAL MOTORS COMPANY

Ignition Lock Cylinder Replacement (Type B)

Callout	Component Name
Preliminary Procedure Remove the steering column lower trim cover. Refer to <u>Steering Column Lower Trim Cover Replacement</u> .	
1	Ignition Lock Cylinder Procedure 1. Ignition switch is ON. 2. Remove ignition lock cylinder after pressing the spring of ignition lock housing hole by suitable tool.

IGNITION LOCK CYLINDER REPLACEMENT (TYPE A)

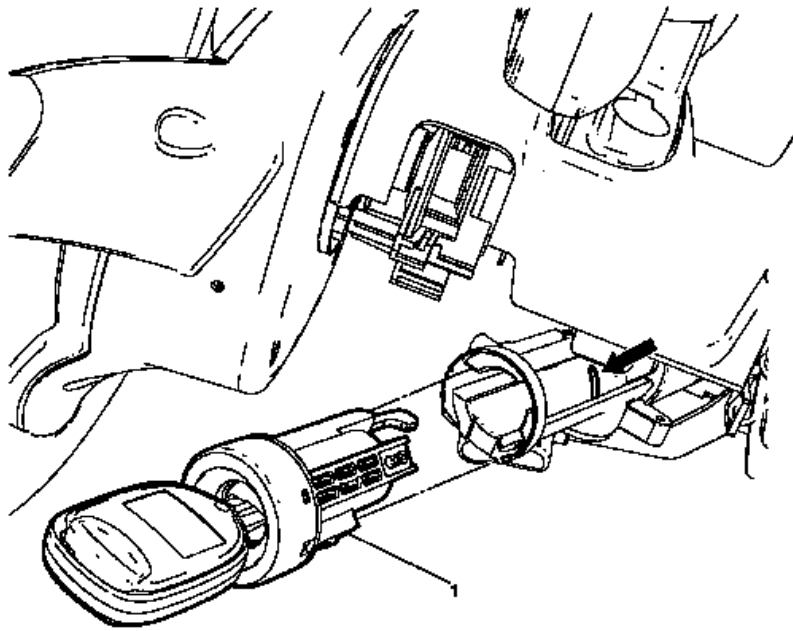


Fig. 14: Ignition Lock Cylinder (Type A)
 Courtesy of GENERAL MOTORS COMPANY

Ignition Lock Cylinder Replacement (Type A)

Callout	Component Name
Preliminary Procedure Remove steering column lower trim cover. Refer to <u>Steering Column Lower Trim Cover Replacement</u> .	
1	Ignition Lock Cylinder Procedure 1. Ignition Switch is ACC. 2. Remove ignition lock cylinder after pressing the spring of ignition lock housing hole by suitable tool.

ELECTRICAL

Wiring Systems and Power Management - Schematic and Routing Diagrams - Spark

WIRING SCHEMATICS AND ROUTING DIAGRAMS

HARNESS ROUTING VIEWS

Forward Lamp Harness Routing (1 of 3)

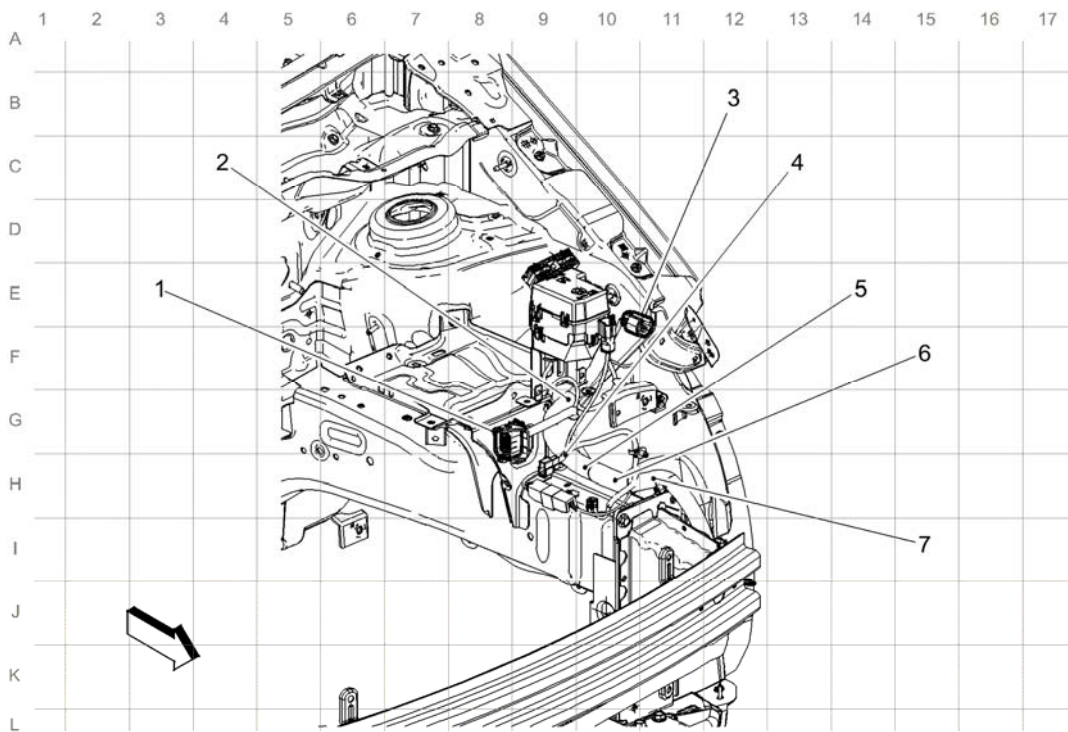


Fig. 1: Forward Lamp Harness Routing (1 of 3)

Courtesy of GENERAL MOTORS COMPANY

Items

- 1: X111 X111 Forward Lamp Harness to Engine Harness
- 2: J121 (LCP)
- 3: X110
- 4: J109 (LC5, LCP or LMT)
- 5: J151
- 6: J150
- 7: J125

Forward Lamp Harness Routing (2 of 3)

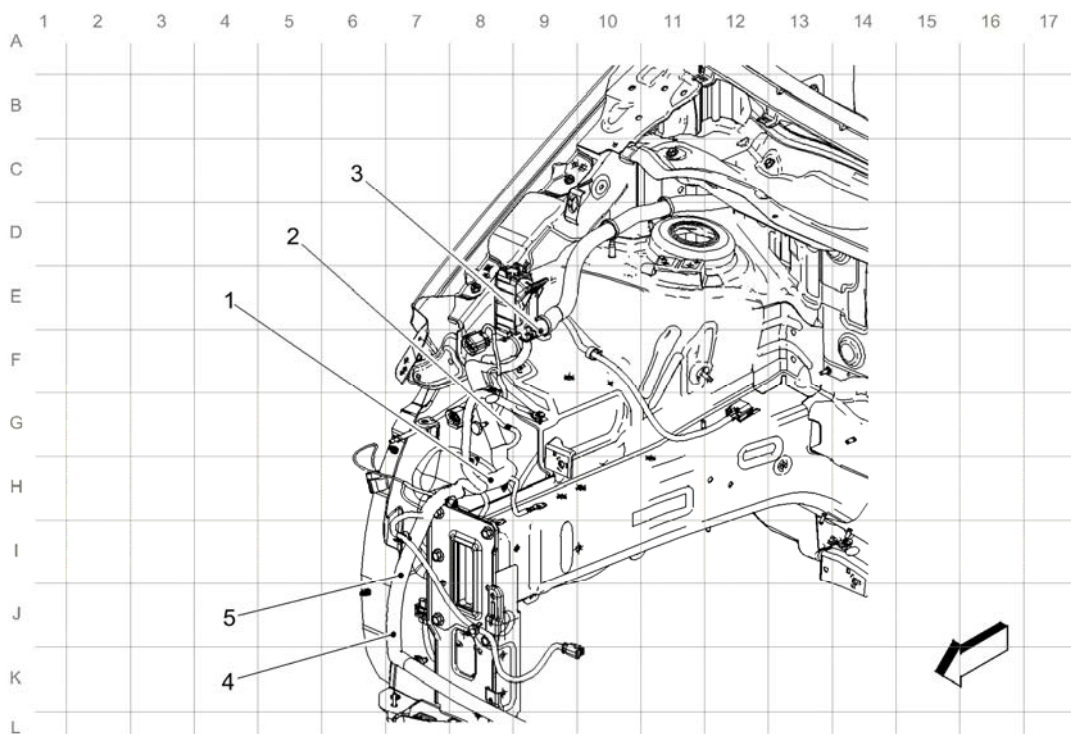


Fig. 2: Forward Lamp Harness Routing (2 of 3)
Courtesy of GENERAL MOTORS COMPANY

Items

- 1:** J153
- 2:** J152
- 3:** J111 (LC5, LCP or LMT)
- 4:** J131
- 5:** J130 Forward Lamp Harness Routing - Left Side of Engine Compartment

Forward Lamp Harness Routing (3 of 3)

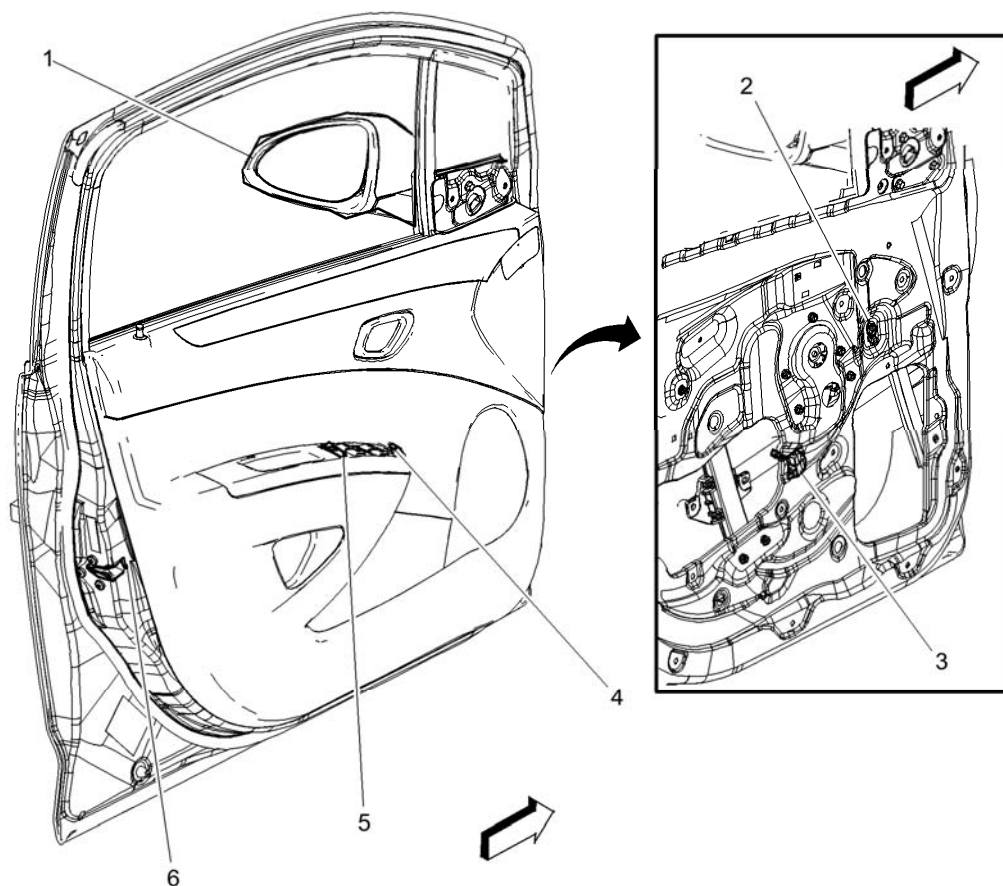


Fig. 3: Forward Lamp Harness Routing (3 of 3)
Courtesy of GENERAL MOTORS COMPANY

Items

- 1: J133
- 2: J132
- 3: X102
- 4: X107
- 5: X106

Engine Harness Routing - Rear (LFM/LLO with M4M)

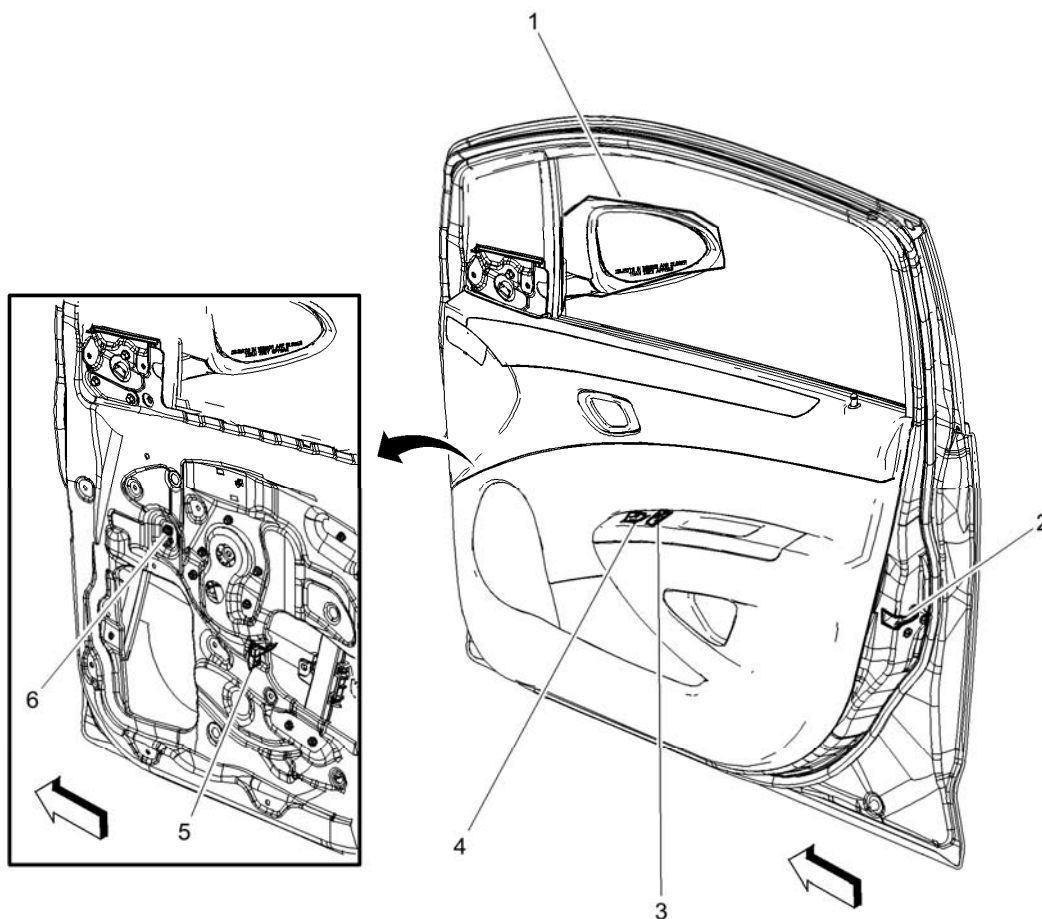


Fig. 4: Engine Harness Routing - Rear (LFM/LLO with M4M)
 Courtesy of GENERAL MOTORS COMPANY

Items

- 1: X111 X111 Forward Lamp Harness to Engine Harness**
- 2: J122**
- 3: J123**
- 4: J124**
- 5: X160 X160 Engine Harness to Fuel Injector Harness**
- 6: X170 X170 Engine Harness to Ignition Coils Harness**
- 7: J129**
- 8: J128**
- 9: J124**
- 10: J126**
- 11: J127**
- 12: X230 X230 Engine Harness to Body Harness**
- 13: X175**

Engine Harness Routing - Front (LFM/LLO with M4M)

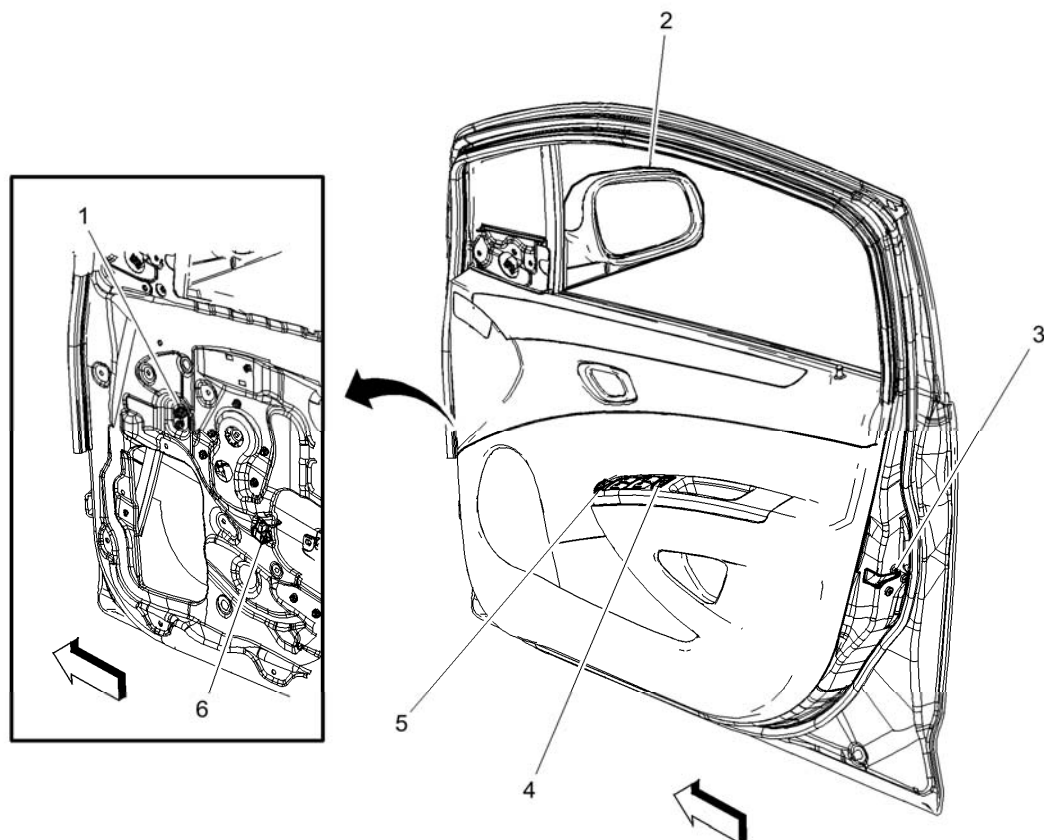


Fig. 5: Engine Harness Routing - Front (LFM/LLO with M4M)
Courtesy of GENERAL MOTORS COMPANY

Items

- 1: X170 X170 Engine Harness to Ignition Coils Harness
- 2: X111 X111 Forward Lamp Harness to Engine Harness
- 3: X175

Engine Harness Routing (LL0 with MNG)

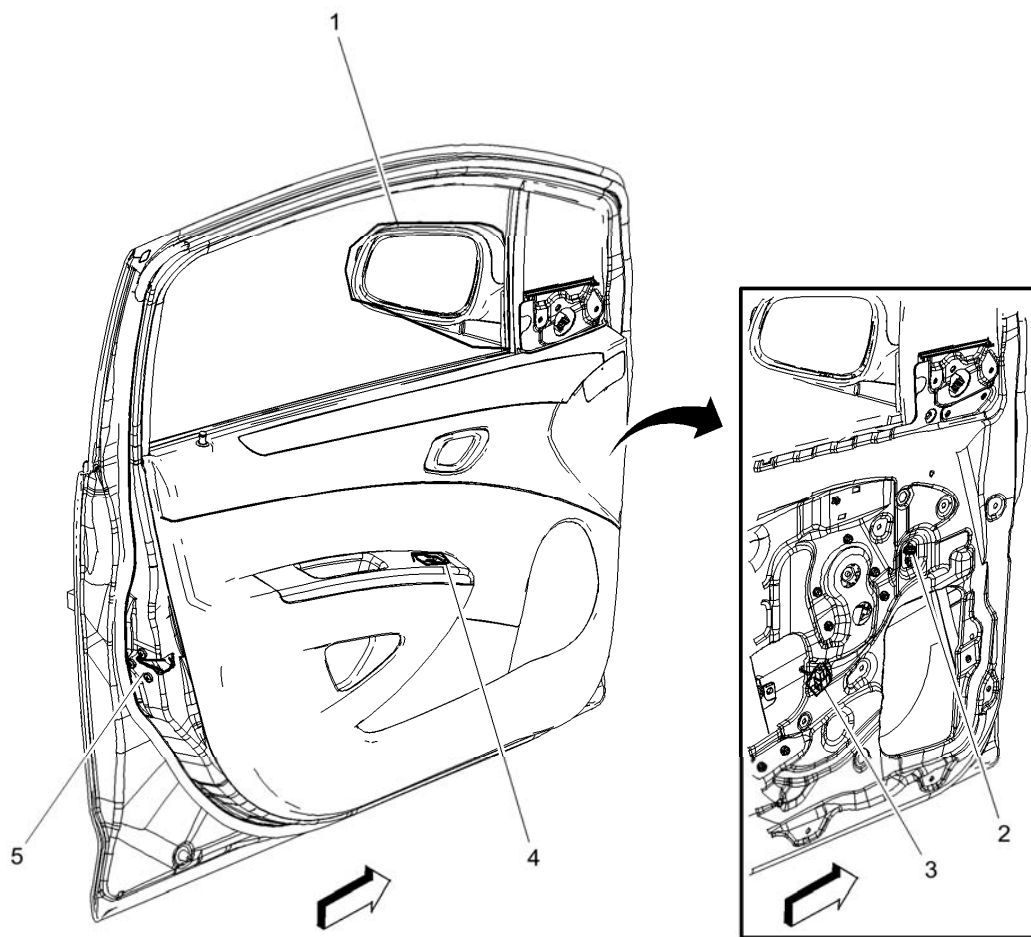


Fig. 6: Engine Harness Routing (LL0 with MNG)
 Courtesy of GENERAL MOTORS COMPANY

Items
1: J140
2: J160
3: J154
4: X160 <u>X160 Engine Harness to Fuel Injector Harness</u>
5: X170 <u>X170 Engine Harness to Ignition Coils Harness</u>
6: J170
7: X214 <u>X214 Engine Harness to Instrument Panel Harness</u>
8: X230 <u>X230 Engine Harness to Body Harness</u>
9: J101
10: J139
11: X111 <u>X111 Forward Lamp Harness to Engine Harness</u>

Engine Harness Routing (LL0 with MX2)

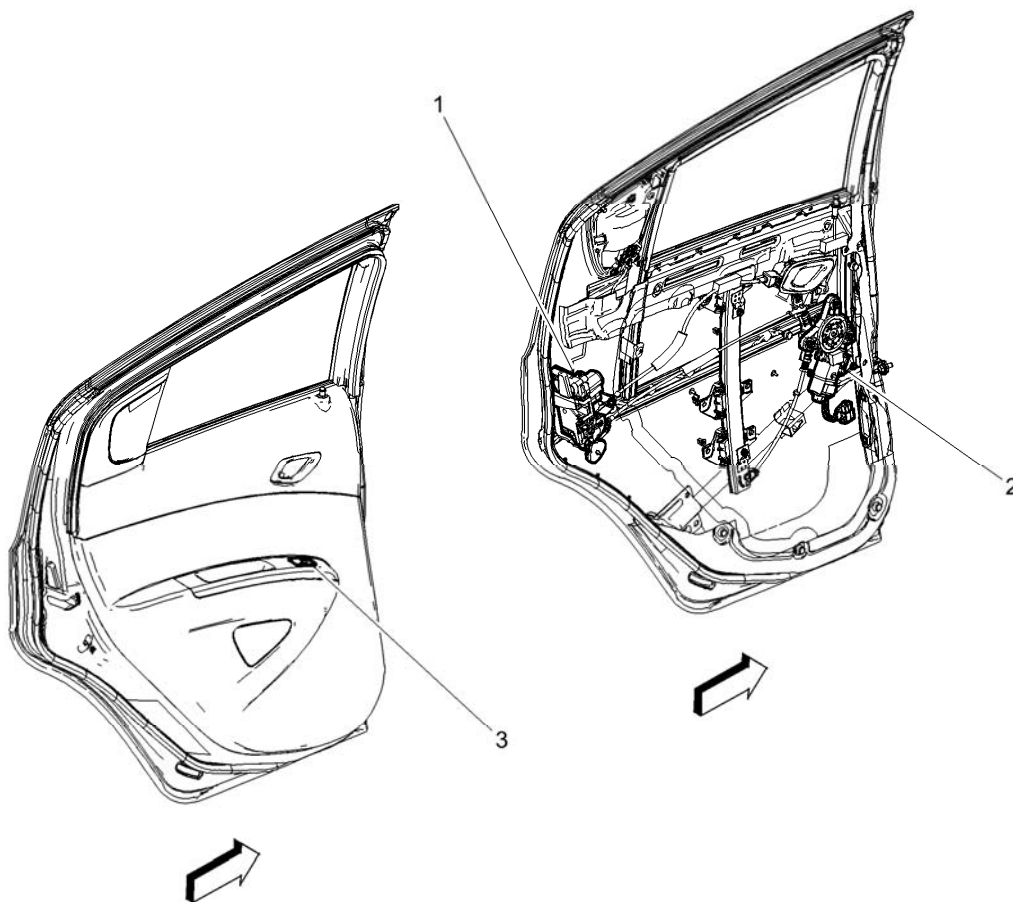


Fig. 7: Engine Harness Routing (LL0 with MX2)
 Courtesy of GENERAL MOTORS COMPANY

Items	
1: X111	<u>X111 Forward Lamp Harness to Engine Harness</u>
2: J160	
3: X160	<u>X160 Engine Harness to Fuel Injector Harness</u>
4: X170	<u>X170 Engine Harness to Ignition Coils Harness</u>
5: J170	
6: X214	<u>X214 Engine Harness to Instrument Panel Harness</u>
7: X230	<u>X230 Engine Harness to Body Harness</u>
8: J154	

Fuel Injector Harness Routing

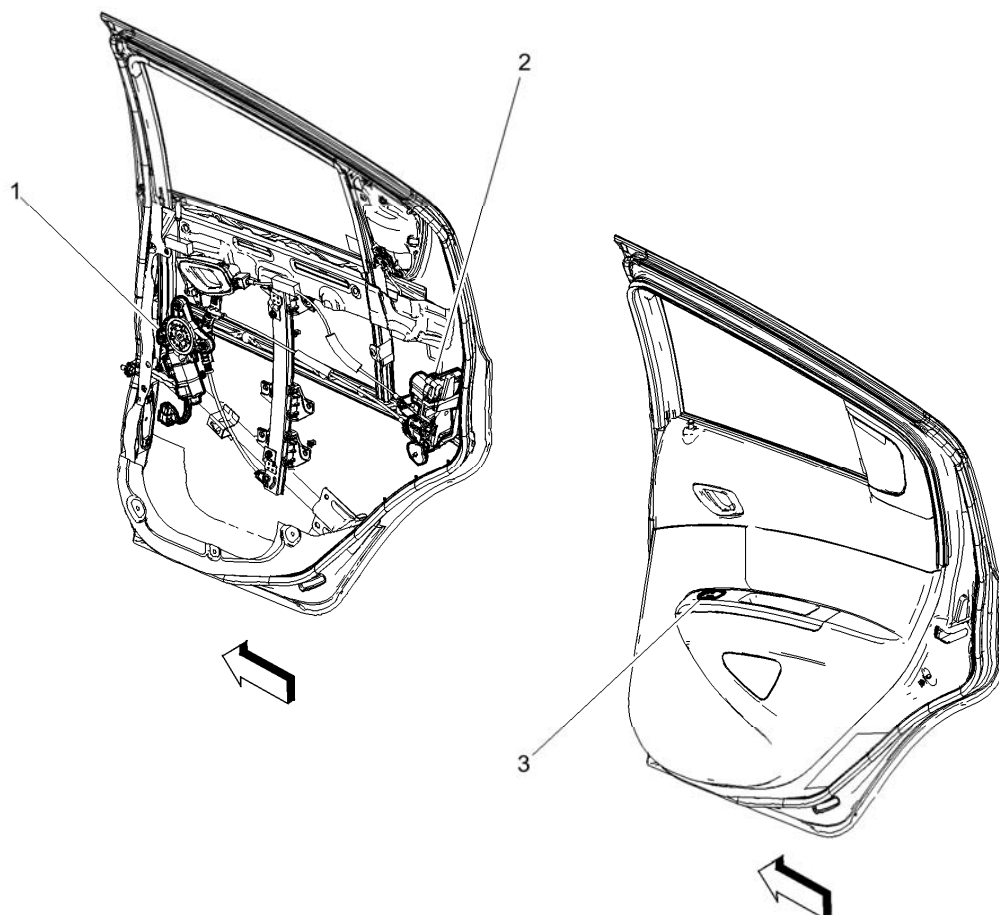


Fig. 8: Fuel Injector Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items
1: X160 <u>X160 Engine Harness to Fuel Injector Harness</u>

Ignition Coil Harness Routing

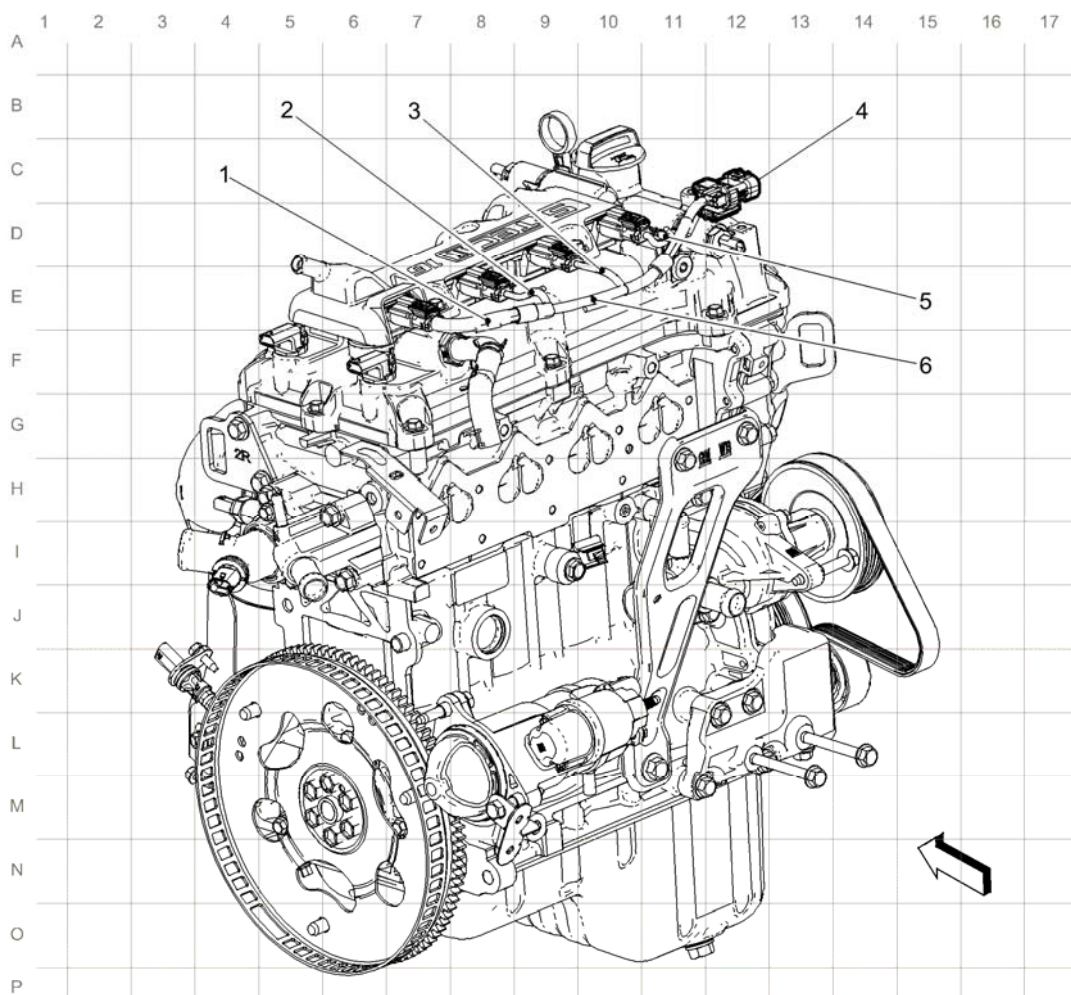


Fig. 9: Ignition Coil Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items

- 1: J174**
- 2: J172**
- 3: J175**
- 4: X170 X170 Engine Harness to Ignition Coils Harness**
- 5: J171**
- 6: J173**

Left and Right Rear Door Harness Routing

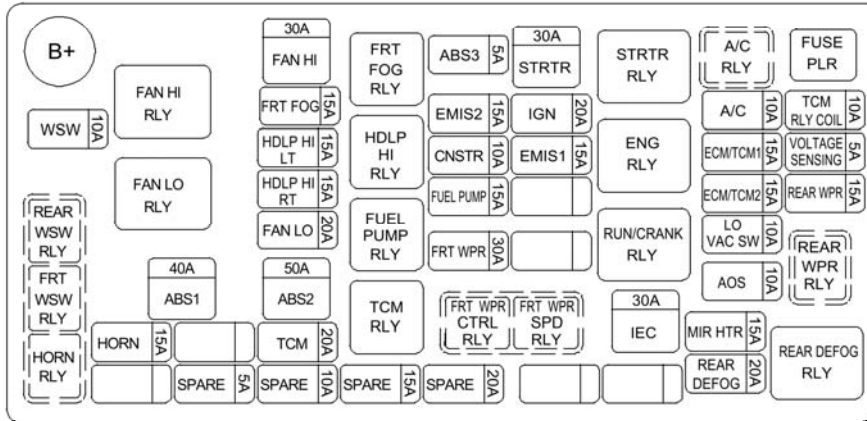


Fig. 10: Left and Right Rear Door Harness Routing
 Courtesy of GENERAL MOTORS COMPANY

Items	
1: X700	<u>X700 Left Rear Door Harness to Body Harness</u>
2: X800	<u>X800 Right Rear Door Harness to Body Harness</u>

Fuel Tank Harness Routing



Fig. 11: Fuel Tank Harness Routing
 Courtesy of GENERAL MOTORS COMPANY

Items	
1:	J350
2:	X350 (LHD)

Liftgate Harness Routing

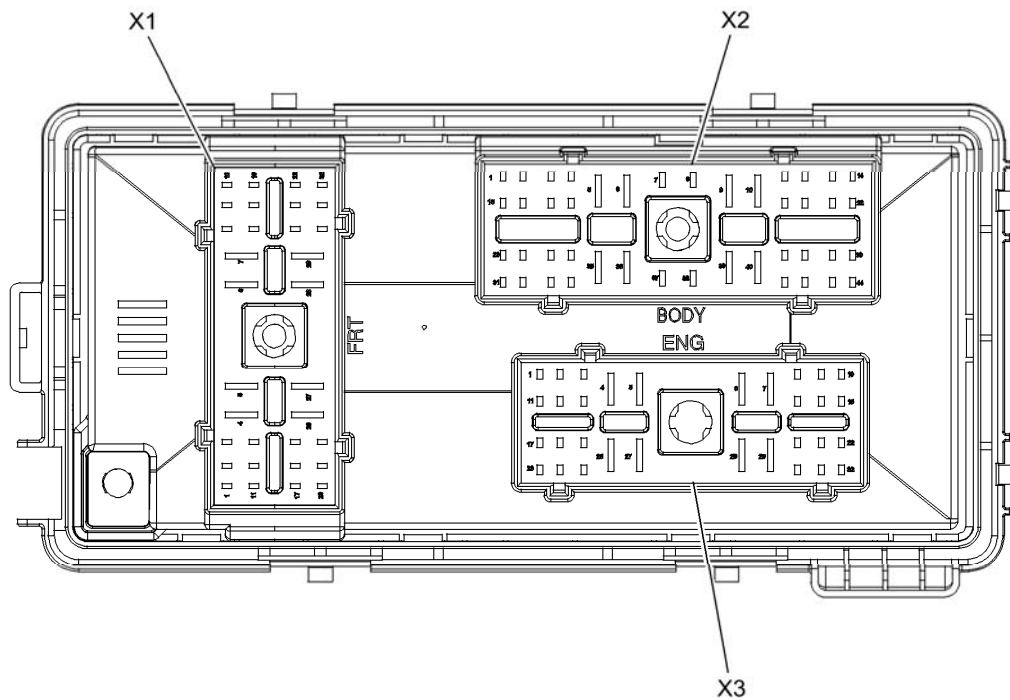


Fig. 12: Liftgate Harness Routing
 Courtesy of GENERAL MOTORS COMPANY

Items
1: J950
2: X900 <u>X900 Body Harness to Liftgate Harness</u>
3: X902 (C49) <u>X902 Liftgate Harness to Liftgate Extension Harness</u>

Liftgate Extension Harness Routing

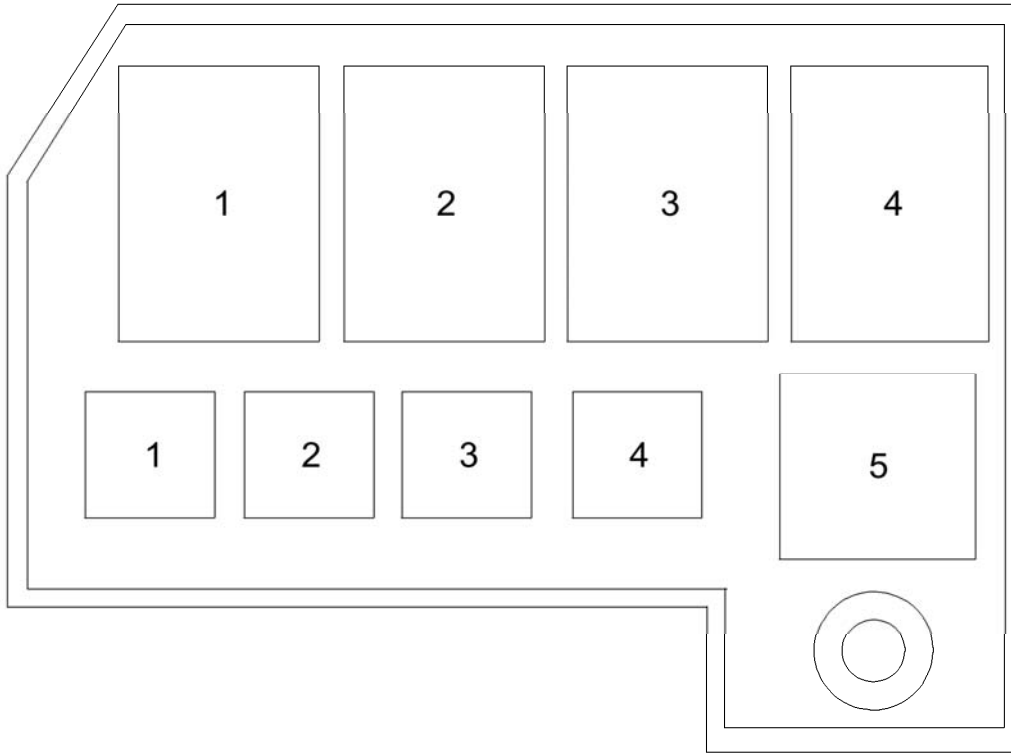


Fig. 13: Liftgate Extension Harness Routing
 Courtesy of GENERAL MOTORS COMPANY

Items
1: X902 (C49) <u>X902 Liftgate Harness to Liftgate Extension Harness</u>

HOW TO USE ELECTRICAL SCHEMATICS

Information Overview

The following explains some of the key parts of the GM wiring diagrams. Included are:

- Color Abbreviations

Color Abbreviations

The following sequence is used when depicting wire colors:

1. Color modifier of the wire, such as light or dark (if applicable)
2. Primary color of the wire
3. Secondary color of the wire (tracer/stripe)

Wire insulation and connector body colors in schematic information are abbreviated with a two character code as listed below.

Abbreviation	Color	Abbreviation	Color
AM	Amber	OG	Orange
BARE	Bare	PK	Pink
BG	Beige	PU	Purple
BK	Black	RD	Red
BN	Brown	RU	Rust
BU	Blue	SR	Silver
CL	Clear	TL	Teal
CR	Cream	TN	Tan
CU	Curry	TQ	Turquoise
GD	Gold	VT	Violet
GN	Green	WH	White
GY	Gray	YE	Yellow
NA	Natural	-	-
Color Modifiers			
L	Light	D	Dark

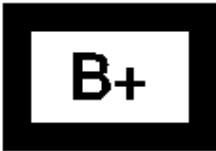
Additionally, industry standard cable types are not identified by color, but are listed by cable type as follows:

Abbreviation	Cable Type
COAX	Coax Cable
FW	Flat Wire
HDMI	High Definition Multimedia Interface
TWINAX	Twinax Cable
USB	Universal Serial Bus

ELECTRICAL SCHEMATIC SYMBOLS

Voltage Indicators

Symbol	Description



Battery
Voltage

IGN 0

Ignition
Switch- Off
Position



Ignition
Switch-
Accessory
Position



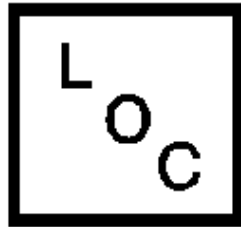
Ignition
Switch-
Run
Position



Ignition
Switch-
Start
Position

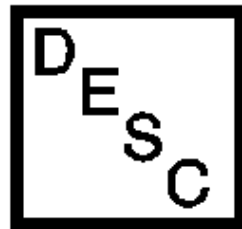
General Icons

Symbol	Description



Master
Component List
Icon
This icon is used
on the schematic
to link to the
Master Electrical
Component List.

Description and

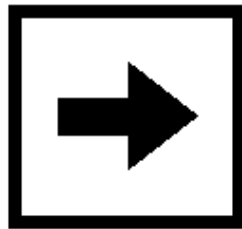


Operation Icon
This icon is used
on the schematic
to link to the
Description and
Operation of that
particular system.

Computer
Programming
Icon
This icon is used

on the schematic
to link to Control
Module
References,
which identifies
which
components need
programming
upon
replacement.





Next Schematic
Page Icon
This icon is used
on the schematic
to navigate to the
next schematic in
the subsystem.

Previous

Schematic Page
Icon
This icon is used
on the schematic
to navigate to the
previous
schematic in the
subsystem.



Supplemental
Inflatable
Restraint (SIR) or
Supplemental



Restraint System
(SRS) Icon
This icon is used
to alert the
technician that
the system
contains SIR/SRS
components that
require certain
precautions
before servicing.

Information Icon



This icon is used to alert the technician that there is additional information that will aid in servicing a system.

Danger Icon
This icon is intended to alert the technician that a component within the system

contains labeling with the same icon.

This icon is used when a source component has potential for 60 volts DC or greater or has potential for 42 volts AC or greater.



High Voltage
Icon

This icon is intended to alert the technician that a component



within the system contains labeling with the same icon.

This icon is used when a component/circuit has potential for 60 volts DC or greater or has potential for 42 volts AC or greater.

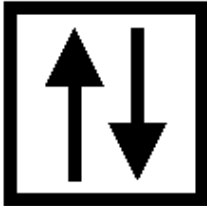
Caution Icon
This icon is used to advise the technician to use

caution when servicing this component. This icon may be used when a component/circuit has a voltage range potential between 30-60 volts DC or 15-42 volts AC.



Functional Serial Data Communication
This icon is used to show the

technician that the serial data circuit detail is shown incomplete. It also provides an active link to the Data Communication Schematics where the circuit is shown complete.



Switch Position Icons

Symbol	Description



Generic Up
Arrows



Generic
Down
Arrows



Generic
Left Arrows



Generic
Right
Arrows



Generic
Express
Down
Arrows



On/Off Icon



Generic
Lock Icon



Generic
Unlock
Icon



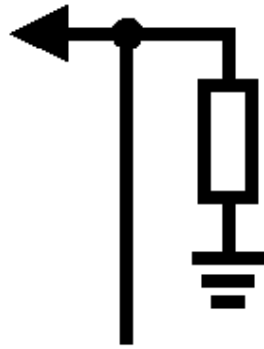
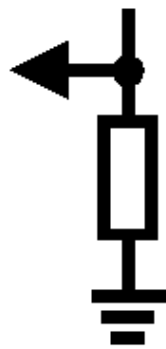
Generic
Window
Switch
Positions- 4
Door



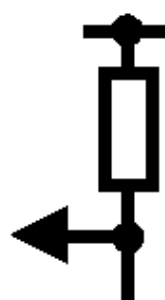
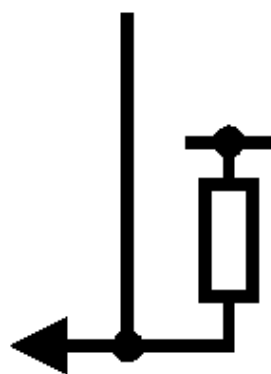
Generic
Window
Switch
Positions- 2
Door

Module Circuit Function Icons

Symbol	Description



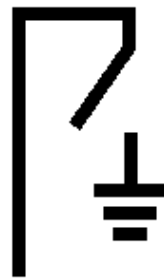
I/O Pull-
Down
Resistors (-)



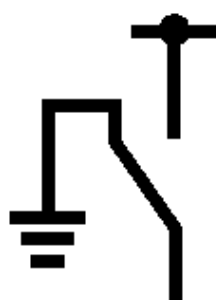
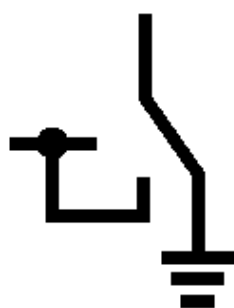
I/O Pull-Up
Resistors (+)



I/O High-Side Drive Switch (+)



I/O Low-Side Drive Switch (+)



I/O
Bidirectional
Switch (+/-)



Pulse-Width
Modulation
Symbol

B+

Battery
Voltage

IGN

Ignition
Voltage

5V

Voltage
Reference

5V AC

A/C Voltage



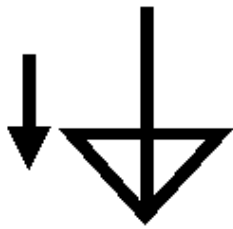
Low
Reference



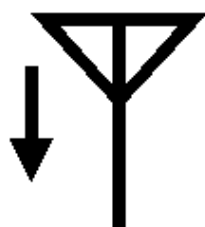
Ground



Serial Data



Antenna
Signal- In



Antenna
Signal- Out



Brake Apply

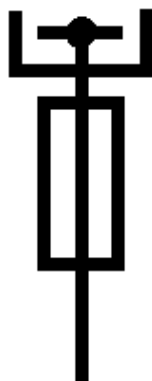
Harness Components

Symbol	Description



Fuse

PWR/TRN Relay



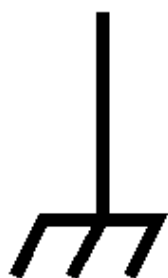
Fuse
Supplied by
a Relay



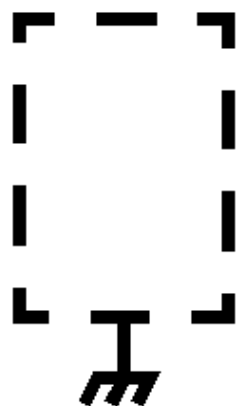
Circuit
Breaker



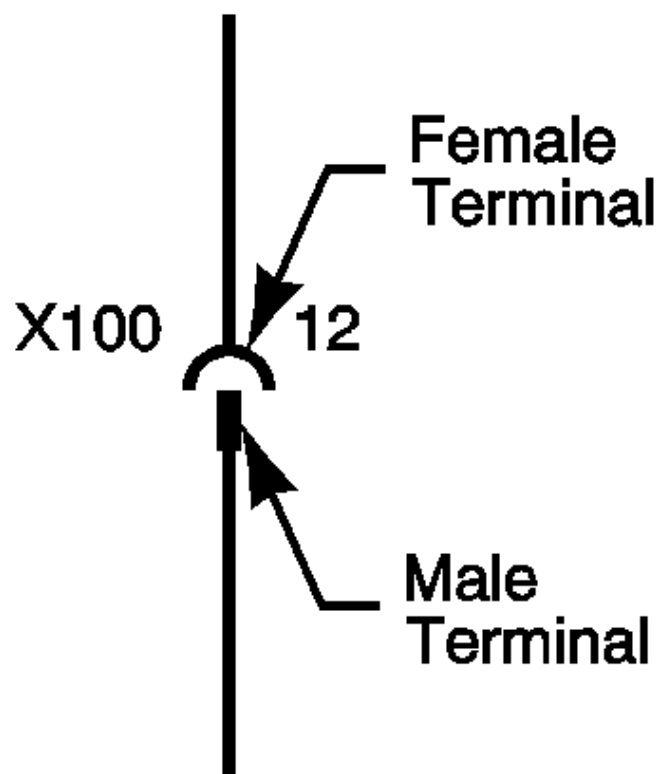
Fusible Link



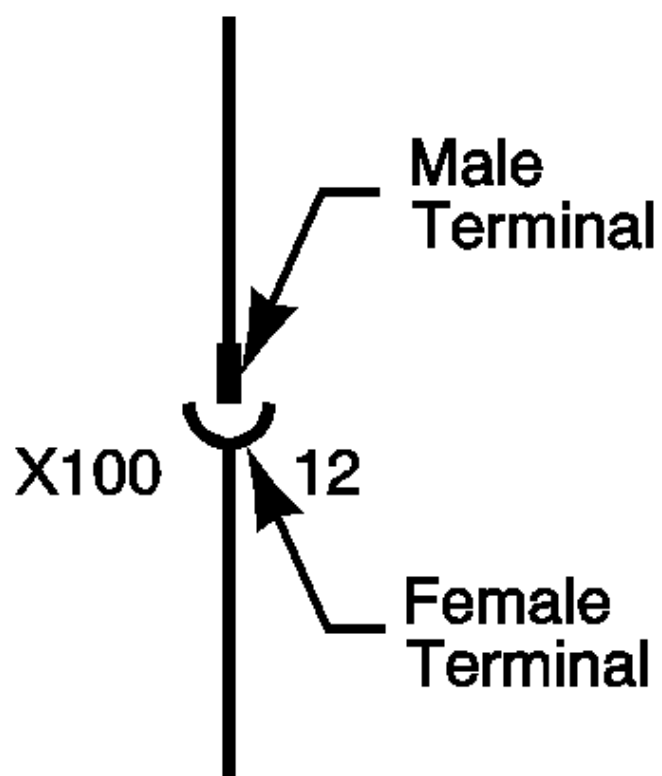
Ground



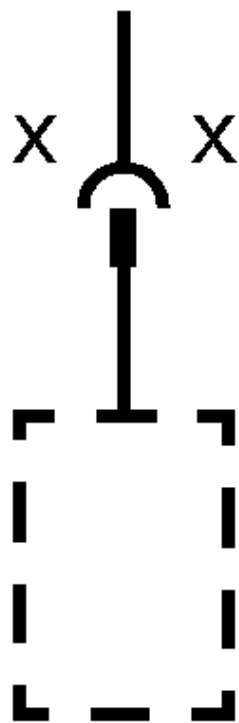
Case
Ground



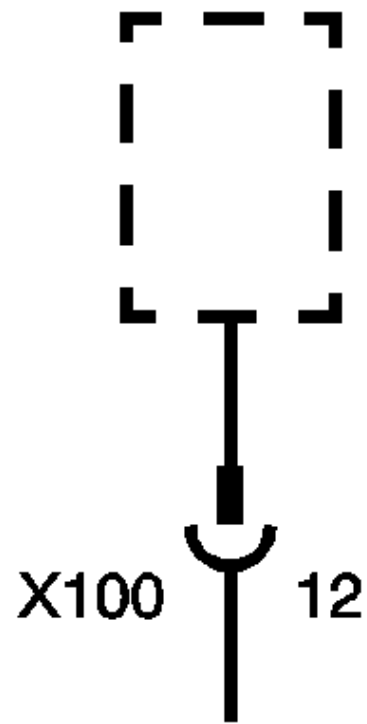
Inline
Harness
Connector



Inline
Harness
Connector



Pigtail
Connection



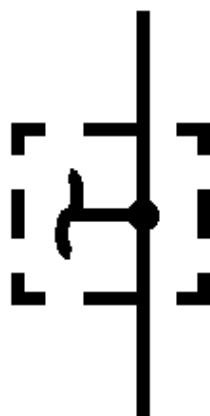
Pigtail
Connection



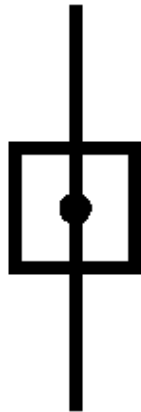
Provisional
or
Diagnostic
Connector



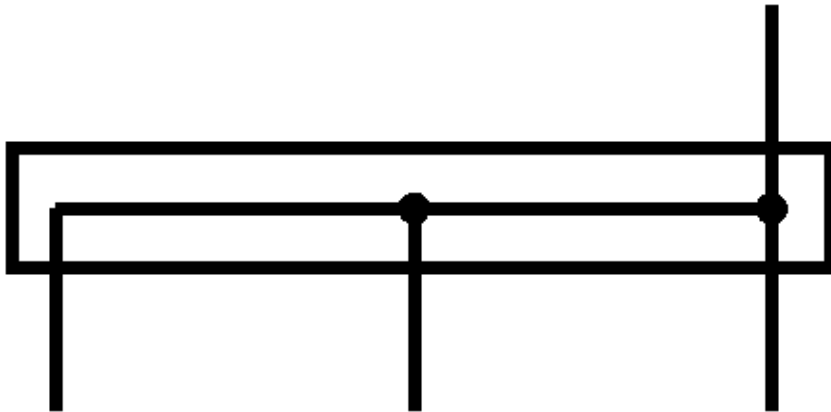
Blunt Cut
Wire



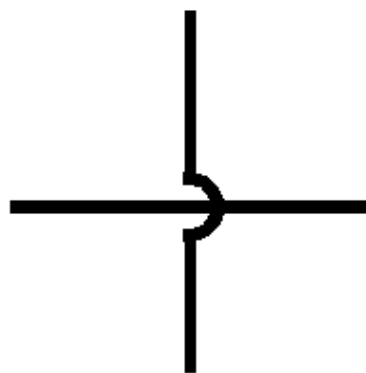
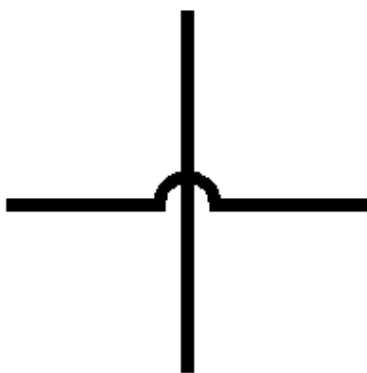
Incomplete
Physical
Splice



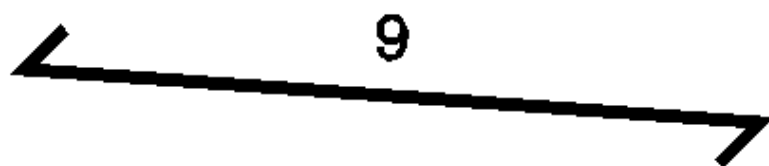
Complete
Physical
Splice- 2
Wires



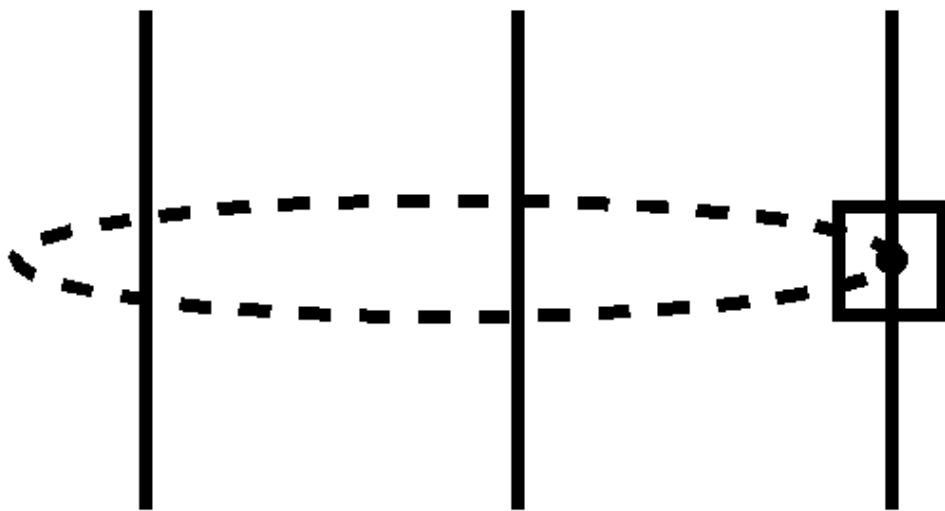
Complete
Physical
Splice- 3 or
more wires



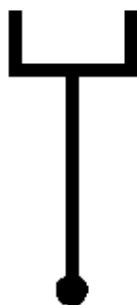
Wire
Crosses



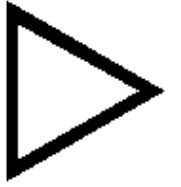
Twisted
Wires



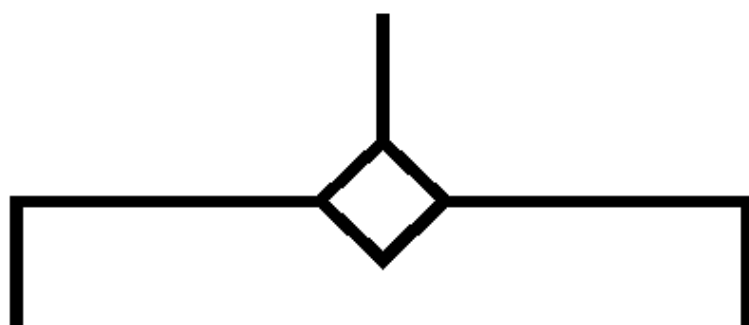
Shield



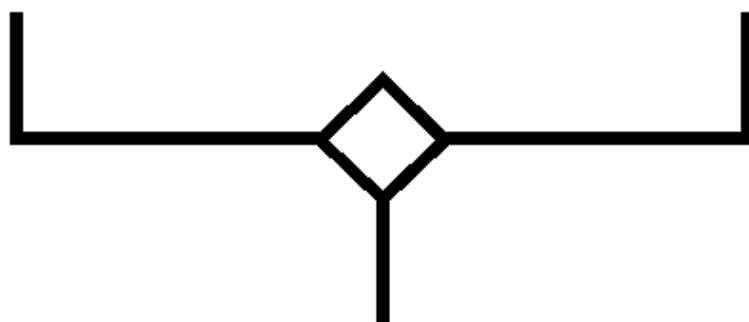
Circuit
References

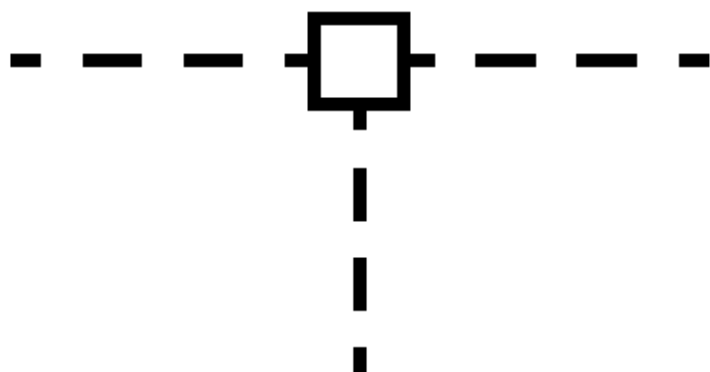


Circuit
Continuation
Arrowheads

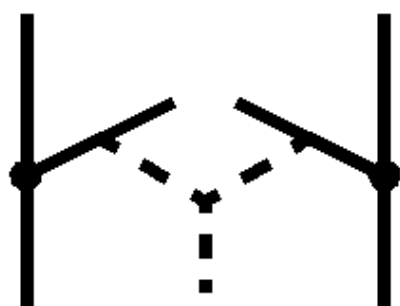


Option
Breakpoint





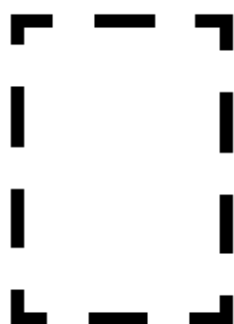
Ground
Circuit
Connection



Connector
Shorting
Clip

Component Parts

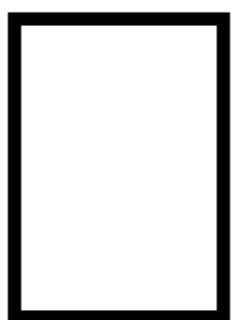
Symbol	Description

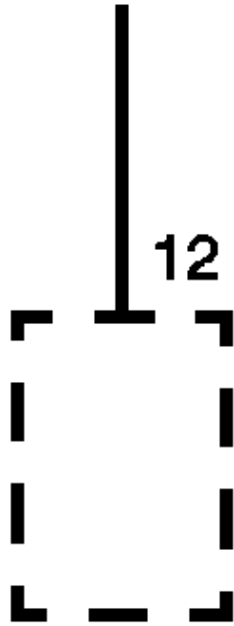


Partial
Component
When a
component
is
represented
in a dashed
box, the
component
or its wiring
is not
shown in its
entirety.

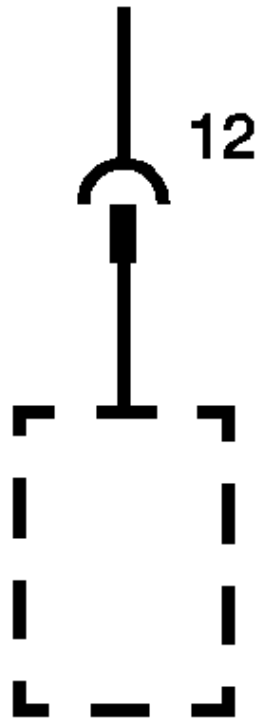
Entire
Component
When a

component
is
represented
in a solid
box the
component
or its wiring
is shown in
its entirety.





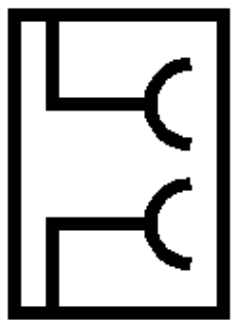
Connector
Directly
Attached to
Component



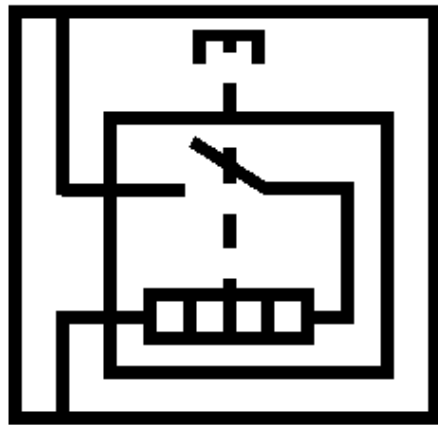
Pigtail
Connector

Switches and Relays

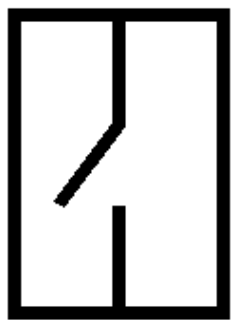
Symbol	Description



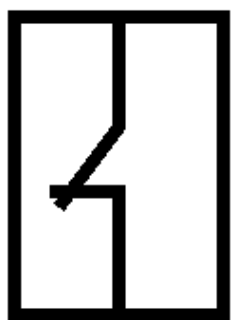
Accessory
Power Outlet



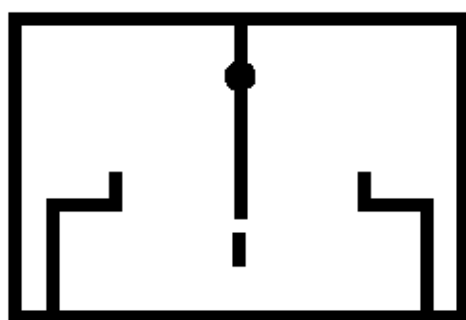
Cigar
Lighter



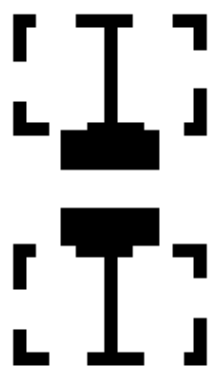
Switch- 2
Position
Normally
Open



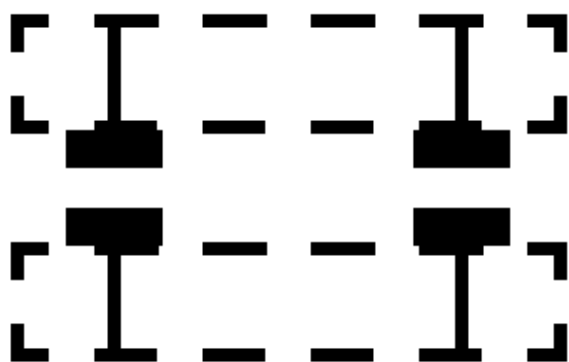
Switch- 2
Position
Normally
Closed



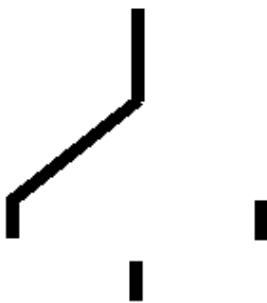
Switch-
Rocker



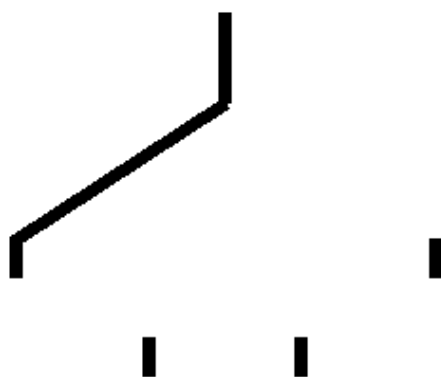
Switch-
Contact
Plate (1
Wire)



Switch-
Contact
Plate (2
Wire)

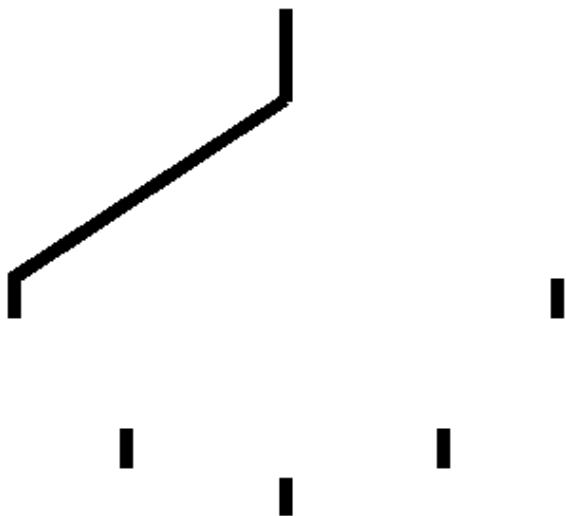


Switch- 3
Position

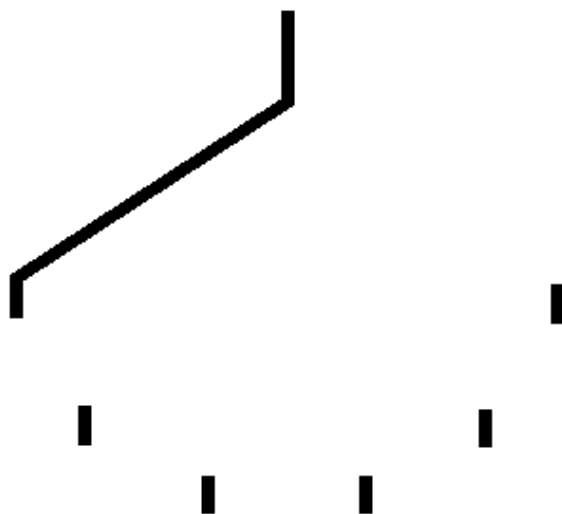


Switch- 4
Position

Switch- 5
Position



Switch- 6
Position



E - - -

Switch
Actuator-
Push
(Momentary)

EV--

Switch
Actuator-
Push
(Latching)

]- - -

Switch
Actuator-
Pull
(Momentary)



Switch
Actuator-
Pull
(Latching)



Switch
Actuator-
Rotate
(Momentary)



Switch
Actuator-
Rotate
(Latching)

F - - .

Switch
Actuator-
Slide
(Momentary)



Switch
Actuator-
Slide
(Latching)



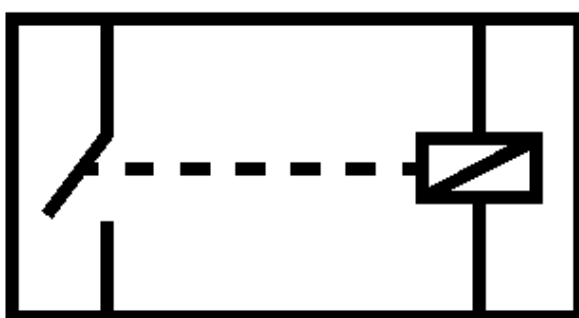
Switch
Actuator-
Pressure
(Momentary)



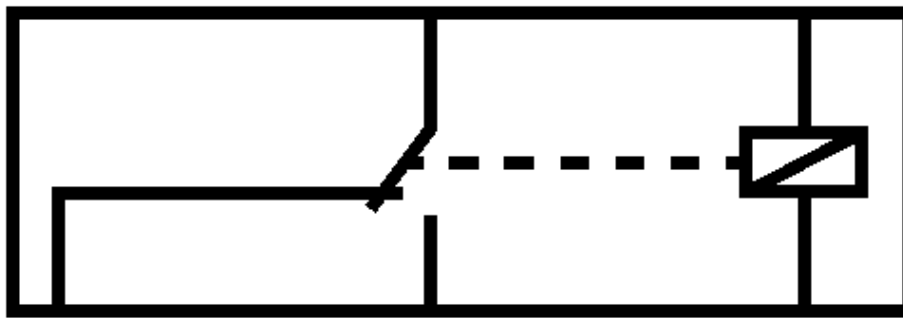
Switch
Actuator-
Temperature
(Momentary)



Switch
Actuator-
Volume
(Latching)



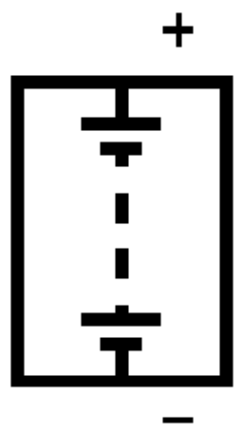
4-Pin Single
Pole/Throw
Relay-
Normally
Open



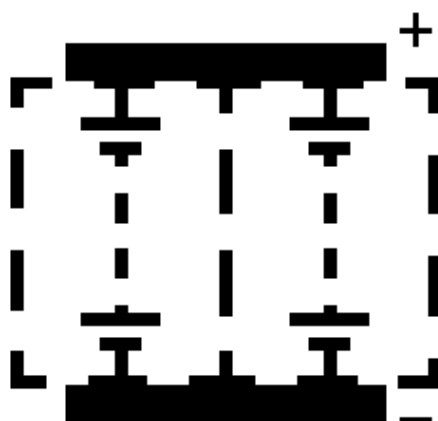
5-Pin Relay-
Normally
Closed

Devices and Sensors

Symbol	Description



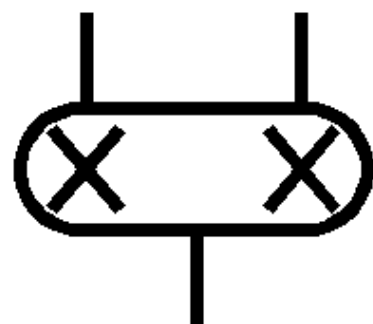
Battery



Battery
Assembly-
Hybrid



Single
Filament
Light Bulb



Double
Filament
Light Bulb



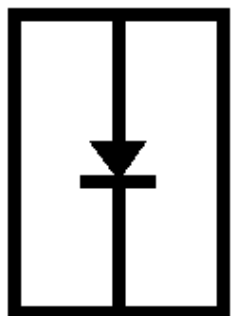
Light
Emitting
Diode
(LED)



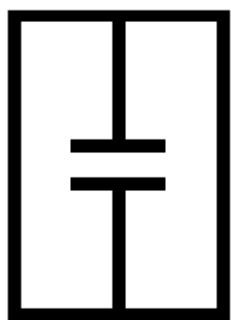
Photo
Sensor



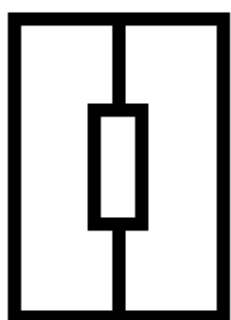
Gauge



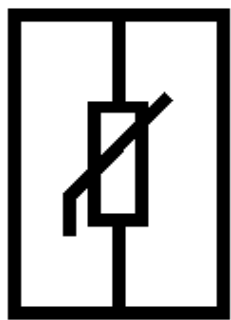
Diode



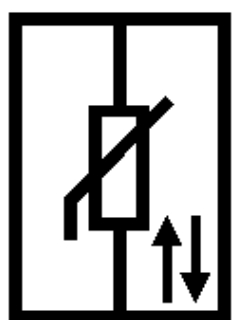
Capacitor



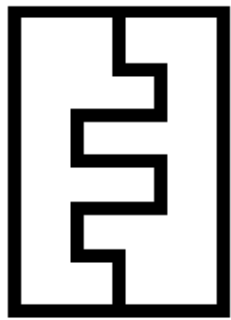
Resistor



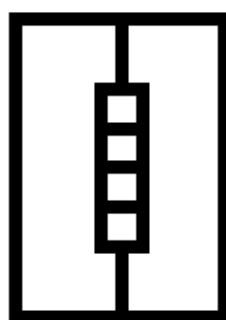
Variable
Resistor



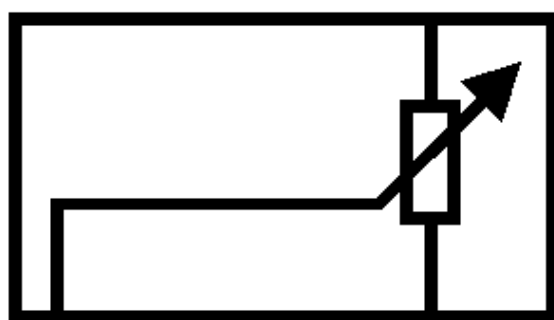
Variable
Resistor-
NTC



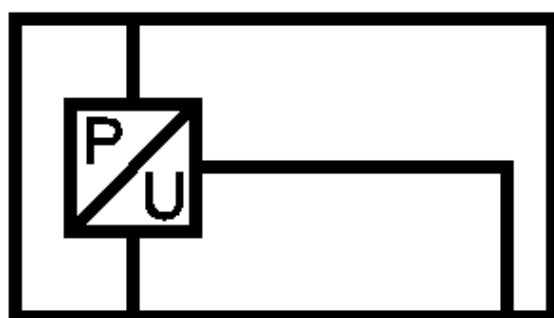
Breakable Wire



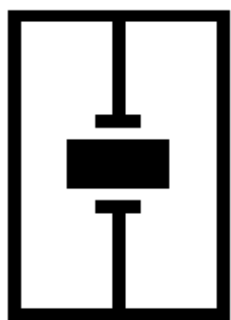
Heating
Element



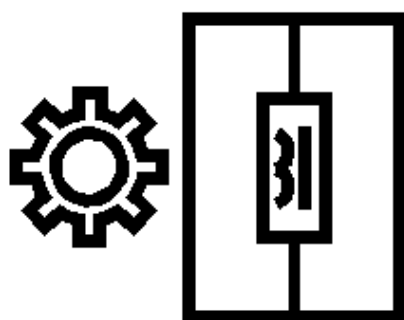
Position
Sensor



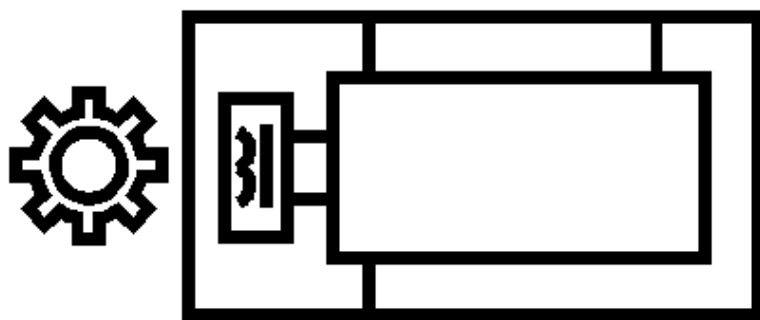
Pressure
Sensor



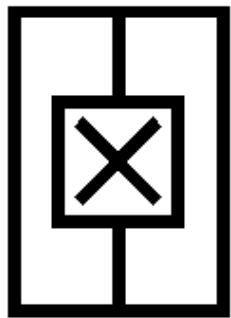
Knock
Sensor



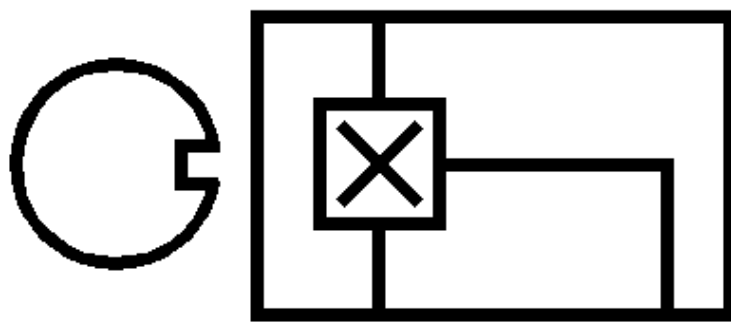
Inductive
Type
Sensor- 2-
Wire



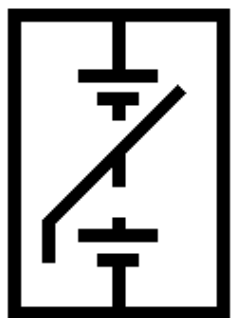
Inductive
Type
Sensor- 3-
Wire



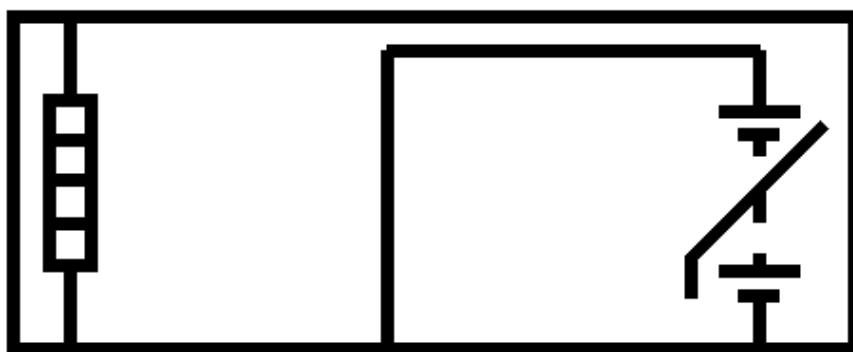
Hall Effect
Sensor- 2-
Wire



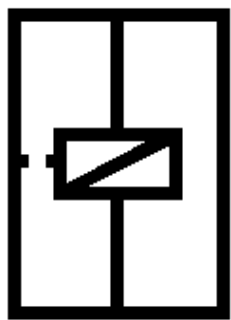
Hall Effect
Sensor- 3-
Wire



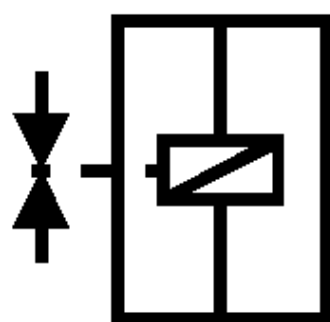
Oxygen
Sensor- 2-
Wire



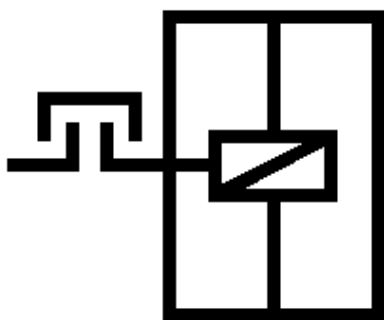
Heated
Oxygen
Sensor- 4-
Wire



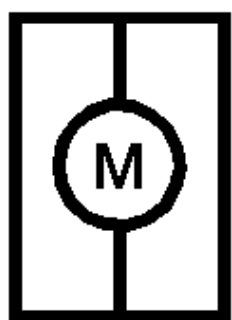
Solenoid-
Actuator



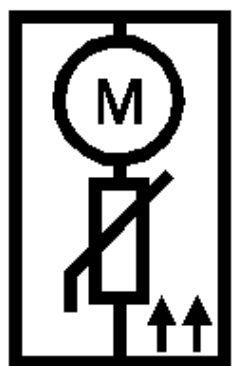
Solenoid-
Valve



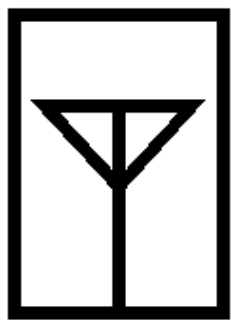
Clutch



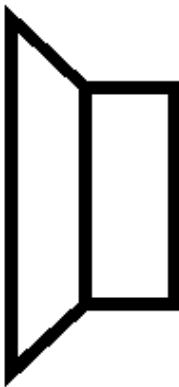
Motor



Motor with
PTC



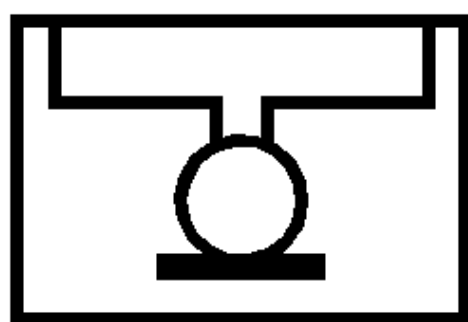
Antenna



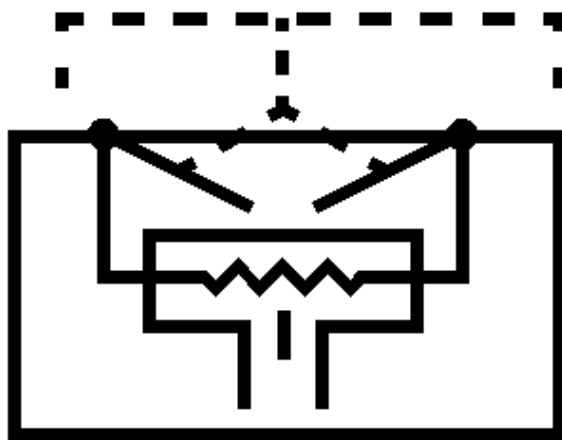
Speaker



Horn



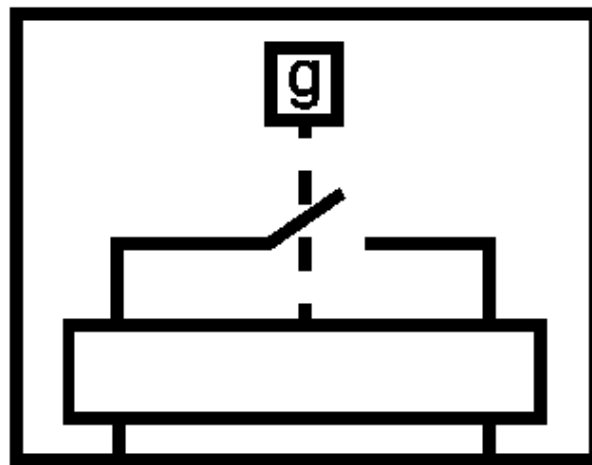
Microphone



Airbag



SIR Coil



SIR Impact
Sensor

VEHICLE ZONING STRATEGY

All grounds, in-line connectors and splices have identifying numbers that correspond to where they are located in the vehicle. The following table explains the numbering system.

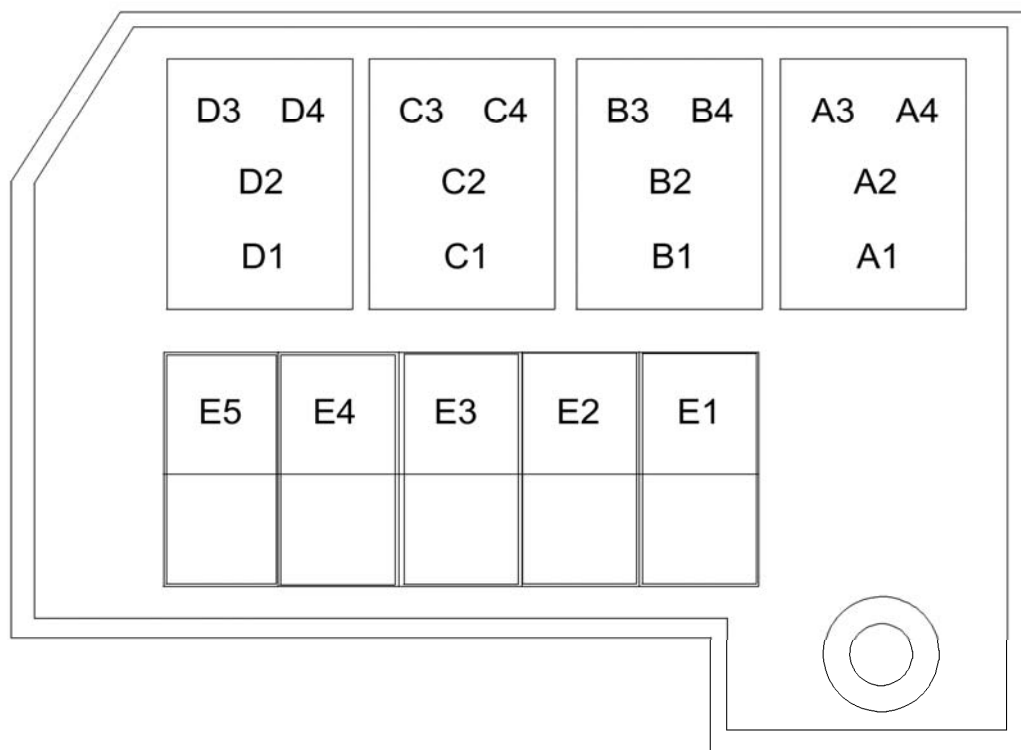


Fig. 14: Passenger Car Zoning View
 Courtesy of GENERAL MOTORS COMPANY

Vehicle Zoning Strategy

Callout Numbers	Zone Description
100-199	Engine compartment (all forward of the instrument panel)
200-299	Within the instrument panel area (between the bulkhead and the front plane of the instrument panel)
300-399	Passenger compartment (from instrument panel to the back of the rear seats)
400-499	Luggage compartment (from the back of the rear seats to the rear of the vehicle)
500-599	Inline harness connectors to or within the driver door
600-699	Inline harness connectors to or within the front passenger door
700-799	Inline harness connectors to or within the left rear

	door
800-899	Inline harness connectors to or within the right rear door
900-999	Inline harness connectors to or within the luggage compartment lid or hatch

SCHEMATICS RPO CODE LIST

Schematics RPO Code List

RPO	Option Name	Country Group
2GB	RADIO-AM/FM STEREO, SEEK, CD, ETR, FADER, MP3, USB	India (MBF), Russia Group (MBR), Uzbekistan (MBN)
A32	WINDOW-POWER OPERATED, FRT DR	Australia/NZ (MBB), India (MBF), Korea (MAW), Other Asia Pacific (MAP), Other SE Asia (MBH), VietNam (MBL), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), S. Africa (MBS), Mid-East (MAM), NW Andean (MCJ), CenAmer/Carib (MBD)
A53	ADJUSTER PASS ST/MANUAL, 6 WAY	Australia/NZ (MBB), India (MBF), Korea (MAW), Other Asia Pacific (MAP), Other SE Asia (MBH), VietNam (MBL), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), S. Africa (MBS), Mid-East (MAM), NW Andean (MCJ), SE Andean (MCK), CenAmer/Carib (MBD), Mexico (MCX)
A83	SEAT RR/SPLIT, FOLDING, 50/50	India (MBF), Russia Group (MBR), Uzbekistan (MBN)
AE2	RR COMPARTMENT, SAFETY, MANUAL RELEASE	Australia/NZ (MBB), India (MBF), Korea (MAW), Other Asia Pacific (MAP), Other SE Asia (MBH), VietNam (MBL), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), S. Africa (MBS), Mid-East (MAM), NW Andean (MCJ), SE Andean (MCK), CenAmer/Carib (MBD), Mexico (MCX)
		Australia/NZ (MBB), India (MBF), Korea (MAW), Other Asia Pacific (MAP), Other SE Asia (MBH),

AE3	WINDOW-POWER OPERATED, FRT AND RR DR	VietNam (MBL), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), S. Africa (MBS), Mid-East (MAM), NW Andean (MCJ), SE Andean (MCK), CenAmer/Carib (MBD), Mexico (MCX)
AJ3	RESTRAINT SYSTEM-SEAT, INFLATABLE, DRIVER, FRT	Korea (MAW), Other SE Asia (MBH), VietNam (MBL), Africa Group (MCA), Egypt (MBP), Mid-East (MAM), NW Andean (MCJ), SE Andean (MCK)
AJ7	RESTRAINT SYSTEM-SEAT, INFLATABLE, DRIVER AND PASS, FRT AND SEAT SIDE	Korea (MAW), VietNam (MBL), Russia Group (MBR), S. Africa (MBS)
AK5	RESTRAINT SYSTEM-SEAT, INFLATABLE, DRIVER AND PASS FRT	India (MBF), VietNam (MBL), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), S. Africa (MBS), Mid-East (MAM), NW Andean (MCJ), SE Andean (MCK), CenAmer/Carib (MBD), Mexico (MCX)
AR1	RESTRAINT SYSTEM-(NONE)	India (MBF), Other Asia Pacific (MAP), Other SE Asia (MBH), VietNam (MBL), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), CenAmer/Carib (MBD), Mexico (MCX)
AU3	LOCK CONTROL-SIDE DR, ELEC	Australia/NZ (MBB), India (MBF), Korea (MAW), Other Asia Pacific (MAP), Other SE Asia (MBH), VietNam (MBL), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), S. Africa (MBS), Mid-East (MAM), NW Andean (MCJ), SE Andean (MCK), CenAmer/Carib (MBD), Mexico (MCX)
AU4	LOCK CONTROL-SIDE DR, ELEC, AUTOMATIC	Korea (MAW), Africa Group (MCA), S. Africa (MBS)
AY0	RESTRAINT SYSTEM-SEAT, INFLATABLE, DRIVER AND PASS FRT, SEAT SIDE, ROOF SIDE	Australia/NZ (MBB), Korea (MAW), Europe Group (MBM), Russia Group (MBR)
BAE	EQUIPMENT-SECURITY SYSTEM, IMMOBILIZATION	Australia/NZ (MBB), Europe Group (MBM), Russia Group (MBR), S. Africa (MBS), Mid-East (MAM), SE Andean (MCK), Mexico (MCX)
BAH	EQUIPMENT-SECURITY SYSTEM,	Europe Group (MBM)

	IMMOBILIZATION, STEP TWO	
BTV	REMOTE START	Australia/NZ (MBB), Europe Group (MBM), Russia Group (MBR), S. Africa (MBS), Mid-East (MAM), SE Andean (MCK), Mexico (MCX)
C37	HEATER-SEAT, DRIVER	Australia/NZ (MBB), Korea (MAW), Europe Group (MBM), Russia Group (MBR)
C38	HEATER-SEAT, PASS	Australia/NZ (MBB), Korea (MAW), Europe Group (MBM), Russia Group (MBR)
C46	HVAC SYSTEM	Australia/NZ (MBB), Korea (MAW), Europe Group (MBM), Russia Group (MBR)
C48	HEATER	Australia/NZ (MBB), Korea (MAW), Europe Group (MBM), Russia Group (MBR)
C49	DEFOGGER-RR WINDOW, ELECTRIC	Australia/NZ (MBB), India (MBF), Korea (MAW), Other Asia Pacific (MAP), Other SE Asia (MBH), VietNam (MBL), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), S. Africa (MBS), Mid-East (MAM), NW Andean (MCJ), SE Andean (MCK), CenAmer/Carib (MBD), Mexico (MCX)
C50	DEFROSTER-HEATED, WINDSHIELD	Korea (MAW), Europe Group (MBM), Russia Group (MBR)
C60	HVAC SYSTEM-AIR CONDITIONER FRT, MAN CONTROLS	Australia/NZ (MBB), India (MBF), Korea (MAW), Other Asia Pacific (MAP), Other SE Asia (MBH), VietNam (MBL), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), S. Africa (MBS), Mid-East (MAM), NW Andean (MCJ), SE Andean (MCK), CenAmer/Carib (MBD), Mexico (MCX)
C66	HVAC SYSTEM-AIR CONDITIONER PROVISION FOR DEALER INSTALLATION	Africa Group (MCA)
		Australia/NZ (MBB), India (MBF), Korea (MAW), Other Asia Pacific (MAP), Other SE Asia (MBH), VietNam (MBL), Europe Group

C68	AIR CONDITIONER FRT, AUTO, ELECTRONIC CONTROLS	(MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), S. Africa (MBS), Mid-East (MAM), NW Andean (MCJ), SE Andean (MCK), CenAmer/Carib (MBD), Mexico (MCX)
C99	SWITCH-INFL RST I/P MDL MAN SUPPRESSION	Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), S. Africa (MBS)
CD6	WIPER SYS RR WINDOW-CONTINUOUS	Australia/NZ (MBB), India (MBF), Korea (MAW), Other Asia Pacific (MAP), Other SE Asia (MBH), VietNam (MBL), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), S. Africa (MBS), Mid-East (MAM), NW Andean (MCJ), SE Andean (MCK), CenAmer/Carib (MBD), Mexico (MCX)
CW1	KOREA	KOREA
CZ2	CHINA	CHINA
DLW	MIRROR O/S-LH AND RH, REMOTE CONTROL, ELECTRIC, MANUAL FOLDING, HEATED	Australia/NZ (MBB), Korea (MAW), Other Asia Pacific (MAP), Other SE Asia (MBH), VietNam (MBL), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), S. Africa (MBS), SE Andean (MCK)
DRL	DAYTIME RUNNING LAMPS	Australia/NZ (MBB), Korea (MAW), Other Asia Pacific (MAP), Other SE Asia (MBH), VietNam (MBL), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), S. Africa (MBS), SE Andean (MCK)
FX3	RIDE AND HANDLING-AUTOMATIC ELECTRONIC CONTROLLED	Australia/NZ (MBB), Europe Group (MBM)
J41	BRAKE SYSTEM-PWR, FRT DISC, RR DRUM, CAST IRON	India (MBF), Other Asia Pacific (MAP), Other SE Asia (MBH), VietNam (MBL), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), Mid-East (MAM), NW Andean (MCJ), SE Andean (MCK), CenAmer/Carib (MBD), Mexico (MCX)
		Australia/NZ (MBB), India (MBF),

JM4	BRAKE SYSTEM-PWR, FRT DISC, RR DRUM, CAST IRON, ANTILOCK, FRT ANDRR WHL	Korea (MAW), VietNam (MBL), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), S. Africa (MBS), Mid-East (MAM), SE Andean (MCK), Mexico (MCX)
KRB	FUEL RATING-OCTANE NO. 83	Africa Group (MCA)
KRC	FUEL RATING-OCTANE NO. 87	Other Asia Pacific (MAP), Other SE Asia (MBH), VietNam (MBL), Africa Group (MCA), NW Andean (MCJ), CenAmer/Carib (MBD)
KRD	FUEL RATING-OCTANE NO. 91	Australia/NZ (MBB), India (MBF), Other SE Asia (MBH), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), Mid-East (MAM), NW Andean (MCJ), CenAmer/Carib (MBD), Mexico (MCX)
KRE	FUEL RATING-OCTANE NO. 95	Europe Group (MBM), Africa Group (MCA), S. Africa (MBS), SE Andean (MCK)
K34	CRUISE CONTROL-AUTOMATIC, ELECTRONIC	Korea (MAW), Other Asia Pacific (MAP), Other SE Asia (MBH), VietNam (MBL), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), Mid-East (MAM), NW Andean (MCJ), SE Andean (MCK), CenAmer/Carib (MBD), Mexico (MCX)
LC5	ENGINE-GAS, 4 CYL, 1.19L, MFI, L4, DOHC	India (MBF)
LCP	ENGINE-PROPANE GAS, 4 CYL, 1.0L, MFI, DOHC	Korea (MAW)
LEB	ENGINE-DIESEL, 3 CYL, 1.0L, CRI, DOHC, FGT, 39KW, INDIA	India (MBF)
LFM	ENGINE-GAS, 4 CYL, 1.0L, MFI, DOHC, VVT, FAM A/B, GEN 2, 51 KW	Korea (MAW), Other Asia Pacific (MAP), Other SE Asia (MBH), VietNam (MBL), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), Mid-East (MAM), NW Andean (MCJ), SE Andean (MCK), CenAmer/Carib (MBD), Mexico (MCX)
		Korea (MAW), Other Asia Pacific (MAP), Other SE Asia (MBH),

LHD	VEHICLE DRIVE-LEFTHAND DRIVE	VietNam (MBL), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), Mid-East (MAM), NW Andean (MCJ), SE Andean (MCK), CenAmer/Carib (MBD), Mexico (MCX)
LKY	ENGINE-GAS, 4 CYL, L4, 1.2L, MFI, DOHC, FAM A/B, PDA, GEN 2, GMAP	Russia Group (MBR), Uzbekistan (MBN)
LL0	ENGINE-GAS, 4 CYL, L4, 1.2L, MFI, DOHC, FAM A/B, DCVCP, GEN 2, GMAP	Australia/NZ (MBB), Other Asia Pacific (MAP), Other SE Asia (MBH), VietNam (MBL), Europe Group (MBM), Africa Group (MCA), Egypt (MBP), S. Africa (MBS), NW Andean (MCJ), SE Andean (MCK), CenAmer/Carib (MBD), Mexico (MCX)
LMT	ENGINE-GAS, 4 CYL, L4, 1.0L, MFI, DOHC, IRON, GMDAT	Korea (MAW), Other Asia Pacific (MAP), Other SE Asia (MBH), VietNam (MBL), Europe Group (MBM), Russia Group (MBR), Africa Group (MCA), Mid-East (MAM), CenAmer/Carib (MBD)
LMU	ENGINE-GAS, 4 CYL, L4, 1.2L, MFI, DOHC, GMDAT	Australia/NZ (MBB), Other Asia Pacific (MAP), Other SE Asia (MBH), VietNam (MBL), Europe Group (MBM), Africa Group (MCA), Egypt (MBP), S. Africa (MBS), NW Andean (MCJ), SE Andean (MCK), CenAmer/Carib (MBD), Mexico (MCX)
MEL	TRANSMISSION-MAN 7 SPD, TREMEC (TR6070), 2.966 1ST, 0.478 7TH	Australia/NZ (MBB), Other Asia Pacific (MAP), Other SE Asia (MBH), VietNam (MBL), Europe Group (MBM), Africa Group (MCA), Egypt (MBP), S. Africa (MBS), NW Andean (MCJ), SE Andean (MCK), CenAmer/Carib (MBD), Mexico (MCX)
MFL	TRANSMISSION-AUTO 4 SPD, JATCO, JF405E	Korea (MAW), Other SE Asia (MBH), VietNam (MBL), Russia Group (MBR), Africa Group (MCA), Mid-East (MAM), CenAmer/Carib (MBD)
MFM	TRANSMISSION-MAN 5 SPD, Y4M HD, 1ST 3.539, 5TH 0.781	Australia/NZ (MBB), India (MBF), Korea (MAW), Other Asia Pacific (MAP), Other SE Asia (MBH), VietNam (MBL), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), S. Africa (MBS),

		Mid-East (MAM), NW Andean (MCJ), SE Andean (MCK), CenAmer/Carib (MBD), Mexico (MCX)
MNG	TRANSMISSION-AUTO 4 SPD, AISIN-WARNER, AW 80-40LE, FWD, GEN2	Australia/NZ (MBB)
MX2	TRANSMISSION-MAN 5 SPD, Y4M HD, 1ST 3.539, 5TH 0.756	Korea (MAW), Other Asia Pacific (MAP), Other SE Asia (MBH), VietNam (MBL), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), Mid-East (MAM), NW Andean (MCJ), SE Andean (MCK), CenAmer/Carib (MBD), Mexico (MCX)
M4M	TRANSMISSION-AUTO, CONTINUOUSLY VARIABLE RATIO (CVT), FWD, JATCO, VAR 1	Australia/NZ (MBB), Korea (MAW), Other Asia Pacific (MAP), Other SE Asia (MBH), VietNam (MBL), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), S. Africa (MBS), Mid-East (MAM), NW Andean (MCJ), SE Andean (MCK), CenAmer/Carib (MBD), Mexico (MCX)
NJ1	STEERING-POWER, NON-VARIABLE RATIO, ELECTRIC	Australia/NZ (MBB), India (MBF)
RHD	VEHICLE DRIVE-RIGHTHAND DRIVE	Australia/NZ (MBB), India (MBF), Other Asia Pacific (MAP), Other SE Asia (MBH), Europe Group (MBM), S. Africa (MBS), CenAmer/Carib (MBD)
T3U	LAMP FRT FOG-FRT FOG	India (MBF), Korea (MAW), VietNam (MBL), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), S. Africa (MBS), Mid-East (MAM), NW Andean (MCJ), SE Andean (MCK), CenAmer/Carib (MBD), Mexico (MCX)
T79	LAMP-FOG, RR	Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), SE Andean (MCK)
T90	LAMP-SIGNALING AND MARKER, EXPORT	Australia/NZ (MBB), India (MBF), Korea (MAW), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), S. Africa (MBS), Mid-East (MAM)
		Australia/NZ (MBB), Europe Group

TFC	ALARM-SEAT BELT WARNING, PASS	(MBM), Russia Group (MBR), SE Andean (MCK)
TR6	CONTROL, HEADLAMPS-LEVELING SYSTEM, MANUAL	India (MBF), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN)
U04	HORN-SINGLE NOTE	Australia/NZ (MBB), Korea (MAW), Other Asia Pacific (MAP), Other SE Asia (MBH), VietNam (MBL), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), S. Africa (MBS), Mid-East (MAM), NW Andean (MCJ), SE Andean (MCK), CenAmer/Carib (MBD), Mexico (MCX)
U05	HORN-DUAL	India (MBF)
U25	LAMP-INTR, RR COMPT, COURTESY	Korea (MAW), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), NW Andean (MCJ), SE Andean (MCK)
U7J	CKD OPTION	CHILE
UC3	Steering Wheel Controls	Australia/NZ (MBB), Korea (MAW), Other Asia Pacific (MAP), Other SE Asia (MBH), VietNam (MBL), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), S. Africa (MBS), Mid-East (MAM), NW Andean (MCJ), SE Andean (MCK), CenAmer/Carib (MBD), Mexico (MCX)
UD7	PARK ASSIST-REAR	Australia/NZ (MBB), Korea (MAW), Europe Group (MBM), Russia Group (MBR), S. Africa (MBS)
UH5	INDICATOR-SEAT BELT WARNING, REAR SEAT	Europe Group (MBM)
UK3	CONTROL-STEERING WHEEL, ACCESSORY	Australia/NZ (MBB), India (MBF), Korea (MAW), Other SE Asia (MBH), Europe Group (MBM), Russia Group (MBR), Africa Group (MCA), Egypt (MBP), S. Africa (MBS), NW Andean (MCJ), SE Andean (MCK)
UO5	HORN-DUAL	Australia/NZ (MBB), Korea (MAW), Other Asia Pacific (MAP), Other SE Asia (MBH), VietNam (MBL), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), S. Africa (MBS),

		Mid-East (MAM), NW Andean (MCJ), SE Andean (MCK), CenAmer/Carib (MBD), Mexico (MCX)
UT3	Radio-AM/FM STEREO, SEEK SCAN, CD, ETR	Australia/NZ (MBB), Korea (MAW), Other Asia Pacific (MAP), Other SE Asia (MBH), VietNam (MBL), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), S. Africa (MBS), Mid-East (MAM), NW Andean (MCJ), SE Andean (MCK), CenAmer/Carib (MBD), Mexico (MCX)
UTJ	THEFT DETERENT-ELECTRICAL, UNAUTHORIZED ENTRY	Australia/NZ (MBB), Korea (MAW), VietNam (MBL), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), S. Africa (MBS), Mid-East (MAM), SE Andean (MCK), CenAmer/Carib (MBD), Mexico (MCX)
UV8	TELEPHONE-PROVISIONS FOR MOBILE	Australia/NZ (MBB), Korea (MAW), VietNam (MBL), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), S. Africa (MBS), Mid-East (MAM), SE Andean (MCK), CenAmer/Carib (MBD), Mexico (MCX)
UZM	RADIO-AM/FM STEREO, CD-ROM, MP3/WMA, NAVI, RDS, SD SLOT, USB, WIRELESS INTERFACE	Australia/NZ (MBB), Korea (MAW), Other Asia Pacific (MAP), Other SE Asia (MBH), VietNam (MBL), Europe Group (MBM), Russia Group (MBR), Uzbekistan (MBN), Africa Group (MCA), Egypt (MBP), S. Africa (MBS), Mid-East (MAM), NW Andean (MCJ), SE Andean (MCK), CenAmer/Carib (MBD), Mexico (MCX)
WU5	SWITCH-I/P LP DIMR	Australia/NZ (MBB), CenAmer/Carib (MBD)

MASTER ELECTRICAL SCHEMATIC ICONS

Master Electrical Schematic Icons

Icon	Icon Definition
	WARNING: When performing service on or near the SIR components or the SIR wiring, the SIR system must be



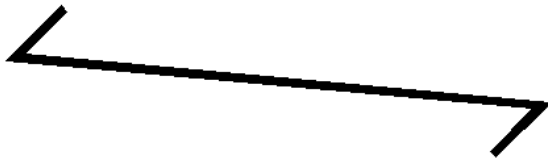
disabled. Refer to SIR Disabling and Enabling. Failure to observe the correct procedure could cause deployment of the SIR components, personal injury or unnecessary SIR system repairs.

NOTE:

Twisted wires provide an effective shield that helps protect sensitive electronic components from electrical interference.

In order to prevent electrical interference from degrading the performance of the connected components, you must maintain the proper specification when making any repairs to the twisted wires shown :

- The wires must be twisted a minimum of 10 turns per 31 cm (12 in) as measured anywhere along the length of the wires.
- The outside diameter of the twisted wires must not exceed 6.0 mm (0.25 in).



POWER DISTRIBUTION WIRING SCHEMATICS

B+ Bus (1 of 3) Wiring Schematics

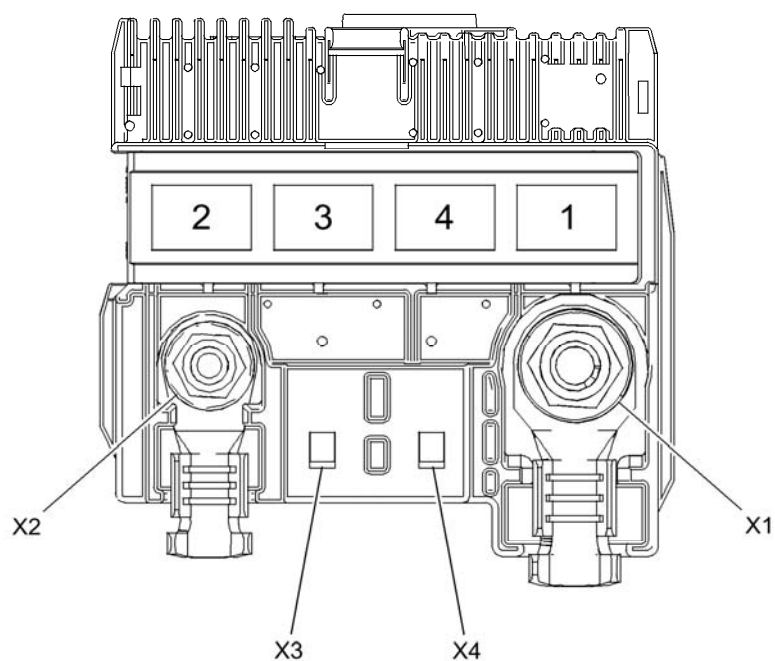


Fig. 15: B+ Bus (1 of 3) Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
40	Battery Positive Voltage
CAV_A	A
CONN_X5	X5
40_RD/GN	40 RD/GN
2	TBD
2_RD/YE	2 RD/YE
CAV_1	1
CONN_X4	X4
CAV_A	A
CONN_X2	X2
2_RD/YE	2 RD/YE
CAV_B	B
CONN_X2	X2
B_REF	B
F2UB	F2UB 150A
F3UB	F3UB 40A
A_REF	A
F10UA	F10UA 15A

F17UA	F17UA 15A
F16UA	F16UA 20A
F11UA	F11UA 15A
F12UA	F12UA 15A
F13UA	F13UA 15A
F14UA	F14UA 20A
F15UA	F15UA 30A
F33UA	F33UA 30A
F32UA	F32UA 50A
F31UA	F31UA 40A
F9UA	F9UA 15A
F7UA	F7UA 20A
F5UA	F5UA 10A
F3UA	F3UA 5A
F1UA	F1UA 5A
F8UA	F8UA 15A
F6UA	F6UA 15A
F4UA	F4UA 10A
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B+ Bus (2 of 3) Wiring Schematics

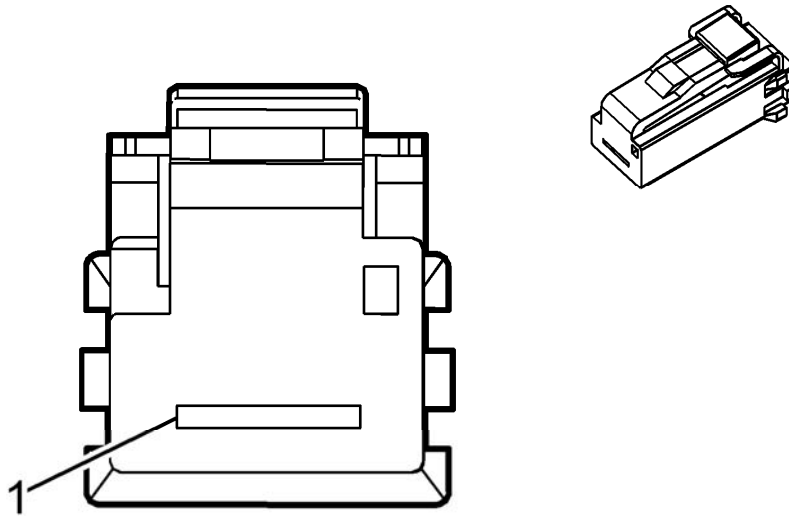


Fig. 16: B+ Bus (2 of 3) Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
A_REF	A
F30UA	F30UA 10A
F29UA	F29UA 10A
F23UA	F23UA 15A
F24UA	F24UA 10A
F25UA	F25UA 10A
F26UA	F26UA 10A
F27UA	F27UA 10A
F36UA	F36UA 30A
F28UA	F28UA 15A
F18UA	F18UA 15A
F19UA	F19UA 20A
F20UA	F20UA 20A
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B+ Bus (3 of 3) Wiring Schematics

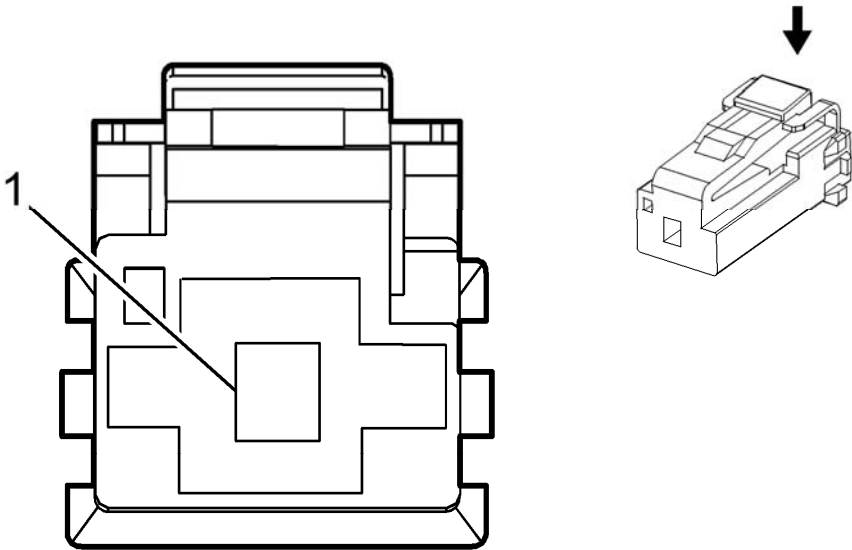


Fig. 17: B+ Bus (3 of 3) Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
2740	Battery Positive Voltage
2740_RD/WH	2740 RD/WH
CAV_1	1
CONN_X1	X1
CAV_1	1
CONN_X3	X3
2740_RD/WH	2740 RD/WH
CAV_2	2
B_REF	B
F3UB	F3UB 80A

F1UB	F1UB 250A
F4UB	F4UB 80A
X214	X214
C_REF	C
F1DA	F1DA 15A
F2DA	F2DA 10A
F3DA	F3DA 15A
F4DA	F4DA 15A
F5DA	F5DA 15A
F6DA	F6DA 15A
F7DA	F7DA 15A
F8DA	F8DA 30A
F9DA	F9DA 10A
F10DA	F10DA 10A
F11DA	F11DA 30A
F12DA	F12DA 10A
F13DA	F13DA 10A
F14DA	F14DA 2A
F28DA	F28DA 15A
F27DA	F27DA 15A
F26DA	F26DA 10A
F25DA	F25DA 25A
F24DA	F24DA 25A
F23DA	F23DA 20A
F22DA	F22DA 10A
F21DA	F21DA 10A
F20DA	F20DA 20A
F19DA	F19DA 15A
F18DA	F18DA 15A
F17DA	F17DA 25A
F16DA	F16DA 7.5A
F15DA	F15DA 10A
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Ignition Switch Wiring Schematics

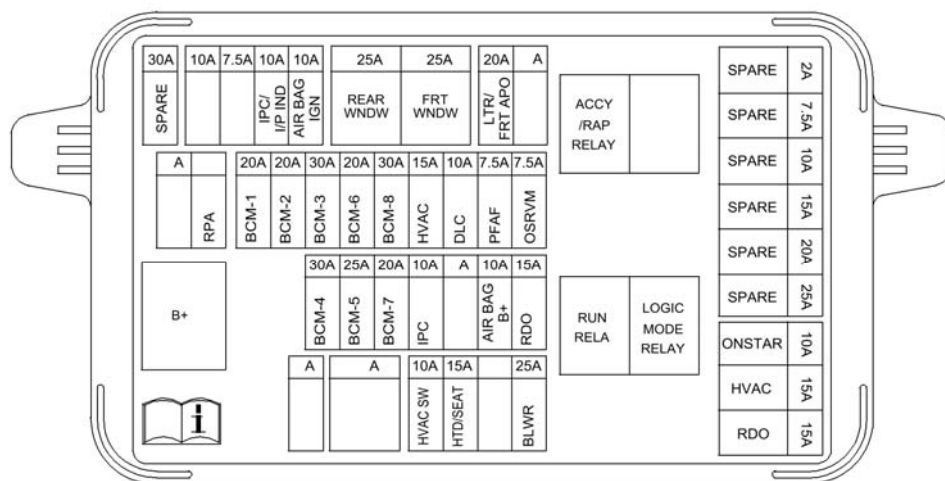


Fig. 18: Ignition Switch Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
2440	Battery Positive Voltage
2440_RD/GN	2440 RD/GN
CAV_5	5
1073	Ignition Key Resistor Signal
1073_WH/BK	1073 WH/BK
CAV_22	22
CONN_X3	X3
CAV_2	2
1020	Off/Run/Crank Voltage
1020_WH/VT	1020 WH/VT
CAV_15	15
CAV_3	3

4	Accessory Voltage
4_VT/YE	4 VT/YE
CAV_5	5
CAV_6	6
3	Run/Crank Ignition 1 Voltage
3_VT/BK	3 VT/BK
CAV_6	6
CAV_4	4
5199	Run/Crank Relay Coil Control
5199_GN/VT	5199 GN/VT
CAV_11	11
CONN_X2	X2
CAV_15	15
5985	Accessory Wakeup Serial Data
5985_VT/YE	5985 VT/YE
CAV_22	22
CONN_X4	X4
5985_VT/YE	5985 VT/YE
CAV_36	36
CONN_X1	X1
5985_VT/YE	5985 VT/YE
CAV_24	24
CONN_X1	X1
5985_VT/YE	5985 VT/YE
MNG	TRANSMISSION-AUTO 4 SPD, AISIN-WARNER, AW 80-40LE, FWD, GEN2
MX2	TRANSMISSION-MAN 5 SPD, Y4M HD, 1ST 3.539, 5TH 0.756
CAV_16	16
C_REF	C
J101	J101
X230	X230
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF

F1BA, F2BA, F3BA and F4BA Fuses Wiring Schematics

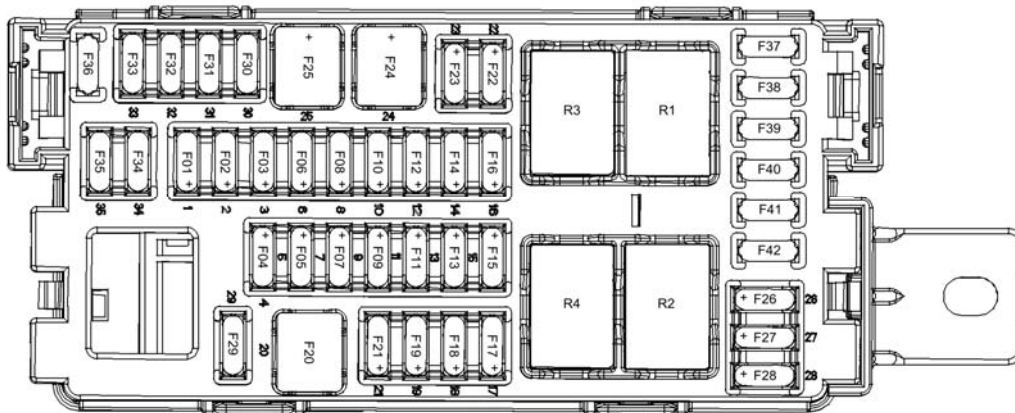


Fig. 19: F1BA, F2BA, F3BA and F4BA Fuses Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Unfused Battery Positive Voltage
1_RD	1 RD
CAV_1	1
CONN_X2	X2
CAV_A	A
CONN_X1	X1
1_RD	1 RD
CAV_A	A
CONN_X2	X2
2	TBD
2_RD/YE	2 RD/YE
CAV_A	A

CONN_X2	X2
2740	Battery Positive Voltage
2740_RD/WH	2740 RD/WH
CAV_1	1
CONN_X3	X3
540	Battery Positive Voltage
540_RD/BU	540 RD/BU
CAV_1	1
CONN_X1	X1
CAV_1	1
CONN_X4	X4
2740_RD/WH	2740 RD/WH
540_RD/BU	540 RD/BU
X214	X214
CAV_2	2
CAV_1	1
F1UD	F1UD 400A
F2UD	F2UD 120A
F3UD	F3UD 80A
F4UD	F4UD 80A
D_REF	D
E_REF	E
X214	X214
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF

F1UA, F2UA, F3UA, F4UA, F5UA, F6UA, F7UA, F8UA, F9UA, F31UA and F32UA Fuses Wiring Schematics

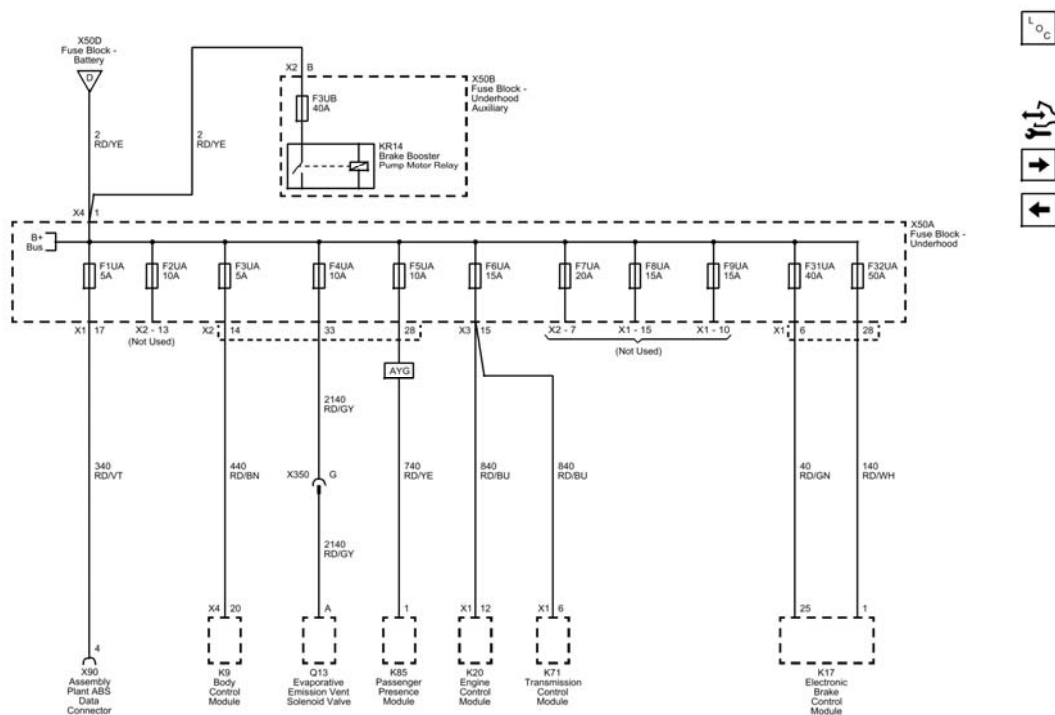


Fig. 20: F1UA, F2UA, F3UA, F4UA, F5UA, F6UA, F7UA, F8UA, F9UA, F31UA and F32UA Fuses Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
2	TBD
2_RD/YE	2 RD/YE
CAV_1	1
CONN_X4	X4
2_RD/YE	2 RD/YE
CAV_B	B
CONN_X2	X2
340	Battery Positive Voltage
340_RD/VT	340 RD/VT
CAV_4	4
CAV_17	17
CONN_X1	X1
440	Battery Positive Voltage
440_RD/BN	440 RD/BN
CAV_20	20
CONN_X4	X4

CAV_14	14
CONN_X2	X2
2140	Battery Positive Voltage
2140_RD/GY	2140 RD/GY
CAV_A	A
CAV_33	33
740	Battery Positive Voltage
740_RD/YE	740 RD/YE
CAV_1	1
CAV_28	28
840	Battery Positive Voltage
840_RD/BU	840 RD/BU
CAV_12	12
CONN_X1	X1
CAV_15	15
CONN_X3	X3
840_RD/BU	840 RD/BU
CAV_6	6
CONN_X1	X1
2140_RD/GY	2140 RD/GY
40	Battery Positive Voltage
40_RD/GN	40 RD/GN
CAV_25	25
CAV_6	6
CONN_X1	X1
140	Battery Positive Voltage
140_RD/WH	140 RD/WH
CAV_1	1
CAV_28	28
AYG	TBD
CAV_G	G
D_REF	D
F3UB	F3UB 40A
F1UA	F1UA 5A
F2UA	F2UA 10A
F3UA	F3UA 5A
F4UA	F4UA 10A
F5UA	F5UA 10A
F6UA	F6UA 15A
F7UA	F7UA 20A
F8UA	F8UA 15A
CONN_X1	X1

	F9UA 15A
F31UA	F31UA 40A
F32UA	F32UA 50A
X350	X350
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF

F10UA, F11UA, F12UA, F13UA, F14UA and F33UA Fuses Wiring Schematics

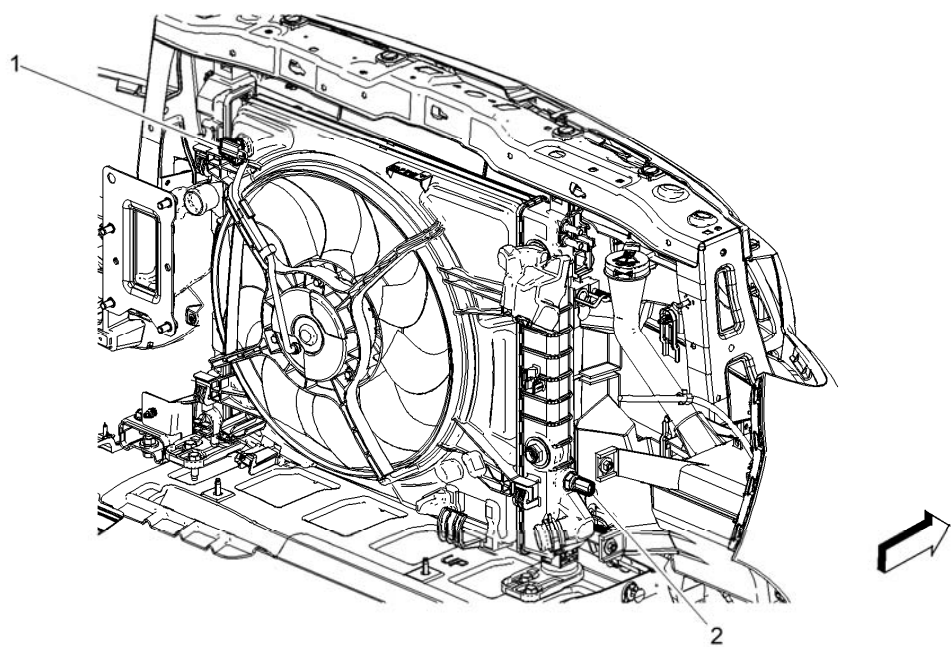


Fig. 21: F10UA, F11UA, F12UA, F13UA, F14UA and F33UA Fuses Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
29	Horn Control

	_REF
_REF	_REF
_REF	REF
_REF	_REF
_REF	REF

F15UA, F16UA, F17UA, F29UA and F30UA Fuses Wiring Schematics

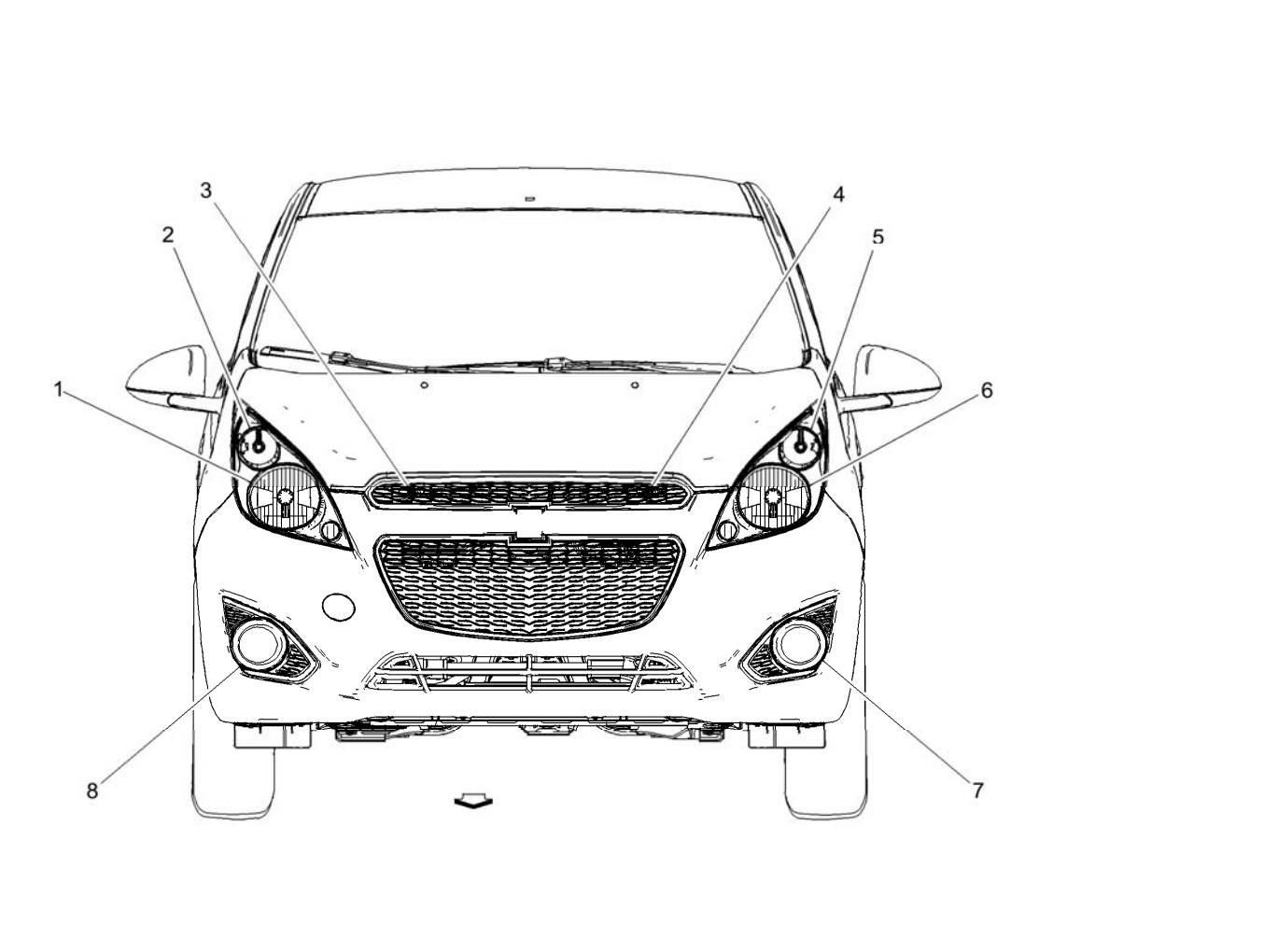


Fig. 22: F15UA, F16UA, F17UA, F29UA and F30UA Fuses Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1640	Battery Positive Voltage
1640_RD/VT	1640 RD/VT
CAV_3	3
CAV_29	29

[illegible]

F18UA, F20UA, F21UA, F22UA and F35UA Fuses Wiring Schematics

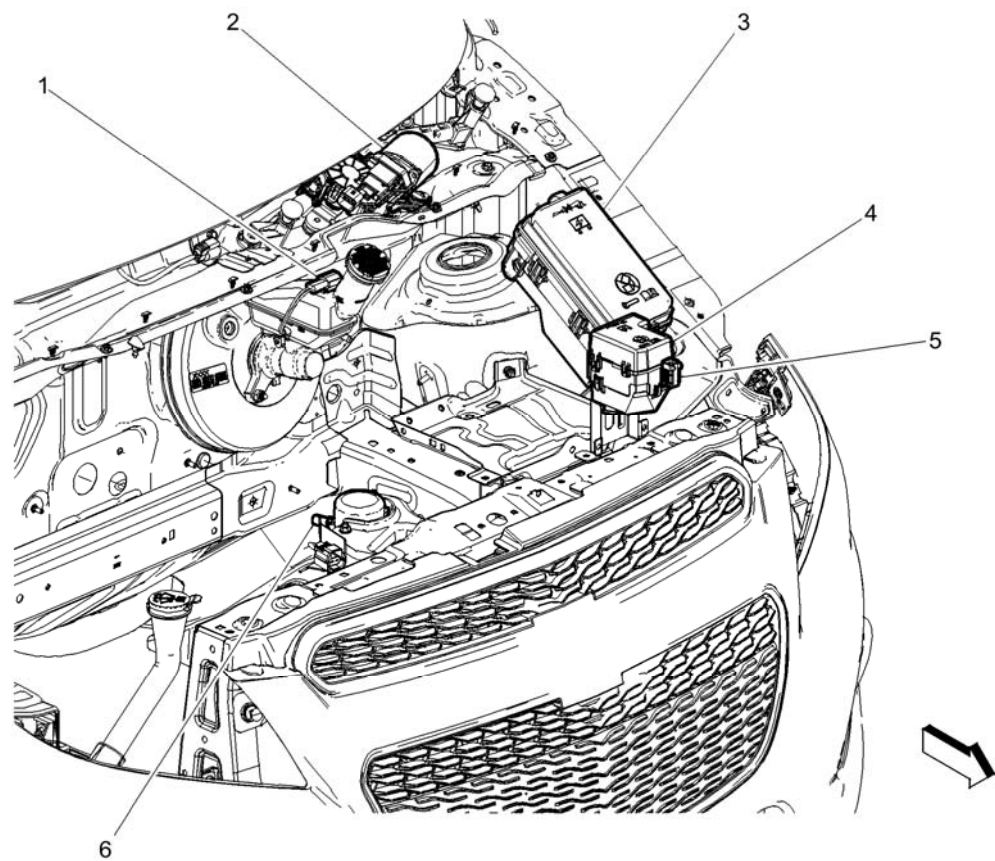


Fig. 23: F18UA, F20UA, F21UA, F22UA and F35UA Fuses Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
5290	Powertrain Main Relay Fused Supply (1)
5290_VT/BU	5290 VT/BU
CAV_3	3
CONN_X1	X1
CAV_18	18
CONN_X3	X3
5291	Powertrain Main Relay Fused Supply (2)
5291_VT/BU	5291 VT/BU
CAV_3	3
CONN_X3	X3

5291_VT/BU	5291 VT/BU
CAV_4	4
5290_VT/BU	5290 VT/BU
CAV_C	C
CAV_2	2
5291_VT/BU	5291 VT/BU
CAV_1	1
CAV_13	13
5291_VT/BU	5291 VT/BU
CAV_1	1
CAV_12	12
5291_VT/BU	5291 VT/BU
CAV_B	B
CAV_16	16
CAV_D	D
CAV_D	D
F_REF	F
F20UA	F20UA 15A
F18UA	F18UA 15A
F21UA	F21UA 10A
F22UA	F22UA 20A
F35UA	F35UA 30A
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF

F19UA Fuse Wiring Schematics

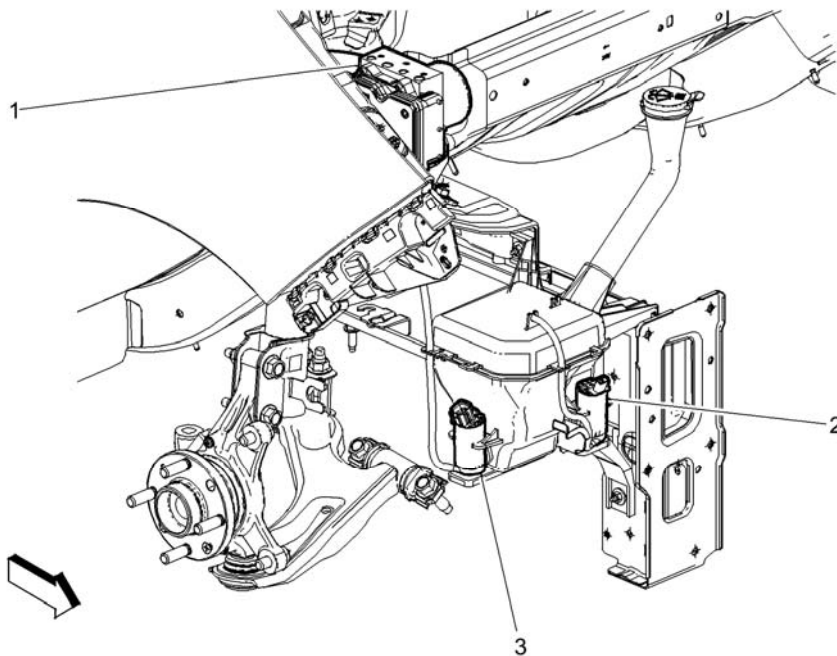


Fig. 24: F19UA Fuse Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
5290	Powertrain Main Relay Fused Supply (1)
5290_VT/BU	5290 VT/BU
CAV_1	1
CAV_26	26
CONN_X3	X3
5290_VT/BU	5290 VT/BU
CAV_1	1
5290_VT/BU	5290 VT/BU
CAV_1	1
5290_VT/BU	5290 VT/BU
CAV_1	1
5290_VT/BU	5290 VT/BU
CAV_4	4
CAV_27	27
5290_VT/BU	5290 VT/BU
CAV_4	4
5290_VT/BU	5290 VT/BU
CAV_4	4

5290_VT/BU	5290 VT/BU
CAV_4	4
5290_VT/BU	5290 VT/BU
5290_VT/BU	5290 VT/BU
5290_VT/BU	5290 VT/BU
5290_VT/BU	5290 VT/BU
5290_VT/BU	5290 VT/BU
5290_VT/BU	5290 VT/BU
5290_VT/BU	5290 VT/BU
5290_VT/BU	5290 VT/BU
5290_VT/BU	5290 VT/BU
5290_VT/BU	5290 VT/BU
X160	X160
CAV_A	A
CAV_B	B
CAV_C	C
CAV_D	D
X170	X170
CAV_5	5
CAV_3	3
F_REF	F
F19UA	F19UA 20A
J160	J160
J170	J170
J171	J171
J172	J172
X160	X160
X170	X170
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF

F23UA, F24UA, F25UA, F26UA, F27UA, F28UA and F36UA Fuses Wiring Schematics

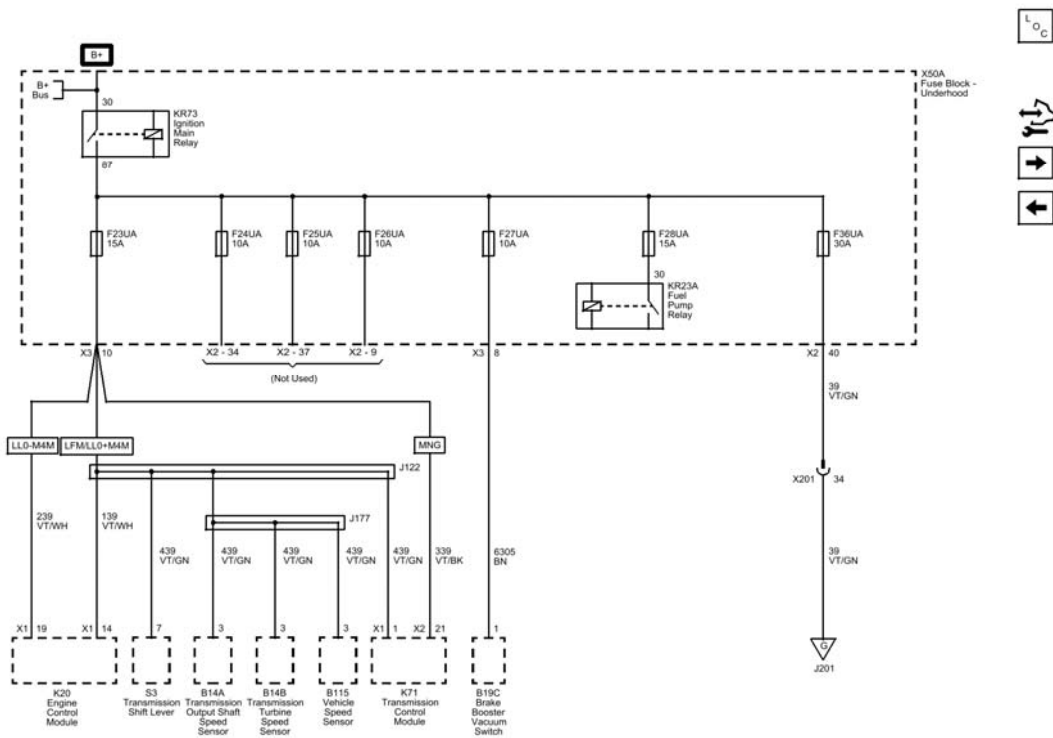


Fig. 25: F23UA, F24UA, F25UA, F26UA, F27UA, F28UA and F36UA Fuses Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
39	Run/Crank Ignition 1 Voltage
39_VT/GN	39 VT/GN
CAV_40	40
CONN_X2	X2
6305	Brake Vacuum Switch Signal
6305_BN	6305 BN
CAV_1	1
CAV_8	8
CONN_X3	X3
139	Run/Crank Ignition 1 Voltage
CAV_10	10
CONN_X3	X3
339	Run/Crank Ignition 1 Voltage
339_VT/BK	339 VT/BK
CAV_21	21
CONN_X2	X2
39_VT/GN	39 VT/GN

MNG	TRANSMISSION-AUTO 4 SPD, AISIN-WARNER, AW 80-40LE, FWD, GEN2
CAV_34	34
439	Run/Crank Ignition 1 Voltage
439_VT/GN	439 VT/GN
439_VT/GN	439 VT/GN
239	Run/Crank Ignition 1 Voltage
239_VT/WH	239 VT/WH
CAV_19	19
CONN_X1	X1
CAV_14	14
CONN_X1	X1
139_VT/WH	139 VT/WH
LL0	
M4M	
LFM	
LL0	
M4M	
CAV_1	1
CONN_X1	X1
439_VT/GN	439 VT/GN
439_VT/GN	439 VT/GN
439_VT/GN	439 VT/GN
CAV_7	7
CAV_3	3
CAV_3	3
CAV_3	3
F23UA	F23UA 15A
F24UA	F24UA 10A
F25UA	F25UA 10A
F26UA	F26UA 10A
F27UA	F27UA 10A
F28UA	F28UA 15A
F36UA	F36UA 30A
G_REF	G
X201	X201
J177	J177
J122	J122
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF

1240_RD/BU	1240 RD/BU
CAV_4	4
CONN_X1	X1
1340	Battery Positive Voltage
1340_RD/WH	1340 RD/WH
CAV_3	3
1440	Battery Positive Voltage
1440_RD/BN	1440 RD/BN
CAV_2	2
1540	Battery Positive Voltage
1540_RD/GN	1540 RD/GN
CAV_3	3
CONN_X2	X2
1640	Battery Positive Voltage
1640_RD/VT	1640 RD/VT
CAV_4	4
CONN_X5	X5
1740	Battery Positive Voltage
1740_RD/GY	1740 RD/GY
CAV_3	3
1840	Battery Positive Voltage
1840_RD/GN	1840 RD/GN
CAV_4	4
CONN_X2	X2
1940	Battery Positive Voltage
1940_RD/VT	1940 RD/VT
CAV_32	32
CONN_X1	X1
2240	Battery Positive Voltage
2240_RD/BN	2240 RD/BN
CAV_16	16
1640_RD/VT	1640 RD/VT
1740_RD/GY	1740 RD/GY
CAV_B3	B3
CAV_B4	B4
CAV_B5	B5
CAV_B12	B12
CAV_B13	B13
CAV_B6	B6
CAV_B14	B14
CAV_B7	B7
CAV_B15	

	B15
CAV_B8	B8
CAV_B16	B16
CAV_B9	B9
X201	X201
CAV_23	23
CAV_24	24
E_REF	E
F1DA	F1DA 15A
F2DA	F2DA 10A
F3DA	F3DA 15A
F4DA	F4DA 15A
F5DA	F5DA 15A
F6DA	F6DA 15A
F7DA	F7DA 15A
F8DA	F8DA 30A
F9DA	F9DA 10A
F10DA	F10DA 15A
F11DA	F11DA 30A
F12DA	F12DA 10A
X201	X201
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF

F13DA, F14DA, F15DA, F16DA, F17DA, F18DA, F19DA, F20DA and F21DA Fuses Wiring Schematics

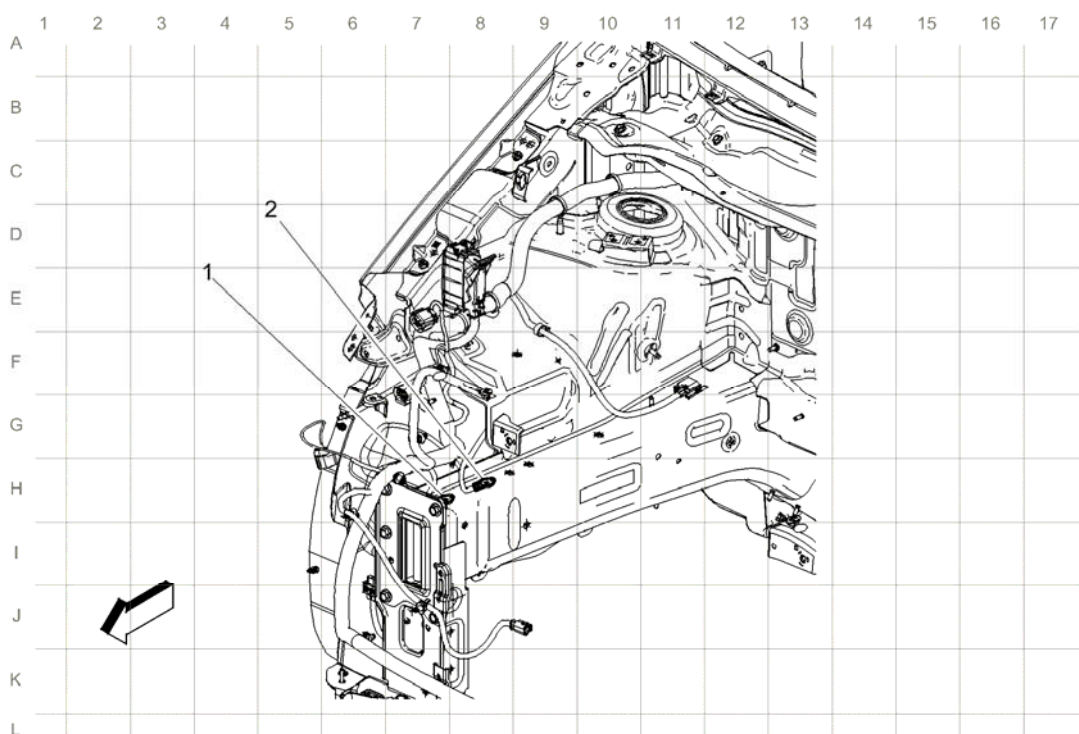


Fig. 27: F13DA, F14DA, F15DA, F16DA, F17DA, F18DA, F19DA, F20DA and F21DA Fuses Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
640	Battery Positive Voltage
640_RD/WH	640 RD/WH
CAV_9	9
CONN_X1	X1
2440	Battery Positive Voltage
2440_RD/GN	2440 RD/GN
CAV_5	5
2640	Battery Positive Voltage
2640_RD/VT	2640 RD/VT
CAV_6	6
41	Run Ignition 3 Voltage
41_VT/BN	41 VT/BN
CAV_1	1
341	Run Ignition 3 Voltage
CAV_2	2
341_VT/BN	341 VT/BN
341_VT/BN	341 VT/BN

341_VT/BN	341 VT/BN
CAV_2	2
C37	HEATER-SEAT, DRIVER
441	Run Ignition 3 Voltage
441_VT/BN	441 VT/BN
CAV_9	9
CONN_X1	X1
CAV_B17	B17
CAV_B10	B10
CAV_B18	B18
CAV_B11	B11
CAV_B22	B22
CAV_B21	B21
CAV_B20	B20
CAV_C3	C3
CAV_B19	B19
F13DA	F13DA 10A
F14DA	F14DA 2A
F15DA	F15DA 10A
F16DA	F16DA 7.5A
F17DA	F17DA 25A
F18DA	F18DA 15A
F19DA	F19DA 15A
F20DA	F20DA 20A
F21DA	F21DA 10A
J241	J241
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
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_REF	_REF
_REF	_REF

F22DA, F23DA, F24DA and F25DA Fuses Wiring Schematics

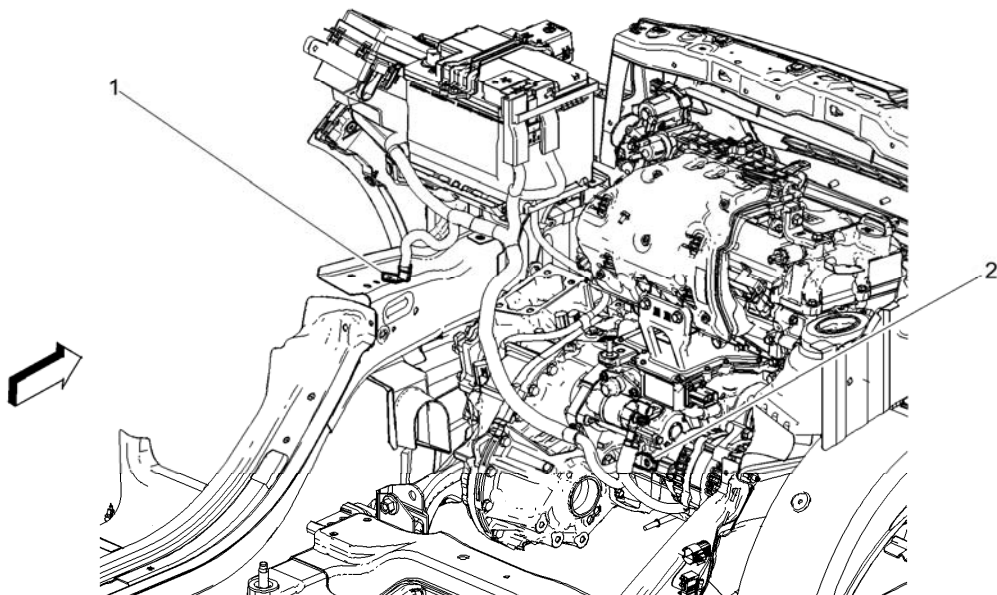


Fig. 28: F22DA, F23DA, F24DA and F25DA Fuses Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
CAV_B2	B2
CAV_B1	B1
CAV_C1	C1
CAV_C2	C2
1301	Retained Accessory Power Fuse Supply Voltage
1301_VT	1301 VT
CAV_6	6
1301_VT	1301 VT
CAV_6	6
1701	Retained Accessory Power Fuse Supply Voltage
1701_VT	1701 VT
CAV_2	2
801	Retained Accessory Power Fuse Supply Voltage
801_VT	801 VT
CAV_A	A
1301_VT	1301 VT
1301_VT	1301 VT
1701_VT	1701 VT

1301_VT	1301 VT
1301_VT	1301 VT
1701_VT	1701 VT
1301_VT	1301 VT
CAV_B8	B8
CAV_15	15
CAV_10	10
X500	X500
CAV_20	20
CAV_19	19
X201	X201
CAV_44	44
CAV_45	45
F24DA	F24DA 25A
F25DA	F25DA 25A
F23DA	F23DA 20A
F22DA	F22DA 10A
X210	X210
X600	X600
X205	X205
X500	X500
X201	X201
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF

F26DA, F27DA and F28DA Fuses Wiring Schematics

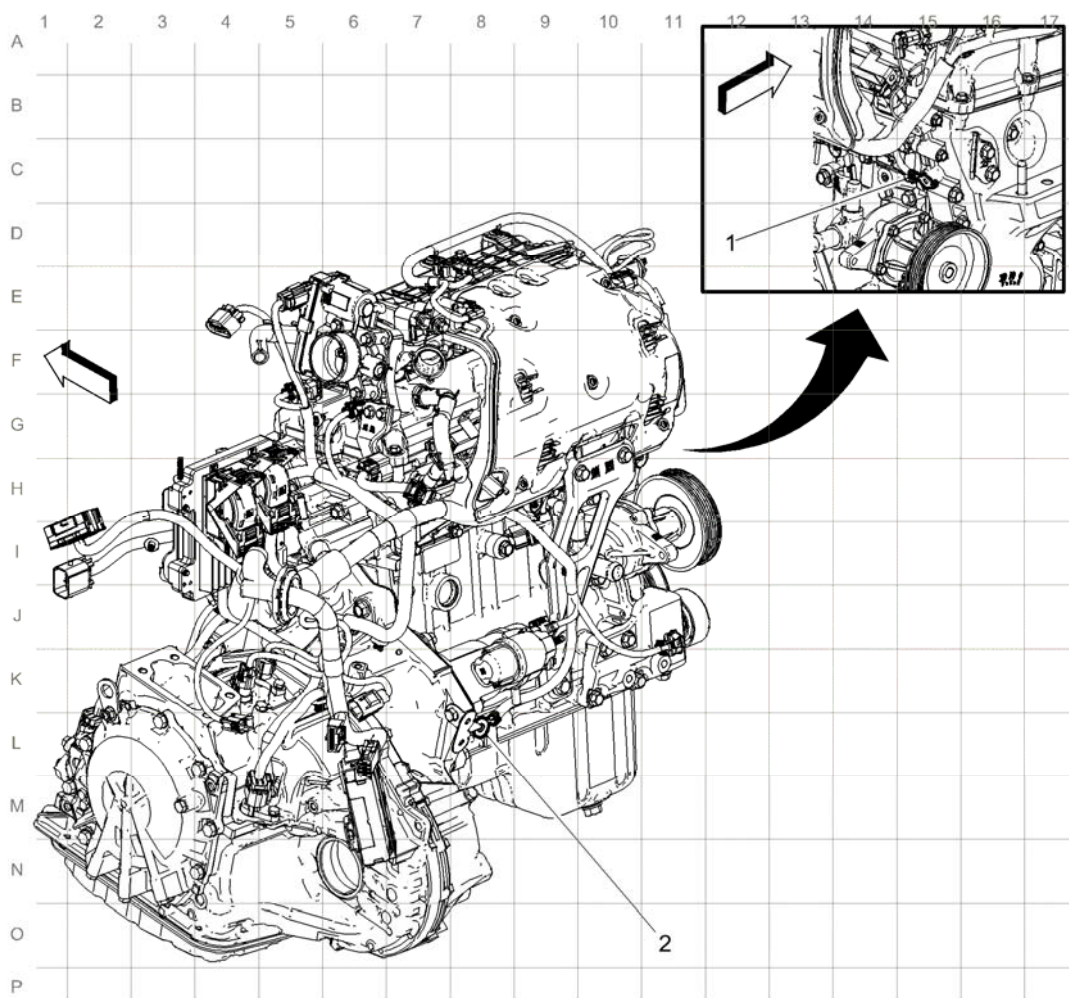


Fig. 29: F26DA, F27DA and F28DA Fuses Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
CAV_B23	B23
CAV_B24	B24
CAV_B25	B25
2340	Battery Positive Voltage
2340_RD/YE	2340 RD/YE
CAV_15	15
CONN_X1	X1
2040	Battery Positive Voltage
2040_RD/WH	2040 RD/WH
CAV_1	1
2540	Battery Positive Voltage
2540_RD/BU	2540 RD/BU

CAV_44	44
CONN_X1	X1
CONN_X1	X1
2340_RD/YE	2340 RD/YE
CAV_47	47
F26DA	F26DA 10A
F27DA	F27DA 15A
F28DA	F28DA 15A
X201	X201
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF

F30DA, F31DA and F34DA Fuses Wiring Schematics

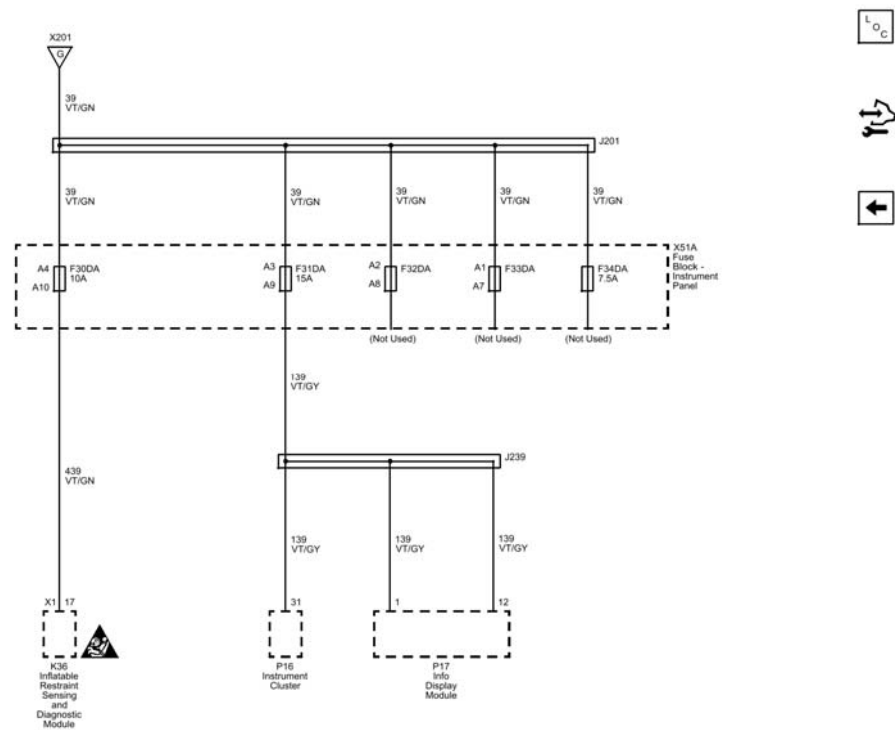


Fig. 30: F30DA, F31DA and F34DA Fuses Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

39	Run/Crank Ignition 1 Voltage
39_VT/GN	39 VT/GN
39_VT/GN	39 VT/GN
39_VT/GN	39 VT/GN
39_VT/GN	39 VT/GN
39_VT/GN	39 VT/GN
39_VT/GN	39 VT/GN
439	Run/Crank Ignition 1 Voltage
439_VT/GN	439 VT/GN
CAV_17	17
CONN_X1	X1
139	Run/Crank Ignition 1 Voltage
CAV_31	31
139_VT/GY	139 VT/GY
139_VT/GY	139 VT/GY
139_VT/GY	139 VT/GY
CAV_1	1
139_VT/GY	139 VT/GY
CAV_12	12
CAV_A4	A4
CAV_A10	A10
CAV_A3	A3
CAV_A9	A9
CAV_A2	A2
CAV_A8	A8
CAV_A1	A1
CAV_A7	A7
G_REF	G
J201	J201
J239	J239
F30DA	F30DA 10A
F31DA	F31DA 15A
F32DA	F32DA
F33DA	F33DA
F34DA	F34DA 7.5A
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF

POWER MODING WIRING SCHEMATICS

KR73 Ignition Main Relay Wiring Schematics

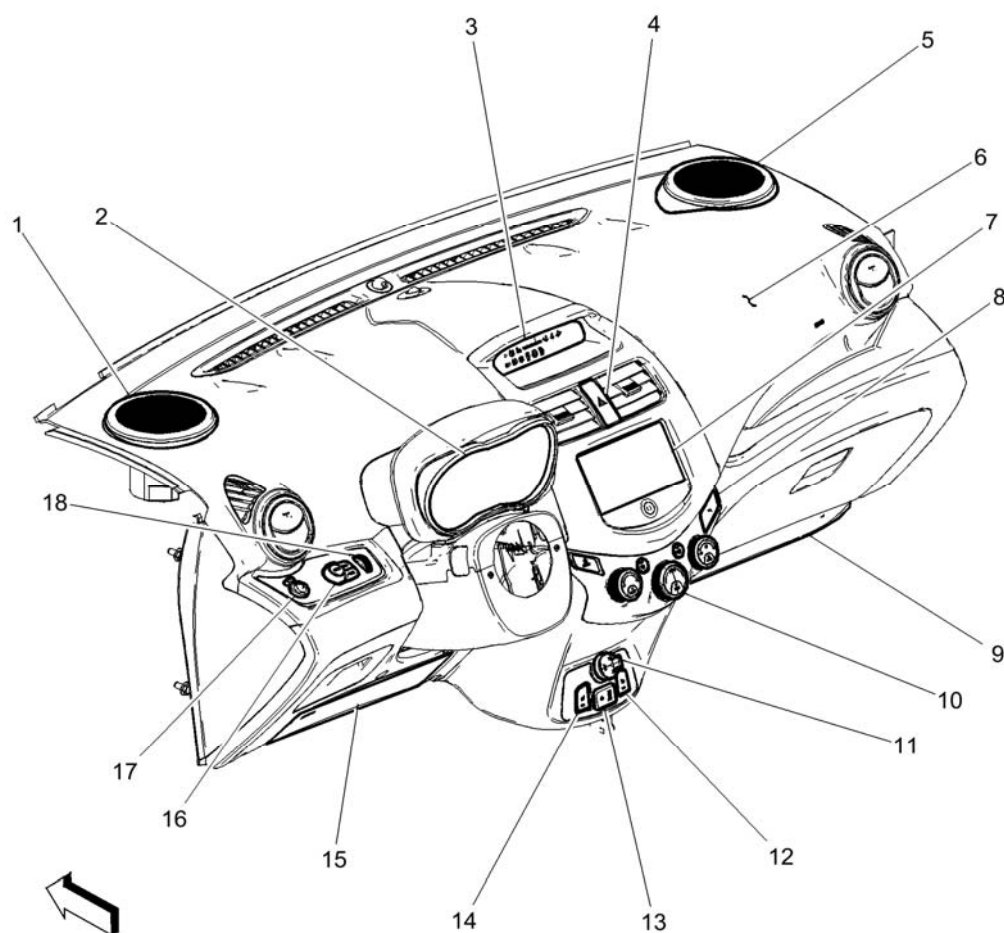


Fig. 31: KR73 Ignition Main Relay Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
2440	Battery Positive Voltage
2440_RD/GN	2440 RD/GN
CAV_5	5
CAV_B10	B10
3	Run/Crank Ignition 1 Voltage
3_VT/BK	3 VT/BK
CAV_6	6
CONN_X3	X3
CAV_4	4
5199	Run/Crank Relay Coil Control

5199_GN/VT	5199 GN/VT
CAV_11	11
CONN_X2	X2
CAV_15	15
CONN_X4	X4
450	Ground
450_BK	450 BK
CAV_39	39
CONN_X2	X2
F14DA	F14DA 2A
F23UA	F23UA 15A
F24UA	F24UA 10A
F25UA	F25UA 10A
F26UA	F26UA 10A
F27UA	F27UA 10A
F28UA	F28UA 15A
F36UA	F36UA 30A
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF

KR74 Ignition Run Relay, KR76 Retained Accessory Power Relay, KR104A Battery Saver Relay 1 Wiring Schematics

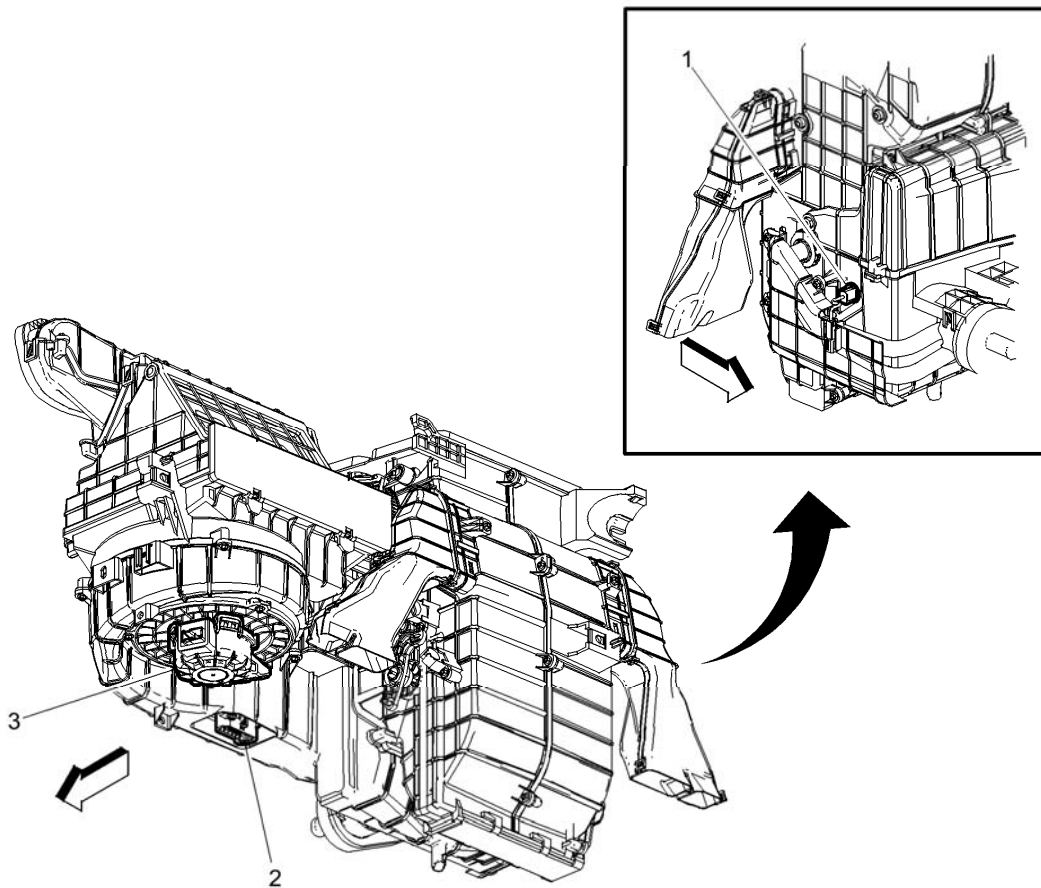


Fig. 32: KR74 Ignition Run Relay, KR76 Retained Accessory Power Relay, KR104A Battery Saver Relay
1 Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
5486	Run Relay Coil Control
5486_BN/VT	5486 BN/VT
CAV_14	14
CONN_X5	X5
755	RAP Relay Coil Control
755_GY/VT	755 GY/VT
CAV_12	12
CONN_X4	X4
3263	Logistic Mode Relay Open Control
3263_VT/BU	3263 VT/BU
CAV_11	11

CONN_X5	X5
3264	Logistic Mode Relay Close Control
3264_GY/VT	3264 GY/VT
CAV_16	16
CONN_X7	X7
5486_BN/VT	5486 BN/VT
755_GY/VT	755 GY/VT
3263_VT/BU	3263 VT/BU
755_GY/VT	755 GY/VT
3263_VT/BU	3263 VT/BU
3264_GY/VT	3264 GY/VT
CAV_B22	B22
CAV_B21	B21
CAV_B20	B20
CAV_C3	C3
CAV_B19	B19
CAV_C2	C2
CAV_C1	C1
CAV_B1	B1
CAV_B2	B2
CAV_B23	B23
CAV_B24	B24
CAV_B25	B25
X201	X201
CAV_27	27
CAV_16	16
CAV_15	15
G202	G202
G202	G202
G202	G202
F17DA	F17DA 25A
F18DA	F18DA 15A
F19DA	F19DA 15A
F20DA	F20DA 20A
F21DA	F21DA 10A
F24DA	F24DA 25A
F25DA	F25DA 25A
F23DA	F23DA 20A
F22DA	F22DA 10A
F26DA	F26DA 10A
F27DA	F27DA 15A
F28DA	

	F28DA 10A
X201	X201
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF

IGNITION LOCK WIRING SCHEMATICS

Key Capture Wiring Schematics

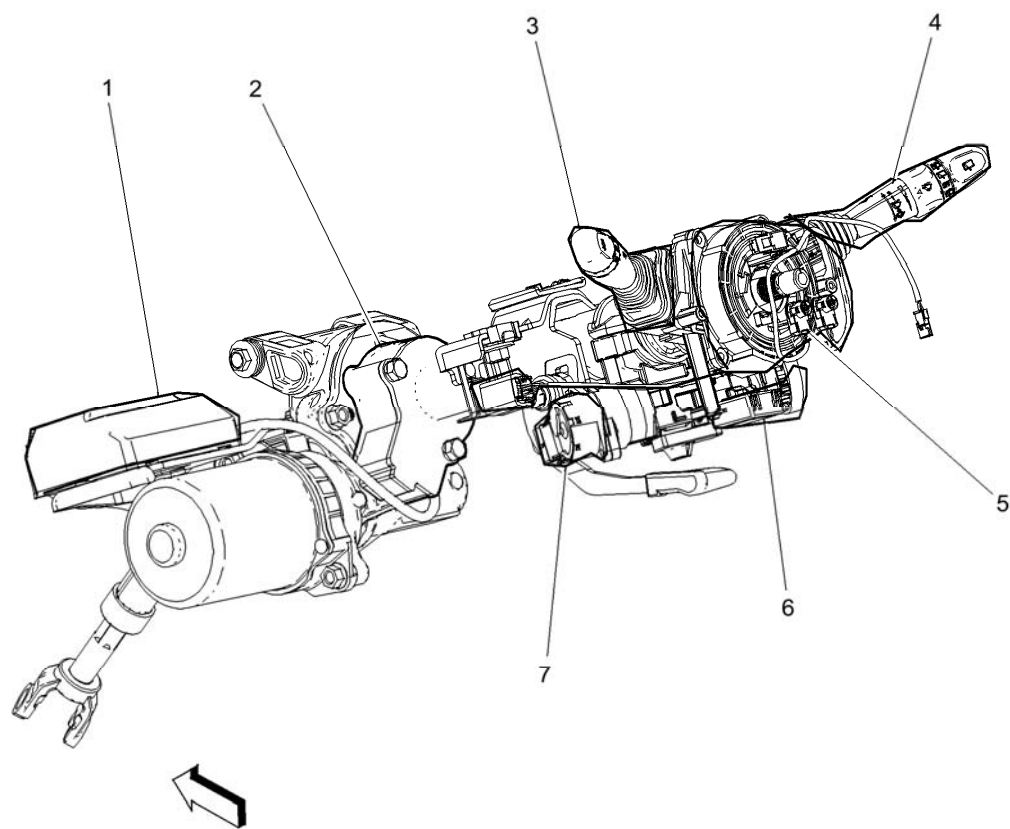


Fig. 33: Key Capture Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
143	Accessory Voltage

143_VT/YE	143 VT/YE
CAV_1	1
CAV_7	7
CONN_X3	X3
5905	Key Capture/Column Lock Shift Position Signal
5905_WH/VT	5905 WH/VT
CAV_4	4
CAV_2	2
850	Ground
850_BK	850 BK
CAV_3	3
G203	G203
F6DA	F6DA
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF

GROUND DISTRIBUTION WIRING SCHEMATICS

G101 Wiring Schematics

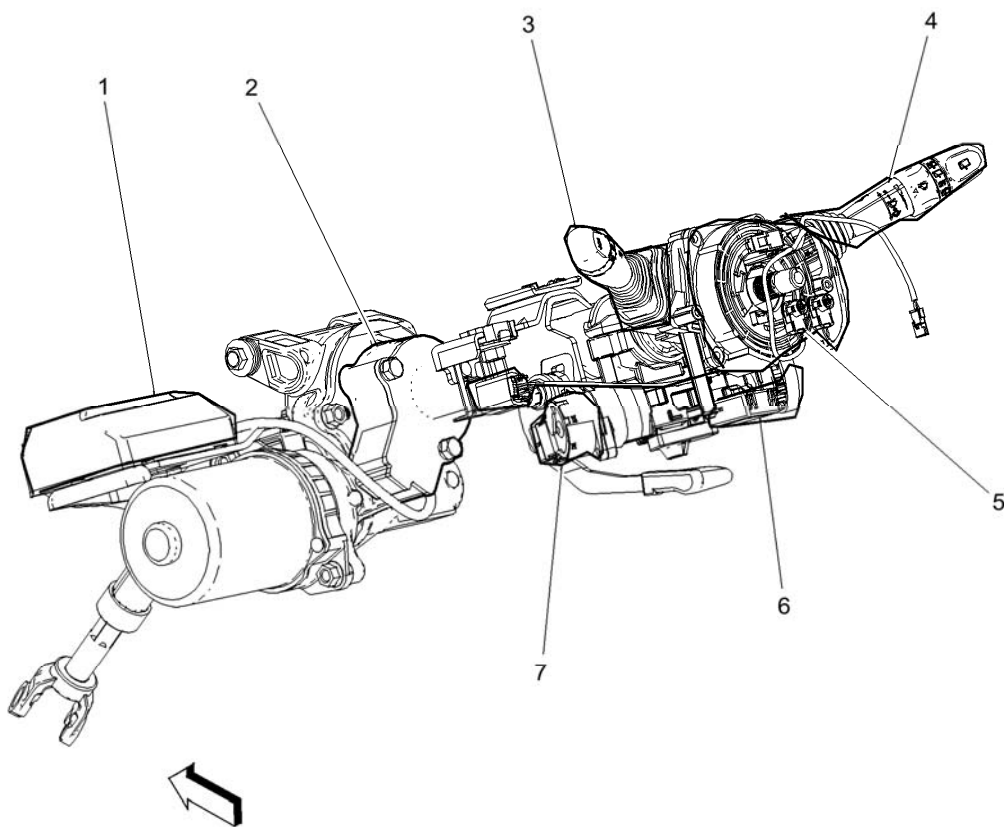


Fig. 34: G101 Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
50	Ground
50_BK	50 BK
CAV_2	2
50_BK	50 BK
50_BK	50 BK
CAV_1	1
50_BK	50 BK
50_BK	50 BK
CAV_A	A
50_BK	50 BK
CAV_3	3
50_BK	50 BK

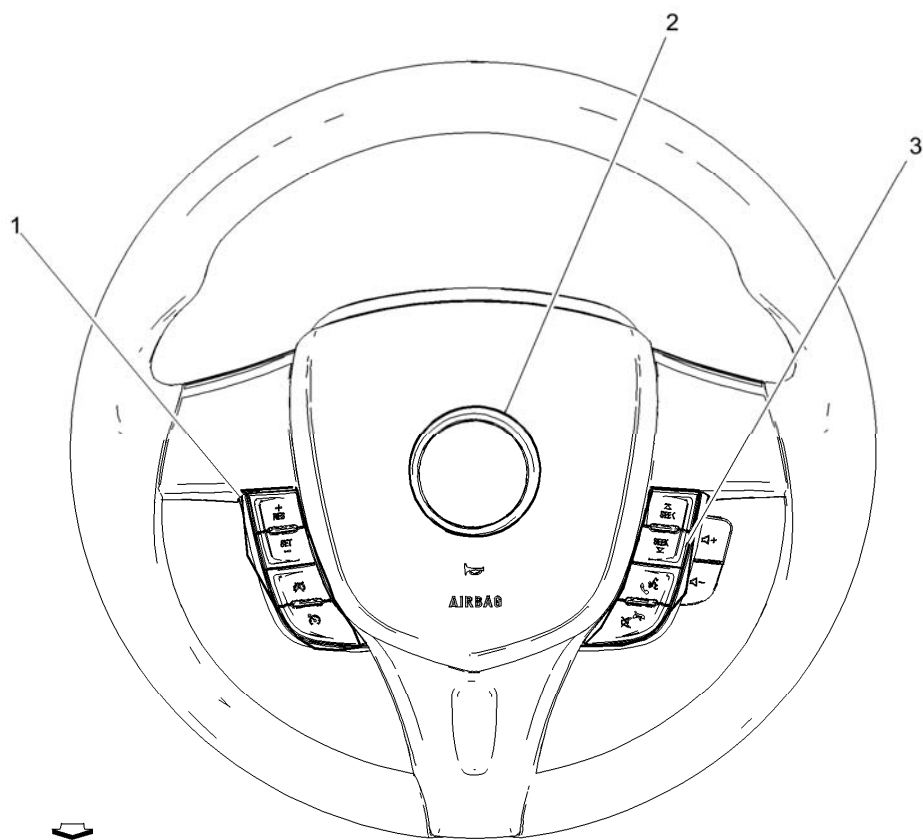


Fig. 35: G102 Wiring Schematics
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
150	Ground
150_BK	150 BK
CAV_A	A
150_BK	150 BK
150_BK	150 BK
CAV_1	1
150_BK	150 BK
150_BK	150 BK
CAV_2	2
150_BK	150 BK
CAV_2	2
150_BK	150 BK

CAV_4	4
150_BK	150 BK
CAV_2	2
150_BK	150 BK
CAV_C	C
150_BK	150 BK
150_BK	150 BK
CAV_2	2
CAV_1	1
T3Y	LAMP FRT FOG-FRT FOG, PROJECTION TYPE
T90	LAMP-SIGNALING and MARKER, EXPORT
RHD	VEHICLE DRIVE-RIGHTHAND DRIVE
RHD	VEHICLE DRIVE-RIGHTHAND DRIVE
RHD	VEHICLE DRIVE-RIGHTHAND DRIVE
G102	G102
J153	J153
J152	J152
J120	J120
X120	X120
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF

G103 and G104 Wiring Schematics

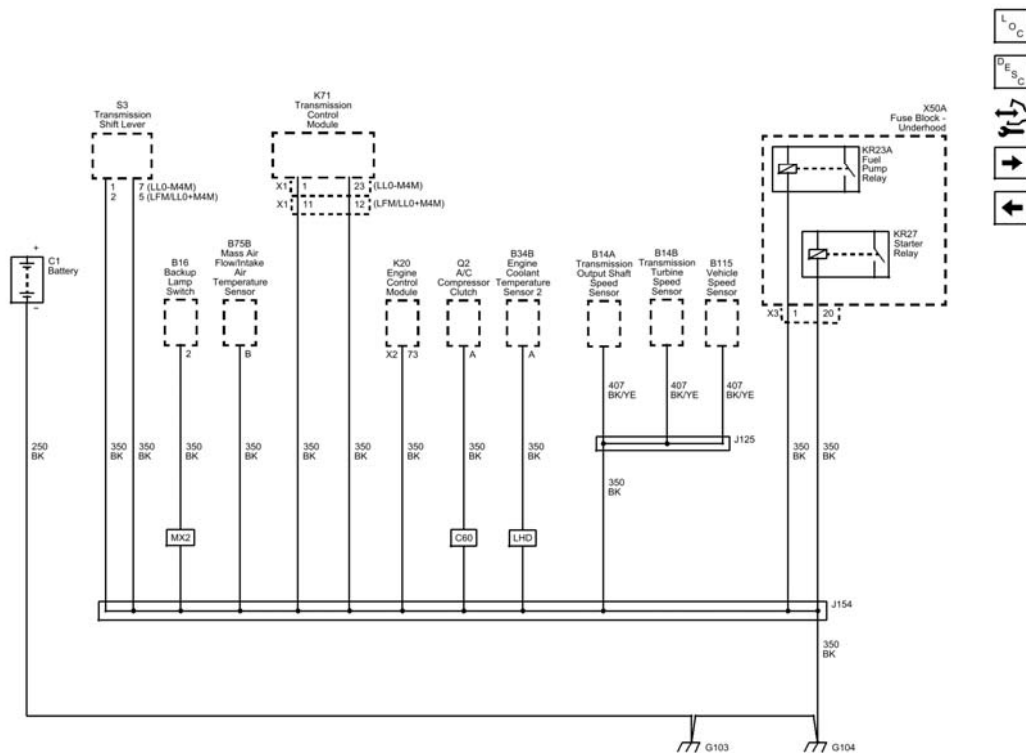


Fig. 36: G103 and G104 Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
250	Ground
250_BK	250 BK
350	Ground
350_BK	350 BK
CAV_1	1
350_BK	350 BK
CAV_7(LL0-M4M)	7 (LL0-M4M)
350_BK	350 BK
CAV_2	2
350_BK	350 BK
CAV_B	B
350_BK	350 BK
CAV_1	1
CONN_X1	X1
350_BK	350 BK
CAV_23	23
350_BK	350 BK

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G105, G106 and G107 Wiring Schematics

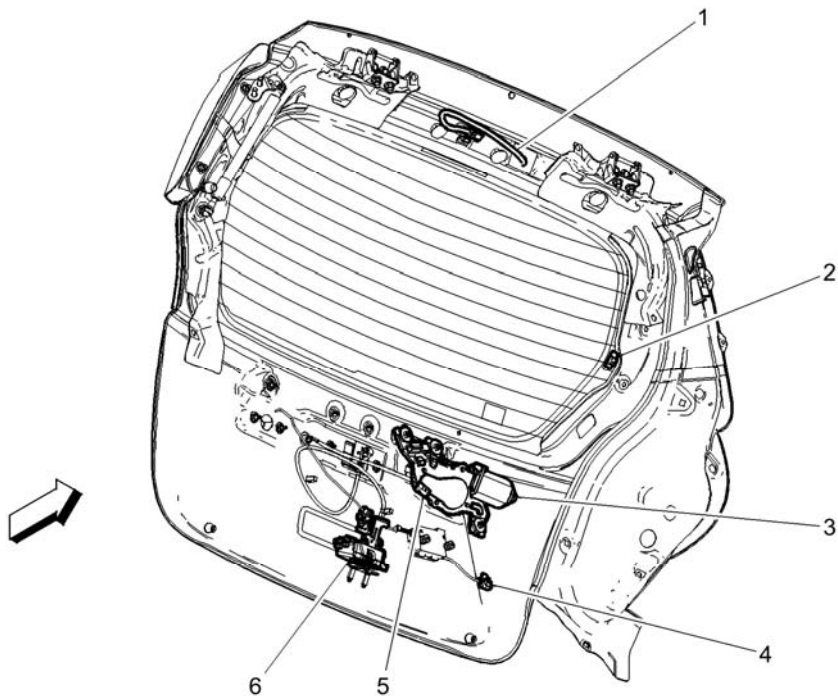


Fig. 37: G105, G106 and G107 Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
450	Ground
450_BK	450 BK
CAV_26	26
CONN_X4	X4
250	Ground
250_BK	250 BK
CAV_13	13
CONN_X1	X1
250_BK	250 BK
CAV_38	38
150	Ground
150_BK	150 BK
CAV_1	1

150_BK	150 BK
CAV_1	1
150_BK	150 BK
CAV_1	1
150_BK	150 BK
CAV_1	1
150_BK	150 BK
150_BK	150 BK
150_BK	150 BK
150_BK	150 BK
450_BK	450 BK
X170	X170
CAV_4	4
CAV_2	2
G106	G106
J174	J174
J175	J175
G105	G105
G107	G107
X170	X170
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF

G201 and G202 Wiring Schematics

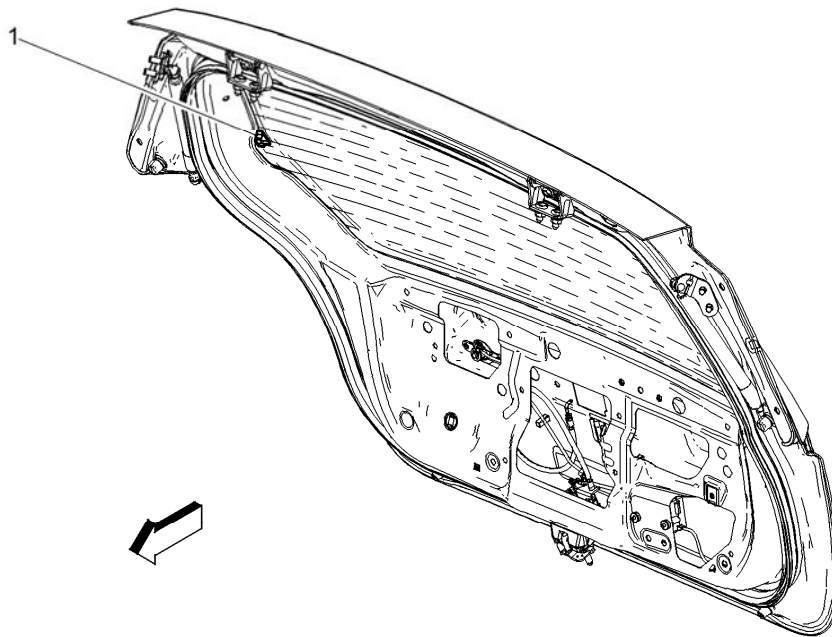


Fig. 38: G201 and G202 Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1090	Passenger Door Lock Actuator Lock Control
1090_YE/GN	1090 YE/GN
CAV_2	2
CONN_X1	X1
1050	Ground
1050_BK	1050 BK
CAV_3	3
1050_BK	1050 BK
CAV_C	C
1050_BK	1050 BK
CAV_8	8
1050_BK	1050 BK
750	Ground
750_BK	750 BK
750_BK	750 BK
750_BK	750 BK
750_BK	750 BK
CAV_8	8

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_REF	REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF

G203 and G401 Wiring Schematics

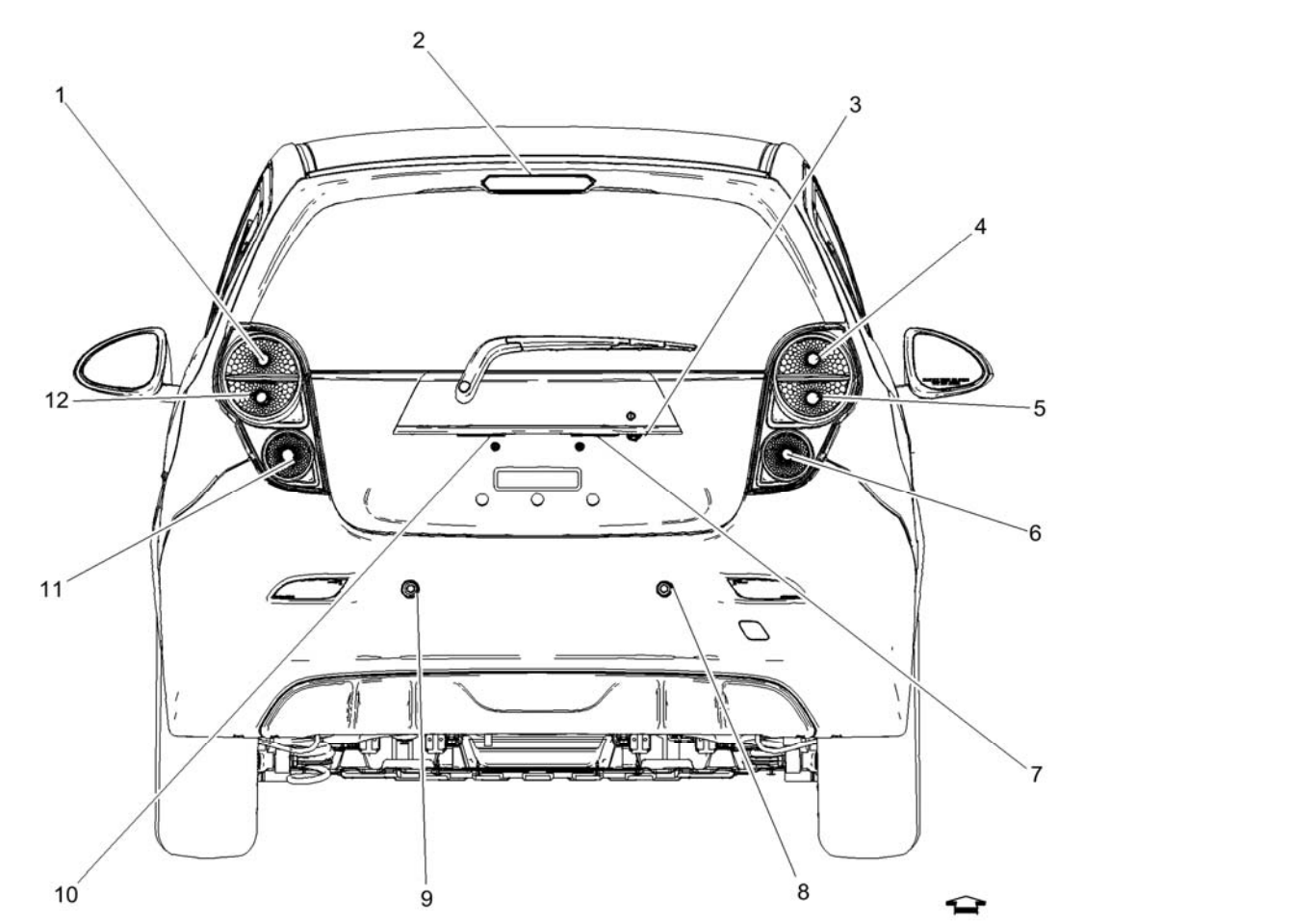


Fig. 39: G203 and G401 Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
850	Ground
850_BK	850 BK

CAV_7	7
850_BK	850 BK
CAV_4	4
850_BK	850 BK
CAV_8	8
850_BK	850 BK
CAV_6	6
850_BK	850 BK
CAV_38	38
CONN_X1	X1
850_BK	850 BK
CAV_4	4
850_BK	850 BK
CAV_6	6
850_BK	850 BK
CAV_1	1
CONN_X1	X1
850_BK	850 BK
CAV_2	2
CONN_X2	X2
850_BK	850 BK
850_BK	850 BK
1950	Ground
1950_BK	1950 BK
CAV_19	19
CONN_X1	X1
CAV_4	4
CAV_5	5
850_BK	850 BK
850_BK	850 BK
AU3	LOCK CONTROL-SIDE DR, ELEC
AU3	LOCK CONTROL-SIDE DR, ELEC
G203	G203
G401	G401
J253	J253
J254	J254
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF
_REF	_REF

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_REF	_REF
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_REF	_REF
_REF	_REF

G301 Wiring Schematics

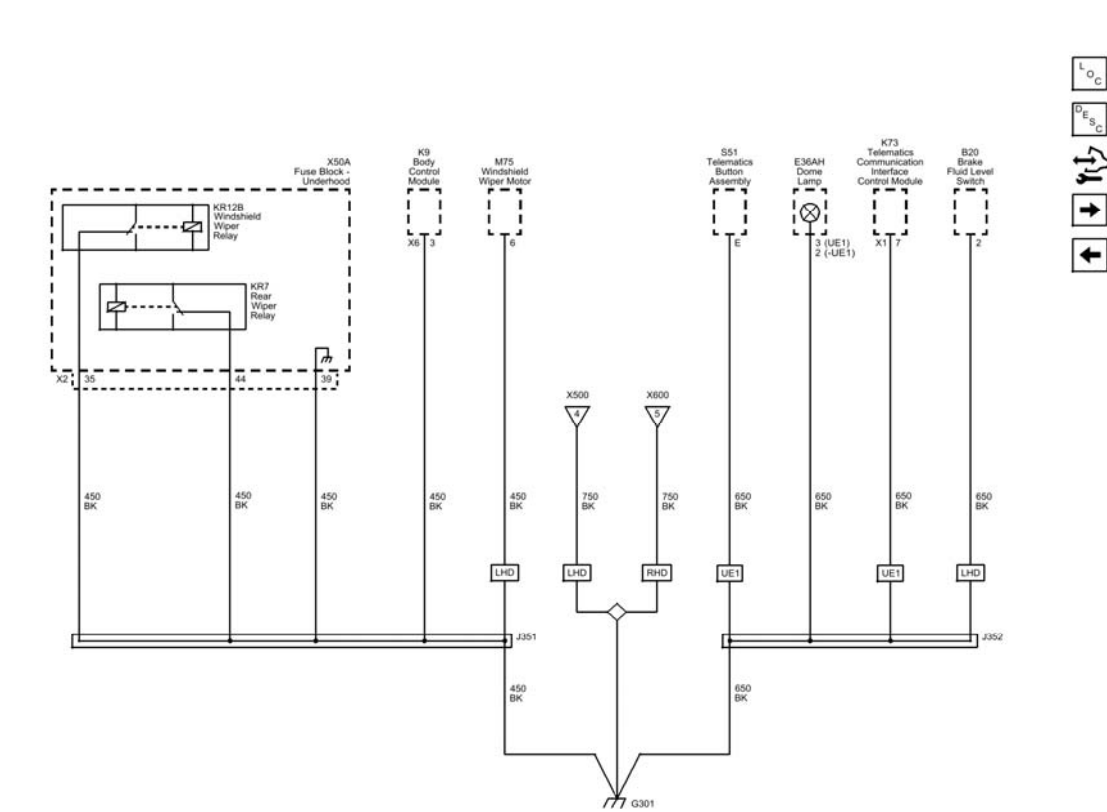


Fig. 40: G301 Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
450	Ground
450_BK	450 BK
CAV_35	35
CONN_X2	X2
450_BK	450 BK
CAV_44	44
450_BK	450 BK
CAV_39	39
450_BK	450 BK

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G302 Wiring Schematics

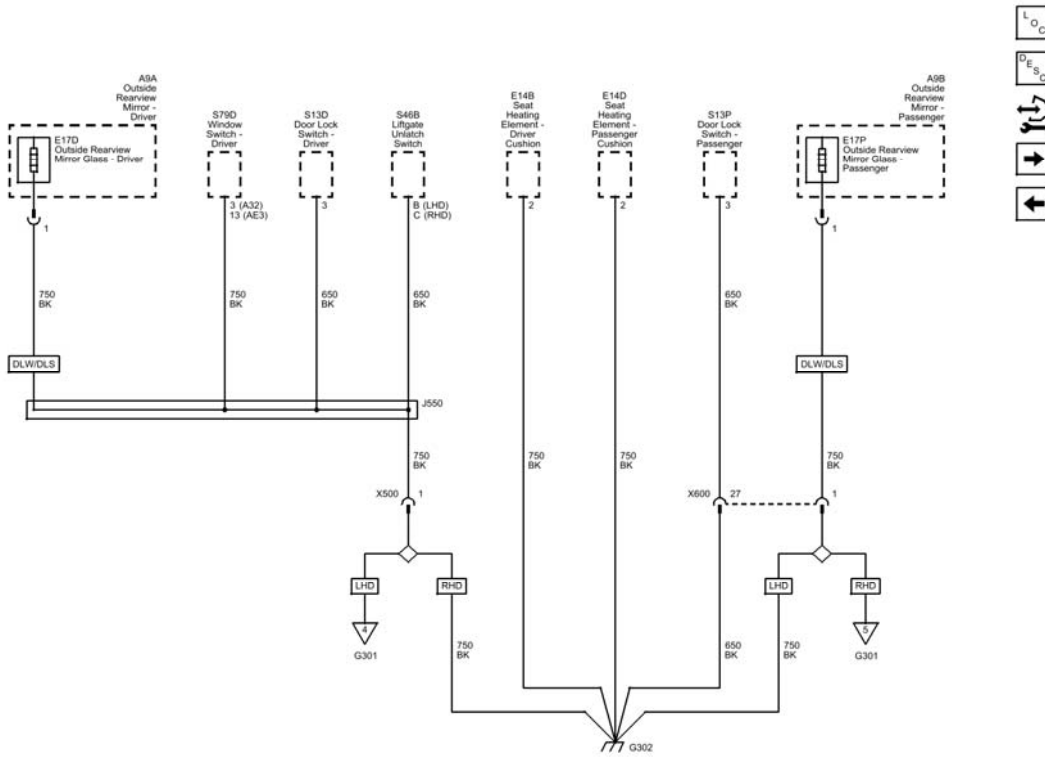


Fig. 41: G302 Wiring Schematic
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
750	Ground
750_BK	750 BK
750_BK	750 BK
CAV_3	3
650	Ground
650_BK	650 BK
CAV_3	3
CAV_B	B
750_BK	750 BK
CAV_2	2
750_BK	750 BK
CAV_2	2
650_BK	650 BK

[illegible]

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_REF	_REF
_REF	_REF

G303 and G304 Wiring Schematics

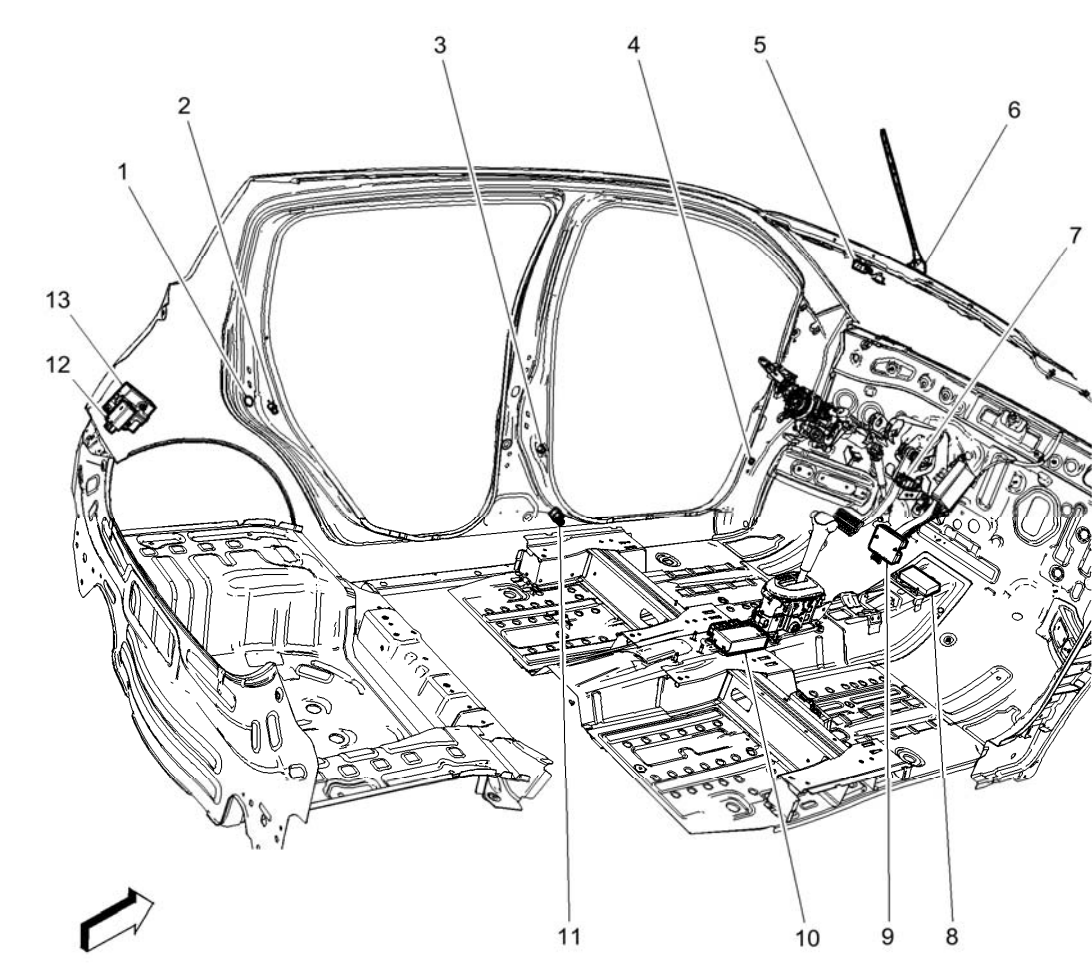


Fig. 42: G303 and G304 Wiring Schematic
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1150	Ground
1150_BK	1150 BK
CAV_4	4
1150_BK	1150 BK
1150_BK	1150 BK

CAV_1	1
1150_BK	1150 BK
1150_BK	1150 BK
CAV_2	2
1150_BK	1150 BK
CAV_1	1
1150_BK	1150 BK
CAV_1	1
CONN_X2	X2
1150_BK	1150 BK
CAV_A	A
1150_BK	1150 BK
CAV_1	1
1150_BK	1150 BK
CAV_2	2
950_BK	950 BK
CAV_4	4
950_BK	950 BK
CAV_1	1
950_BK	950 BK
1250	Ground
1250_BK	1250 BK
50	Ground
50_BK	50 BK
CAV_2	2
CAV_F	F
1150_BK	1150 BK
1150_BK	1150 BK
1150_BK	1150 BK
CAV_3	3
1150_BK	1150 BK
1250_BK	1250 BK
CAV_1	1
1150_BK	1150 BK
1250_BK	1250 BK
X900	X900
CAV_9	9
CAV_10	10
G303	G303
G304	G304
G501	G501

[illegible]